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THE

NATIONAL DISPENSATORY.

CONTAINING THE

NATURAL HISTORY, CHEMISTRY, PHARMACY,
ACTIONS, AND USES OF MEDICINES.

INCLUDING THOSE RECOGNIZED IN THE

PHARMACOPŒIAS OF THE UNITED STATES, GREAT BRITAIN,
AND GERMANY, WITH NUMEROUS REFERENCES
TO THE FRENCH CODEX.

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FOURTH EDITION,

REVISED AND IMPROVED.

WITH THREE HUNDRED AND ELEVEN ILLUSTRATIONS.

LONDON:
J. & A. CHURCHILL, NEW BURLINGTON STREET.
1886.

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PREFACE TO THE FOURTH EDITION.

SINCE the publication of the third edition of the NATIONAL DISPENSATORY in 1884, the new British Pharmacopœia has appeared, necessitating a careful revision of the references to it throughout the pages of the *Dispensatory*. This has been done, and in addition the work has been brought fully up to the existing knowledge of its subject by the incorporation, in the shape of "Addenda," of all new and important articles, among the more noteworthy of which are Antipyrine, Cocaine Hydrochlorate, Cascara Sagrada, Fabiana, Franciscea, Gymnocladus, Hydroquinone, Hypnone, Iodol, Jacaranda, Lanolin, Menthol, Phormium, Sulphophenol, Thalline, and Urethane.

It is hoped, therefore, that in its present shape the work will, to a great degree, fill the place of the projected Supplement to the U. S. Pharmacopœia, which was not issued at the expiration of five years, as contemplated, and that it will be found more than ever to merit the remarkable favor which each successive edition has enjoyed from the professions both of Medicine and Pharmacy.

PREFACE TO THE THIRD EDITION.

THE present edition of the NATIONAL DISPENSATORY may be regarded as embodying the Pharmacopœias of the four chief civilized nations. Those of the United States and Germany appeared at the close of 1882, and formed the basis of our revision. The French Codex was published after our work was prepared for the press, but in time to admit of its incorporation. The British Pharmacopœia, unfortunately, has not been revised since 1867, and the references to it therefore remain unchanged.

The immense mass of new material thus brought into view has required no little labor for its presentation in a shape adapted to the wants of the practical men for whom the *Dispensatory* is designed. Absolute accuracy being of the first importance in a work of this nature, it was felt that the statements even of the Pharmacopœia were not to be blindly accepted, and a long series of investigations and tests has been carried out for the purpose of verifying or correcting them. Not a few corrections have been made, some of which the reader will find noted in their appropriate places. The formulas of the Pharmacopœia, expressed in parts by weight, have been translated into definite weights and measures, which it is hoped will facilitate their use.

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In addition to the strictly officinal articles, a large number of extra-pharmacopœial medicines have been added to those in the previous editions, and no exertion has been spared to render the work complete in all respects.

No change has been made in the general plan of arrangement, which has been found convenient for speedy reference to the vast aggregate of matter comprehended in the volume; but a number of agents which were previously entered under individual headings have been transferred to more important articles as "Allied Drugs," while others, again, have been treated separately, as their growing importance would seem to justify. Numerous historical notes have been added. The descriptions have been extended or condensed as occasion seemed to require, and microscopical structure has been more fully described and illustrated. A large portion of the work has thus been rewritten, and the extent of the modifications and additions may be estimated from the fact that the General Index of this edition contains over thirty-seven hundred more references than that of the Second Edition. The series of illustrations has undergone a similar careful scrutiny. Many wood-cuts have been replaced by new and more satisfactory ones, and the whole number has been increased by about eighty.

Like the previous editions, this one will be found to contain the most recent views of the physiological action—as far as it explains the curative effects—of medicines; but all generalizations have been sedulously kept subordinate to the practical character of the work. The fruits of recent clinical experience have proved to be very large, and have required for their presentation an additional space equivalent to about eighty pages of the therapeutical portion of the Second Edition. Their number and variety may be inferred from the fact that the Index of Therapeutics contains nearly sixteen hundred new references. In the previous editions very few references to authorities were furnished in this department of the work; but maturer experience has made it desirable to aid readers who wish to extend their investigations, by directing them to the more important sources of original information.

Those who use this Index should remember that its purpose is not to exhibit the *relative* values of the various medicines used in each disease. Its object is to present a suggestive list of *all* such medicines, while in the text an attempt is made to assign to each its relative as well as its positive value.

The doses of medicines are expressed in terms of the decimal system, as well as in those of apothecaries' weight, but the two are seldom exact equivalents of each other. Doses are not fixed quantities, and the numbers that represent them in either posological system should be such as are used in practice. Following the usage of German and French authorities, the doses of liquid medicines according to the metrical system are stated in terms of weight, and not of measure.

Perfection is not to be hoped for in a work consisting of infinite detail on a subject of such magnitude, but the authors feel that they may honestly claim to have shrunk from no labor in the endeavor to meet the requirements of those who will consult its pages.

PHILADELPHIA, August, 1884.

PREFACE TO THE FIRST EDITION.

In the rapid progress of modern research few subjects have of late years received greater accessions of facts than the group of sciences connected with materia medica and therapeutics. The new resources thus placed at the command of the pharmaceutist and physician have seemed to the authors to justify an attempt to make, from the advanced stand-point of the present day, a concise but complete statement of all that is of practical importance to both professions—a digest in which that which is old and that which is new shall be so brought together as to give to the reader, within the most moderate practicable compass, all the details in pharmacology, pharmacy, and therapeutics which he is likely to need in his daily avocations. In the almost infinite accumulation of material this has required a careful and conscientious sifting to discard that which is obsolete, untrustworthy, or comparatively trivial, without impairing the practical completeness of the work. That they have wholly accomplished their object the authors do not venture to claim; but they can say that years of constant labor have been devoted to the task of producing a work to which the inquirer may refer with the certainty of finding everything which experience has stored up as worthy of confidence in the subjects embraced within its scope.

To this end there have been included all crude drugs and chemical and pharmaceutical preparations officinal in the Pharmacopœias of the United States and Great Britain, together with the more important medicines of the French Codex and German Pharmacopœia which are to some extent prescribed here or which may serve for comparison with similar articles in the English and American standards. Besides these, a large number of drugs which are not recognized by any pharmacopœia are often kept in the shops because they are prescribed by physicians or used in domestic practice. Some of these give promise of future importance, and in making a selection among this class of remedies it was deemed best not to err on the side of exclusiveness. Not only have many of them been admitted as separate articles, but a large number have found place as *allied drugs* under the heading of more important substances. To these allied drugs reference can readily be made by means of the Index.

The alphabetical order of arrangement has been adopted throughout, as being on the whole the most convenient for reference. In this the non-officinal medicines have been included with the officinal, the latter being distinguished by an affix showing the pharmacopœia to which they have been admitted. The title of each article is followed by a full synonymy, English, French, and German, together with Latin appellatives and popular names, such as are occasionally used in prescriptions and standard works or through which articles may be recognized. As all substances thus have their appropriate place in the body of the work, but little is left for the Appendix, in which may be found the leading reagents, tables of weights and measures, comparisons of the scales of different hydrometers, alcoholometers, and thermometers, etc.

In the treatment of the separate articles detailed botanical descriptions have generally been omitted as being of no practical value, but plants yielding drugs have been briefly characterized as to their general aspect and habitat, while fuller descriptions have been given of those which are native or naturalized or which seemed to require it from the nature of their product. The treatment which drugs undergo before they reach the hands of the pharmacist also receives attention, because the physical appearance and chemical composition are sometimes influenced thereby. Especial care has been bestowed upon both the external and the structural characteristics of drugs, so that they may be readily identified and distinguished from those which resemble them, and in aid of this object a limited number of illustrations has been introduced, representing their outward forms as well as their histological appearances revealed by the microscope. Their proximate constituents, when of practical interest, have received special attention, and the effort has been made to decide between the conflicting statements of which these have been the subject. Chemical formulas have been expressed in the new notation, together with the molecular weights of the principal chemicals. Whenever products can be advantageously prepared by the pharmacist, one or more processes have been given and explained as fully as seemed necessary. Attention has been drawn to adulterations and impurities, and the means for detecting them have been pointed out. The officinal processes for pharmaceutical preparations have in most instances been detailed in the language of the Pharmacopœia, followed, when requisite, by explanatory and critical remarks and practical observations for the guidance of the operator.

With regard to Pharmacodynamics, there is presented, for the first time in a Dispensatory, a succinct account of the physiological action of medicines. The results of experiments are stated as clearly as possible, and occasionally in the theoretical language of the day; but, as a rule, terms have been employed whose meaning is not likely to become obsolete or unintelligible. Whenever it seemed possible an attempt to apply the results of physiological experiments to therapeutical uses has been made; for although the two fields of inquiry may not be so organically connected as to render the former a guide to the latter, it is nevertheless true that a scientific explanation of the curative powers of medicines must be sought in the results of their experimental operation upon the animal functions.

In treating of Therapeutics the most trustworthy results of clinical experience are concisely set forth, without discussing the grounds on which they rest. This method has proved laborious, and has often required a prolonged judicial examination to arrive at a conclusion expressed in a few lines. Its object has been to spare the reader the labor of a personal investigation, which could only be made with facilities which comparatively few possess.

Another feature, novel in a Dispensatory, is the Therapeutical Index. Care has been taken to render it as complete as possible, in order that the inquirer may be enabled to learn by its means all of the more important medicines that have been employed in the treatment of each disease. Such an index thus becomes to some extent a therapeutical classification of medicines, and it is believed must greatly enhance by its suggestiveness the working value of the book to the practitioner.

On mature consideration it was deemed best not to encumber the text with references to authorities, save in exceptional cases, such as those in which the opinions cited must be estimated by the credit attaching to their originators. Frequently, in the pharmaceutical portion, the year is stated in which the observation or discovery was made, which may serve as a guide to those desiring to undertake further research. For the more recent investigations, the Reports on the Progress of Pharmacy contained in the annual *Proceedings of the American Pharmaceutical Association* and the *Year-Book of Pharmacy* of the British Pharmaceutical Conference afford sufficient opportunities for ascertaining the original sources and consulting abstracts of original papers.

The statistics of importation have been taken from the Reports of the New York Chamber of Commerce, for which they were prepared by Mr. D. C. Robbins, based upon the Tables of the Bureau of Statistics at Washington.

PHILADELPHIA, February, 1879.

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ABBREVIATIONS.

Br. or *Br. P.*, British Pharmacopœia, 1867.
Br. Add., Additions to the British Pharmacopœia, 1874.
Ccm., Cubic centimeter.
Cm., Centimeter.
E., English.
F. Cod., Codex Medicamentarius; Pharmacopée Française, 1884.
Fr., French.
G., German.
Gm., Gram.
M., Meter.
Mgm., Milligram.
Mm., Millimeter.
Nat. Ord., Natural Order.
Off. Prep., Officinal Preparations.
P. G., Pharmacopœa Germanica, 1882.
Sp. gr., Specific gravity.
U. S. or *U. S. P.*, the Pharmacopœia of the United States of America, 1882.

The titles of many books and periodicals to which reference is made in the text are abbreviated, but not to such an extent as to necessitate their addition to this list.

THE
NATIONAL DISPENSATORY.

ABRUS.—Abrus.

Indian Liquorice, *Wild Liquorice*, E.; *Liane réglisse*, *Réglisse d'Amérique*, Fr.; *Indisches Süssholz*, G.

The root and seeds of Abrus precatorius, *Linné*. Bentley and Trimen, *Medicinal Plants*, 77.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a twining shrub, attaining a height of 10 or 15 feet (3 or 4.5 M.). It is indigenous to India, where it is known as *gunja*, *goontch*, or *gurgonje*, and now grows wild in all tropical countries. The leaves are 4 to 6 inches (10–15 Cm.) long, short-petiolate, abruptly pinnate, and have from 20 to 30 linear or oblong, obtuse, entire, smooth, and pale-green leaflets. The flowers are rose-colored, short-stalked, and clustered in one-sided, long-stalked racemes. The legumes are about 1⅕ inch (3 Cm.) long, oblong-rhomboidal, short-beaked, and contain from 4 to 6 seeds.

Description.—Radix abri. The root is long, and is seen in commerce in more or less twisted pieces, varying in length, and about ¼ to 1 inch (6 to 25 Mm.) thick. It has a thin, pale reddish-brown bark, containing near the middle layer a circular zone of sclerenchyma-cells, and in the inner layer strong bast-fibres, which are scattered without regularity through the liber parenchyma. The wood is yellowish, porous, breaks with a short fibrous fracture, and is composed of circles of wood-fibres containing rather large ducts and alternating with circles of parenchyma, the whole radially traversed by medullary rays, some of which are narrow, others much broader. The root has a slight not agreeable odor and a bitterish, mucilaginous taste, with a sweet after-taste resembling that of liquorice-root.

Semen abri; Prayer-beads, Jumble-beads, Crab's eyes, *E.;* Pois d'Amérique, *Fr.;* Paternoster-Erbsen, *G.* The seeds are globular-ovate, about ⅕ inch (5 Mm.) long, scarlet-red, glossy, and have a black spot surrounding the hilum; the testa is hard, and encloses a whitish fleshy embryo consisting of plano-convex cotyledons and an accumbent radicle. The seeds are inodorous and have a slight bean-like taste. They have been introduced under their Brazilian name, *jequiriti* or *guequiri*.

Composition.—Berzelius ascertained that the leaves and branches contain a principle closely resembling glycyrrhizin. The same principle is also present in the root, which in addition contains sugar; but nothing is known of the remaining constituents. Prof. Warden (1882), by treating the seeds with boiling alcohol, obtained white crystalline *abric acid*, which is slightly soluble in cold water, and appears to have the formula $C_{12}H_{24}N_3O$. The seeds also contain fixed oil, and an alkaloid has been isolated by Rigaud and Dusart (1883); but neither of these compounds seems to be the irritating principle.

Medical Action and Uses.—This plant is said to have been used for centuries in Brazil as a popular remedy for granular lids and pannus. In 1862 attention was called to it in Europe, but it was soon forgotten, and it was not until 1882 that renewed interest was awakened in it by the reports of De Wecker. An infusion, of the strength of one to twenty, applied to the eye of a rabbit produced violent inflammation of the organ, with œdema and false membrane, ulceration of the cornea, swelling of the parotid and submaxillary glands, and finally internal suppuration of the eyes and maxillary glands, and gangrene of the eyelids. It is said that the drug is much abused in Brazil, and that "one often sees violent inflammation of the lids which extends to the face, neck, and upper part of the thorax, the submaxillary glands often taking on an intense inflammation which ends in suppuration" (*Med. News*, xlii. 412). In experiments upon animals

Carnil and Berlioz determined that when injected under the skin or into the blood it produces in the former situation abscess or gangrene, and in the latter virulent tonical phenomena, with an enormous generation of bacilli in the blood and lymph (*Archives gén.*, Nov. 1883, p. 623). As to its mode of action, Sattler comes to the conclusion that "an apparently widely distributed and apparently harmless bacillus, when its spores come in contact with an infusion of jequirity, acquires a new physiological property—viz. of vegetating on the living conjunctiva, and producing a ferment there which produces the inflammation known as jequirity ophthalmia" (*Edinb. Med. Jour.*, xxix. 378).

The use of abrus is limited at present to those obstinate cases of *granular ophthalmia*, *trachoma*, and *pannus* which are notoriously rebellious to treatment, and which some surgeons have not scrupled to attempt to cure by the application of gonorrhœal pus. Its action is altogether substitutive, the removal of an existing inflammation by the action of a stronger but temporary one. De Wecker described the effects of its application thus: The infusion is applied several times a day until its action begins to be felt. Within a few hours after the first use of the lotion the conjunctiva becomes strongly irritated, and on the following day severely inflamed; the eyes cannot be opened, the lids are œdematous, and a watery liquid escapes from between them. This period of irritation lasts for about three days, and is attended with fever, pain, and sleeplessness. On the third day suppuration begins, and for five days continues copiously, and then gradually declines until about the fifteenth day, when the patient finds himself free from both inflammation and granulation, while the cloudiness of the cornea subsides (*Centralbl. f. Therapie*, i. 200). In this description no allusion is made to the striking peculiarity mentioned by most other reporters, the formation of a false membrane upon the conjunctiva; which, indeed, was originally described by De Wecker and by various other observers as a yellowish-white membrane adhering firmly to the upper, but less so to the lower, lids (Gruening, *Med. Record*, xxiii. 288; Brown, *Med. News*, xlii. 412). De Wecker also asserted that the cornea is not at all endangered by the artificial inflammation (*loc. sup. cit.*), a statement also made by Peek (*Med. Record*, xxiv. 30); but Sattler makes the very opposite declaration, saying that not only may the application cause existing ulcers to spread, but that it may also create new ones (*Centralbl. f. Therap.*, i. 335); and Standish admits that the result is not unusual (*Boston Med. & Surg. Jour.*, June, 1883, p. 609).

It is perhaps natural that under the influence of current medical doctrines some ophthalmologists have insisted that the curative action of abrus is much more than that of a substitutive inflammation such as the various stimulants produce which are used to cure granular lids, and that "jequirity ophthalmia arises from pathogenic micro-organisms," which Sattler professes to have differentiated, declaring that the removal of these bodies from the solution renders it inert, while they, on the other hand, preserve the power of generating the characteristic inflammation. Haranger also claims to have "found in an infusion of jequirity, as in the pus of gonorrhœa, micrococci, corpuscles, and granules" (*Bull. de thérap.*, civ. 42). These conclusions appear to have been fully sustained by the experiments of Carnil and Berlioz, who declare that "the bacteriæ of jequirity are its only active principle" (*Archives gén.*, Nov. 1883, p. 618).

The mode of using this remedy is described by De Wecker as follows: "Powder 32 jequirity beans, and macerate them for 24 hours in 500 Gm. (a pint) of cold water; then add an equal quantity of hot water, and filter when cool. The patient should bathe the eyes with this infusion several times a day until inflammation sets in." Others advise the liquid to be applied with a camel's-hair pencil. Sattler directs that the envelope of from 10 or 12 seeds (Gm. 1) should be removed with hot water before the infusion is made; the seeds should then be powdered and 200 Ccm. (f℥vi) of hot water added. This infusion should, after standing for 24 hours, be filtered. Its strength is reckoned as ½ per cent. At the Wills' Eye Hospital, Philadelphia, an infusion is used containing 9 grains to the ounce. Its decomposition is prevented by the addition of boric acid in the proportion of 4 grains of the acid to each ounce of the infusion.

ABSINTHIUM, *U. S.*—Absinthium.

Herba s. Summitates absinthii, P. G.; *Wormwood*, E.; *Absinthe commune*, *Grande absinthe*, *Armoise amère*, Fr.; *Wermuth*, *Alsei*, G.

The tops and leaves of Artemisia Absinthium, *Linné;* s. Absinthium vulgare, *Lamarck;* Woodville, *Med. Bot.*, 22; Bentley and Trimen, *Med. Plants*, 156.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This perennial plant is indigenous to hilly and mountainous regions of Northern Africa, of the greater portion of Europe, and of the northern part of Asia; it is frequently cultivated for medicinal purposes both in Europe and in this country, where it has become naturalized in some localities, and grows wild in waste places and along roadsides. The root produces several stems, which are 3 to 4 feet high (1 to 1.2 M.), woody at the base, nearly round, somewhat furrowed, and branching above. The radical leaves attain a length of 6 to 8 inches (15 to 20 Cm.); the stem-leaves are 1 to 3 inches (25 to 75 Mm.) long, petiolate, the upper ones sessile; their outline is roundish-triangular; they are twice or thrice pinnatifid, the segments lanceolate, the terminal one spatulate. The bracts are merely three-cleft or simple and lanceolate. The very numerous nodding heads of yellow flowers are in paniculate racemes, hemispherical in shape, with the involucre imbricate; the receptacle small and hairy, the marginal florets pistillate, and not ligulate, the numerous disk-florets perfect and five-toothed, and the ovary obovoid and crowned with a disk, but destitute of pappus. The entire plant, with the exception of the stouter portions of the stem, has a hoary appearance from the numerous appressed white silky hairs, leaving merely the upper surface of the leaves of a dark-green color.

Wormwood should be gathered while flowering, during July or August, the coarse stems being rejected. On careful drying the fresh herb loses from 75 to 80 per cent. of its weight. The wild-grown herb has a strong aromatic not very agreeable odor, and a persistent and intensely bitter taste; in cultivation the bitter taste is somewhat decreased.

Constituents.—The odor of wormwood is due to a limpid volatile oil, of which from .4 to 1.5 per cent. is obtained from the dry herb. According to Zeller, wormwood grown in a warm climate yields less volatile oil, and cultivation appears to decrease it. Its color varies between dark-green and yellowish-brown, but by careful rectification it may be obtained colorless. On exposure to light and air it acquires a dark-brown color and a somewhat viscid consistence. Its specific gravity varies between .90 and .973; it dissolves in 1 part of 85 per cent., and in all proportions of absolute alcohol; has a rotating power to the right in the polariscope, and possesses the pungent aromatic odor and taste of the herb. It consists mainly of *absinthol*, the composition of which is $C_{10}H_{16}O$, which boils at 200° C. (392° F.), and splits with zinc chloride into water and cymene, $C_{10}H_{14}$; it contains also 2 per cent. of terpenes boiling at 150° and above 120° C., and a few per cent. of blue oils boiling at 300° C. and upward (C. R. A. Wright, 1874). The volatile oil is the chief constituent of the liquor, which is largely consumed in Western Europe under the name of *absinthe*, and which is prepared either by distilling wormwood, melissa, anise, and other aromatics with whiskey, or by dissolving in the latter the corresponding volatile oils.

The intensely bitter taste resides in *absinthin*, which may be obtained from the hot infusion of the herb by precipitating it with tannin, washing the precipitate, and decomposing it by oxide of lead; the dry residue is exhausted with alcohol, the solution treated with animal charcoal, evaporated, and dissolved in ether. On evaporating the ether, it is left behind as a colorless mass yielding a white powder. It is fusible; slightly soluble in hot water, freely in alcohol and ether. Its solution in potassa is brown-red; the ammoniacal solution, treated with hydrochloric acid in excess, is rose-red. Composition: $C_{40}H_{58}O_9$, Kromayer ($C_{40}H_{56}O_{12}$, Luck). It was first obtained in 1828 by Caventou, in a still impure condition; Mein prepared it in white prisms (1834). Wormwood contains also some tannin (green with iron salts), resin, starch, albumen, potassium nitrate and other salts, succinic (Braconnot's absinthic acid, 1815), malic, and acetic acids.

Other Medicinal Species of Artemisia.—A. Pontica, *Linné;* Roman wormwood, *E.;* Petite absinthe, *Fr.;* Römischer Beifuss, *G.* Indigenous to Southern Europe and Central Asia. Hoary tomentose, leaves decompound pinnatifid, segments narrow linear; smaller than the preceding; odor strong, more pleasant; taste pungent, aromatic, and bitter; less esteemed than wormwood.

A. abrotanum, *Linné;* Southernwood, Old Man, *E.;* Aurone des jardins, *Fr.;* Eberraute, *G.* Western Asia and Southern Europe; cultivated in U. S. Minutely hairy, segments of the pinnatifid leaves capillaceous; odor lemon-like; taste aromatic and bitter.

A. vulgaris, *Linné;* Mugwort, *E.;* Couronne de Saint-Jean, Armoise commune, *Fr.;* Beifuss, *G.* Northern Africa, Europe, and Siberia; cultivated and spontaneous in U. S. Stem often purplish; leaves subsessile, green above, white tomentose beneath, pinnatifid, segments linear lanceolate, often incised; odor aromatic, agreeable; taste aromatic, bitterish, and somewhat acrid. The root, *Radix artemisiæ*, is also medicinally employed in Europe. It is about 8 inches (20 Cm.) long, nearly an inch (25 Mm.) thick, woody and beset with numerous thin and tough radicles, which are the parts used; they are 2 to 4 inches (5 to 10 Cm.) long, and about $\frac{1}{12}$ of an inch (2 Mm.) thick, are light brown, internally whitish, and have an angular wood and a thick bark, with a thin bast-layer, and, outside thereof, with 5 or 6 groups of resin-cells. The root has a slight not very pleasant odor, a sweetish and slightly acrid taste, and contains, according to Hummel and Jænicke (1826), Bretz and Eliason (1826), and Hergt (1830), a little butyraceous volatile oil, acrid resin, tannin, etc.

A. DRACUNCULUS, *Linné;* Tarragon, *E.;* Estragon, *Fr.;* Dragunbeifuss, Kaisersalat, *G.* Siberia, Tartary, Southern Europe; cultivated. Plant green and glabrous; radical leaves trifid; stem-leaves narrow lanceolate, entire; odor anise-like; taste aromatic, bitterish. The volatile oil is identical in composition with oil of anise.

A. LUDOVICIANA, *Nuttall;* Western Mugwort. It grows from Michigan to Oregon and southward, is 3 to 5 feet (1–1.5 M.) high, white woolly, with lanceolate, deeply cut, serrate, or entire leaves and numerous small flower-heads. It has a bitter taste, and a slight odor like that of wormwood. The fruit of this species, and of A. dracunculoides, *Pursh*, is used as food by the Indians. The last-named plant extends from Western Illinois to Oregon and southward to Arizona; recently it has also appeared in Arkansas. It has linear entire smooth leaves, of which the lower ones are occasionally three-cleft, and very numerous small mostly pedicelled heads in compound leafy panicles. The odor is wormwood-like, not very strong, and the taste somewhat bitter.

A. FILIFOLIA, *Torrey*, growing west of the Rocky Mountains, and known there as *Southernwood*, has filiform, revolute, sometimes three-cleft, whitish tomentose leaves, and small about four-flowered heads in leafy panicles, and is more aromatic than the preceding.

A. TRIDENTATA, *Nuttall*, is the *sagebrush* of Western North America, growing from Sonora to Nevada and Oregon and eastward to the Rocky Mountains. It is a shrub 5 or 6 feet (1½ to 2 M.) high, with crowded canescent, cuneate, and truncate, mostly bluntly three-toothed leaves and obovoid or oblong flower-heads, which are about ⅙ inch (4 Mm.) long, are about five-flowered, and spicately clustered in narrow compound panicles. The plant contains a pungent volatile oil, and is used by the Indians in the form of infusion for headaches, colds, and for worms.

A. ARBUSCULA, *Nutt.*, and A. TRIFIDA, *Nutt.*, are the dwarf sagebrushes of the same localities, and have similar properties.

A. ABYSSINICA, *Olivier*, is known in Abyssinia as *tshuking* and *zerechtit*. The inflorescence, which is employed, forms corymbose racemes with small globular heads, having a woolly involucre, whitish florets, an aromatic odor, somewhat resembling chamomile and tansy, and an aromatic bitterish taste. Dragendorff (1878) found in it 1.7 per cent. volatile oil, 2.8 tannin, and a trace of bitter principle.

Pharmaceutical Preparations.—EXTRACTUM ABSINTHII of the German Pharmacopœia is prepared with diluted alcohol; that of the French Codex with boiling distilled water.

TINCTURA ABSINTHII, *P. G.* 1 part of wormwood is digested with 5 parts of alcohol, sp. gr. 892, and expressed.

Physiological Action.—*On Animals:* Given to dogs and rabbits, the essential oil and the extract of absinth produce a species of intoxication, with spasms and insensibility, and, in large doses, epileptiform convulsions. During this state the pupil is dilated and the interior of the eye intensely congested, as are also the membranes of the brain. *On Man:* Absinth in medicinal doses acts as a stimulant tonic, but excessive doses occasion disturbance of the cerebral functions, and convulsions, which, according to Lancereaux, are clonic and not tonic, hysteroidal and not epileptiform; but their form varies with the dose administered. The habitual use of alcohol flavored with absinth gives rise to a peculiar chronic intoxication, in which degradation of the mental and physical powers and a tendency to convulsive epileptiform affections are conspicuous. The sensibility of the skin, and especially over the lower part of the abdomen, is said to be morbidly increased. Chronic intoxication by alcohol containing absinth is said to be characterized by alternations of excitement and depression, and by more frequent and frightful hallucinations than chronic alcoholism. The male victims of the habit soon lose their genital vigor, and the females cease to menstruate prematurely. Nearly all die of phthisis (Gautier, *Bull. de thér.*, ciii. 95). Absinthin produces similar phenomena. It is alleged that the convulsive attacks it causes differ from those of epilepsy in not including stertor, coma, or lividity of the face.

Medical Uses.—Wormwood may be advantageously employed in *atonic* and especially *flatulent dyspepsia*, and in various conditions of the system in which local disorders are maintained by general debility of the functions, and particularly by that of the digestive apparatus. In this manner partly, and partly also as a direct anthelmintic, it sometimes is used successfully to remove *intestinal worms.* Externally, a decoction of wormwood may be applied as a dressing to unhealthy and indolent *ulcers.* The *dose* of wormwood in substance is from 20 to 40 grains (Gm. 1.30–2.60). An *infusion* made with an ounce (Gm. 32) of wormwood in a pint of water (Gm. 500) may be given in doses of 1 or 2 fluidounces (Gm. 32–64).

A. vulgaris was at one time held in high repute as a remedy for *epilepsy*, and especially for those cases of it which occur in persons of feeble constitution and of a highly nervous temperament—more especially in young females with disordered menstruation. It was prescribed in hot infusion, so as to provoke diaphoresis, not only for epilepsy, but also for the cure of *amenorrhœa.*

Prof. Maisch has included the following statements in a "Note on Some American Species of Artemisia" (*Amer. Jour. of Phar.*, lii. 69): The infusion of A. ludoviciana was recommended as a hair tonic and febrifuge. The same plant was used by the Pah-Utes to assist childbirth and to stop hæmorrhage from the nose. A. dracunculoides is said to produce irritation when bruised, and the tea of it to be diaphoretic. A. filifolia, according to Dr. Palmer, is used in decoction by the Indians against swellings and bruises, and a very penetrating volatile oil obtained by distillation is useful in liniments. According to the same authority, a strong tea made from the sage-plant of the Rocky Mountains, which includes several species of Artemisia, is given for headache, colds, and worms, and a pungent volatile oil may be obtained from it.

ABSTRACTA.—ABSTRACTS.

Abstraits, Saccharures, Fr.; *Abstrakte*, G.

These are a new class of preparations which have been proposed by Professor Remington, and are intended to replace certain commercial so-called powdered extracts made by processes which have not been made public. The abstracts are alcoholic extracts diluted with sugar of milk, so that the weight of one part of the finished product represents two parts of the drug. This definite relation of weight is of advantage in adjusting the dose, which is one-half that of the drug itself. But since they are in no case directed to be made from standardized drugs, the variation of the medicinally active principles must be in proportion to the variation existing naturally in the crude drugs; even in the case of jalap only the lowest limit of alcoholic resin (12 per cent.) has been fixed for the drug. A valuable paper on this class of preparations was contributed by C. S. Hallberg to the *Proceedings* of the American Pharmaceutical Association, 1881, p. 424.

Similar preparations were recommended by Béral (1830) under the name of *saccharures*, and have been employed to a limited extent in France. They are prepared by intimately mixing 60 Gm. of tincture with 500 Gm. of granulated white sugar, and drying the mixture by exposure to the air or at a moderate heat; the tinctures being made in the proportion of 1 : 5, these saccharures represent 1 per cent. of their weight of the drug. Réveil subsequently proposed their preparation from a definite quantity of the alcoholic extract instead of from the drug. Dannecy recommended saccharures made in the same manner with aqueous extracts, as convenient for the extemporaneous preparation of *tisanes*. (See INFUSIONS.)

In some parts of Europe it has long been customary, for convenience in dispensing, to mix the narcotic extracts with milk-sugar, to exsiccate the mixture, and reduce it to powder. This practice was legalized by the Prussian Pharmacopœia in 1846, and has been retained in the Austrian Pharmacopœia, which directs such *extracta narcotica sicca* to represent one-half their weight of the extracts. Aside from the manipulation, these preparations differ from the abstracts in being exactly one-half the strength of the officinal extracts, instead of double the strength of the drugs.

Preparation.—The pharmacopœial formulas for the different abstracts are alike, with the exception of a few mostly unimportant differences, which are pointed out below. The menstruum directed is in all cases, except for aconite and nux vomica, a stronger alcohol than is required for the corresponding fluid extracts, and the latter cannot therefore be employed for preparing identical abstracts. The general formula is as follows:

Drug in powder No. 60 (conium-fruit and jalap in powder, No. 40) 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, alcohol (for ignatia and nux vomica alcohol and water), each a sufficient quantity; to make 100 parts (2 oz. av.). Moisten the powder with 80 parts (700 grains or 15 fluidrachms) of Alcohol (for modifications for aconite, conium, jalap, ignatia, and nux vomica, see table), and pack firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the powder is exhausted. Reserve the first 170 parts (1488 grains, or about 3½ fluidounces) of the percolate; evaporate the remainder to 30 parts (263 grains, or about 4 fluidrachms) at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating-dish, and, having added 50 parts (1 oz. av.) of sugar of milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough sugar of milk to make the mixture weigh 100 parts (2 oz. av.), reduce it to a fine, uniform powder. Preserve the powder in a well-stoppered bottle.—*U. S.*

The following table exhibits the modifications of each process:

Drug, 200 parts (4 oz. av.).	Powder.	Menstruum directed.	Menstruum for moistening powder.			Percolate. Reserved quantity.			Percolate. Last portion evaporate to—			Add milk-sugar.		Final product. Weight.		Final product. Color.
			P'ts.	Gr's.	fl.dr.	P'ts.	Gr's.	fl.oz.	P'ts.	Gr's.	fl.dr.	P'ts.	Oz. av.	P'ts.	Oz. av.	
Aconiti radix	No. 60	Alcohol.	*80	700	15	170	1488		30	263	About 4.	50	1	100	2	Brown.
Belladonnæ radix	No. 60	Alcohol.	80	700	15	"	"		30	263		"	"	"	"	Brown.
Conii fructus	No. 40	Alcohol.	†80	700	15	"	"		30	263		"	"	"	"	Green-brown.
Digitalis	No. 60	Alcohol.	80	700	15	"	"		30	263		"	"	"	"	Green.
Hyoscyamus	No. 60	Alcohol.	80	700	15	"	"		30	263		"	"	"	"	Green.
Jalapa	No. 40	Alcohol.	100	875	18¾	"	"	About 3½.	Distil off the alcohol.			"	"	"	"	Brown-yellow.
Ignatia	No. 60	Mixture of alcohol 8 parts (9¾ fl. oz.) water 1 part (1 fl.oz.)	100	875	18	"	"					"	"	"	"	
Nux vomica	No. 60		100	875	18	"	"					"	"	"	"	
Podophyllum	No. 60	Alcohol.	80	700	15	"	"					"	"	"	"	Brown.
Senega	No. 60	Alcohol.	80	700	15	"	"		30	263	About 4.	"	"	"	"	Brown-yellow.
Valeriana	No. 60	Alcohol.	80	700	15	"	"		30	263		"	"	"	"	Brown.

* Containing 2 parts (or 17½ grains) of tartaric acid.——† Containing 6 parts (52½ grains = 48 minims) of hydrochloric acid.

Properties.—Abstracts prepared according to the Pharmacopœia form light-colored powders, having the shade indicated in the above table and retaining the odor of the drug in a marked degree. On exposure to the air they attract some moisture and are apt to cake somewhat, those of hyoscyamus and valerian more than the others; abstracts should therefore be kept in well-corked vials and in a dry place.

ABSTRACTUM ACONITI RADICIS, *U. S.*—ABSTRACT OF ACONITE-ROOT.

Abstrait d'aconit, Fr.; *Akonitabstrakt*, G.

Preparation.—Aconite-Root in No. 60 powder 200 parts (4 oz. av.); Tartaric Acid 2 parts (17½ grs.); Sugar of Milk recently dried and in fine powder, and Alcohol, each a sufficient quantity. Dissolve the tartaric acid in 80 parts (700 grains, or 15 fluidrachms) of alcohol; moisten the powder with this solution, and pack firmly in a cylindrical *glass* percolator. Then proceed according to the general directions given on page 5, using alcohol for percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Although tartaric acid is used in the preparation of aconitine in an unaltered condition, in accordance with the suggestion of C. R. A. Wright (see ACONITIA), it is doubtful whether it serves a really useful purpose in this case (see also EXTRACTUM ACONITI). 30¾ fluidrachms of the present officinal fluid extract of aconite-root, if evaporated with a sufficient quantity of milk-sugar, will yield 2 oz. av. of abstract identical with the above.

DOSE.—One-half to 1 grain (Gm. 0.03–0.06).

ABSTRACTUM BELLADONNÆ, *U. S.*—ABSTRACT OF BELLADONNA.

Abstrait de belladone, Fr.; *Belladonnaabstrakt*, G.

Preparation.—Belladonna-Root in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions given on page 5, using alcohol for moistening and percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

DOSE.—Half a grain, as a commencing dose (Gm. 0.03).

ABSTRACTUM CONII, *U. S.*—Abstract of Conium.

Abstrait de ciguë, Fr.; *Schierlingabstrakt*, G.

Preparation.—Conium-fruit in No. 40 powder 200 parts (4 oz. av.); diluted Hydrochloric Acid 6 parts (52½ grains, or 48 minims); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Mix the hydrochloric acid with 80 parts (700 grains, or 15 fluidrachms) of alcohol; moisten the powder with this mixture, and pack firmly in a cylindrical *glass* percolator. Then proceed according to the general directions on page 5, using alcohol for percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

The addition of hydrochloric acid is made to prevent the volatilization of the alkaloid coniine during the concentration of the tincture.

Dose.—The dose of conium itself is quite variable, and hence the dose of its abstract must be uncertain. At first not more than 1 or 2 grains (Gm. 0.06–0.12) should be given at a time.

ABSTRACTUM DIGITALIS, *U. S.*—Abstract of Digitalis.

Abstrait de digitale, Fr.; *Digitalisabstrakt*, G.

Preparation.—Digitalis *recently dried* and in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions given on page 5, using alcohol for moistening and percolating. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Dose.—From half a grain to 1 grain (Gm. 0.03–0.06).

ABSTRACTUM HYOSCYAMI, *U. S.*—Abstract of Hyoscyamus.

Abstrait de jusquiame, Fr.; *Hyoscyamusabstrakt*, G.

Preparation.—Hyoscyamus recently dried and in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions on page 5, using alcohol for moistening and percolating. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Dose.—From 3 to 6 grains (Gm. 0.20–0.40).

ABSTRACTUM IGNATIÆ, *U. S.*—Abstract of Ignatia.

Abstrait de fève de Saint-Ignace, Fr.; *Ignazbohnen-Abstrakt*, G.

Preparation.—Ignatia in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, Water, each a sufficient quantity. Mix 8 parts of alcohol with 1 part of water (or in the proportion of 9¾ fluidounces of alcohol to 1 fluidounce of water); moisten the ignatia with 100 parts (2 oz. av., or 18 fluidrachms) of the mixture, and then proceed according to the general directions on page 5, using the same mixture for percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Ignatia is difficult to powder; the object is best accomplished on a small scale by somewhat crushing the seeds, and then heating them with a little water until they become soft enough to be bruised, while still warm, into a pulpy mass, with which a little alcohol is incorporated. It may then be dried and powdered for displacement.

Dose.—Half a grain (Gm. 0.03), and gradually increased.

ABSTRACTUM JALAPÆ, *U. S.*—Abstract of Jalap.

Abstrait de jalap, Fr.; *Jalapenabstrakt*, G.

Preparation.—Jalap in No. 40 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Moisten the jalap with 100 parts (2 oz. av., or 18¾ fluidrachms) of alcohol, and proceed according to the general directions on page 5. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

This abstract is of about the same medicinal activity as the extract prepared by exhausting jalap successively with alcohol and water, and is free from the inert matter contained in the latter. The alcoholic extract amounts to from 14 to 22 per cent. of the weight of jalap, of which a portion is soluble in water; this aqueous extract of the alcoholic extract possessing mild diuretic and laxative properties, the officinal resin of jalap should not be used for the preparation of the abstract. The dry alcoholic extract of jalap triturated with milk-sugar yields an apparently uniform powder, the ingredients of which will separate to some extent on keeping; prepared according to the Pharmacopœia process, the abstract retains its uniform composition apparently for an indefinite period.

Dose.—From 8 to 12 grains (Gm. 0.50–0.80).

ABSTRACTUM NUCIS VOMICÆ, *U. S.*—Abstract of Nux Vomica.

Abstrait de noix vomique, Fr.; *Brechnussabstrakt*, G.

Preparation.—Nux Vomica in No. 40 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, Water, each a sufficient quantity. Mix 8 parts of alcohol with 1 part of water (or in the proportion of 9¾ fluidounces of alcohol to 1 fluidounce of water); moisten the nux vomica with 100 parts (2 oz. av., or 18 fluidrachms) of the mixture, and proceed according to the general directions on page 5, using the same mixture for percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Nux vomica may be powdered for displacement in the same manner as ignatia-seeds, or the unbroken nux vomica may be exposed to steam until thoroughly softened, when, while still warm, it is crushed, dried, and powdered.

Dose.—Half a grain (Gm. 0.03), and gradually increased.

ABSTRACTUM PODOPHYLLI, *U. S.*—Abstract of Podophyllum.

Abstrait de podophyllum, Fr.; *Podophyllum-Abstrakt*, G.

Preparation.—Podophyllum in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions on page 5, using alcohol for moistening and percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S*

Dose.—5 to 10 grains (Gm. 0.30–0.60).

ABSTRACTUM SENEGÆ, *U. S.*—Abstract of Senega.

Abstrait de sénéga, Fr.; *Senega-Abstrakt*, G.

Preparation.—Senega in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions on page 5, using alcohol for moistening and percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Dose.—5 to 10 grains (Gm. 0.30–0.60).

ABSTRACTUM VALERIANÆ, *U. S.*—Abstract of Valerian.

Abstrait de valériane, Fr.; *Baldrianabstrakt*, G.

Preparation.—Valerian in No. 60 powder 200 parts (4 oz. av.); Sugar of Milk recently dried and in fine powder, Alcohol, each a sufficient quantity. Proceed according to the general directions on page 5, using alcohol for moistening and percolation. The finished abstract should weigh 100 parts (2 oz. av.).—*U. S.*

Dose.—5 to 15 grains (Gm. 0.30–1).

ACACIA, *U. S.;* Acaciæ Gummi, *Br.*—Gum Acacia.

Gummi arabicum, *Gummi mimosæ*, P. G.—*Gum arabic*, E.; *Gomme arabique*, **Fr.**; *Arabisches Gummi*, G.

A gummy exudation from Acacia Verek, *Guillemin et Perottet*, and other species of Acacia. Bentley and Trimen, *Med. Plants*, 94.

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—The gum-yielding species of Acacia are shrubs or trees with mostly abruptly bipinnate leaves, and with the stipules often transformed into thorns. The flowers are generally yellow, have numerous stamens, and are aggregated in dense elongated spikes or in globular heads.

A. Verek, *Guil. et Per.*, s. A. (Mimosa, *Linné*) Senegal, *Willdenow*, occurs from Kordofan, where it is called *Hashab*, west to the river Senegal; it is a small tree attaining the height of 20 feet (about 6 M.), and yields the Kordofan and Senegal gums.

Acacia vera and A. arabica, *Willd.*, which Ehrenberg considered as mere varieties, are now regarded as such, and identical with A. nilotica, *Desfontaines*, and Mimosa arabica, *Roxburgh*. This middling-sized tree is indigenous and also cultivated from Egypt south to Abyssinia and west to Senegambia; also in Arabia and India. Near the Nile it is known by the name of *Sont*.

A. tortilis, *Forskäl*, a small or medium-sized tree, called *Seyal* or *Seyaleh*, grows in Arabia and Upper Egypt.

A. Ehrenbergii, *Hayne*, a shrub 10 to 12 feet (3 or 4 M.) high, called *Segah*, is found in Arabia and Upper Egypt.

Collection and Commerce.—Gum arabic is probably formed by the metamorphosis of the cell-walls of the parenchyma, or, according to Carré, of the vascular bundles in the cambium layer; some investigators, however, consider it as the product of the transformation of starch, and that this process occurs either regularly, or is increased in consequence of a diseased condition of the plant. The gum exudes spontaneously, but the discharge is often hastened by incisions. It is yielded most plentifully during the hot summer months, the trees producing it in largest quantity having a sickly appearance. The thick liquid hardens upon the bark, and finally falls to the ground, but is collected by detaching it from the tree with the aid of a wooden axe.

The best gum is collected westward of the White Nile in Kordofan, and enters commerce by being shipped down the Nile to Alexandria; it is the *Kordofan gum*, called *Hashabi* in Egypt. A gum nearly or quite as handsome in appearance, though considered inferior in quality, is collected near the Blue Nile and shipped from Sennaar, either down the Nile or by way of the port of Suakin (Savakin) on the Red Sea; it is the *Sennaar* or *Sennari gum*, which, of late years, has become quite plentiful in our commerce. The kind known in commerce as *Suakin* or *Savakin gum* is collected farther east, not far from the west coast of the Red Sea, and shipped from the port named. The gum collected in Southern Abyssinia and adjoining countries is mostly exported from Berbera, either by way of the East Indies or through some neighboring ports of Arabia to the Mediterranean. Some gum is collected in India from several species of Acacia, and also from Feronia elephantum, *Correa*, but the great bulk of the commercial *East Indian gum* is of African origin. Arabia also yields a little gum, but the *Gedda* or *Jidda gum* and the *gum Tor* or *Turic* come originally from the Somali coast of Eastern Africa.

Gum arabic, before it finally enters commerce, is usually assorted in the Mediterranean ports, the clearest and whitest quality being known as *Turkey gum*. It is imported in casks, boxes, bags, and also in skins. The importation of gum arabic into the United States has risen to over 3,000,000 pounds annually.

Description.—Gum arabic occurs in roundish tears of various sizes, but usually more or less broken, and then constitutes angular fragments, of a glass-like, somewhat iridescent fracture, opaque in consequence of the numerous fissures contained in it, but transparent in thin pieces. The finest quality is colorless or white in mass, the pieces exhibiting more or less of a yellowish or brownish tint being the inferior varieties.

It has a very faint odor and a mucilaginous insipid taste. It is completely insoluble in strong alcohol, but dissolves in 2 parts of water, forming a thick transparent mucilage of an acid reaction; this solution is not precipitated by lead acetate, but subacetate of lead and soluble silicates yield white precipitates, and borax and ferric salts gelatinize the solution. Its specific gravity varies between 1.355 and 1.491; when completely dried at 100° C. (212° F.) it is increased to 1.525, with an absolute loss of 13.14 per cent. (Flückiger).

Savakin gum, which is quite brittle, is often not entirely soluble in water, but yields with it a pasty mass of rather strong acid reaction, depositing, when diluted with water, transparent globules, which Reimann (1881) found to consist of metagummic acid; this may be rendered soluble by the addition of a little potassa or by lime-water.

For pharmaceutical purposes only the whitest gum should be used, but in the arts the colored gums are frequently quite as serviceable, and their solutions are decolorized by filtering through aluminum hydrate, or by treatment with sulphurous acid, followed by barium carbonate.

Composition.—Gum arabic or arabin is the calcium compound of *arabic* or *gummic acid*, but contains also magnesium and potassium. This acid, which has been found by Scheibler (1873) in the sugar-beet, and is identical with Frémy's *metapectic acid*, may be obtained pure by precipitating with alcohol the mucilage, previously acidulated with hydrochloric acid, washing the precipitate well with alcohol and repeating the operation several times. While still moist, gummic acid is soluble in water, and from this solution it is not precipitated by alcohol unless hydrochloric acid be added. After drying (metagummic acid of Frémy) it merely swells up, but does not dissolve either in cold or boiling water, in which it is rendered soluble again on the addition of alkalies. It is amorphous, and after drying at 100° C. (212° F.) its composition is $C_{12}H_{22}O_{11}$; treated with lime-water and alcohol, the compound $C_{12}H_{20}CaO_{11} + 5C_{12}H_{22}O_{11}$ is obtained (Neubauer, 1854). This contains 2.56 per cent. $CaO = 4.58\ CaCO_3$. Löwenthal and Hausmann (1853) obtained 3.17 to 3.30 per cent. of ashes from gum arabic. Solution of gum rotates polarized light usually to the left, but some kinds have a right rotation. By continued boiling with dilute sulphuric acid, sugar is produced; nitric acid oxidizes it to mucic, saccharic, tartaric, and oxalic acids. Some gums yield little or no mucic acid, and these, on being treated with dilute sulphuric acid, produce *arabinose*, $C_{12}H_{22}O_{11}$, which crystallizes from hot alcohol in groups of minute radiating prisms, is not fermentable, but reduces Fehling's solution like grape-sugar. It was discovered by Scheibler in 1868, and obtained also from the gum of the juice of the sugar-beet. Kiliani (1880) regarded the sugar as identical with lactose. But Claësson (1881) proved it to be distinct from the latter; however, from gums which yield much mucic acid a sugar was obtained corresponding in the main with lactose. Reichardt's *pararabin* (1875) is a constituent of the sugar-beet, soluble in warm dilute acids, swelling with water, and by long-continued boiling with alkalies converted into arabic acid.

The inferior qualities of gum contain a little grape-sugar, which may be removed by alcohol; thus purified, gum does not reduce alkaline solutions of cupric oxide. 3 Gm. Kordofan (and Senegal) gum, precipitated from its aqueous solution by an excess (15 grams) of solution of subacetate of lead, yield a scarcely opalescent filtrate, which remains almost clear with ammonia. The filtrate yielded under similar circumstances from Sennaar gum is slowly obtained, is milky, and yields with ammonia a gelatinous precipitate (Schlosser, 1869).

Other Varieties of Gum.—Savakin or Suakin gum, which is described above, is also known as *talca* or *talha gum*, and is the exudation of Acacia stenocarpa, *Hochstetter*, and A. fistula, *Schweinfurth*.

Gum Senegal derives its name from the river Senegal. It is the product of Acacia Verek, A. Adansonii, *Guillemin et Perottet*, and other species of Acacia growing in Senegambia and adjoining countries of Western Africa. It occurs often in elongated and larger tears than the Egyptian gum, which mostly vary in color between yellow and brownish-red, have few fissures, but occasionally air-cavities in the centre, and otherwise have the appearance and chemical properties of gum arabic. A variety called *gum Galam*, *gomme du bas du fleuve* in France, is lighter in color, and has not the bitterish taste often found in the ordinary kind. Senegal gum enters commerce through France, where it is officinal; it is extensively used in the arts. From 5,000,000 to 6,000,000 pounds are gathered annually, the principal collection commencing in March (Féraud, 1873).

Gum Mogador, named after the port in North-western Africa whence most of it is exported from Morocco, also known as *Morocco* and *Barbary gum*, is probably obtained from Ac. nilotica, *Desfontaines*. It is in irregular tears of a yellowish-brown to red-brown color, superficially fissured, but breaking with a glass-like fracture.

Cape Gum, imported from the Cape of Good Hope, exudes from Acacia horrida, *Willdenow*, occurs in small tears and fragments, and is of a pale-yellow to amber color.

Australian Gum, Wattle Gum, the produce of Acacia decurrens, *Willdenow*, A. pycnantha, *Bentham*, and other species, is found in tears, which are frequently quite large, vary in color from yellowish- to reddish-brown, have a slightly astringent taste, and break with a glass-like fracture.

Mezquite Gum is obtained from Algarobia (Prosopis, *Gray*) glandulosa, *Torrey & Gray*, s. Prosopis juliflora, *De Candolle*, a tree 20 to 40 feet (6–12 M.) high, indigenous to Texas, New Mexico, and California, and southward through Mexico to Chili and Buenos Ayres; the yield by natural exudation is increased by making incisions; it is collected during the months of July, August, and September. It occurs in tears varying in size and in color from colorless to amber-brown, and resembles gum arabic in the fissures, specific gravity, solubility, its behavior to nitric acid, and the amount of ash yielded on incineration, 2.1 to 3 per cent.; but its aqueous solution is not precipitated by subacetate of lead, ferric salts, or borax; acetate of lead, with ammonia subsequently added, yields a gelatinous precipitate. The reactions, however, differ to some extent in different samples, and it is not unlikely that several Mimoseæ may furnish this gum.

Chagual Gum is collected in Chili from Pourretia (Puya, *Molina*) lanuginosa, *Ruiz et Pavon*, nat. ord. Bromeliaceæ, and yields a thick acidulous mucilage, which is precipitated by lead acetate, but not by borax or silicates. About 20 or 25 per cent. of the gum is insoluble in water.

Hog gum, Doctor gum, comes from South America, in translucent or transparent reddish irregular tears, which are but partly soluble in water. It is usually referred to Rhus Metopium, *Linné*, by others to Moronobea coccinea, *Aublet*, both of which yield gummy exudations. It is not identical with Hogg gum or Kuteera gum, which, according to Royle, is obtained from Cochlospermum Gossypium, *De Candolle*, nat. ord. Bixaceae, but appears also to be collected from Acacia leucophlœa, *Willdenow*, and probably from other trees. It is exported from India, and closely resembles the inferior kinds of tragacanth; its solution in water is neutral; the portion insoluble in water yields with alkalies a thick mucilage of a pinkish color, which according to Mitchell (1880) is not precipitated by acids.

Adulterations and Substitutions.—The inferior kinds of gum described above are frequently substituted for gum arabic in tears. In powder it is liable to the same substitution, and also to adulteration with flour and dextrin. The former is easily detected by adding to the cold mucilage, prepared with hot water, a solution of iodine, when a blue color will be produced; the latter by Trommer's test, which will separate cuprous oxide at ordinary temperature in an hour or two, or immediately on heating.

Pharmaceutical Uses.—Powdered gum arabic is extensively used in the preparation of emulsions of oleoresins, fixed and volatile oils, also for forming troches and pills; for the latter purpose a solution of gum in glycerin is preferable, particularly if the pills are to be kept for some time. Gum arabic is preferably made into a moderately fine powder (*sanded gum*), which retains its ready solubility in water; by drying it so that it may be finely powdered, it loses nearly 10 per cent. in weight, does not dissolve rapidly, and reduces alkaline copper solutions (Hager, 1873).

Pasta gummosa s. Pasta althææ, Marshmallow paste, *E.;* Pâte de gomme; P. de guimauve, *Fr.;* Gummipaste, *G.* Dissolve 1000 Gm. of white gum arabic in 1000 Gm. of water, strain, add 1000 Gm. of sugar, and with continuous stirring, evaporate in a water-bath to the consistence of thick honey; then add gradually 100 Gm. of orange-flower water and the white of 12 eggs, previously well beaten; continue to beat the mixture until of proper consistence; let it cool upon a marble slab or in boxes, and keep it in a mixture of 3 parts of powdered starch and 1 of sugar.—*F. Cod.*

Off. Prep.—Mistura amygdalæ, *U. S.;* Mist. cretæ, *U. S.*, *Br.;* Mist. glycyrrhizæ composita, *U. S.;* Mist. guaiaci, *Br.;* Mucilago acaciæ, *U. S.*, *Br.;* Pulvis amygdalæ compositus, P. tragacanthæ compositus, *Br.;* Trochisci, *Br.*, *U. S.;* Syrupus acaciæ, *U. S.*

Other Products of Acacia (see also Catechu).—The *sabicu-wood* of Cuba, from A. formosa, *Kunth*, the *blackwood* of Australia, from A. melanoxylon, *R. Brown*, the fragrant *myall-wood* of Australia, from A. homalophylla, *Cunningham*, and others, are valuable for cabinet and other work.

Acacia Farnesiana, *Willdenow*, is indigenous to the tropical and subtropical parts of America, and is cultivated in Southern Europe for the fragrant flowers, which yield a delicious perfume. In Germany the flowers of the *sloe*, Prunus spinosa, *Linné*, are also known as *flores acaciæ*.

Physiological Action and Medical Uses.—Various observations on the use of acacia as food, and experiments upon animals that were kept exclusively upon a diet of this substance, appear to render it probable that it cannot contribute much to real nutrition—that is, by providing materials for forming tissue. It is certain that an exclusive diet of gum cannot sustain life. Yet it may possibly retard waste, and thereby prolong life. Such appears to be in part its operation when used by the sick in the form of gum-water. But unquestionably its more demonstrable merit consists in its serving as a protective to inflamed surfaces, such as the mucous membrane during *pharyngitis*, *laryngitis*, etc., when it is usually given in the form of troches or lozenges. In *febrile* affections generally, in *inflammations* of the gastro-intestinal mucous membrane, in *gastritis*, *typhoid fever*, *dysentery*, etc., it is in ordinary use. In all such cases it is a palliative of irritation. By coating the mucous membrane, it moderates the irritation which the contents of the intestine tend to maintain, and thereby checks *diarrhœa* and tends to constipate. Its solution (*mucilago acaciæ*) may be rendered more agreeable and useful by the addition of sugar and various flavoring syrups; or the syrup, which is officinal, may be used alone. Powdered acacia may be applied to arrest bleeding from leech-bites and other sources of slight *hæmorrhage*. Its thick mucilage is sometimes used as a protective for superficial *burns*, *excoriations*, and *ulcers*.

ACETONUM.—Acetone.

Spiritus (s. *Æther*) *pyroaceticus.*—*Pyroacetic spirit or ether*, E.; *Acétone, Éther* (*Esprit*) *pyroacétique*, Fr.; *Aceton, Essiggeist, Mesitalkohol*, G.

Formula C_3H_6O. Molecular weight 58.

Formation and Preparation.—Acetone is formed on the dry distillation of wood, of acetates, citric acid, and, in the presence of lime, from sugar and other carbohydrates It is obtained pure by the dry distillation of barium acetate (Liebig), but is usually prepared from calcium acetate or from a mixture of 4 parts of crystallized acetate of lead and 1 of burnt lime; the distillate is neutralized with dry sodium carbonate, treated with calcium chloride, and purified by fractional distillation over lime.

Properties.—It is a thin, colorless liquid, which when ignited burns with a luminous, non-sooty flame. It has a peculiar ethereal somewhat mint-like odor, and a refreshing, but very pungent and sweetish taste. Its density at 15° C. (59° F.) is .8008, and at 18° C. (64.4° F.) .792; it boils between 55.5° and 56.3° C. (132° and 133.3° F.). It is soluble in all proportions in water, alcohol, ether, volatile oils, and most compound ethers, and dissolves gun-cotton, camphor, many resins, including copal, and fats. Most of the salts soluble in alcohol are insoluble in acetone, which separates even from a concentrated aqueous solution of calcium chloride.

Composition.—The empirical formula has been given above. Constitutionally it has been regarded as aldehyd, with 1H replaced by methyl $= C_2H_3(CH_3)O$; also as *dimethyl-ketone* $CO.CH_3.CH_3$.

Impurities.—The principal impurities met with in acetone are alcohol and water, which impart a higher specific gravity; the former may be recognized by the addition of iodine, followed by potassa solution, when iodoform will be separated. Water, if present, will liquefy a fragment of calcium chloride, but the same salt powdered, according to Hlasiwetz (1850), will form with acetone a solid compound which is decomposed by water. Empyreumatic products present in acetone will cause an opalescence on dilution with water.

Allied Compound.—Acetal, $C_6H_{14}O_2$ or $CH_3CH(C_2H_5O)_2$; mol. weight 118. It is formed on the oxidation of alcohol by manganese dioxide and sulphuric acid, or by platinum black or by chlorine, and is obtained by fractional distillation and by treatment with calcium chloride and potassa. It is a thin, colorless liquid, of an agreeable alcohol-like odor, a refreshing taste, and the specific gravity .831 at 20° C. (68° F.). It boils at 104° C. (219.2° F.), dissolves in alcohol and ether in all proportions, but is rather sparingly soluble in water. In contact with air and by oxidizing agents it is readily converted into aldehyd, and finally into acetic acid.

Medical Action and Uses.—This preparation was originally employed in chronic *pulmonary affections* to allay cough and diminish expectoration; but it has long been disused for these purposes. It is asserted to act, not as an anæsthetic, but as a soporific only; but the better opinion is that, while its anæsthetic action is comparatively feeble, its intoxicating operation is decided. It has been recommended as an *anthelmintic*, and in *rheumatism* and *gout*. It may be prescribed in doses of 15 or 20 drops (Gm. 1.0–1.30), dissolved in spirit of nitrous ether. It may also be used by inhalation from a watery solution, either atomized or diffused by heat.

Acetal, according to Von Mering, acts first on the brain, causing gradual loss of consciousness, and then upon the spinal marrow, arresting respiration before the heart. When fatal it kills by asphyxia. Hiller reports that its internal administration is not easy, since its taste is acrid and burning, and, moreover, that it is six times as weak as chloral hydrate, acting as a hypnotic only in doses of from 2 to 3 drachms (Gm. 8–12). On the day after taking it patients complained of depression, heaviness of the limbs, and nausea (*Zeitschrift f. klin. Med.*, vi. 492).

ACETUM, *Br.*, *P. G.*—Vinegar.

Acetum crudum, *Acetum vini*.—*Vinaigre*, Fr.; *Essig*, G.

Vinegar is a dilute acetic acid, obtained by the acetic fermentation of alcoholic liquids; the materials from which it is prepared influence its color, and to a considerable extent also its odor and taste.

Production.—Wine, cider, beer, and similar liquids not containing too large an amount of alcohol, when exposed to the atmosphere, turn sour in consequence of the oxidation of alcohol, to acetic acid; $C_2H_6O + O_2$ yields $C_2H_4O_2 + H_2O$. This acetification is accomplished in partly-filled casks having a small opening at the top, and requires several weeks or months, or even about two years, to be complete, according to the temperature, which is most suitably kept between 20° and 35° C. (68° and 95° F.). During this process a cryptogamic growth is observed, consisting, according to Pasteur, of *Mycoderma aceti*. The acid liquid thus obtained requires clarification, which is effected either by allowing it time to settle or by transferring it to other casks containing wood shavings. In this manner, *wine*, *cider*, *malt*, and *beer vinegars* are made.

Most generally, however, vinegar is made by the so-called *German* or *quick vinegar process*, for which the simple apparatus suggested by Wagenmann is employed. This consists of several straight-sided casks 6 to 9 feet high, having, a few inches above the bottom, a false bottom or perforated diaphragm, upon which is packed a layer, 2 to 3 feet in thickness, of fresh beech-wood shavings which have been previously steeped in vinegar. Several inches below the top another perforated diaphragm is inserted, or, in place of it, the cask is covered with a well-fitting tub having a perforated bottom. The liquid, containing from 6 to 10 per cent. alcohol, being placed upon the upper diaphragm, its flow is regulated by means of wooden pins inserted into the perforations, and it is thus compelled to trickle through the shavings, and thereby to present a large surface to the oxidizing influence of the atmosphere, with which free communication is established by a number of holes bored through the side of the cask immediately above the lower diaphragm, and by several tubes passing through the upper diaphragm and above the surface of the alcoholic liquid. The partly acetified liquid is drawn off from below the lower false bottom by means of a tap or pipe, and transferred to another similarly prepared cask, until the whole of the alcohol has been converted into acetic acid. During all this time the change of air in the room and its temperature must be carefully attended to, as otherwise the oxidation may become too rapid and the heat within the casks too high, so that the alcohol would be oxidized into carbonic acid and water. At and below 7.2° C. (45° F.) little or no acetic acid is produced. The process is finished in from 3 to 15 days.

Theory of Acetification.—Ethylic alcohol C_2H_6O is first oxidized to aldehyd acetylaldehyd, or acetylhydride, with the elimination of water; $C_2H_6O + O = H_2O + C_2H_4O$. By the further acquisition of oxygen, acetic acid $C_2H_4O_2$ is formed. These oxidations are brought about, according to Pasteur, through the agency of the Mycoderma above referred to, while others ascribe it mainly to the oxidizing influence of the air; according to Mulder the appearance of Mycoderma aceti in vinegar is accompanied by a decrease of the acetic acid.

Properties.—Made by the German process, vinegar generally contains some aldehyd and alcohol, which are usually absent if the production has been effected by the slow oxidation in casks. The sensible properties of vinegar are affected to a much larger extent by the material from which it has been obtained. *Malt vinegar* is largely made in Great Britain from beerwort, or from the fermented solution of malt; it is of a more or less deep-brown color. *Beer vinegar* made from stale beer has the bitter taste of the hops. *Wine vinegar* is very extensively made in Southern and Western Europe from the lower grades of wines, the aroma of which is, to some extent, preserved; it contains also tartaric acid and tartrates, and if made from a red wine possesses a red color. *Cider vinegar*, which is much employed in the United States, is made from cider, and contains malic acid. *Common vinegar*, made from diluted whiskey, has the flavor of the latter to some extent, and contains the alkaline and earthy salts of the water used in its manufacture.

The color of vinegar varies from yellowish to brown or red; its specific gravity is about 1.008 to 1.018. It has an agreeable acidulous odor, differing from that of diluted acetic acid by the presence of some acetic or other ethers. By exposure to the air it undergoes putrefaction and becomes muddy. It should contain between 5 and 6 per cent. of acetic acid. A fluidounce of it should require for neutralization not less than 35 grains of bicarbonate of potassium (*U. S.*, 1870), indicating 4½ per cent. 445.4 grains by weight require at least 402 grain-measures of the volumetric solution of soda for neutralization, indicating 5.4 per cent. of acid or 4.6 per cent. of acetic anhydride (*Br.*). 10 Gm. of vinegar neutralize 10 Ccm. of volumetric solution of potassa (*P. G.*), indicating 6 per cent. of acetic acid. Evaporated to dryness, a residue amounting to 1 or 2 per cent. is obtained, and on incineration a small amount of ashes, usually between 0.01 and 0.03 per cent., is left behind.

ACETUM DESTILLATUM, Distilled vinegar, *E.;* Vinaigre distillé, Oxéolat simple, *Fr.;* Destillirter Essig, *G.*—*Distilled vinegar* is made by distilling crude vinegar from a glass retort until about three-fourths have passed over. It is colorless, lighter in specific gravity (about 1.004), owing to the removal of extractive and other substances, and should contain not less than 4.5 per cent. of acetic acid. *Acetum purum s. destillatum* of the German Pharmacopœia is equivalent to the diluted acetic acid *U. S. P.*

Impurities and Adulterations.—Poisonous metallic salts, like tin, lead, and copper, which may be present as accidental impurities, are detected by the dark coloration or precipitate occurring with hydrosulphuric acid; moreover, copper would be precipitated upon a bright iron spatula kept in the vinegar for a short time; lead, if present, will yield a white precipitate with sulphuric acid, and a yellow one with potassium iodide.

Acrid substances, such as capsicum, pepper, pellitory, ginger, etc., which may have been added to impart artificial strength, are recognized by the taste of the vinegar after it has been neutralized with an alkali, or after it has been evaporated in a water-bath to a syrupy consistence.

The most common adulterations are acids, and particularly sulphuric acid. In testing for these it must be remembered that crude (but not distilled) vinegar is likely to contain sulphates, chlorides, and occasionally even nitrates, derived from the water which has been used in its manufacture. *Sulphuric acid* is detected by the white precipitate yielded on boiling with chloride of calcium, which is not precipitated by the small amount of sulphates present. On evaporating the vinegar and mixing with the extract, while still warm, a little powdered potassium chlorate, an ignition will be observed in the presence of free sulphuric acid, or if its quantity be minute the odor of chlorine will be produced (J. C. Wharton, 1882). A more delicate test is that of Chevallier, which was in 1872 again suggested by James T. King: an ounce of vinegar is evaporated to half a drachm, an ounce of alcohol is added, which removes all traces of sulphates; the liquid is now filtered, mixed with an ounce of water, and may be either directly tested with a solution of chloride of barium in diluted alcohol, or the alcohol may be previously evaporated at a moderate temperature. W. C. Young (1877) has proposed to add to 30 Ccm. of vinegar some barium chloride in excess, estimate the chlorine in one-third of the liquid, and then evaporate the other two-thirds to dryness, incinerate, and determine the chlorine in the ashes. The difference between the two results, calculated for the same quantity of vinegar, is due to hydrochloric acid, liberated by an equivalent quantity of free sulphuric acid. *Hydrochloric acid* is recognized by the distillate producing a white turbidity or precipitate with nitrate of silver, which is not removed by nitric acid, but is soluble in ammonia. *Oxalic acid*, if present, occasions with chloride of calcium at once a white precipitate, which is dissolved by nitric acid. *Tartaric acid* is best recognized by concentrating the vinegar in a water-bath, evaporating it to one-fourth or one-sixth of its volume, filtering and adding a concentrated solution of acetate of potassium, when acid potassium tartrate will be precipitated. *Nitric acid* may be detected by evaporating the vinegar in a water-bath to one-third its volume, and digesting it with copper filings, when nitrous acid vapors will be given off, which are recognized by the red color. Since a solution of ammonium acetate, on being evaporated in a water-bath, leaves no residue, about an ounce of vinegar (30 Gm.) may be mixed with a slight excess of ammonia and evaporated, when merely an extractive mass should be left; but if crystalline, one or more of the above-mentioned acids are present. According to Chiappe (1882), a very simple test for the presence of mineral acids is methyl-aniline-violet or Paris violet, the color of which is not affected by organic acids, but is changed to ultramarine blue by inorganic acids; a solution of the dye in 1000 parts of water or alcohol is used for testing.

The presence of *aldehyd* in vinegar is indicated by the brown color produced in the first portion of the distillate with an excess of potassa solution. Vinegar which has been prepared or kept in oaken barrels contains a little tannin, and acquires a black color with ferric salts.

Distilled vinegar should not be colored by an excess of potassa; it should not on heating destroy the blue tint occasioned by indigo solution (*nitric acid*), not leave any residue on evaporation, and not occasion any precipitates with chloride of barium or nitrate of silver.

Pharmaceutical Uses.—Crude vinegar is now rarely employed in pharmacy, and in place of distilled vinegar dilute acetic acid is usually used.

Acetum aromaticum, *P. G.;* Aromatic vinegar, *E.;* Vinaigre aromatique, V. vulnéraire, *Fr.;* Aromatischer Essig, *G.* Oil of Lemon, Oil of Cloves, each 2 parts; Volatile Oils of Lavender, Peppermint, Rosemary, Juniper, and Cinnamon, each 1 part; Alcohol 300 parts; Acetic Acid 450 parts; Water 1200 parts; dissolve, set aside for several days and filter. It is a clear, colorless liquid, of an aromatic acetous odor, and miscible with water in all proportions without becoming turbid. (See also Acidum Aceticum.)

Off Prep.—Emplastrum cerati saponis, *Br.*

Physiological Action.—Vinegar is a mild stimulant and astringent, but distilled vinegar more nearly resembles acetic acid in the energy of its action. The universal employment of vinegar as a condiment, to facilitate the digestion of crude vegetable and fatty animal food, proves that it is useful for these purposes. Its favorable action is supposed to depend upon its power of softening and promoting the solution of animal fibre and converting cellulose into sugar. The latter explanation may be well founded, but the former does not apply to the utility of the liquid as a condiment for fatty substances. It seems not improbable that, as vinegar powerfully excites the secretion of the salivary glands, it exerts a similar influence on the stomach, augmenting the flow of gastric juice, and thereby increasing the digestive power of the organ. It is probable that, in a similar manner, it moderates thirst, a purpose to which it has always been applied by the laity as well as by physicians. Like other stimulants, if used in excess it exhausts the susceptibility of the stomach, impairs digestion and nutrition, and may induce a state of marasmus accompanied by degenerative changes in the lungs, and ending in fatal phthisis. Such effects have resulted from the excessive use of vinegar for the purpose of restraining a tendency to obesity. After death, in some cases of this sort, the stomach itself has been found to present the lesions of chronic gastritis. Experience has shown that, as a condiment, vinegar is most suitable for fat and plethoric persons, and in warm weather. It should be very sparingly used by the thin and anæmic, and by those who are subject to diarrhœa. Its tendency to affect the milk of nursing mothers and occasion diarrhœa in their infants should be constantly kept in mind. Applied to the skin, vinegar by its evaporation causes a sense of coolness, even while it produces some irritation and stimulates the cutaneous blood-vessels and glands.

Medical Uses.—In common with other acids, vinegar possesses the property of assuaging thirst, and hence it has always been used for this purpose in *fevers*. It appears also to diminish the frequency of the pulse and the heat of the skin in these affections. Its power of preserving animal and vegetable substances immersed in it probably led to the notion that it possesses special virtues in the falsely-called putrid fevers, and especially that it prevents contagion. But these notions are groundless. In those affections, however, the use of vinegar as a lotion is useful by the evaporation of the liquid producing a refreshing sense of coolness. Probably, also, its stimulant action upon the skin may promote a salutary diaphoresis. It is an error to suppose, as the ancients did, that vinegar is an antidote to the poisonous effects of *narcotics;* its stimulant action may be advantageous when the poison has been removed from the system and its direct operation has ceased. In this respect, however, it is greatly inferior to ammonia, coffee, and even alcohol. When given after the ingestion of caustic *alkalies* or earths, or of the carbonates of these substances, it unites with them, and, forming innocuous acetates, arrests their corrosive action. Vinegar and dilute acetic acid have been used beneficially in the treatment of *lead colic* after the bowels had been moved by purgatives. The stimulant action of strong vinegar or dilute acetic acid is usefully employed by snuffing the fumes of these liquids, to which camphor and various aromatics have been added. This expedient is useful in relieving *nervous headache*, *faintness*, *drowsiness*, *commencing coryza*, etc., but is less efficient than a similar application of ammonia. Vinegar, distilled or not, is a very useful agent for arresting *hæmorrhage*, especially from the nose, stomach, rectum, and uterus. It should, if possible, be applied directly to the source of the bleeding, as in post-partum hæmorrhage by expressing vinegar from a sponge introduced into the cavity of the uterus. At the same time compresses saturated with vinegar and water should be laid upon the abdomen. Vinegar is popularly employed to prevent *discoloration* of the skin after injuries of the integument, and to retard the redness and swelling and allay the pain of local *inflammations*. This method is particularly useful in superficial *burns* and in preventing *suppuration* of the mamma. A weak solution of vinegar may be used to limit the action of particles of *lime* in the eye. Lotions of vinegar check colliquative *perspiration*, and produce a refreshing coolness when the skin is hot in *fevers*, and allay *headache* and *delirium* when applied to the forehead. Enemas of vinegar are sometimes used to destroy *ascarides* of the rectum.

The *dose* of vinegar is from 1 to 4 fluidrachms (Gm. 4–16) in from 2 to 4 parts of water. An acidulated drink may be made with 2 fluidounces (Gm. 64) of vinegar in a quart (Gm. 1000) of water. By enema vinegar may be given to the extent of from 1 to 4 fluidounces (Gm. 30–130). A lotion may be made with 1 part of vinegar and 3 or 4 of water. The doses of distilled vinegar do not differ materially from the above.

ACETUM CANTHARIDIS, *Br.*—VINEGAR OF CANTHARIDES.

Vinaigre cantharidé, Fr.; *Canthariden-Essig*, G.

Preparation.—Take of Cantharides in powder 2 ounces; Glacial Acetic Acid 2 fluidounces; Acetic Acid 18 fluidounces, or a sufficiency. Mix 13 fluidounces of the acetic acid with the glacial acetic acid, and digest the cantharides in this mixture for 2 hours at a temperature of 93.4° C. (200° F.); then transfer the ingredients after they have cooled to a percolator, and when the liquid ceases to pass pour 5 ounces of acetic acid over the residuum in the apparatus. As soon as the percolation is complete, subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient acetic acid to make 1 pint (Imp. meas.).—*Br.*

At the elevated temperature directed in this process the cantharidin, with various extractive matters, is readily dissolved by the acetic acid, and after cooling remains in solution.

Medical Action and Uses.—Vinegar of cantharides is irritating to the skin by means of both its constituents. Like other strong liquid vesicants, it is especially appropriate when the surface to be blistered is uneven and of very limited extent, and when it is an object to produce vesication rapidly. It is more painful than other vesicating preparations of cantharides. It should be applied with a brush in several successive coats, and then covered with some simple ointment. Vesication usually occurs within 2 or 3 hours. It is very suitable for blistering the skin over the superficial portions of nerves in *neuralgia*, as was first recommended by Cotugno, and more recently systematized by Valleix; and also for blistering in *rheumatism* after the manner of Herbert Davies.

ACETUM LOBELIÆ, *U. S.*—Vinegar of Lobelia.

Vinaigre de Lobélie enflée, Fr.; *Lobelien-Essig*, G.

Preparation.—Take of Lobelia in No. 30 powder 10 parts (1 oz. av.); Diluted Acetic Acid sufficient. Moisten the powder with 5 parts (½ oz. av.) of the acid, pack it firmly in a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts (10 oz. av., or about 9¼ fluidounces) of percolate are obtained.—*U. S.* This vinegar is about one-fourth weaker than that of the Pharmacopœia of 1870.

It is a reddish-brown liquid, in which the alkaloid lobeline is supposed to be preserved from alteration by the free acetic acid.

Medical Action and Uses.—The advantages of this preparation appear to be its stability and strength. It is especially indicated in congested states of the *bronchial* mucous membrane, with imperfect secretion and *spasmodic constriction* of the air-tubes. It may be appropriately associated with preparations of antimony, squill, seneka, or ipecacuanha. The dose for an adult is from 30 minims to a fluidrachm (Gm. 2–4) when a merely expectorant operation is desired; but as a nauseant and antispasmodic, from 1 to 2 fluidrachms (Gm. 4–8) should be given at intervals of an hour until its characteristic effects are produced.

ACETUM OPII, *U. S.*—Vinegar of Opium.

Black drop, E.; *Vinaigre d'Opium*, Fr.; *Opium-Essig*, G.

Preparation.—Take of powdered Opium 10 parts (1 oz. av.); Nutmeg in No. 30 powder 3 parts (131 grains); Sugar 20 parts (2 oz. av.); Diluted Acetic Acid sufficient to make 100 parts (10 oz. av., or about 8⅝ fluidounces). Macerate the opium and nutmeg in 50 parts (5 oz. av.) of the acid for 24 hours. Put the mixture into a conical glass percolator, and return the liquid until the percolate passes clear. Then pour on diluted acetic acid until 80 parts (8 oz. av., or about 7⅛ fluidounces) of liquid have been obtained. In this dissolve the sugar, without heat, and strain.—*U. S.*

This is, by measure, the strongest of the liquid preparations of opium, but is about one-third weaker than that of the preceding Pharmacopœia, 1 grain of opium being represented by 10 grains (or by about 9 minims) of the vinegar. It is of a deep reddish-brown color.

Medical Action and Uses.—Vinegar of opium is nearly free from the sickening smell and taste which belong to laudanum, and is much less apt to nauseate. This last quality is probably due in part to the nutmeg it contains, and in part to the almost complete absence from it of narcotine, the most irritating to the stomach and depressing to the nervous system among the constituents of opium. This advantage it shares with the deodorized tincture. The dose is from 5 to 10 drops or minims (Gm. 0.30–0.60).

ACETUM SANGUINARIÆ, *U. S.*—Vinegar of Sanguinaria.

Vinaigre de Sanguinaire, Fr.; *Blutwurzel-Essig*, G.

Preparation.—Take of Bloodroot in No. 30 powder 10 parts (1 oz. av.); Diluted Acetic Acid sufficient. Moisten the powder with 5 parts (½ oz. av.) of the acid, pack it firmly into a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts (10 oz. av., or about 9¼ fluidounces) of filtered liquid are obtained.—*U. S.*

Recently prepared, this vinegar is of a deep-red color, which becomes lighter on standing, owing to the deposition of coloring matter, which appears to be independent of that due to the sanguinarine salt (Procter, 1864).

Medical Action and Uses.—The very limited use of this preparation prevents any definite knowledge of its peculiar virtues. Whatever utility it may have displayed as a gargle in *scarlatinous sorethroat* was probably due to its menstruum. It would be folly to employ it as an emetic when other more certain emetics are at hand; and there is nothing to show that as an expectorant, which it is reputed to be, its beneficial action outweighs its harsh operation and its depressing action on the heart and nervous system. Its dose as an emetic is stated to be 3 or 4 fluidrachms (Gm. 12–16), and as an alterative and expectorant, from 15 to 30 drops or minims (Gm. 1–2).

ACETUM SCILLÆ, *U. S., Br., P. G.*—VINEGAR OF SQUILL.

Vinaigre scillitique, Fr.; *Meerzwiebel-Essig*, G.

Preparation.—Take of Squill in No. 30 powder 10 parts (1 oz. av.); Diluted Acetic Acid sufficient. Mix the powder with 30 parts (3 oz. av.) of the acid, and when the mixture has ceased to swell pack it carefully into a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts (10 oz. av., or about 9¼ fluidounces) of filtered liquid are obtained.—*U. S.*

Powdered squill forms a solid mass with a small amount of aqueous liquids, and absorbs a much larger amount, increasing thereby considerably in bulk. For 10 parts of the powder 40 parts of dilute acetic acid may be used without disadvantage previous to introducing it into the percolator. The moist coarse powder should be carefully packed, a moderate amount of pressure being used, so that the liquid will penetrate uniformly and pass through in drops. The British, French, and German Pharmacopœias direct this preparation to be made by maceration, that of the latter being practically identical with, that of the former somewhat stronger than, that of the present *U. S. P.* The formula of the British Pharmacopœia is as follows: Macerate 2½ ounces of bruised squill in an imperial pint of diluted acetic acid for 7 days, strain with expression, add to the strained liquid 1½ fluidounces of proof spirit, and filter. The German Pharmacopœia macerates 5 parts of squill in 5 parts of alcohol, 9 parts of acetic acid, and 36 parts of water for 3 days. The French Codex directs 1 part of squill to be macerated in 12 parts of white vinegar for 8 days.

Off. Prep.—Oxymel scillæ, *Br.;* Syrupus scillæ, *U. S.*, *Br.*

Medical Action and Uses.—Vinegar of squill was anciently employed, and for very diverse purposes, among which it is only necessary to mention the cure of spongy gums, various forms of sorethroat, hoarseness, etc., in all of which it is certain that the vinegar, and not the squill, in the compound was the efficacious ingredient. The diuretic action of squill is probably enhanced by its solution in vinegar, which is the best form for its administration in *dropsy*. Its efficiency is much increased by associating it with acetate of potassium and digitalis, as in the following formula: ℞. Tinct. scillæ f℥ss; tinct. digitalis fʒij; spt. juniperi comp., vin. hispan., āā fʒij; aquæ f℥viij; potassii acetat. ℥j.—M. S. A tablespoonful, diluted, three times a day. Vinegar of squill should not be used in renal dropsy, but only in dropsy of cardiac origin. Its average dose is about 15 minims (Gm. 1), and it is best administered in an aromatic draught.

ACHILLEA.—YARROW.

Herba s. Summitates achilleæ s. millefollii.—*Milfoil*, E.; *Millefeuille*, *Herbe aux charpentiers*, Fr.; *Schafgarbe*, *Schafrippe*, G.

Achillea Millefolium, *Linné.* Woodville, *Med. Bot.* 15; Bentley and Trimen, *Med. Plants*, 153.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—A perennial herb, 2 to 3 feet (60–90 Cm.) high, growing in fields and pastures throughout the greater part of the northern temperate zone of America and Europe. The hairy furrowed stem is nearly simple, branching only near the top. The radical leaves are petiolate, 8 to 12 inches (20–30 Cm.) long; the stem-leaves nearly sessile, 2 to 4 inches (5–10 Cm.) long, all more or less soft-hairy, dark-green, lanceolate in outline, and twice or thrice deeply pinnatifid; the segments are linear-spatulate, three- to five-cleft, crowded, finely mucronate, and upon the lower side with small oil-glands. The flowers grow in level-topped corymbs; heads numerous, with the involucre oblong; scales imbricate, keeled; receptacle flat, chaffy; ray-florets pistillate, 4 or 5, short ligulate, white or rose-colored; disk-florets several, perfect, tubular, with the margin whitish and the tube greenish; akenes flattened, oblong, without pappus. It has a feeble aromatic somewhat chamomile-like odor, and a bitterish, rather saline taste. It should be collected in July, while flowering, the coarse stems being rejected. The loss in drying is about 85 per cent.

Constituents.—Yarrow yields by distillation with water about $\frac{1}{10}$ per cent. of a blue or dark-green volatile oil, that of the flowers having a spec. grav. of 0.92, that of the leaves .85 to .92, the latter being butyraceous. The bitter principle *achilleïn* was obtained by Zanon (1846) as a reddish-brown extract-like mass, and was regarded by Von Planta (1870) as being identical with the alkaloid achilleïne of iva (see below). Zanon's *achilleïc acid* is aconitic acid (Hlasiwetz, 1857). Yarrow also contains a small quantity of resin, tannin, and gum, and various salts, consisting of malates, nitrates, phosphates, and chlorides of potassium and calcium; on incineration, from 13 to 17 per cent. of ash is obtained.

Pharmaceutical Preparations.—In Europe an Extractum Millefolii is employed, which is prepared by digesting the drug with diluted alcohol and evaporating. The yield is from 20 to 25 per cent.

Other Species of Achillea.—The following, which are indigenous to Europe, are to some extent employed:

Ach. ptarmica, *Linné;* Sneezewort, *E.;* Herbe à éternuer, *Fr.;* Bertramgarbe, *G.* It has been naturalized in some of the New England States. It has lance-linear, finely, but sharply serrate leaves, and elongated white ray florets. The root is sternutatory.

Ach. ageratum, *Linné*, has tufted, oblong, serrate, and clammy leaves, and very short ray florets; its odor is strong, but not agreeable; taste bitter.

Ach. nobilis, *Linné*, is softly pubescent, has oval or oblong bi- or tri-pinnatifid leaves, with linear-oblong toothed lobes; the 5 ray-florets are reflexed; odor and taste stronger than in the common yarrow.

Ach. moschata, *Linné;* Iva, *E., G.;* Génépi blanc, *Fr.;* is largely used in Switzerland; has white flowers and smooth pinnatifid leaves with linear entire lobes; it is strongly aromatic and bitter. Von Planta-Reichenau (1870) obtained from it a bluish-green volatile oil, *ivaol*, of a refreshing odor and bitterish mint-like taste; *ivain*, $C_{24}H_{42}O_3$, soft, yellow, insoluble in water, soluble in alcohol and bitter; *achilleïne*, $C_{20}H_{38}N_2O_{15}$, is readily soluble in water, with difficulty in absolute alcohol, insoluble in ether, and when boiled with dilute acids yields sugar, ammonia, an odorous body, and *achilletine*, $C_{11}H_{17}NO_4$, which is dark-brown, insoluble in water, and not bitter; *moschatine*, $C_{21}H_{27}NO_7$, is insoluble in cold water, and has an aromatic bitter taste.

Ach. atrata, *Linné*, and Ach. nana, *Linné*, are used like the other species.

Medical Action and Uses.—Milfoil appears to be a general stimulant and tonic, with peculiar relations to the pelvic organs. Like other stimulant tonics, it has been found capable of curing certain cases of intermittent fever, and is apt to promote the appetite and digestion in atonic gastric disorders. Its special local action is illustrated by the virtues ascribed to it in *piles* and *amenorrhœa*, for the cure of which it was celebrated even in ancient times. The form of the first of these diseases, in which it appears to be most efficient, is that in which, along with relaxation of the sphincter ani, there is a discharge of mucus, more or less bloody, during defecation. A similar condition of atony in the reproductive organs of the female is attended sometimes with *menorrhagia*, and sometimes with imperfect and painful menstruation. A tonic and stimulant regimen is essential to its successful treatment, and as a portion thereof milfoil may sometimes be employed with advantage. By this mode of action, doubtless, milfoil has proved beneficial in *leucorrhœa* and flatulent *colic;* and it may assist in curing relaxed and otherwise inert conditions of the *throat*, when its infusion is used as a gargle, or in cases of *sore nipples*, when it is applied as a lotion. An infusion may be made with half an ounce (Gm. 16) of milfoil in half a pint of water, reduced by heat to 6 ounces. It may be given in tablespoonful doses every hour. The expressed juice has been prescribed in doses of 1 or 2 fluidounces (Gm. 32–64) three times a day. The volatile oil may be given in doses of 20 drops (Gm. 1.30).

Achilleïn, in doses of from 8 to 20 grains (Gm. 0.50–1.30), is reported to have occasioned a sense of epigastric oppression and some irregularity of pulse, but to have increased the appetite.

Sneezewort, as its name implies, is very irritating to the nostrils when applied in powder, and the root, when chewed, produces salivation and an acrid impression on the fauces. These qualities have led to its use in commencing *coryza*, *conjunctivitis*, *pharyngitis*, and *laryngitis.* *Musk milfoil* is stated to be stimulant and antispasmodic, and, like A. atrata, is used as a stimulant at the commencement of febrile attacks.

ACIDUM ACETICUM, *U. S., Br., P. G.*—ACETIC ACID.

Acide acétique, Fr.; *Essigsäure*, G.

Formula $HC_2H_3O_2 = CH_3COOH$. Molecular weight 60.

Production.—To obtain acetic acid from vinegar, Stahl proposed, about the year 1700, to expose it to cold and separate the stronger acid from the ice, or to neutralize it with an alkali, evaporate, and distil with sulphuric acid. Crystallized acetic acid was observed by the Count de Lauraguais (1759) in the so-called *copper spirit*, the distillate of copper acetate; and Lowitz found that a diluted acetic acid, if repeatedly rectified over powdered charcoal, would yield a product crystallizing at a low temperature, and named it glacial acetic acid. Acetic acid and glacial acetic acid are obtained by the decomposition of an acetate by a stronger acid; for this purpose sodium (or potassium) acetate and sulphuric acid are most generally employed now. The proportions (equal equivalents) adopted already by Stahl, were recently (1873) proven to be correct by Mohr, Buchner, and others also for the preparation of the glacial acid; in this case, however, the mechanical difficulties of the operation are such as to make it preferable to use a larger quantity, nearly 2 equivalents of sulphuric acid. The British Pharmacopœia, 1864, directed fully 2 equivalents; in the last edition, 1867, the process has been omitted. By far the largest quantity of the acetic acid of commerce is now obtained from wood vinegar. Glauber (1648) was already acquainted with vinegar as one of the products of the destructive distillation of wood and other vegetable substances; but the identity of the volatile acid contained therein with that of vinegar from alcoholic liquids was proven by Fourcroy and Vauquelin (1800), and Thénard showed (1802) the same to be contained among the products of the dry distillation of animal substances.

I. Acidum aceticum pyrolignosum, Acidum pyrolignosum.—*Pyroligneous acid*, E.; *Acide acétique du bois, acide pyroacétique, acide pyroligneux*, Fr.; *Holzessig-Säure*, G.

Preparation.—The destructive distillation of wood is effected in sheet-iron cylinders, either upright or horizontal, which may be charged with billets of wood from the top, and from which the charcoal may be removed through a lateral opening. The cylinder is rapidly heated, the resulting volatile products being passed through wide condensing-tubes, cooled by being surrounded with water, into a wooden or iron receiver, from which the condensed products may be drawn off by means of a tap, while the uncondensible gaseous products, consisting of *acetylene* C_2H_2, *ethylene* C_2H_4, *propene* C_3H_6, *marsh gas* CH_4, and other hydrocarbons, as well as carbonic oxide, are carried off through a pipe into the furnace, there to be burned up in place of other fuel. The condensed portion consists of an aqueous stratum and of an oily or tarry layer containing empyreumatic oils and resins, cresylic and phenylic compounds, various hydrocarbons, etc., and furnishing the material used for the preparation of creasote.

The watery liquid, amounting to about 30 per cent. of the weight of the wood, is the *crude wood vinegar* or *pyroligneous vinegar*, a solution of a large number of products of decomposition, such as small quantities of phenols, guaiacol, and empyreumatic oils and resins, also furfurol $C_5H_4O_2$, acetone, methylic and allylic alcohol, methylamine, pyrocatechin, and several acids, the principal one of which is acetic acid, accompanied by formic, propionic, butyric, capronic, crotonic, and other acids. The distillation being carefully conducted, wood yields from 6 to 8, or even 9, per cent. of acetic acid, and wood vinegar, on being evaporated in the water-bath, leaves about 8 per cent. of residue.

On subjecting the crude product to distillation, the first portion (about 10 per cent.) of the distillate contains mainly the alcohols and acetone, and subsequently a colorless or yellowish acid liquid is obtained, amounting to about 75 or 80 per cent. of the crude article. This distillate is *Acetum pyrolignosum rectificatum*, P. G,; *purified pyroligneous* or *wood vinegar; Vinaigre de bois*, Fr.; *Holzessig*, G.; and contains variable quantities of most of the constituents of crude wood vinegar, which on exposure to light and the atmosphere cause the distillate to assume a brown color, rendering filtration or redistillation necessary; to avoid this, it should be kept in full and well-corked bottles and in a dark place. The peculiar smoky odor of wood vinegar is due to the presence of empyreumatic products.

Wood vinegar, both crude and rectified, is required by the German Pharmacopœia to contain at least 6 per cent. of acetic acid, so that 10 Gm. of it require for neutralization not less than 10 Ccm. of volumetric solution of potassa. With diluted ferric chloride it usually acquires a dark-green color, due to pyrocatechin. Wood vinegar, particularly that obtained from beech-wood, contains *hydrocœrulignone* $C_{16}H_{18}O_6$, a colorless diatomic phenol, which under the influence of oxidizing agents yields *cœrulignone* $C_{16}H_{16}O_6$. Liebermann (1872) obtained it from the brown precipitate produced in crude wood vinegar by potassium bichromate, and regards it as identical with Reichenbach's *cedriret;* it forms purplish-blue minute needles, is insoluble in most solvents, but dissolves in strong sulphuric acid with a blue, and in phenol with a red, color, the latter solution yielding with alcohol or ether dark steel-blue needles of cœrulignone, and this, by reduction with tin and hydrochloric acid or other agents, is again converted into hydrocœrulignone.

A much cleaner pyroligneous acid than by the process described above is obtained by subjecting strips of wood for about 4 hours to the heat of steam under a pressure of from 70 to 100 pounds (150° to 162° C. = 300° to 330° F.), whereby the texture of the wood is but little altered, and the subsequent purification of the acid is simplified. On rectifying the crude product a heavy oil is separated, in which Heill (1877) found furfurol, pyromucic acid, a yellow body yielding, with caustic soda, pyroxanthin and other products.

By fractional distillation the volatile impurities of pyroligneous acetic acid cannot be removed, nor can they be readily destroyed by chlorine or other oxidizing agents. To attain this end milk of lime is added in excess, partly for the purpose of forming calcium acetate, partly with the view of removing various tarry products, as insoluble calcium compounds. The solution of calcium acetate freed from the precipitate is evaporated to dryness; the crude salt thus obtained, which contains from 74 to 75 per cent. of hydrogen acetate, is carefully heated upon an iron plate in thin layers until it chars, then redissolved in water, the solution decomposed by sulphuric acid, or preferably by hydrochloric acid, and then distilled. Owing to the difficulty of regulating the heat so as to avoid the destruction of the calcium acetate, the solution of this salt is usually decomposed by sulphate of sodium, the resulting gypsum removed by settling and filtration, and the filtrate evaporated to dryness. The sodium acetate is more manageable in regard to the regulation of the temperature (about 260° C. = 500° F.) necessary to destroy the empyreumatic compounds without affecting the acetate. The latter is purified by dissolving it in a little water, and decanting from the sediment; sulphuric acid is added, the liquid separated from the crystals of sodium sulphate and distilled, when an acetic acid will be obtained more or less pure in accordance with the care exercised in the process of purification.

11. **Acidum aceticum glaciale,** U. S., Br.; *Acidum aceticum s. Acidum aceticum concentratum s. Acetum glaciale*, P. G.; *Glacial acetic acid*, E.; *Acide acétique concentré, esprit de vinaigre, vinaigre glacial*, Fr.; *Essigsäure, Eisessig*, G.

Preparation.—Carefully heat 13½ parts of pure crystallized acetate of sodium until the water of crystallization has been completely expelled and the salt has been fused; the residue, weighing nearly 8¼ parts, is coarsely powdered, introduced into a glass retort, intimately mixed with 9½ to 10 parts of concentrated sulphuric acid, and then distilled. It is advisable to warm the retort, by placing it in a sand-bath, before the acid is added. The condensation of the acetic acid vapors may be effected either by a Liebig's condenser, or in a receiver connected directly with the retort, or by means of an adapter.

The reaction is as follows: $NaC_2H_3O_2 + H_2SO_4 = NaHSO_4 + HC_2H_3O_2$. Acid sodium sulphate and acetic acid are formed, the latter distilling over, free from empyreuma if the heat has not been suddenly raised too high, and also free from sulphurous and other acids if the sodium acetate has not been contaminated with organic or other impurities. Although, theoretically, the hydrogen acetate or so-called monohydrated acid should be obtained, the product always contains some water, but crystallizes readily near the freezing-point of water. By partial crystallization, pouring off the liquid portion, and repeating this operation, an acid nearly free from water will be obtained. Hydrogen acetate is prepared, according to Hirsch (1873), by intimately mixing 12 parts of exsiccated sodium acetate with 20 parts of fused acid potassium sulphate, and with a carefully regulated heat distilling 7 parts.

Properties.—Glacial acetic acid forms colorless, flat, rhombic crystals, which melt on the application of heat to a colorless liquid, and this retains the fluid condition frequently on being cooled to 10° C. (74° F.), unless brought in contact with a crystal. At the mean temperature of the air it forms a colorless liquid with a pungent acetous odor. When heated to boiling, the vapor may be ignited and burns with a blue flame. Hydrogen acetate fuses at 22.5° C. (72.5° F., Mollerat); has at 16° C. (60.8° F.) a specific gravity of 1.0553, and boils at 119° C. (246.2° F., Sébille-Auger), or, according to Oudemans, between 117° and 118.2° C.

Rüdorff (1870) gives the congealing point of hydrogen acetate at 16.7° C. (62° F.), and if 100 parts of this acid are mixed with water, the congealing-point will be as follow:

With water,	0.5	1.0	1.5	2.0	3	4	5	6	7	8	9	10 parts.
Congealing part,	15.65°	14.8°	14.0°	13.25°	11.95°	10.5°	9.4°	8.2°	7.1°	6.25°	5.3°	4.3° C.

The *U. S.* and *Br.* Pharmacopœias require glacial acetic acid to contain 99 per cent. of $C_2H_4O_2 = 84$ per cent. $(C_2H_3O)_2O$; but the melting-point is given at about 15° C. (59° F.) *U. S.*, and above 60° F. *Br.*, and the specific gravity at 1.056–1.058 *U. S.*, 1.064 *P. G.*, 1.063 *F. Cod.*, 1.058 *Br.* An acid of the strength indicated dissolves an equal weight of fresh oil of lemon, but less of the resinified oil. The oil is also far less soluble in weaker acetic acid, requiring about 10 parts of the latter if of 96 per cent. A more reliable test for the absence of water is carbon bisulphide; equal parts of it and glacial acetic acid form, according to Flückiger, a clear solution at and above 20° C. (68° F.), but an opalescent or turbid liquid below that temperature. On neutralizing the acid, 3 Gm. of it require not less than 49.5 Ccm. of the volumetric solution of soda (*U. S.*), or 60 grains of the former 990 grain-measures of the latter (*Br.*); 1 Gm. of the acid requires 16 Ccm. of volumetric solution of potassa (96 per cent. acetic acid, *P. G.*).

Glacial acetic acid absorbs moisture from the atmosphere, whereby its melting-point is lowered and its density increased to a certain degree (see below). For the detection of impurities and adulterations this acid is to be diluted with distilled water previous to testing it as stated below.

Pharmaceutical Uses.—ACIDUM ACETICUM AROMATICUM; Aromatic acetic acid, *E.; Acide acétique aromatisé*, Vinaigre anglais, *Fr.;* Gewürzhafte Essigsäure, *G.* Oil of cloves 9 parts, oil of lavender 6 parts, oil of lemon 6 parts, oil of bergamot 3 parts, oil of thyme 3 parts, oil of cinnamon 1 part, glacial acetic acid 25 parts; dissolve by agitation.—*P. G.*, 1872. The preparation of the French Codex contains 10 per cent. of camphor and ½ per cent. of volatile oils. Aromatic acetic acid is sometimes designated *aromatic vinegar* (see page 14).

Off. Prep.—Acetum cantharidis, Mistura creasoti, *Br.*

Derivative of Acetic Acid.—ACIDUM CHLOROACETICUM, Chloracetic acid, $C_2H_2Cl_2O_2$; mol. weight 129. When glacial acetic acid is left in contact with dry chlorine gas, monochloracetic acid is produced; but on exposing the mixture to direct sunlight *dichloracetic acid* is formed, or trichloracetic acid if the chlorine be in excess. Besides hydrochloric acid, oxalic acid, carbonic oxide, chloroform, chlorocarbon, and other products may be obtained. According to H. Müller (1864), dichloracetic acid is conveniently prepared by passing dry chlorine gas into a retort, which is connected with a reversed condenser, and in which a mixture of acetic acid, specific gravity 1.065, with 10 per cent. of iodine, is heated to boiling. After several days the liquid is distilled; the distillate obtained below 130° C. (356° F.) consists of acetic acid and iodine; at about 135° C. (362° F.), monochloracetic acid, and above 188° C. (370° F.) dichloracetic acid distils. The latter requires further purification by fractional distillation. It is a colorless liquid of a suffocating odor, having at 15° C. (56° F.) the density of 1.5216, congealing in rhombohedral plates, and boiling at 190.5° (375° F.). It acts as a powerful escharotic, and forms salts, which are mostly readily soluble in water. The mono- and trichloracetic acids possess likewise caustic properties.

III. **Acidum aceticum,** U. S., Br.; *Acidum aceticum dilutum s. Acetum concentratum*, P. G.; *Acetic acid*, E.; *Acide acétique*, Fr.; *Verdünnte Essigsäure*, G.

Preparation.—10 parts of crystallized acetate of sodium are mixed in a suitable retort with the cool mixture of 4 parts of sulphuric acid and 2 parts of water, and heated until at 112° C. (333.6° F.) a dry, spongy mass remains behind (Mohr, 1873). The distillate is then diluted with distilled water until it has the proper specific gravity. If the addition of water is omitted, a larger amount of sulphuric acid will be necessary; the quantity directed here scarcely exceeds the absolutely necessary 1 equivalent, and the reaction proceeds as follows: $2(NaC_2H_3O_2 3H_2O) + H_2SO_4 = 2HC_2H_3O_2 + 6H_2O + Na_2SO_4$. The residue in the retort is neutral sodium sulphate.

Properties.—Acetic acid has the specific gravity 1.048 *U. S.*, 1.044 *Br.*, 1.040 *P. G.* These figures indicate a percentage of hydrogen acetate amounting to 36 *U. S.*, 32 *Br.*, and 29 *G.* For acetic acid of a somewhat greater strength, the determination of its specific gravity does not afford a reliable criterion, since the acid of maximum strength on being mixed with water increases in its relative weight until the percentage is reduced to about 79, when the maximum density will be reached, which at 0° C. (32° F.) is 1.0397 for acid of 80 to 82 per cent., at 15° C. (59° F.) 1.0748 for acid of 77 to 80 per cent., and at 40° C. (104° F.) 1.0501 for acid of 75 to 77 per cent. hydrogen acetate. An acid of 43 per cent. has, at 15° C., the same specific gravity as one of maximum strength, and between 72 and 85 per cent. the density of acetic acid shows very little variation. The following table, by A. C. Oudemans (1866), gives the percentage of hydrogen acetate and the specific gravity of acetic acid of different strengths at 15° C. (59° F.):

Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.
100	1.0553	80	1.0748	60	1.0685	40	1.0523	20	1.0284
99	1.0580	79	1.0748	59	1.0679	39	1.0513	19	1.0270
98	1.0604	78	1.0748	58	1.0673	38	1.0502	18	1.0256
97	1.0625	77	1.0748	57	1.0666	37	1.0492	17	1.0242
96	1.0644	76	1.0747	56	1.0660	36	1.0481	16	1.0228
95	1.0660	75	1.0746	55	1.0653	35	1.0470	15	1.0214
94	1.0674	74	1.0744	54	1.0646	34	1.0459	14	1.0201
93	1.0686	73	1.0742	53	1.0638	33	1.0447	13	1.0185
92	1.0696	72	1.0740	52	1.0631	32	1.0436	12	1.0171
91	1.0705	71	1.0737	51	1.0623	31	1.0424	11	1.0157
90	1.0713	70	1.0733	50	1.0615	30	1.0412	10	1.0142
89	1.0720	69	1.0729	49	1.0607	29	1.0400	9	1.0127
88	1.0726	68	1.0725	48	1.0598	28	1.0388	8	1.0113
87	1.0731	67	1.0721	47	1.0589	27	1.0375	7	1.0098
86	1.0736	66	1.0717	46	1.0580	26	1.0363	6	1.0083
85	1.0739	65	1.0712	45	1.0571	25	1.0350	5	1.0067
84	1.0742	64	1.0707	44	1.0562	24	1.0337	4	1.0052
83	1.0744	63	1.0702	43	1.0552	23	1.0324	3	1.0037
82	1.0746	62	1.0697	42	1.0543	22	1.0311	2	1.0022
81	1.0747	61	1.0691	41	1.0533	21	1.0298	1	1.0007

The strength of the officinal acid is ascertained by weighing out 100 grains of it, diluting with half an ounce of water, applying a moderate heat, and gradually adding 60 grains of bicarbonate of potassium; after effervescence has ceased, and the carbonic acid has been entirely expelled, the liquid should have a neutral reaction to test-paper, or 6.0 Gm. of the acid are neutralized with volumetric solution of soda, of which exactly 36 Ccm. (*U. S.*), 32 Ccm. (*Br.*), 30 Ccm. (*P. G.*) should be required. The test of the British Pharmacopœia, neutralization of 182 grains of acetic acid by 1000 grain-measures of volumetric solution of soda, indicates 33 per cent. of $C_2H_4O_2$; and that of the German Pharmacopœia, neutralization of 10 Gm. of the acid by 50 Ccm. of volumetric solution of potassa, proves a strength of 30 per cent. of the same acid. The use of bicarbonate of potassium for neutralization has the advantage of ready calculation, since three-fifths of its weight in grains necessary for 100 grains of the acid indicates directly the strength; the resulting potassium acetate has a faint alkaline reaction, but the error occasioned thereby, being quite insignificant, does not detract from the practical value of the test, more particularly if alkanet-paper be used in place of litmus-paper for determining the neutrality. Absolute accuracy may also be had by treating 200 grains of the acid with an excess of dry, pure carbonate of calcium, washing out the resulting calcium acetate, drying and weighing the undissolved carbonate; the loss in grains, multiplied by three-fifths, gives directly the percentage strength of $C_2H_4O_2$. If dry carbonate of barium be employed instead of the calcium carbonate, the loss in grains is to be divided by 1.6417 to ascertain the percentage of monohydrated acid.

Tests.—The tests for the purity of vinegar are, with some modifications, also applicable to acetic acid. The transparency of the acid is not disturbed on diluting it with distilled water or alcohol, and on evaporating it in a water-bath no residue should be left (saline impurities). Calcium salts will produce a white precipitate with ammonium oxalate. Iron is best detected by the blue color or precipitate occasioned with potassium ferrocyanide; zinc, by the white precipitate; and other metals, like copper, lead, or tin, by the brown or black color or precipitate formed on the addition of hydrosulphuric acid after previous dilution with water. Empyreumatic products, if present in considerable proportion, may be detected by the odor after the acid has been largely diluted with water or neutralized with an alkali; smaller quantities are indicated by adding a minute quantity of solution of potassium permanganate, the color of which will readily disappear; pure acetic acid, containing less than 50 per cent. of hydrogen acetate, is not affected by this test (Hager, Merck, 1873). Sulphuric and hydrochloric acids are detected in the diluted acid by the white precipitates occurring with barium chloride and silver nitrate respectively. If sulphurous acid be present, the hydrogen evolved by hydrochloric acid and zinc in the presence of the acetic acid will be contaminated with sulphuretted hydrogen, which will darken the color of white bibulous paper wetted with solution of subacetate of lead and suspended in the test-tube or flask; the same acid will also discharge the color of potassium permanganate, and, like the empyreumatic products, cause a dark color and precipitate with silver nitrate. In the presence of nitric acid the liquid will assume an orange-red color on dissolving a little brucine in it, and a dark-brown color on adding first strong sulphuric acid, and afterward a crystal of ferrous sulphate.

The salts of acetic acid are, with very few exceptions, readily soluble in water, and their solutions acquire a dark brown-red color with ferric salts, which disappears on the addition of hydrochloric acid. On adding sulphuric acid to an acetate the pungent odor of acetic acid is recognized.

Off. Prep.—Acetum cantharidis, *Br.;* Extr. colchici rad., Liq. ammon. acetat., *U. S.;* Linim. terebinth. aceticum, Liq. ammon. acetatis, Liq. epispasticus, Morph. acetas, Oxymel, Plumbi acetas, Potass. acetas, Zinci acetas, *Br.*

IV. **Acidum Aceticum Dilutum,** U. S., Br.; *Acetum purum s. destillatum.—Diluted acetic acid,* E.; *Acide acétique dilué,* Fr.; *Reiner Essig,* G.

Preparation.—Mix Acetic Acid 17 parts (9 fluidounces) and Distilled Water 83 parts (46 fluidounces), *U. S.;* Acetic Acid 1 pint, and Distilled Water 7 pints, *Br.*

Properties.—Diluted acetic acid has a specific gravity of 1.0083 (1.006 *Br.*), and 100 parts of it neutralize 10 parts ($7\frac{2}{10}$ parts, *Br.*) of potassium bicarbonate, or 5.3 parts (3.8 parts, *Br.*) of exsiccated sodium carbonate, indicating a strength of acetic acetate corresponding to 6 per cent. (4.27 per cent., *Br.*) of hydrogen acetate; therefore 10 Gm. of the acid require for neutralization 10 Ccm. (7.12 Ccm., *Br.*) of volumetric solution of soda; or, as the British Pharmacopœia directs, 440 grains of its diluted acetic acid require for neutralization 313 grain-measures of the soda solution, corresponding to 3.63 per cent. anhydride. The purity of diluted acetic acid is ascertained by the same tests mentioned for the stronger acid.

Off. Prep.—Aceta. Emplast. ammoniaci, Liquor ammon. acet., *U. S.;* Liq. morph. acetat., *Br.;* Syrupus allii, *U. S.*

Physiological Action.—When given to animals in large doses acetic acid appears to destroy life by arresting the action of the heart. On examination the stomach is found injected and its mucous membrane softened. Applied to the human skin, it acts as a mild irritant, causing redness and swelling, followed by paleness, of the part, and, if its application is prolonged, it is followed by vesication and desquamation of the cuticle. It first whitens mucous membranes, then turns them brown, causing meanwhile a severe burning pain. Taken internally, it occasions gastric pain, vomiting, and purging, and in rare fatal cases softening of the coats of the stomach and perforation, the pulse meanwhile growing slow and feeble and the skin cool. In a diluted condition it produces no local effects, but when absorbed combines with the alkaline bases in the blood, and is eliminated with the urine and sweat, lowering the pulse in tension and frequency and depressing the temperature. Its continued use may give rise to the changes which are ascribed to its power of impairing the integrity of the blood-corpuscles. It is reported that on being injected into fistulous ulcers it has occasioned death, with symptoms of collapse. It is absorbed by the skin. Foot-baths containing a large proportion of acetic acid have also given rise to symptoms of cardiac and vascular atony, with a marked fall of temperature. When the strong acid was injected into the veins of animals it caused coagulation of their contents, and the same effect has been observed when it was largely administered by the stomach. In these experiments the blood acquired a very dark color.

Medical Uses.—Acetic acid is seldom if ever employed internally, except in the diluted form, which may be used for the same purposes as vinegar, and in the same dose. Strong and glacial acetic acids are applied chiefly as caustics for the removal of *warts* and *corns*, and occasionally for *blistering* the skin. The former is a valuable application in the treatment of *favus*, and, if diluted, allays itching in *lichen*, *prurigo*, and *psoriasis*. It was alleged to possess peculiar advantages as a caustic in *cancer* when injected into the substance of the tumor. But the results of this method are satisfactory only in cases in which, from the situation of the tumor or the objections of the patient, an operation is inadvisable. A solution employed by Gies (1877) varied in strength from

1 part in 3 to 1 part in 9 of glacial acetic acid in water. *Nasal polypus* is reported to be readily curable by injections of pure acetic acid into its substance. The growth shrivels and decays, and its fetor may be corrected by a weak carbolic acid solution (Caro, *Med. Record*, xvi. 526).

Chloracetic acid has been compared with nitric acid in its action. It penetrates deeply, but does not excite much inflammation of the adjacent parts, and leaves behind a moderate eschar, which soon separates and exposes healthy granulations. The scar is rather smooth, and does not contract a great deal. It is said to cause less pain than nitrate of silver, chloride of zinc, or caustic potassa. It has been used for removing *warts*, *condylomata*, *lupus*, and other neoplasms. It may be applied by means of a glass rod or an asbestos brush.

ACIDUM ARSENIOSUM, *U. S.*, *Br.*—ARSENIOUS ACID.

Acidum arsenicosum (P. G.), *Arsenicum album.*—*Arsenic*, *White arsenic*, *Arsenious anhydride*, E.; *Acide arsénieux*, *Arsenic blanc*, *Fleurs d'arsenic*, Fr.; *Arsenige Säure*, *Weisser Arsenik*, G.

Formula As_2O_3. Molecular weight 197.8.

Preparation.—Arsenious acid appears to have been known since about the beginning of the Christian era, but was first distinguished from other arsenical compounds by Geber in the eighth century. It has been found in many mineral waters in minute proportion, and is obtained in large quantities as a by-product in roasting cobalt, nickel, tin, and even some silver ores, and particularly arsenical iron pyrites; the vapors are conducted through long tubes or chambers, where they are condensed in the form of a white powder, formerly called *flowers of arsenic*. This is not pure, but contains some metallic arsenic, sulphide of arsenic, dirt, etc., from which it is purified by resublimation. For this purpose the crude powder is introduced into cast-iron kettles, surmounted by several communicating iron cylinders, from the top of which a large pipe leads into a series of chambers, where the vapors, which are not condensed in the cylinders, are recovered again as a white powder. The heat, which is applied directly to the kettle, is sufficient to keep the condensing product in the heads or in the first chamber in a soft condition, so that on cooling it congeals into masses. That consumed in this country is mostly imported from Europe; the average annual importation is about 2,500,000 pounds.

Properties.—Arsenious acid occurs in heavy, inodorous masses, which are at first glass-like, transparent, and of a conchoidal fracture, but become superficially white, opaque, and of a waxy lustre, the change penetrating gradually to the interior, so that ultimately the entire mass is converted into a porcelain-like mass, the formation of which is dependent upon a molecular change, the amorphous glass-like arsenious acid becoming indistinctly crystalline. The specific gravity of the vitreous acid is 3.7385, and of the opaque variety 3.699 (Guibourt). Durand and Mitchell determined (1832) the density of the former to be about 3.3. When heated in a sealed tube arsenious acid may be melted to a thick liquid, and again be obtained as a glass-like mass, or, when very slowly cooled, in crystals of different form. Rapidly heated in an open test-tube, it begins to soften superficially at about 218° C. (424° F.), but is at the same time rapidly volatilized. Slowly heated in a glass tube to about 200° C. (392° F.), minute transparent crystals are obtained, which under a magnifying-glass are recognized as regular octahedra. It is dimorphous, crystallizing also in thin pearly prisms, which are sometimes obtained in the process of roasting arsenical ores. When thrown upon burning charcoal, it is reduced to the metallic state and vaporized, arsenious acid being again produced and an alliaceous odor emitted. It does not readily mix with water, and has a scarcely perceptible, faintly sweetish taste, due to its slow and sparing solubility in water; but this solution has a slight but distinct metallic taste and a feeble acid reaction, and unless acidulated with a mineral acid is not completely precipitated by hydrogen sulphide, but remains yellow and transparent, or in reflected light slightly turbid from dissolved As_2S_3. The crystalline acid is less soluble than the amorphous, but one is under various circumstances converted into the other. By prolonged contact with cold water about ¼ per cent., and by boiling water about 7 per cent., of the acid is dissolved, but after boiling for several hours about 11 per cent. is taken up, the greatest portion crystallizing on cooling, leaving about 2½ per cent. in the solution; and on prolonged standing this amount is reduced to somewhat less than 2 per cent. The acid does not volatilize with the vapors of boiling water. Bussy found (1847) that 100 parts of water of 13° C. (55.4° F.) will dissolve 4 parts of amorphous and 1.2 parts of crystalline arsenious acid, the former solution gradually depositing crystals until reduced in strength to the latter. Treated with warm or cold ammonia-water, the amorphous acid is converted into the crystalline variety without combining with the ammonia (Guibourt). Solutions of both the amorphous and crystalline variety pass readily through the septum of the dialysator. By the aid of heat glycerin dissolves arsenious acid slowly but freely, and deposits again a portion of it on dilution with water. Arsenious acid is insoluble in ether, quite sparingly soluble in alcohol, but combines with fixed oils when heated, forming a plaster-like mass; several acids increase its solubility in water, particularly hydrochloric and tartaric acids.

Powdered arsenious acid is often adulterated; hence it should not be employed for medicinal purposes unless its purity has been previously established. When rubbing the hard masses of vitreous or porcelain-like acid to powder, sufficient alcohol should be sprinkled over it to prevent the dust from rising, and the mouth and nostrils should be protected by a moist sponge. When larger quantities are powdered, it is even advisable to protect the eyes and the bare hands.

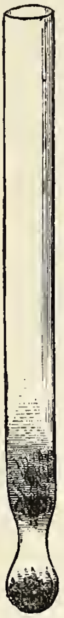
Tests.—Arsenious acid is completely volatilized without fusion at a temperature of 204.5° C. (400° F.), and yields a white sublimate free from gray or orange-colored portions (absence of metallic arsenic and sulphides). By prolonged boiling with diluted hydrochloric acid, it dissolves completely without leaving any residue, and 100 grains of it, thus dissolved, yield with hydrosulphuric acid a deposit of tersulphide of arsenic weighing, after washing and drying, 124 grains. 4 grains of it, dissolved in boiling water with 20 grains of bicarbonate of sodium, discharge the color of 808 grain-measures of the volumetric solution of iodine.—*Br.* Both the tests mentioned prove arsenious acid to be almost absolutely free from impurities; but the U. S. Pharmacopœia of 1880 admits this compound if containing not less than 97 per cent. of the pure anhydride; in which case .247 Gm. of it, dissolved in boiling water with 2 Gm. of sodium bicarbonate, will decolorize not less than 48.5 Ccm. of the volumetric solution of iodine; if pure, 49.95 Ccm. of the latter would be required. The reaction occurring in this test is shown by the equation: $As_2O_3 + 5H_2O + 2I_2 = 2H_3AsO_4 + 4HI$; 1 molecular weight of arsenious acid is oxidized by 4 atomic weights of iodine, with the formation of 2 molecules of arsenic and 4 of hydriodic acid. The admixture of arsenic acid is detected by agitating an excess of the powder with cold alcohol, filtering, evaporating, and neutralizing with ammonia, when silver nitrate will produce a red-brown precipitate.

Pharmaceutical Uses.—PULVIS ARSENICALIS COSMI.—Côme's arsenical powder, *E.;* Poudre caustique du frère Côme, *Fr.;* Cosmisches Pulver, *G.* An intimate mixture of vermilion 5 parts, arsenious acid 1 part, and burned sponge 2 parts.—*F. Cod.* The French Codex recognizes also a weak arsenical powder, containing one-twenty-fifth its weight of arsenious acid, and known as *poudre escharotique d'Antoine Dubois.*

Off. Prep.—Liquor arsenicalis (potass. arsenitis), Liq. acidi arseniosi (arsenici hydrochloricus), Sod. arsenias, *U. S.*, *Br.*

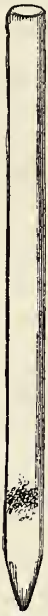
Detection of Arsenic and Arsenious Acid.—A neutral or, more promptly, an acidulated solution of arsenic yields with sulphuretted hydrogen a bright-yellow precipitate of *sulphide of arsenic*, which is entirely insoluble in dilute acids, but dissolves readily in alkalies, their carbonates and sulphides; if such a solution in sulphydrate of ammonium is acted upon by nitrate of silver in excess, sulphide of silver is precipitated, and the solution contains the arsenic in its original state of oxidation, either as arsenious or arsenic acid, and on the careful neutralization of the ammonia by means of nitric acid, the former is precipitated as yellow arsenite of silver, and the latter as red-brown arseniate of silver, both precipitates being readily soluble in nitric acid and in ammonia. Neutral solutions of arsenious and arsenic acids yield with sulphate of copper precipitates, that of the former being yellowish-green (*Scheele's green*), and of the latter bluish-green, in color; both precipitates are freely soluble in nitric acid and in ammonia. It follows, from the behavior just described, that in testing by a soluble silver or copper salt for arsenious or arsenic acid, the solutions of the latter must be very carefully neutralized, or, if acid, are best tested with ammoniacal solutions of copper and silver; but the complete precipitation of arsenic is most conveniently effected from an acidulated solution by means of sulphuretted hydrogen gas; if strongly acid, the liquid should be diluted with water, and it is in all cases advisable, after adding an excess of the gas, to set the mixture aside for some time, if little arsenic is present, even for 24 hours. If not mixed with other metals, the precipitate thus obtained is pretty characteristic, since only two other metals yield under the same circumstances precipitates of sulphides having a similar color—namely, *cadmium* and tin in *stannic* compounds. *Cadmium sulphide* has a bright lemon-yellow color, but is readily distinguished from the corresponding arsenic compound by being completely insoluble in potassa, ammonia, and sulphydrate of ammonium; on the other hand, cadmium sulphide dissolves completely in strong hydrochloric acid, forming cadmium chloride, and giving off sulphuretted hydrogen, while sulphide of arsenic is insoluble in the acid mentioned. *Stannic sulphide* has a dusky-yellow color, and dissolves in potassa, ammonia, and sulphydrate of ammonium, but differs from sulphide of arsenic not only in the shade of color, but also in its complete solubility in strong hydrochloric acid. The three sulphides may likewise be distinguished from each other by their behavior with *cyanide flux*, which is an intimate mixture of 1 part of cyanide of potassium with 3 parts of anhydrous sodium carbonate; when heated with this flux in the bulb of a Berzelius reduction-tube, sulphide of arsenic yields, in the cooler part of the tube, a sublimate of metallic arsenic having an iron-gray color, and in the upper portion of the ring occasionally a brown color, produced by the intimate mixture of metallic arsenic with some arsenious acid; during the sublimation a garlic-like odor is observed; the sublimate volatilizes on the application of heat, and condenses again in a cooler part of the tube, and, if atmospheric air has been admitted, is partly or entirely converted into minute brilliant octahedral crystals of arsenious acid. Sulphide of cadmium, under the same circumstances, yields a red-brown sublimate, consisting of oxide of cadmium, which is not volatilized by heat; and sulphide of tin produces no sublimate; but in the fused mass will be found metallic grains of tin.

FIG. 1.



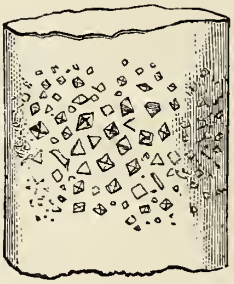
Reduction-tube of Berzelius.

FIG. 2.



Reduction-tube with sublimate of arsenious acid.

FIG. 3.



Sublimate of arsenious acid, magnified.

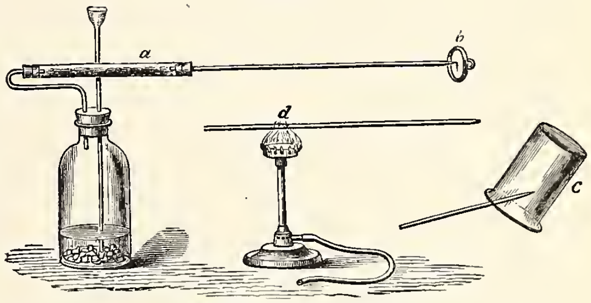
The above tests characterize arsenic if in the form of solution and if present in more than a very minute quantity. Tests of still greater delicacy will be described below. Arsenious acid, which is usually met with in cases of accidental or criminal poisoning, yields, if heated in a narrow tube, the crystalline sublimate described above; and if mixed with charcoal or cyanide flux, the sublimate will, as in the above case, consist of metallic arsenic, and this, on being sublimed in the presence of air, will yield the same crystals.

In the presence of much organic matter the detection of arsenic is a more complicated process, involving the separation of most of the organic matter; which Fresenius and Babo (1844) have accomplished by heating the mass in a water-bath with hydrochloric acid, and adding to it chlorate of potassium in small quantities until a thin liquid is produced; if the heat be not raised beyond the temperature of boiling water no chloride of arsenic will be volatilized, but the mixture becomes more liquid in proportion as the solid organic substances are destroyed. The liquid is then filtered, the clear filtrate saturated with sulphuretted hydrogen, and the precipitate, which contains organic matter, treated with strong nitric acid, and subsequently fused with pure nitrate of sodium, whereby the organic compounds are completely destroyed, and the antimony and arsenic are converted into soluble arseniate and insoluble antimoniate of sodium. On mixing this residue intimately with about twelve times its weight of an exsiccated mixture prepared of sodium carbonate 3 parts and potassium cyanide 1 part, the powder may be heated to redness in a reducing-tube in a current of dry carbonic acid gas, when a mirror of metallic arsenic will be obtained, while the presence of antimony, tin, and other metals will not interfere with the result. This method is less delicate than others mentioned below; however, the mass obtained after the destruction of the organic matter and fusion with sodium nitrate may be dissolved in water, and this solution, after acidulation with hydrochloric acid, may then be treated again with sulphuretted hydrogen, or in Marsh's apparatus—in the latter case, after evaporation with an excess of sulphuric acid to expel the nitric acid.

The destruction of the organic matter, as described above, may in some cases be omitted, the material being simply boiled with water and the filtrate acidulated with hydrochloric acid, previous to passing sulphuretted hydrogen through it. A solution suitable for the purpose may likewise be obtained by the process of dialysis, whereby mucous, amylaceous, and albuminous substances are left behind, while the dialyzed liquid contains the arsenious acid, besides organic and inorganic salts. A method for converting arsenious acid and sulphides of arsenic into the volatile chloride, which may be readily separated from the organic matter by distillation, was proposed by F. C. Schneider (1851); it consists in mixing the material with large crystals of sodium chloride equal in weight to the dry matter, adding concentrated sulphuric acid and heating slowly to boiling. To avoid the generation of sulphurous acid, an excess of sodium chloride must be present during the entire operation. A modification of this process, whereby the sulphides are more readily decomposed and arsenic acid is reduced to arsenious acid, and then readily converted into chloride, consists, according to Hager, in the addition of ferrous chloride to the contents of the retort. Dr. Penny (1852) suggested the thorough drying of the material, mixing it with strong hydrochloric acid, and then heating in a retort placed in a sand-bath. Dr. A. S. Taylor observed that portions of dried liver or stomach gave up every trace of arsenic by one distillation. The distillate may be tested for arsenic by the reagents mentioned above, or in Marsh's apparatus.

Marsh's test depends upon the formation of arseniuretted hydrogen (hydride of arsenic) by the action of nascent hydrogen upon the oxygen compounds of arsenic. A simple form of Marsh's apparatus is shown in Fig. 4. Hydrogen is generated in a suitable flask, and dried by conducting it through a tube, *a*, filled with fragments of calcium chloride. After the air has been completely expelled, and the apparatus filled with hydrogen, some of the liquid to be tested is introduced through the funnel-tube, and the escaping gas ignited at *b*. Upon holding a piece of porcelain in the flame, a brown-black spot of metallic arsenic will be deposited, which will quickly dissolve on the addition of a little chlorinated lime or chlorinated soda (Bischoff, 1840). Antimony compounds will yield a similar spot, which, however, is not affected by the hypochlorites. When a dry beaker, *c*, is held over the jet, arsenious acid is deposited upon the inside, and may be recognized by its crystalline form; and, after dissolving it in a little hot water, a yellow precipitate will be obtained on the addition of some solution of ammonio-nitrate of silver. Antimony similarly treated gives no precipitate. The delivery-tube, which must be of hard glass, may be heated to redness by the flame of a gas-lamp, *d*, when the hydride of arsenic will be decomposed, metallic arsenic being deposited. Antimony gives a similar reaction, and the two metals may be distinguished by heating the deposit in contact with air, when the arsenic will be converted into crystallized arsenious acid; or sulphuretted hydrogen may be passed through the tube and the deposit gently heated, when the arsenic will be converted into yellow sulphide and the antimony into orange sulphide. On now passing dry hydrochloric acid through the tube the sulphide of antimony will disappear and the sulphide of arsenic remain unaffected.

FIG. 4.



Marsh's test for arsenic.

On passing the hydrogen gas from the delivery-tube, through acetate of lead to remove any H_2S, into a solution of nitrate of silver, a black precipitate will be produced both by antimony and arsenic. If the former, the deposit will consist of a compound of antimony and silver; if the latter, metallic silver only is precipitated, while the solution contains the arsenic as arsenious acid mixed with the excess of silver salt, and on cautiously neutralizing with ammonia a yellow precipitate of arsenite of silver is obtained.

Bettendorff's Test (1869).—On adding some arsenical solution to a solution of stannous chloride in strong hydrochloric acid, a gradual, or, on heating, a somewhat rapid, reduction to metallic arsenic takes place, the deposit having a brown or black color according to quantity. Dilution with water and the presence of nitric acid or nitrates interfere with the reaction.

Reinsch's Test (1843).—If an arsenical solution is strongly acidulated with hydrochloric acid, and heated to boiling in the presence of a thin slip of bright copper—or, according to A. S. Taylor, preferably of finest copper gauze—the copper will become tarnished by the deposition upon it of metallic arsenic, the film having a bluish or iron-gray color according to quantity; the presence of nitric acid interferes with the reaction. The copper is washed with water, dried, and heated in a narrow test- or reduction-tube, when arsenious acid will be sublimed in the form of octahedral crystals.

Fleitmann's test, like the process of Marsh with its numerous modifications, depends upon the generation of arseniuretted hydrogen from zinc; instead of an acid, however, a strong solution of caustic potassa or soda is employed, which has the advantage of preventing the formation of antimoniuretted hydrogen. If the gas is generated in a test-tube, the orifice of which is covered with a piece of filtering-paper moistened with a solution of nitrate of silver, the appearance of a black spot will indicate the presence of arsenic. In applying this test care must be taken to prevent the paper from coming into contact with the alkaline liquid, which would produce a similar color. A plug of cotton loosely inserted in the upper part of the tube will prevent any spirting of the liquid. A strip of paper moistened with solution of lead acetate, if colored brown or black by the gas, would prove the presence of sulphuretted hydrogen.

This process has been modified in various ways. Himmelmann (1868) proposed to generate the gas with a mixture of granulated zinc and powdered iron, which is warmed in a concentrated solution of ammonium chloride rendered alkaline by ammonia. The gas is passed through a solution of zinc and ammonium chlorides into the silver solution. Johnson proposed aluminium in connection with potassa solution for the generation of hydrogen. In this as in the preceding case the metals employed are to be previously tested for the presence of arsenic.

Much simpler is the modification by E. W. Davy (1876), who employs an amalgam prepared by warming 8 or 10 parts of mercury, and dropping upon it gradually in small pieces 1 part of metallic sodium. The amalgam should be used only in a neutral or alkaline liquid; the gas is generated by the action of the sodium upon water, and the presence of arsenic in it is recognized with nitrate of silver, as stated above.

Precautions.—It is scarcely necessary to remark that when testing for arsenic all the reagents must be absolutely free from that metal. The purity of sulphuric and hydrochloric acids is most conveniently ascertained by Bettendorff's or Reinsch's process, and the purity of zinc by that of Fleitmann. The use of copper for the purpose referred to is not, as a rule, interfered with by its containing arsenic, but the presence of the latter may be readily detected, according to Odling (1863), by heating it in a retort with six times its weight of ferric chloride and an excess of hydrochloric acid, when chloride of arsenic will distil over and give the usual reactions of arsenic compounds.

In forensic analysis it is usually required that the arsenic be separated in the metallic state, and that the quantity of the poison be estimated. The former is accomplished by the methods described above; the latter, by weighing the metal deposited in the heated delivery-tube of Marsh's apparatus, either upon the glass or upon platinum introduced for the purpose, or by estimating it in the form of pyroarseniate of magnesium.

Physiological Action.—Arsenic is hostile to all forms of vegetable life, whether it acts upon the foliage of plants through the air or through their juices by absorption from the soil. It tends to shrivel the leaves and other soft structures if the supply of water is small, or to rot them if the soil and air are moist. It speedily destroys the life of insects and fishes, occasioning convulsive movements in the latter. In birds, however introduced into the system, it produces symptoms of gastro-intestinal irritation, as well as nervous depression, exhibited by debility, spasm, or paralysis. In quadrupeds the same evidences of gastro-intestinal irritation and nervous prostration or irritability predominate. But to produce such effects the quantity of the poison introduced at once into the system must be large. After slow poisoning the digestive organs do not usually present the ordinary evidences of inflammation, although they may exhibit an unusual amount of mucous secretion, containing more or less fibrin. The mineral may be detected in the milk of nursing women using it, and in all the organs, but chiefly in the liver and spleen, of animals poisoned by its use. A very curious effect observed by Gies in animals is that continued, small, non-irritant doses of it produce a very marked augmentation in the growth of the bones, which become thicker and denser. At the same time, however, the liver undergoes fatty degeneration, and the heart likewise, but in a less degree. Indeed, according to some experimenters (Saikowsky; Livon), the same lesion exists, more or less, in all the organs. If, however, the dose exceeds a certain minimum quantity, chronic poisoning ensues, with symptoms like those described below as occurring in man —viz.: emaciation, loss of hair, gastric catarrh, diarrhœa, impaired sensibility, and paralysis of the legs.

The application of arsenical preparations to the surface of the body is often followed by symptoms of poisoning, particularly if the integument is not whole, as where they are employed in the topical treatment of skin diseases. But such effects are sometimes observed even when the skin is sound, as when an arsenical solution has been used to destroy vermin upon the head and other hairy parts, or when for any purpose it has been allowed to remain too long applied.

In these cases also gastro-intestinal symptoms predominate, together with thirst, difficult deglutition, pain in the head, and sometimes micturition. Still more severe symptoms are promptly induced by the prolonged contact of arsenic with the vagina and with the surface of wounds and ulcers, including ulcers from cancer treated by arsenical caustics. Poisoning also results from the inhalation of arsenical vapors given off during the combustion of this mineral, from the fine dust produced during its manufacture, and by that of compounds into which it enters. Of these the most prolific in mischief are arsenite of copper, or Scheele's green, and Schweinfurth green, which are extensively used as pigments for paper-hangings, artificial flowers, and even dress goods. Other colors used in the arts besides green contain arsenic; it has been found in blue, red, and yellow papers. The symptoms produced in this manner include irritation of the eyes, sore mouth, dyspepsia, neuralgia, spasm, paralysis, cutaneous eruptions, and progressive emaciation.

It is certain that when arsenic is taken habitually, commencing with very small doses, a certain tolerance of its action is induced, so that quantities may at last be consumed which at first would have been actively or fatally poisonous. This remarkable fact has been largely illustrated by the arsenic-eaters of Styria, who employ the drug for the purpose of maintaining a ruddy complexion and enabling them to climb without panting the steep mountain-paths of their country. Their acquired tolerance of it is such that some of them have been known to take 5 or 6 grains of arsenious acid without the slightest inconvenience. Similar tolerance has been observed in isolated cases elsewhere, and in certain experiments of Flandin animals that began with the daily dose of $\frac{1}{65}$ of a grain were able at the end of 9 months to take upward of 15 grains of arsenious acid in powder mixed with their food in the course of 24 hours, without injury to their appetite or health. To the same purpose is the statement of Hebra that in the treatment of psoriasis he sometimes raised the daily quantity to nearly a grain of arsenious acid (gr. 0.99), and continued the dose for many months. "In this way," he adds, "it has several times occurred that the patient has taken the enormous quantity of more than 160 grains of arsenious acid before he got rid of the disease. . . . . In no instance did I see any ill effects produced" (*Dis. of the Skin*, Syden. Soc. ed., ii. 29). If we seek a reason for at least the former of these effects, it may be found, theoretically, in the power which arsenic has of diminishing oxidation, and therefore the need of oxygen in the system, and also of causing a paralysis of the vaso-motor nerves. But evidently this explanation will not apply to those cases—the most numerous indeed—in which, so far from producing the fatty degeneration spoken of above, the habitual use of arsenic does not impair, but improves, the health. Possibly the explanation may be found in the rapid oxidation which the active life of the Styrian mountaineers secures, and which is checked and reduced to a due degree by the opposite and, as it were, antidotal action of arsenic.

When arsenic is taken in small doses, as from 3 to 5 drops of solution of arsenite of potassium, and after meals, it may be used for some time without occasioning any local symptoms; but if the dose be too large it is apt to cause loss of appetite, nausea, abdominal pain, and vomiting or purging. A metallic taste may also be perceived in the mouth, the eyes grow red, and œdema of the eyelids takes place, which, if the medicine is continued, may extend to the whole body. The urine may also become albuminous or even bloody. A longer continuance of the medicine is apt to occasion affections of the skin, particularly itching, urticaria, pityriasis, psoriasis, desquamation of the cuticle, and shedding of the nails. Sometimes the hair falls out. If the medicine is continued in the same or in greater doses, signs of irritation arise in the œsophagus and stomach, with vomiting and diarrhœa; the nervous system becomes disturbed; tremor, convulsion, muscular rigidity, and paralysis have followed acute and also chronic arsenical poisoning; the paralyses are nearly always peripheral; the pulse is irregular; there is a complete loss of appetite, with a silvery coating of the tongue, salivation, thirst, tenesmus, and colic; the respiration grows oppressed, the flesh wastes, and the limbs are the seat of severe pains. These phenomena are most frequently observed in workmen employed in the sublimation of arsenical ores; and among them it is not unusual to see numbness and contraction of the extensor muscles of the lower limbs, with torpor of the mind, and a general cachectic, emaciated appearance, with pustules and ulcers of the skin. According to the experiments of Cutler and Bradford (1878), solution of arsenite of potassium given in health causes a progressive decrease in the number of the red and white blood-corpuscles, that of the latter being the most marked. In simple anæmia, on the contrary, there seems to be an increase at first of both the red and white corpuscles. After a certain point there is a steady diminution of both. In a case of leucocythemia there was also a decrease of both, that of the white corpuscles being very marked. In a case of "idiopathic anæmia" Dr. Edes found that under very moderate doses of arsenic the number of red corpuscles increased nearly fourfold in the course of one month (*Boston M. & S. Jour.*, Oct. 1880, p. 392), and in four cases of "pseudo-leukæmia" Warfynge, without specifying the precise increase in the hæmatin of the blood, noted the improved general condition and the subsidence of the glandular swellings while arsenic was administered (*Med. News*, etc., June, 1881, p. 342).

The symptoms of acute arsenical poisoning are the following: constriction and heat of the fauces, burning pain in the stomach and bowels, violent retching and vomiting, with spasms of the throat; insatiable thirst, a dry tongue, bloody stools and strangury, muscular spasms, oppressed breathing, irregular pulse, paleness and coldness of the skin, and general collapse. When death does not result the cure is generally slow and sometimes imperfect; digestion remains impaired, the muscles are stiff and feeble, and sometimes they are more or less paralyzed, especially those of the lower limbs. After death from acute arsenical poisoning the gastro-intestinal mucous membrane is usually found inflamed, softened, and sometimes, when the poison has been taken as a powder, covered with a false membrane; but in other cases, those in which nervous prostration has predominated, the gastric lesions may be quite inconsiderable. The violence of the symptoms and the subsequent lesions are apt to be greatly modified by the presence of food in the stomach when the poison is swallowed, and hence the fatal dose varies between remote extremes. The spinal and nervous symptoms are to be explained, according to Popow (*Virchow's Archiv*, xciii. 351), by a myelitis involving both the gray and the white elements of the cord.

The curative operation of arsenic cannot be explained by the effects of directly poisonous doses. The explanation must be sought in the nature of those changes in the blood, nervous system, and general nutrition occurring in chronic poisoning, and especially in the dropsical effusions and the alterations in the skin and its products which are so commonly observed. They point directly to changes in the blood by which the proportion of its solid elements is diminished, and the facility of elimination of its morbid constituents is increased. That this elimination takes place through the kidneys is not improbable, since the mineral itself is chiefly discharged through those channels, and the proportion of the urea in the urine is augmented. But such phenomena are still to a certain extent morbid, and they are not usually developed by the therapeutical operation of the medicine. Indeed, the occurrence of dropsy in the form of œdema of the eyelids is generally held to be a signal for suspending the use of the medicine or for diminishing its dose. Within these limits arsenic appears to act as a tonic, improving the digestion and nutrition, restricting the excretion of tissue in the forms of carbonic acid and urea, and lowering the temperature. It would seem, then, that, according to its dose, it may act as a conservative tonic or as an eliminative agent; and this interpretation would appear to reconcile its apparently opposite effects. Thus, comparatively small doses suffice to cure neuralgia and certain cases of intermittent fever, while comparatively larger doses are required by chronic malarial affections and diseases of the skin.

In this sketch of the probable operation of arsenic a subordinate place is given to its direct action upon the nervous system. But there is much reason for thinking that as, physiologically, the supply of blood in the tissues, and the molecular action of the latter, must be under the control of the nervous system, so many of the effects of arsenic may be plausibly ascribed to a primary and direct action upon that system. It is well known that numerous cases of acute skin disease (herpes, urticaria, lichen) arise under the direct influence of mental causes, and are some of them closely related in their distribution to that of the nerves. Again, the symmetrical eruption of the patches in scaly affections appears to demonstrate a nervous influence in the derangement, for such symmetry from a mere alteration of the blood is less conceivable. Moreover, the phenomena of chronic arsenical poisoning are, as already stated, presented by the nervous system. Finally, the action of arsenic in curing intermittent fever, like the similar action of quinia, is rendered more intelligible by referring it to the nervous system than in any other manner. Very probably the actions of the medicine upon the blood and upon the nervous system are simultaneous and co-operate with one another.

Numerous experiments upon animals have within the last few years been performed to illustrate the action of arsenic upon certain portions of the nervous system, and especially upon the cardiac ganglia and respiratory centres. But it is difficult to discern any relations between them and the action of arsenic on man in either poisonous, physiological, or therapeutical doses. If they prove anything, it is that this agent impairs the circulatory and respiratory vigor; whereas the very opposite effects are among the most striking as well as the most useful operations of arsenic as a medicine. Nevertheless, since the excessive action of a medicine produces effects the very opposite of those occasioned by its primary medicinal doses, it becomes of interest to know that both in acute and chronic poisoning by arsenic the metal accumulates in the brain and medulla oblongata more than in the liver and muscles. It is especially so since it has been shown by Binz and Schulz (*Arch. f. Exp. Path.*, xi. 219) that in fatal cases of arsenical poisoning death cannot be explained by the gastric lesions, but is apparently due to depression of the functions of the great nervous centres; which, indeed, may amount to complete paralysis.

Medical Uses.—The use of arsenic as a remedy for *intermittent fever* has prevailed in China from time immemorial. As a substitute for the cinchona alkaloids in its treatment it has been extensively resorted to, and the general result of experience is that it is not comparable to the latter medicines in efficacy. The greater number of cases in which it shows a decidedly curative operation are of the chronic form above referred to—cases in which quinia had failed to effect a cure, and in which the malarial cachexia was distinctly marked. In these the cure by arsenic generally coincides with evidences of the constitutional operation of the remedy. In various *skin diseases* arsenic is an invaluable remedy, but is especially so in *lepra*, *psoriasis*, and *chronic eczema*. In a large proportion of cases of these affections it effects a perfect cure; but in none of them can it be regarded in the light of a specific. Some dermatologists advise that the medicine should be given in very small doses at first, and gradually in larger doses, until its constitutional effects are developed; others insist upon commencing at once with a full but moderate dose (5 minims of the solution), and persisting in its use until the injection of the eyes or the swelling of the eyelids appears, when the dose should be gradually reduced until these phenomena subside. In either case the medicine should be continued for some time after the eruption has disappeared. The last point is of essential importance. Chronic *eczema* is less amenable than the dry scaly eruptions to the use of this medicine, but nevertheless will often yield to it alone. By several dermatologists arsenic is pronounced a specific for *pemphigus*, and, although this estimate of its value is too absolute, there is no doubt of the superiority of the medicine to any other in that disease. It must, however, be given perseveringly and for some time after the disappearance of the eruption, and does not dispense with the necessity of using preparations of cinchona and iron and appropriate diet and regimen. Syphilitic eruptions of the skin are not curable by arsenic. Of that most intractable of skin diseases, *prurigo*, arsenic is credited with a cure by Geber. But the patient was young, and other treatment was employed (*Boston Jour.*, Oct. 1880, p. 396). *Lichen ruber*, also a disease which is rarely cured, is stated by Koebner to have been removed by hypodermic injections of from 3 to 6 minims daily of Fowler's solution, diluted with twice as much water. The treatment lasted for 2 months (*Med. News*, etc., May, 1881, p. 292). *Warts*, especially those which appear rapidly in large crops, may generally be cured by arsenic given internally. Enlarged lymphatic glands (*lymphoma*), whether superficial or occupying the great cavities, are singularly amenable to this medicine when the dose is carried to the extent of producing its full constitutional effects and then gradually reduced. When the tumors are accessible their injection with the arsenical solution (Fowler's) has been successfully practised. The operation is apt to produce some febrile reaction, but leads to the absorption of the hyperplasia. It may be mentioned for information, but not as an example to be imitated, that Fowler's solution has been injected into the *enlarged spleen* by means of the hypodermic syringe, and with alleged success, although in other cases the effects were injurious or even fatal (*Bull. de thér.*, c. 380).

It is reported that several cases of *obesity* have been restored to a normal condition by the continued use of Fowler's solution in the dose of 5 drops three times a day.

This medicine has enjoyed a certain reputation in the treatment of *nodosity of the joints*, both as an internal medicine and under the form of arsenite of sodium in baths. Several distinguished names vouch for its efficacy, but we have made use of it persistently in several cases of the disease without the slightest advantage. In *chorea* it has enjoyed a very high repute, so much so as to have been looked upon by certain physicians as a specific; but, on the other hand, some of the best authorities do not even refer to it among the remedies for the disease. The former judgment is undoubtedly the correct one; but to ensure the efficiency of the medicine it must usually be given so as to induce its constitutional effects as rapidly as possible. Our own impression of its value is very decided in those numerous cases in which chorea occurs, as it so often does in delicate children, from overstrain of the mind or from any other exhausting excitement. Its hypodermic administration, which has been advocated, is not to be commended.

The advantages of arsenic in *neuralgia*, especially of the fifth pair and of the intercostal nerves, the forms which most usually depend upon constitutional or acquired debility, have been recognized ever since they were first pointed out by Fowler. It is true that the cases most readily cured by it are those of miasmatic origin; but whether the disease depends upon miasma as a direct effect, or upon its indirect influence on the constitution of the blood, is not clearly determined. Instances are indeed cited of its effecting the cure of traumatic neuralgia, but they are very rare and open to criticism. Besides the miasmatic forms, there are but few cases of neuralgia which are not benefited, even if not cured, by arsenic. The mode of its action may be inferred also from the well-known fact that facial and intercostal neuralgias are precisely those in which iron is a very efficient remedy. It would appear that large doses of the medicine are sometimes essential to the cure, such as 20 or 30 minims of Fowler's solution at first, and subsequently smaller quantities (Francis). In certain cases sulphate of quinia and the arsenical medicine, each in half of the full dose, have been associated with results that could not be secured by either alone. Another form of the disease, *gastralgia*, very frequently arises under similar states of the system, and is often curable by arsenic; this is the more remarkable, considering how frequently this neuralgia is associated with gastric ulcer, and renders it probable that both affections are cured by the action of arsenic in improving nutrition. This power is conspicuously manifested by it in many cases of pulmonary *phthisis*. Under its influence the bronchial irritation and secretion decline, the hectic abates, the breathing grows calmer, the appetite improves, flesh is gained, and life is prolonged, if not permanently secured. It is not in every case that these effects are witnessed, nor is it possible to determine in what cases they may be looked for. But it would seem that arsenic is most efficient when the bronchitic element is strongest and the degenerative process is least active. This judgment is rendered probable by the manifest benefits derived from the medicine in many cases of chronic *bronchitis* affecting the lower lobes of both lungs. In nearly all of the diseases mentioned in this article more or less impairment of the blood exists, and many of them are more or less curable by iron. Indeed, in all of them the association of iron and arsenic is more efficient than either medicine alone. In no disease is this operation more distinct than in *chlorotic anæmia*, an affection in which the nervous as well as the blood element requires a specific treatment. Sulphuret of arsenic was anciently used for asthmatic affections. Many years ago Koepl employed Fowler's solution in *spasmodic asthma*, in which he was imitated by Trousseau, who also prescribed cigarettes made of tissue-paper impregnated with the same solution. Subsequently Thorowgood (1874) stated that this solution is alike useful in dry and in humid asthma, and that if the affection is connected with old chronic skin disease it may be prescribed with every prospect of benefiting the patient. No doubt the medicine is occasionally efficient in pure nervous asthma, but it is more successful in ordinary disease combined with chronic bronchitis and emphysema. To the tonic and reconstituent power of arsenic must be attributed its utility in many cases of *uterine disorder* due to an enfeebled constitution or to more local causes; for it is in *amenorrhœa*, *menorrhagia*, *dysmenorrhœa*, and *leucorrhœa* that it has been found efficient; and these affections, although very different symptomatically, may have their root in the same organic debility. The utility of the medicine in many cases of *diabetes* may fairly be attributed to a like operation. They are cases in which iron and also strychnia have been found useful—cases in which general debility is attended with a comparatively small secretion of urine, how high soever its specific gravity may be. Yet there are others which have been materially improved by this medicine, although the diuresis was profuse. In three-drop doses it is represented by Von Pap as greatly diminishing the sugar in the urine in diabetes, sometimes removing it, and in certain cases causing it to disappear for some time after the arsenic had ceased to be given. (Compare Quinquaud, *Bull. de thér.*, ciii. 241.)

In a case of long-continued *albuminuria*, apparently depending upon debility and indigestion, and in which the presence of albumen in the urine was not constant, Dr. Brinton found that small doses of Fowler's solution were more efficient than any other medicine. In the *chronic diarrhœa* of children it is reported to have cured cases that resisted other remedies.

The treatment of *cancer* by arsenic has been both internal and external. At one time the administration of iodide of arsenic was held by competent authorities to be capable of diminishing the size of cancerous tumors, but the treatment has now lost whatever credit it once possessed. As a caustic, arsenic was used for the destruction of cancerous tumors even by the ancients, and throughout the course of medical history examples may be found of faith in its propriety and efficacy. But in recent times the practice has chiefly fallen into the hands of quacks. Superficial cancers, and tumors under various names which tend to occasion ulceration, including *lupus*, continue to be occasionally treated by means of arsenical caustics. Most of them are, however, excessively painful, and if applied over a large surface involve the risk of producing poisonous effects. Esmarch, in the treatment of desperate cases too far advanced for the use of the knife, employed arsenic both internally and externally, the former because the medicine is supposed to promote the disintegration of albuminous compounds; and for the latter purpose he applied a powder composed of 1 part each of arsenious acid and sulphate of morphia, 8 parts of calomel, and 48 parts of powdered gum arabic. The powder was thickly strewn over the ulcer or wound every day; its action was powerfully escharotic, but painless, and it neutralized the fetor of the sore. Kaposi, after Hebra, employs a paste composed as follows: Arsenious acid gr. x, Factitious cinnabar ʒss, Rose-water ointment ℥ss. "The healthy skin is not in the least affected by it, not even excoriated, whilst each individual lupus nodule is invariably and thoroughly destroyed." Lauboléne removed *epithelial* tumors without severe pain by means of 2 parts of arsenious acid, 6 parts of sulphide of mercury, and 12 parts of burnt sponge, mixed and reduced by water to a paste. He claimed that this preparation attacks the abnormal growth, and not the natural tissues (*Bull. de thérap.*, cv. 143). Koebner cured a case of multiple *sarcoma* of the skin by injecting each of the small tumors with Fowler's solution (*Archives gén.*, Avril, 1883, p. 496). Unna recommends for the treatment both of venereal and common *warts* the continuous application of mercurial ointment containing 5 per cent. of arsenic. The growths disappear by reabsorption, as in cases of spontaneous cure (*Practitioner*, xxix. 468). The peculiar caustic and drying action of arsenic has long been used to destroy the exposed pulp of *carious teeth*. About $\frac{1}{60}$ of a grain (Gm. 0.001), or from that to $\frac{1}{30}$ of a grain (Gm. 0.002), is applied to the nerve-pulp previously benumbed by some anæsthetic or astringent, and securely covered to prevent its displacement. The pain produced is severe in proportion to the inflammation of the part.

The symptoms of *poisoning* produced by arsenic taken into the stomach should be met by thoroughly evacuating that organ by means of ipecacuanha, alum, or the sulphate of zinc or copper, and the administration of tepid water containing white of egg, flour, or lime-water. If these are unsuccessful, the stomach-pump should be speedily resorted to, after which the hydrated sesquioxide of iron or the hydrated sulphuret of iron should be largely administered as a chemical antidote. The saccharated oxide of iron, solution of perchloride of iron, dialyzed iron, and also magnesia, have been recommended with the same object. The tendency of the patient to collapse is to be counteracted by means of hot bottles, bricks, etc. applied to the limbs and back, and by the cautious administration of alcoholic liquors and opiates by enema.

Administration.—The dose of arsenious acid may be stated to be between $\frac{1}{30}$ and $\frac{1}{15}$ of a grain (Gm. 0.002–0.004). Like other preparations of the medicine, it should never be given when the stomach is empty, and like them, also, its dose should be gradually increased until the eyes begin to show signs of its operation or the symptoms of the disease for which it is prescribed are ameliorated.

ACIDUM BENZOICUM, *U. S., Br., P. G.*—Benzoic Acid.

Acidum benzoicum sublimatum, Flores benzoes.—Flowers of benzoin, E.; *Acide benzoique, Fleurs de benjoin*, Fr.; *Benzoesäure, Benzoeblumen*, G.
Formula $HC_7H_5O_2 = C_6H_5COOH$. Molecular weight 122.

Origin.—Benzoic acid is contained in benzoin, Tolu balsam, Peru balsam, storax, Botany Bay resin, in several other resinous exudations, and in certain plants. It was described by Vigenère (1608) as one of the products of the dry distillation of benzoin, and recognized by Lemery (1675) and Scheele (1775) as an acid. Liebig (1830) found it among the products of the dry distillation of hippuric acid, and Dessaignes (1847) obtained it from the latter by the action of acids and alkalies. Its artificial preparation is described below.

Preparation.—Take of Benzoin in coarse powder 12 troyounces. Spread it evenly over the bottom of an iron dish 8 inches in diameter and 2 inches deep; cover the dish with a piece of filtering-paper, and by means of paste attach it closely to the rim. Then, having prepared a conical receiver or cap of thick well-sized paper, of rather larger diameter than the dish, invert it over the latter so as to fit closely around the rim. Next apply heat by means of a sand-bath or of the iron plate of a stove, until, without much empyreuma, vapors of benzoic acid cease to rise. Lastly, separate the receiver from time to time, and remove the benzoic acid from it and the paper diaphragm as long as the acid continues to be deposited. By renewing the paper diaphragm after it has become so obstructed as to prevent the passage of vapor, an additional quantity of benzoic acid may be obtained.—*U. S.*, 1870.

The above process and apparatus were first proposed by Mohr. The directions are plain, and if followed an excellent product will be obtained, particularly if a few precautions have been adopted. The benzoin, which may be mixed with an equal bulk of sand, should be previously deprived of all adhering moisture by keeping the coarse powder for a few days in a close vessel over burned lime, removing it to the dish only when ready for use; if this moisture be not expelled, it will condense in the cap, and with it a portion of the acid will be absorbed by the paper. Loose filtering-paper should be used for the diaphragm, so that the passage of the vapors will not be impeded. The heat should be regulated; to accomplish which it is preferable to place the dish in a sand-bath, which at the beginning of the operation should be carefully kept at a temperature of about 145° C. (293° F.), and gradually raised to 200° C. (392° F.). The operation will require about 4 hours or more, the length of time depending upon the thickness of the benzoin layer in the iron dish, upon the proper regulation of the heat, and upon the care with which the entire apparatus is handled during the operation. The sublimed acid obtained from the cooled apparatus is ready for use. The yield from good benzoin is usually from 7 to 8 per cent. A considerable portion of the acid remains in the benzoin, which, by the heat employed, has been fused. It may be obtained by breaking the mass again into small pieces, and submitting it to another sublimation, or preferably by the wet process described below.

If during the operation the apparatus should be shaken, a portion of the sublimed acid will be detached from the paper cap, and, falling upon the diaphragm, will be absorbed with the empyreumatic oils, and require to be resublimed. A change of the receiving-cap is therefore not advisable if the apparatus remains entirely undisturbed until the process is finished. To avoid these difficulties, one or two diaphragms of gauze may be inserted in the receiver a few inches above the subliming vessel, so as to retain any acid which may become accidentally detached. To attain the same end, several modifications of the apparatus described above have been proposed. Mohr covers the subliming vessel with a very shallow sheet-iron funnel, terminating in a tube about 1 inch long and about 3 inches in diameter. The receiving vessel consists of a nearly cubical box made of pasteboard, and covered upon the inside with glazed paper, a circular hole, fitting closely around the tube, being cut in one side. By this arrangement very little acid can fall back into the iron dish.

Hager replaces the shallow funnel by a flat sheet-iron cover, having near the edge a tubulure, through which the termination of the sublimation may be ascertained by removing the stopper and covering the opening for a short time with glass, upon which some benzoic acid, if it still sublimes, will be deposited. The receiving vessel consists of a pasteboard cylinder, terminating conically at one end, so as to fit well around the large circular tubulure in the centre of the cover. The upper end of the cylinder is closed during the operation with a plate of glass. The insertion of one or two gauze diaphragms near the conical end is advisable.

C. Rump (1868) recommends a sheet-iron kettle 18 inches in diameter and 12 inches deep, which has inserted in it, on two opposite sides, tubes 6 inches in length and diameter, with which large paper boxes serving as receivers may be connected, into the extreme end of which a short tube is fitted to establish communication with the air. Sublimation is effected from a cast-iron or earthen dish, which is placed in the kettle and may be charged through an opening in the cover. The temperature is ascertained by means of a thermometer suspended in the vessel and passing through a tubulure in the cover. Since a portion of the acid is liable to condense on the cover, the latter should be kept hot.

Benzoic acid may also be prepared by boiling 4 parts of powdered benzoin and 1 part of lime with from 40 to 50 parts of water, filtering while hot, and supersaturating the clear liquid, after some concentration, with hydrochloric acid. In this process, which is essentially that of Scheele (1775), the benzoic acid, together with a little resin, is rendered more freely soluble in water through the formation of benzoate of calcium. This salt is decomposed in the filtrate by the hydrochloric acid, with the production of freely soluble chloride of calcium and crystallizing benzoic acid, the latter being contaminated with some resin and coloring matter, from which it may be freed by dissolving it in twenty times its weight of boiling water, adding some animal charcoal, filtering while hot, and crystallizing.

Benzoate of sodium is about fifteen times more soluble in water than the calcium salt, and from it the acid may be prepared with smaller quantities of liquid. Bucholz recommends (1810) the digestion for 3 hours, at a temperature of 40° to 60° C. (104° to 140° F.), of from 4 to 5 parts of powdered benzoin with 1 part of crystallized carbonate of sodium and 8 to 10 parts of water. The mixture may afterward be boiled, filtered, and treated as stated above in Scheele's process. If the digestion is prolonged for a day or two, care being taken not to raise the heat to such a degree that the resin fuses, boiling will not be necessary, and the pulverulent residue may easily be washed with warm water to remove the benzoate. The resin left by this process may be advantageously used in the preparation of fumigating pastilles. The acid obtained is mixed with a larger amount of resin than that obtained by the lime process.

The process suggested by Wagner (1879) has only scientific interest: Benzoin is dissolved in 3 or 4 parts of warm strong acetic acid, and the solution poured into 4 parts of boiling water, when the resin will be precipitated and the acid will crystallize from the clear liquid on cooling. Thus prepared, it has a pleasant storax-like odor.

Most of the benzoic acid of commerce is now made artificially, either from urine or from tar-products, and is employed in the preparation of blue tar-colors. The urine of cattle or horses is mixed with an excess of lime, evaporated to one-sixth or one-twelfth its volume, and supersaturated with hydrochloric acid (Gregory). The impure hippuric acid thus obtained may be purified by recrystallization after treatment with animal charcoal or with chlorinated lime, or with hydrochloric acid and some chlorate of potassium. By boiling the purified hippuric acid, $C_9H_9NO_3$, with hydrochloric acid for half an hour it is split into glycocoll, $C_2H_5NO_2$, and benzoic acid, $HC_7H_5O_2$. The latter has a fetid odor, and is purified by recrystallization from water, and sometimes by sublimation with a little benzoin.

Naphthalin, $C_{10}H_8$, which is most advantageously obtained from coal-tar, when oxidized with nitric acid yields phtalic acid, $C_8H_6O_4$, crystallizing in colorless scales or prisms, and easily soluble in hot water. This is converted into the calcium salt, which, on being mixed with calcium hydrate and heated to 300° or 350° C., is decomposed into calcium carbonate and benzoate, from the latter of which benzoic acid is liberated in the usual manner.

Recently, benzoic acid is largely manufactured from a derivative of toluol, C_7H_8, from which benzotrichloride, trichloromethyl-benzol, or phenyl-chloroform, $C_7H_5Cl_3 = C_6H_5CCl_3$, is first obtained by passing chlorine into hot toluol. The liquid, on being treated with water under pressure, yields benzoic acid; but a more successful process is the heating of it with a mixture of acetic acid and zinc chloride, when hydrochloric acid and acetic chloride are given off, and benzoic acid remains behind with the zinc chloride.

From 8000 to 9000 pounds of benzoic acid are annually imported into this country.

Properties.—Benzoic acid is in yellowish-white feathery flexible crystalline plates and needles, having an agreeable aromatic odor and a warm acidulous taste. The odor is due to the presence of a small quantity of volatile oil, produced from the benzoin during sublimation. Exposed to the light, benzoic acid sublimed from benzoin becomes darker in color and separates a few oily drops of a brown color. The pure acid is white and without odor. It fuses at 120.5° C. (249° F.), and boils at 239° C. (462° F.), but volatilizes freely with the vapor of boiling water, and more slowly at a somewhat lower temperature. Its vapors are suffocating and acrid, inciting to coughing. It requires for solution 1 part of boiling alcohol, and at 15° C. 2 1/7 parts of absolute alcohol, 2 1/2 parts of 90 per cent. alcohol, and 3.2 parts of absolute ether (Bourgoin). It is also soluble in fixed and volatile oils, in 10 parts of glycerin, in 15 parts of carbon bisulphide at 30° C., in 6 parts of chloroform, in benzol, and in petroleum benzin. Its solubility in water is increased by several sodium salts. According to Bourgoin, 1000 parts of distilled water dissolve—

At	0°	5°	10°	15°	20°	30°	50°	60°	70°	80°	90°	100° C.
in	1.70	1.85	2.10	2.45	2.90	4.10	7.75	11.55	17.75	27.15	40.75	58.75 parts benzoic acid.

According to R. Otto (1862), the benzoic acids obtained from different sources (benzoin, oil of bitter almond, urine, benzalanin, etc.) differ from each other in the degree of their solubility in water. The experiments of Reichenbach and Beilstein (1865), however, indicate the existence of but one variety of benzoic acid.

Its solution in strong sulphuric acid is colorless, and when gently warmed brownish, and on adding it to water benzoic acid is again precipitated; but the solution in fuming sulphuric acid, on being heated, gradually forms sulphobenzoic acid, $C_7H_6SO_5$, which is deliquescent. Boiling nitric acid does not affect benzoic acid, but fuming nitric acid produces substitution compounds. Nascent hydrogen causes deoxidation, with the formation of benzaldehyd (oil of bitter almond) and benzalcohol, and the production of crystalline hydrobenzoic acid, $C_7H_{10}O_2$.

The chemical composition of benzoic acid is represented by the formula C_6H_5COOH. Its salts are more or less soluble in water, and many of them also in alcohol; those with the alkalies dissolve very freely in water. Solutions of the salts yield with neutral or basic ferric salts pale brownish-red, and with lead acetate and silver nitrate white, precipitates, which are sparingly soluble in water.

Tests.—Benzoic acid should completely evaporate from platinum-foil. If much charcoal be left behind, the presence of other organic substances would be indicated, of which sugar manifests itself by the odor of caramel, and hippuric acid by the odor of hydrocyanic acid, during the application of heat, while mineral substances will be left behind as a fixed residue. Since some varieties of benzoin contain cinnamic acid, this should always be tested for before benzoic acid is prepared. Its presence in the latter is readily ascertained by an oxidizing agent, such as chlorine, bichromate of potassium and sulphuric acid, or potassium permanganate, when the odor of oil of bitter almond will be perceived.

If prepared from benzotrichloride, benzoic acid is apt to contain chloro-compounds, which are detected by the blue-green color produced at the tip of a non-luminous flame when a little of the acid attached to cupric oxide is held in the flame.

Pure benzoic acid does not decolorize a solution of potassium permanganate, but the odorous compounds present in the sublimed acid rapidly deoxidize it, both in acid and alkaline solution. This test has recently (1881, 1882) been perfected by C. Schacht and others, and is applied by mixing .1 Gm. (1.5 grains) of the acid and 5 drops of permanganate solution (1 in 200) with 5 Ccm. of distilled water or with 3 Ccm. each of potassa solution, sp. gr. 1.18, and distilled water, and heating the mixture just to boiling, when complete decoloration will be at once effected without the previous production of a green color. Benzoic acid prepared artificially or by the wet process will either not reduce the permanganate, or affect it more slowly than the sublimed acid. For this reason C. Schneider has increased the test-liquid to 16 drops, which, when the mixture has been set aside for 8 hours, will be decolorized only by the sublimed acid, but not by the other kinds even if resublimed with benzoin. In the presence of cinnamic acid reduction will likewise take place, but at the same time the odor of oil of bitter almond will be observed.

Off. Prep.—Ammon. benzoas, Tinct. opii camphorata (composita), *U. S.*, *Br.*; Tinct. opii ammoniata, *Br.*

Medical Action and Uses.—Taken internally in doses of 20 grains, and repeated several times a day, benzoic acid irritates the throat, and is said to occasion a diffused sense of warmth over the whole body, and to increase expectoration and perspiration. In the urine it is converted into hippuric acid at the expense of the urea.

It is maintained by authorities of equal weight to be no less advantageous when the urine contains an excess of *uric acid* than when it is *phosphatic*. Certainly, when the urine is excessively acid, this medicine, in doses of 10 or more grains dissolved in a weak solution of carbonate or phosphate of sodium, will materially lessen its acidity. On the other hand, phosphatic urine may be rendered acid by means of 20 grains of benzoic acid given twice a day, and at the same time the accompanying local irritation will subside whenever the phosphatic state of the urine is due to derangements of the bladder. When, however, this condition is owing to constitutional causes, the medicine is of no avail. Phosphatic deposits are apt to arise when the urine becomes ammoniacal in the bladder from the action of fermenting mucus, and to form masses in layers upon the lining membrane, or calculous concretions of the ammoniaco-magnesian phosphate. The due administration of benzoic acid maintains the acidity of the urine and prevents the formation of such deposits. It is credited with possessing a cholagogue action, which, however, is more demonstrable in its salts.

According to Senator, who employed benzoic acid in the treatment of *rheumatism*, it is useless in the subacute forms of the disease. In the acute articular form its action was found very favorable, although inferior to that of salicylic acid, although it did not produce any disagreeable effects. On the other hand, it did not reduce the pulse or temperature as much. It was given to the extent of 2 or 3 drachms during the day (*Zeitschrift f. klin. Med.*, i. 262).

Incontinence of urine, without any altered condition of this secretion, and depending probably upon irritability of the lining membrane of the bladder, has been frequently treated by this medicine with success. It has also been used with apparent benefit in *Bright's disease* and *albuminuria;* it seemed to cause the disappearance of albumen from the urine. In *chyluria*, with spontaneously coagulable urine, it has restored the secretion to its normal condition (*Am. Jour. of Med. Sci.*, July, 1882, p. 263).

Benzoic acid has some repute as a remedy for *jaundice*, but the conditions for its successful use are undetermined. It may be assumed, however, that it can only be employed with a hope of advantage when jaundice is due to simple obstruction of the ducts by inspissated bile, whatever may be the remaining conditions of the liver.

In *chronic bronchitis* the fumes of benzoic acid have for a long time been inhaled advantageously, and recently atomized solutions of the compound tincture of benzoin, whose internal administration is of older date in the treatment of the same affection.

Administration.—The dose of benzoic acid is from 10 to 40 grains (Gm. 0.60–2.60). In albuminuria much smaller doses, as 1 or 2 grains, have been found sufficient. To promote its solution in water, 4 parts of phosphate of sodium, or 1½ parts of borate of sodium, may be added. It may also be administered in pills made either with balsam of fir or Castile soap (*Am. Jour. of Phar.*, Aug. 1880, p. 406).

ACIDUM BORICUM, *U. S., Br., P. G.*—BORIC ACID.

Acidum boracicum.—Boracic acid, E.; *Acide borique*, Fr.; *Borsäure*, G.
Formula H_3BO_3. Molecular weight 62.

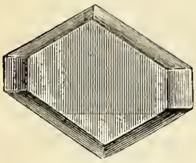
Origin and Preparation.—This acid was obtained by Homberg (1702) by heating borax with copperas, and subsequently from sulphuric acid and borax. It was known as *Sal sedativum Hombergi* until Gay-Lussac and Thénard (1804) proved it to be an oxygen compound of boron. It is a constituent of several minerals, and is present, mostly in minute quantities, in various plants, mineral waters, and sea-water, and in somewhat larger proportion in several of the hot springs in Western North America. The crater of the Liparian island of Volcano, situated north of Sicily, contains a deposit of boric acid mixed with sulphur, and the same acid is found in the vapors which issue from fissures in the volcanic rocks of Tuscany in Italy. These fissures, called *soffioni*, are either natural or made artificially by drilling, sometimes to the depth of 150 or 200 feet. Surrounding one or more of the *soffioni* a series of basins or *lagoons* are constructed on the side of the mountain, either by excavation or masonry, and are then filled with water from a mountain-stream; the hot vapors in passing through the water yield to it boric acid and heat the water at the same time. The solution of boric acid thus obtained is passed from one basin to another lower one, and when sufficiently saturated into a reservoir; thence it is conducted into evaporating-pans, and finally into vats, where the acid is deposited. This crude product, of which about 200,000 pounds are annually imported into the United States, is used in the preparation of borax (see SODII BORAS), and from this salt boric acid is again prepared for medicinal use.

10 parts of borax are dissolved in 24 parts of boiling water; the solution is filtered while hot, mixed with 6 parts of hydrochloric acid, and the liquid set aside for a day in a cool place. The crystals are collected either in a funnel or upon a strainer, and are

drained and washed with a little cold water, after which they are redissolved in five times their weight of boiling distilled water. After a day or two the crystals are collected as before, washed with cold water to remove the last traces of adhering hydrochloric acid, and dried in a moderately warm place. The yield is between 5½ and 6 parts. The reaction which takes place is explained by the equation $Na_2B_4O_7.10H_2O + 2HCl = 4H_3BO_3 + 2NaCl + 5H_2O$. Sulphuric acid may be employed in the place of hydrochloric acid, but will adhere more persistently to the boric acid, necessitating two or three recrystallizations.

Properties.—Boric acid crystallizes in white, translucent six-sided scales, which have a slight pearly lustre, are somewhat fatty to the touch, inodorous, and of an acidulous and slightly acrid taste. The taste of the solutions is somewhat astringent and sweetish, and in the presence of salicylic acid quite bitter. When heated it melts, disengaging vapors of water, which contain some of the acid; between 80° and 100° C. it is converted into *metaboric acid*, HBO_2; between 140° and 160° C. it yields *pyroboric acid*, $H_2B_4O_7$; and at a red heat all the water is expelled, *boric anhydride*, B_2O_3, being left in the form of a transparent, very hard but brittle glass, and weighing about 56 per cent. or less of the boric acid used. Boric acid volatilizes appreciably with water at and above 60° C., and with the vapors of boiling alcohol; its solution in the latter burns with a green flame. It is nearly insoluble in ether, soluble in glycerin and volatile oils, and at 17° C. dissolves in 6 parts of alcohol. According to Brandes and Firnhaber (1824), 1 part of boric acid dissolves—

FIG. 5.



Crystal of Boric Acid.

At 18.8°	25°	37.5°	50°	62.5°	75°	87.5°	100° C.
in 25.66	14.88	12.66	10.16	6.12	4.73	3.55	2.97 parts of water.

The solutions impart a red color to blue litmus- and a red-brown color to turmeric-paper; the last-named reaction is also produced in the presence of diluted mineral acids.

Boric acid, mixed with the salts of mineral acids and ignited, decomposes all those containing volatile acids; in aqueous solution it decomposes the carbonates only, forming borates, of which those with an alkaline base are readily soluble in water, while most others are slightly soluble or nearly insoluble. On ignition they melt to a glass-like mass, and when mixed with sulphuric acid and alcohol, on igniting the latter the green flame of free boric acid is observed.

Tests.—In addition to its fusibility, and its complete solubility in water and alcohol, boric acid, dissolved in 30 parts of distilled water acidulated with nitric acid, should yield no precipitate with the nitrates of silver and of barium (absence of hydrochloric and sulphuric acid), and no dark color with sulphydric acid either before or after neutralization with ammonia (metals). If mixed with an excess of sulphuric acid, the addition of a crystal of ferrous chloride should not cause the appearance of a dark-brown color (absence of nitrates).

Pharmaceutical Uses.—GLYCERYL BORATE or BOROGLYCERIDE has been recommended by F. S. Barff (1881) as a valuable antiseptic. It is prepared by heating 92 parts of glycerin with 62 parts of powdered boric acid to about 150° C. (302° F.) as long as aqueous vapors are given off; if the heat be further continued the product will acquire a dark color. Properly prepared, it is colorless or yellowish, solid, transparent, and soluble in alcohol and more freely in water. It is hygroscopic, and, according to T. D. McElhenie (1882), may be conveniently moulded in camphor-ice tins and preserved by wrapping in waxed paper and tinfoil.

GLACIALIN, which has been recommended as an antiseptic and for the preservation of articles of food, is a mixture of boric acid 6 parts, borax 3 parts, sugar 3 parts, and glycerin 2 parts.

Medical History.—In 1828, Richter stated that Homberg, who discovered the acid in 1702, ascribed to it transiently stimulant, antispasmodic, anodyne, sedative, and narcotic, as well as antiputrescent, virtues. Mitscherlich noted its comparative freedom from irritant properties, and Gahn, in Sweden, called anew attention to its power of hindering putrefaction, which in recent times has been ascribed to its destroying bacteria. Cullen, however, declared that it possessed no medicinal virtues. Since 1874 it has been much used in diseases or conditions supposed to be associated with bacteria, and the most positive assertions and confident predictions have been made of its power to cure diphtheria, erysipelas, cholera, scarlatina, typhus and typhoid, intermittent and puerperal, fevers.

Action.—In 1879, J. Neumann showed that dogs, horses, rabbits, pigs, etc. were unaffected except by very large doses of the acid, and that the symptoms it produced were due to local irritation chiefly. 3 per cent. solutions could be injected without injury into serous cavities (*Archiv Exper. Pathol.*, xiv. 149). It is an insecticide, and has been used to destroy cockroaches. Mododowski found that a 5 per cent. solution of the acid injected into the pleural cavity after paracentesis proved fatal, and a like result is attributed to injecting a lumbar abscess with a similar solution. The symptoms produced were nausea, vomiting, hiccup, and collapse. In a case reported by Huse (*Med. News*, xl. 704) the chest was washed out by a saturated solution of boracic acid. Besides the symptoms of collapse just mentioned, was observed a general erythematous eruption of the skin. This acid having been continuously applied to an ulcer of the thigh, persistent diarrhœa, and afterward vomiting which ultimately became bloody, occurred; and diuresis was followed by suppression of urine and death. The liver and kidneys were found disorganized in their glandular elements (*Med. News*, xliii. 199).

Uses.—Boracic acid has been used chiefly as an external application. According to Theobald (*Med. Record*, xvii. 140), a solution of 4 grains of the acid in an ounce of water does not irritate the conjunctiva. He used a solution of half that strength in various forms of *conjunctivitis*, accompanied or not with *corneal ulcer*. It is, however, to be noted that these beneficial results followed not only the application of the acid, but the simultaneous suspension of atropia, nitrate of silver, and other irritants that had been in use. Greene (*Boston Med. and Surg. J.*, Aug. 1880, p. 197) reports that an ointment of boracic acid is a very efficient dressing for *wounds* of large extent. Barwell and others have stated that a glycerole of the acid is superior to carbolic acid for its antiseptic and cicatrizing virtues. The antiseptic properties of this boro-glycerid have been demonstrated by ample experiment, and the advantages over iodoform, carbolic and salicylic acids, are claimed for it that it is unirritating, and promotes the rapid healing of wounds and the drying up of suppurating surfaces; *e. g.* vaginitis, purulent ophthalmia, otorrhœa, etc. (*Med. News*, xl. 304, 602). Greene ascribed to boracic acid peculiar virtues in healing *ulcers* that follow severe *burns*, and others of a foul and unhealthy aspect. He preferred for this purpose an ointment of vaseline containing the acid. On theoretical grounds Loewenberg proposed to substitute solutions of boracic acid for the usual emollient or stimulant applications to *boils*. Neumann applied boracic acid in watery solution for *parasitic diseases of the skin*, in alcohol for *pruritus* and *urticaria*, and in an ointment for *eczema*. In *pityriasis* and *herpes tonsurans* solutions of from 10 to 20 parts of the acid to 300 of water have been recommended. According to Kurz, a vaseline ointment containing about 5 parts of the acid to 10 or 15 of the excipient is a very serviceable application to *eczema*, *impetigo*, *prurigo*, and non-syphilitic *psoriasis*. Greene used a lotion and also an ointment of the acid in *erythema*, *erysipelas*, and *tinea*. In cases of chronic inflammation of mucous membranes attended with an unhealthy and especially a fetid discharge, such as *nasal catarrh*, *ozæna*, *cystitis*, etc., injections containing about 8 grains of the acid to an ounce of water have been found to correct the fetor and cure the discharge. It has also been used internally (Rosenthal) in conjunction with its topical application. A similar solution is reported to have greatly palliated the coryza of *hay fever* (Atkinson). A 1 or 2 per cent. solution, used as an injection, has cured *gonorrhœa* (Kurz; Hill). *Fetor of the feet* has been corrected by causing the patient to wear stockings that had been soaked in a saturated solution of boracic acid and then dried (*Practitioner*, xxvii. 401). Greene, and also Harries, found it useful as a topical application in "diphtheritic and aphthous inflammation of the fauces."

Internally, boracic acid is said to correct the fetid and other eructations that are apt to attend fermentative *dyspepsia*. The very improbable statement is made by a medical officer of the Madras service that every case of cholera recovered that was treated by him with 10-grain doses of this agent every 2 hours, associated with borax.

Administration.—The strength of the solutions for topical use has already been indicated. Internally, according to Atkinson (*Practitioner*, xxiv. 254), the dose is from 5 to 15 grains; but Greene (*loc. cit.*) says, "I have repeatedly given at a dose 4 fluidounces of a saturated solution which contained about 80 grains of the acid, and in several instances patients have taken much more. I have never known any ill effects from it in any way. My ordinary dose for an adult is from 20 to 30 grains." It may be given in wafers.

ACIDUM CARBOLICUM, *U. S.; Br.*—CARBOLIC ACID.

Acidum phenicum s. phenylicum, Phenol.—Phenic acid, Phenylic alcohol, Phenol, E.; *Acide phénique, Acide carbolique, Hydrate de phényle*, Fr.; *Carbolsäure, Phenylsäure, Phenylalkohol*, G.

Formula $HC_6H_5O = C_6H_5.OH$. Molecular weight 94.

Origin.—Carbolic acid occurs in castoreum, in the urine of man and of herbivorous animals, and in the products of the dry distillation of various organic substances, such as resins, bones, wood, and more especially coal. It is from the latter source that it is obtained in the arts. It was first obtained by Runge (1834), and in a purer condition by Laurent (1840), who ascertained its composition and chemical behavior.

Preparation.—That portion of coal-tar which is known as *dead oil* is subjected to distillation. The portion distilling between 150° and 200° C. (302° and 392° F.) is collected separately, and is twice rectified between 170° and 190° C. (338° and 374° F.). The product thus obtained is sold as *crude carbolic acid, acidum carbolicum crudum s. impurum*, U. S., P. G.; *acide phénique cru*, Fr.; *Rohe Carbolsäure*, G. For the purification of this product it is agitated with warm concentrated solution of potassa or soda, when a crystalline mass of phenol sodium or phenol potassium is obtained, from which the oily liquid is poured off. The solid mass on being heated to about 170° C. (338° F.) parts with a portion of the adhering empyreumatic products, and on being dissolved in water more of the oily impurities separate, and are removed from the aqueous solution, which, on being supersaturated with hydrochloric acid, yields the phenol in the form of an oily liquid. This is repeatedly agitated with solution of table-salt, then digested with chloride of calcium for the purpose of removing the water, and distilled. The portion passing over between 180° and 190° C. (336° and 374° F.) is collected separately and exposed to a low temperature, when it solidifies into a crystalline mass, from which the mother-liquor is drained off and expressed. It may be again distilled or further purified by combining again with alkali and repeating the operations described before.

This is essentially the process of Laurent (1844). Another, proposed by H. Müller (1865), differs from the preceding mainly in the following particulars: The potassium or sodium phenylate is diluted with water as long as naphthalin and other empyreumatic products are separated. The liquid is exposed to the air for some days, by which it acquires a dark-brown color. It is filtered from the precipitated oxidation products, and then mixed with one-eighth or one-sixth of the total amount of sulphuric acid which is necessary for the complete decomposition of the phenylate. Empyreumatic resins are thus separated, and on the addition of a second similar quantity of acid more resinous products and cresylic alcohol are removed, so that a third portion of the acid usually separates almost pure carbolic acid, requiring distillation to obtain it crystallized. It is obvious that if either process be interrupted at different points, carbolic acid varying greatly in degree of purity must be obtained.

Crude carbolic acid may, according to H. Müller, be purified by treating it several times with soda solution sufficient to combine only with a fractional portion of the phenol. The solutions first obtained contain the acid in a purer condition than the last; but, as stated above, they require dilution with water and exposure to the air.

Absolutely pure carbolic acid is obtained by Church (1871) from the nearly pure commercial product by treating it with a quantity of water (about 20 parts) insufficient to dissolve it completely, removing the undissolved portion, and saturating the clear aqueous solution with pure table-salt, when the carbolic acid will separate as an oily layer, requiring distillation over some quicklime to obtain it crystallized. The portion passing up to 185° C. (365° F.) has, at ordinary temperatures, merely a very faint aromatic odor.

Pure carbolic acid is chiefly imported from England; most of the impure acid, and a very fair quality of nearly pure acid, used in this country are manufactured here. 68,000 pounds of carbolic acid were imported in 1878, and 115,691 pounds in 1881.

Properties.—Crude carbolic acid is rarely colorless. It usually has a more or less dark-brown color, caused by the impurities derived from the coal-tar. The better qualities crystallize almost completely below the ordinary temperature, the solidifying point being influenced by the amount of water and of oily impurities present in it. The latter are estimated by agitating the impure acid with two hundred times its bulk of warm water, and allowing the oily matters to separate, when they should measure not over 10 per cent. of the measure of acid employed.—*U. S.* The aqueous solution should not have an alkaline reaction upon test-paper, thus indicating that it is not an alkaline solution of carbolic acid; and if it yields a clear solution with water, not less than 15 parts of this solvent should be necessary for this purpose. Its odor is more or less empyreumatic. In all other respects its properties agree with those of pure carbolic acid.

Absolutely pure carbolic acid has a faint aromatic odor, is colorless, crystallizes in needles, and does not absorb moisture from the atmosphere (Moss, 1875). Usually, however, it retains a minute quantity of water, by which it becomes deliquescent; with a little more of water it forms an oily liquid, which crystallizes at a lower temperature, and if traces of the tar-products are present it acquires a reddish color on exposure, and deliquesces to a brown-colored oil. The red color may also be produced in the dark by ammonium nitrite present in the atmosphere. The odor is modified by the presence of a little cresol. Carbolic acid is insoluble in benzin, but freely soluble in alcohol, ether, glycerin, the essential and fatty oils, in glacial acetic acid, caustic alkalies, carbon bisulphide, and chloroform, the solutions in the last two liquids separating all the water present, the amount of which may thus be determined. Morson (1872) observed that the oily liquid, either pure or containing creasote, will dissolve in an equal bulk of glycerin, and not be reprecipitated by water. (See CREASOTUM.) Carbolic acid dissolves at 15° C. (59° F.) in 20 parts, or, according to Hamberg (1871), in 15 parts, of water between 16° and 17° C. (60.8° and 62.6° F.). The solution is perfectly transparent, and is without action upon litmus-paper. Carbolic acid is less soluble in many saline solutions than in water; it yields with a limited amount of concentrated solutions of the fixed alkalies a crystalline mass, which, after being pressed, consists merely of carbolic acid, and is almost free from potassa (Calvert, 1865). Baumann (1877) observed that carbolic acid slowly decomposes a boiling solution of potassium carbonate, forming potassium phenol, which may be obtained in crystals from alcoholic ether. The fusing-point of crystallized carbolic acid is influenced by the amount of water with which it is combined; pure carbolic acid fuses at 44° C. (112.2° F.), and boils at 187° to 187.8° C. (368.6° to 370° F.) (Flückiger), or at 187.8° C. (370° F.) (*Br.*). Hamberg determined the boiling-point to be 180.5° C. (357° F.). The U. S. Pharmacopœia admits carbolic acid having a melting-point of between 36° and 42° C. (96.8° and 107.6° F.) and a boiling-point of 181° to 186° C. (357.8° to 366.8° F.), and regards the higher melting- and lower boiling-points as those of the pure and anhydrous acid. (See below, CRESOL.) Carbolic acid volatilizes slowly at ordinary temperatures, rapidly at the temperature of boiling water, without leaving any residue. It has the specific gravity 1.065, separates nitrocellulose in a gelatinous form from collodion, coagulates albumen, and has a caustic acrid taste, but when largely diluted with water tastes sweetish and smoky.

A piece of pine wood dipped into an alkaline solution of the acid, and afterward into hydrochloric acid, assumes in the course of half an hour a deep-blue color. According to Tiemann and Haarmann, this color is a characteristic reaction of coniferin. The solution of carbolic acid has no effect on polarized light. The concentrated alcoholic solution yields with ferric chloride a brown liquid, which on the addition of much water remains transparent and assumes a beautiful and permanently violet-blue color (Flückiger, 1872). When heated in sealed tubes with ammonia it yields but small quantities of phenylamine (aniline, $C_6H_5H_2N$). Fused with excess of potassa, oxybenzoic and salicylic acids are found among the products of decomposition. It is oxidized by permanganate of potassium, yielding carbonic and oxalic acids. Concentrated sulphuric acid converts it into sulphocarbolic (phenolsulphonic) acid, $C_6H_5HSO_4$. Under the influence of nitric acid several substitution-products are formed, the most important of which is picric acid. Substitution-compounds are likewise formed with chlorine, iodine, and bromine. The last-named element, acting either in the form of vapor or as bromine-water upon an aqueous solution of carbolic acid, produces a flocculent white precipitate of tribromophenol, $C_6H_3Br_3O$, which crystallizes from alcohol in silky needles, melting at 98° C. (208.4° F.). This reaction was recommended by Degener (1880) for the quantitative determination of phenol, and is so delicate that a solution of the latter in 57,000 parts of water is still rendered turbid; it must, however, be remembered that alkaloids and various other compounds are likewise precipitated by bromine-water.

Tests.—The purity of carbolic acid is recognized by the properties described above, by the absence of all reaction upon blue and red litmus-paper, and by the non-production of a dark color or precipitate in the aqueous solution by sulphydric acid, proving the absence of metallic compounds.

To estimate the quality of commercial carbolic acid, Schoedler (1872) recommends the heating of 3 Gm. in a water-bath to expel alcohol, if present, then the addition of 3 Gm. of sulphuric acid, and the digestion of the mixture for some time at a temperature of 50° to 60° C. (122° to 144° F.). It is then diluted with water, treated with an excess of carbonate of barium, and filtered from the precipitate, which is well washed. The sulphocarbolate of barium contained in the filtrate is then precipitated by sulphuric acid, the sulphate of barium is collected, washed, ignited, and weighed; 100 parts of barium sulphate correspond to 80.69 parts of anhydrous phenol.

The presence of carbolic acid in watery solution may be detected, according to E. Hoffmann (1879), by pouring into a test-tube 1 or 2 Ccm. of pure sulphuric acid, adding but not mixing the same volume of aqueous liquid, and dropping in small particles of potassium nitrate, each of which will produce a deep-violet streak; on agitation the liquid becomes violet, and on the addition of water assumes a red-orange color; $\frac{1}{10}$ per cent. of carbolic acid is thus detected. Salkowski's (1872) process consists in adding to the suspected liquid one-fourth its volume of ammonia, and then a few drops of solution of chlorinated lime (1 part to 20 parts of water). On the application of a moderate heat, a blue or greenish color will be produced, either immediately or in the course of 15 minutes, the color changing to red upon acidulating with sulphuric or hydrochloric acid; 1 part of carbolic acid in 4000 may thus be detected. Bromine may be used in place of the chlorinated solution; the blue compound is insoluble in ether and chloroform, dissolves in alcohol with a green color, and changes with acids to red, but becomes blue again by ammonia. Of still greater delicacy (1 in 200,000) is the test suggested by Plugge (1872); when a liquid containing carbolic acid is boiled with a little solution of mercurous nitrate containing a trace of nitrous acid, a reduction of the mercurous salt occurs, and the liquid assumes, sooner or later, an intense red color.

Pharmaceutical Uses.—ACIDUM CARBOLICUM LIQUEFACTUM, *P. G.*, *Br.* Pure carbolic acid, liquefied with 10 per cent. of water, or, as proposed by O. Facilides (1872), with the same quantity of glycerin; 11 grains of this liquid contain 10 grains of carbolic acid.

AQUA ACIDI CARBOLICI; Carbolic acid water, *E.;* Eau phéniquée *Fr.;* Carbolsäure-Wasser, *G.* Dissolve glycerite of carbolic acid 10 fluidrachms in sufficient distilled water to obtain 1 pint.—*U. S.*, 1870.

LISTER'S CATGUT, for ligatures, is prepared by immersing for 2 days 200 parts of catgut in a fresh mixture of 200 parts of phenol with 4000 parts of water containing 1 part of chromic acid in solution; the string is then dried without untwisting it, and preserved in a solution of 1 part of phenol in 5 parts of olive oil.

Phenol is extensively employed in the manufacture of salicylic acid and of various dyestuffs, like picric acid, phenyl-brown, corallin (scarlet), peonin (red), aurin (yellow), azulin (blue), and others.

Off. Prep.—Glyceritum (glycerinum) acidi carbolici, *U. S.*, *Br.;* Suppositoria acidi carbolici, *U. S.;* Suppositoria acidi carbolici cum sapone, *Br.;* Ung. acidi carbolici, *U. S.*

Allied Compounds.—ACIDUM CRESYLICUM S. CRESOLUM, Cresol or Cresylic acid, $C_7H_8O = C_7H_7OH$. Among the constituents of coal-tar and of beechwood-tar there are found two compounds having this composition, *orthocresol* and *paracresol*, which cannot be easily separated. They form colorless prisms, have a phenol-like odor, and dissolve sparingly in water, yielding solutions which are colored blue by ferric chloride. Orthocresol melts at 31° C. (87.8° F.), boils at 185° C. (365° F.), and by prolonged heating with potassa is converted into salicylic acid. Paracresol melts at 36° C. (96.8° F.), boils at 198° C. (388.4° F.), and by heating with potassa is converted into paraoxybenzoic acid. The presence of cresols in carbolic acid decreases the melting-point and increases the boiling-point of the latter.

Physiological Action.—*On Animals:* A detailed account of the operation of carbolic acid upon the lower animals may serve to illustrate its action on man when taken in poisonous doses, but can have only a slight bearing upon its therapeutical employment, which is confined almost exclusively to its use in checking fermentation and as a local stimulant. The experiments of Sternberg and others show conclusively that a belief in the power of carbolic acid emanations to "disinfect" the atmosphere of chambers, etc. is entirely without rational support. A very small portion of the acid in water is speedily fatal to minute organisms which may be present in the liquid. It is equally destructive to ascarides, earthworms, caterpillars, fleas, moths, ants, and other insects. Fish, frogs, and leeches soon die in a solution of 5 per cent. strength. 2 or 3 drops applied under the wing of a sparrow will produce fatal convulsions. A 5 per cent. solution administered to dogs occasions convulsions, and then paralysis of sense and motion. After the animal's death there is found congestion of the brain, lungs, and bowels, but the blood is not notably affected. A solution of 1 part of the acid in 4 parts of alcohol, applied to a dog's ear, produced circumscribed swelling and an eschar; subsequently the tissues were found mummified and translucent, without being disorganized. The experiments of Prudden on the action of carbolic acid upon ciliated cells and white blood-cells (*Am. Jour. of Med. Sci.*, Jan. 1881, p. 82) led him to conclude that dilute solutions of the acid produce a retardation or a temporary cessation of movement in living white blood-cells, while strong solutions cause the immediate arrest of their movements, and their death; but he abstained from concluding that this action explains the alleged value of carbolic acid in promoting the healing of wounds.

On Man: The principal effects produced on man by doses of 6 or 8 grains of carbolic acid in a wineglassful of water are the following: numbness, followed by a sense of coolness in the mouth and lips; if the stomach is empty, nausea and an uneasy sensation in the abdomen, with vertigo, ringing in the ears, and slight deafness; the force and frequency of the cardiac and arterial impulses decline, and sometimes diarrhœa occurs. The urine is generally diminished, and its specific gravity is raised; it also is apt to be colored brown or black, according to the quantity of the acid employed, whether it be taken internally or applied to a raw surface of the skin, but this effect is more usual after its external use or when it is applied to a serous membrane. Injected into the pleural cavity, it has changed the color of the urine to an almost inky blackness. It has been noticed in the urine of a nursing infant while the mother was using the acid. This effect would seem most apt to occur when the urine is albuminous, and especially during Bright's disease. Occasionally in the same cases it varies from day to day, although the dose of the medicine and the condition of the patient appear to be unchanged. The characteristic color is not always visible when the urine is passed, and may not appear for 48 hours. It is therefore important to detect the presence of the acid as early as possible by other means. It results from Baumann and Herter's observations that as soon as the acid appears in the urine the sulphates begin to disappear from that excretion. The diminution of the sulphates may be detected, after removing any albumen that may be present, by boiling the urine, acidulating with acetic acid, and adding chloride of barium in excess. If the sulphates abound a milky cloud will be produced. Or if 20 Ccm. of the urine be treated with 10 drops of nitric acid and evaporated to dryness, and the residue dissolved in 10 Ccm. of rectified alcohol and filtered, the resulting liquid will have a red color (Tortora). Or, having abstracted the acid from the urine by means of ether, soak a chip of soft wood in the solution, and dip it into a solution containing 50 Ccm. each of hydrochloric acid and distilled water, to which add 20 centig. of potassium chlorate. If the chip after immersion in this solution and exposure to the sunlight turns blue, carbolic acid is present (Tommasi).

In the case of a boy four years old, suffering from bloody stools, an enema of 2 pints of water containing 2 teaspoonfuls of dissolved crystals of carbolic acid was prepared, of which about three-fourths were administered. The respiration became superficial and rapid; the pulse rose to 160, but in the course of 2 hours fell to 120. The bowel was meanwhile washed out with water, but the boy showed no signs of consciousness until the end of 2 hours. He was perfectly anæsthetized. He then slept 2 hours more, naturally, and the next day was as well as ever (Putnam). A woman suffering from diarrhœa received an enema of about 8 ounces of a 1 per cent. solution of carbolic acid. Tinnitus, giddiness, and faintness immediately ensued, although the injection was passed (*Phila. Med. Times*, x. 249). Two children, five years and eight years old, had given them for the removal of seat-worms an enema made with 70 drops of carbolic acid in a pint of water. They talked incoherently, wandered restlessly about the room, then became unconscious; the pupils were dilated, the skin of the head hot, and elsewhere perspiring. The pulse was full and frequent. Coma followed, gradually merging into somnolence, and then consciousness returned (Vinke, *Med. News*, xliii. 52). In another case no less than 144 grains of carbolic acid in 18 ounces of water were injected into the bowel of a boy of five years. In a few minutes he fell into a collapse, and remained unconscious for 6 hours, but at the end of 15 hours died in convulsions (*Jour. Amer. Med. Assoc.*, i. 145). Applied externally as a surgical dressing, carbolic acid may act poisonously in two different ways. In the first the patient suddenly and rapidly sinks after the application. The second form is more insidious, and may not be developed for several weeks. The patient is nauseated, grows restless and hot, and unless the carbolized dressings are suspended, he becomes affected with giddiness, spasms, prostration, and coma, ending in death. The poison may act through a very slight lesion of the skin, as in a case of herpes zoster (Paul, *Phila. Med. Times*, May, 1880, p. 406). In the case of an infant fourteen months old it acted as a caustic on the sound skin, and speedily proved fatal (Zillner, ibid., p. 325). Several other deaths occurring under analogous circumstances are on record (*Med. Record*, xxii. 672). A very complete account of the symptoms of carbolic-acid poisoning, with a rationale of their production, is contained in a paper by Reichert (*Amer. Jour. of Med. Sci.*, Oct. 1881, p. 441). It is based on an analysis of fifty-six cases, of which thirty-three terminated fatally. In some cases the toxical symptoms are almost instantly developed (Müller, *Virchow's Archiv*, lxxxv. 236).

In poisonous doses carbolic acid produces an intense burning pain in the throat and stomach, followed by impaired muscular power and insensibility. The face is pale, the lips and hands livid; the pupils are dilated if death is rapid, otherwise they are contracted; the breath smells of the acid; the tongue is swollen, and a discolored foam is upon the lips; the respiration is stertorous, and the lungs are filled with dry or mucous rhonchi: the pulse may be rapid, or, on the other hand, abnormally slow; the urine is suppressed usually, but sometimes is copious; the bowels are generally not disturbed. Convulsions are not usual, but Treube has referred to twelve cases in which they occurred (*Philad. Med. Times*, March, 1881, p. 403), and in the New York City Insane Asylum a case was observed with clonic convulsions, unilateral at first, and then becoming general. Death may occur as quickly as 3 minutes after a large draught of the liquid, but usually in fatal cases life is prolonged for from 1 to 3 hours. The lesions found after death are: a purplish hue of the skin in dependent parts; a white or brown, dry, and shrivelled condition of the mouth, throat, and œsophagus; the gastric mucous membrane is more or less reddened, but also presents whitish patches, and is easily stripped off. The air-passages contain bloody and frothy mucus; the heart sometimes presents traces of fatty degeneration; it may be engorged or empty, but frequently contains firm clots; the brain is congested; the kidneys present no constant lesions, but in one case, at least, the epithelium of the convoluted and straight tubes showed extensive fatty degeneration (Bradford). In many cases carbolic acid has been detected in the urine. Poisonous effects may follow the external use of the acid, as numerous and even fatal cases attest. The toxical phenomena are chiefly those already mentioned as affecting the nervous and circulatory system—insensibility, feeble pulse, livid skin, cold and clammy sweat, dilated pupils, and collapse. In cases that terminate favorably these symptoms are replaced by stupor, debility, a feeble pulse, cold skin, etc. Vomiting, diarrhœa, and either an increase or a diminution of the secretion of urine has been observed. The local action of carbolic acid, when applied to the sound skin, consists in a burning or tingling sensation, followed by a marked diminution of sensibility. The part then undergoes a sort of mummification, as in the case of the experiments on animals before noticed. There are cases in which, after the finger had been immersed in strong carbolic acid, this condition was established, and amputation of the part became necessary. A case is also reported in which a finger affected with onychia was enveloped in cloths saturated with carbolic acid. The finger became mummified apparently, and yet was saved with the loss of the integuments (*Western Med. Reporter*; *Practitioner*, xxx. 132). The local anæsthesia referred to has been taken advantage of to render certain superficial operations painless.

The treatment of poisoning by carbolic acid consists in evacuating the stomach by copious albuminous drinks, such as milk or white of egg, or by the stomach-pump injecting and then withdrawing such liquids. Oil is also of use by rendering the action of the acid less concentrated and by delaying its absorption. According to Baumann, any soluble sulphate is a direct chemical antidote to carbolic acid; and Sonnenburg states that in a case of poisoning presenting dark urine destitute of sulphates the bad symptoms all disappeared under the use of sodium sulphate. The dose recommended for adults is a tablespoonful every half hour of a solution containing 5 parts of the sulphate of sodium in from 100 to 200 parts of water, and for children a solution of about half this strength (*Practitioner*, xxiv. 299). These statements were confirmed by Cerna's experiments upon animals (*Philad. Med. Times*, ix. 592). Saccharated lime-water has also been recommended. The tendency to collapse should be combated by dry heat and by enemata containing some alcoholic liquid or ether, or by the inhalation of the latter.

Medical Uses.—Carbolic acid has been used as an antipyretic, and especially in *typhoid fever*. It undoubtedly lowers the temperature through its poisonous operation, but no more than any other active medicine does it either reduce the mortality or abridge the duration of the disease. The chief use of carbolic acid in medicine is to prevent or delay *fermentation*, especially of the putrefactive sort. Its power, in this respect, is almost identical with that of the closely analogous product, creasote. It is supposed to act by preventing the production and multiplication of certain minute organisms upon which this process is assumed to depend. Whether these organisms are the causes, the concomitants, or the consequences of the process in question is not fully determined; but that carbolic acid restricts *suppuration* and neutralizes the foul *smells* which accompany fermentation and gangrene, as well as those extricated during all forms of *putrefaction*, including the effluvia of dissecting-rooms, privies, sewers, drains, etc., has become a matter of familiar experience. Its influence in promoting the cicatrization of *wounds* is readily understood without the necessity of invoking its antiseptic qualities, for, like many allied substances (alcohol, creasote, terebinthinates), it operates as a stimulant of the parts to which it is applied, contracting and hardening them, while it protects them from the action of the atmosphere, and thereby limits those secretions which tend to prevent union in wounds, while it favors the natural processes through which alone healing can take place. On the theory that they act antiseptically, carbolic-acid dressings have been very extensively used in this country and in Europe, but most of all in Great Britain under the influence of Prof. Lister. The general result is that accidental or surgical wounds treated by carbolic-acid dressings, with a complete exclusion of the air, are healed with much less fever and suffering and in a shorter time than by any other method. These benefits are very conspicuous in the treatment of wounded or diseased joints and compound fractures, of chronic abscess, and incisions made for the ligation of arteries. The mode of employing the method it would be foreign to the purpose of this work to describe; suffice it to say that as little as possible of the acid should be applied to the affected tissues, but a liberal proportion to the dressings. In this manner the risks of poisoning are diminished. That result was met with five times in the course of 4 years by Küster, and of these cases four were fatal. The same surgeon, examining the experience of others, found seven mild cases of carbolic acid poisoning with one death, and thirteen severe cases with five deaths. Children are peculiarly liable to this danger. Ever since the first introduction of carbolic-acid dressings into surgery it has been assumed that they owed their advantages exclusively to the antiseptic virtues of the acid. But, as was intimated in the second edition of this work, and is repeated above, the exclusion of air is an essential part of all antiseptic dressings. It remained, then, to be determined whether or not the exclusion of air and of all mechanical hindrances to cicatrization formed an indispensable condition for the primary healing of wounds. In the antiseptic method, as originally practised by Mr. Lister, carbolic acid was not applied in spray, but only in lotions, injections, and the like. The observations and experiments of Trondelenburg, Von Bruns, and others led them to the disuse of the spray as unnecessary and disagreeable, but they still employ the acid to neutralize the poisons which, as they conceive, hinder the healing of wounds, occasion erysipelas, pyæmia, etc. Billroth, after sufficient trial, abandoned carbolic acid as a surgical dressing. Perhaps it may be found that the absolute cleanliness of every person and thing concerned in an operation or dressing is, next to a perfect coaptation of the divided tissues, the essential condition of their healing; and that with this precaution carbolic acid, like the sympathetic powder, would cure a wound if applied upon the weapon that inflicted it almost as perfectly as if it were irrigated or sprayed upon the wound itself.

It would seem that carbolized oil is not as apt as carbolic acid diluted with water to occasion symptoms of poisoning. The combined antiseptic and stimulant properties of the latter are serviceable in many cases of *gangrene*, both traumatic and spontaneous, as in *noma pudendi*, *gangrene of the lung*, and in those cases of fetid discharge from the lungs which are sometimes so distressing in *phthisis* and *chronic bronchitis*. In the last-named affections it also tends to lessen the secretion of mucus and pus, and is best employed in the form of an atomized spray. In tubercular phthisis it is often of service by preventing vomiting. It is unnecessary to say that it has no influence upon the tubercular element of the disease; but it does modify very greatly the ulcerative lesions of the lungs and bronchia, just as it does wounds and ulcers upon the skin, and just as the same effect is produced by various other stimulants, including benzoin, creasote, naphtha, oil of turpentine, etc. Years ago the emanations of illuminating gas manufactories were supposed to cure *whooping cough*, and carbolic acid has been applied, in imitation of that treatment, by inhalation. Some have used the atmosphere of a room impregnated with carbolic acid evaporated from extended cloths, others an atomized solution of from 1 to 2 per cent. strength (Thomer; J. L. Smith). The latter was applied three times a day, and seems to have promptly diminished the number of paroxysms and shortened the duration of the attack. In *diphtheria* the inhalation of a 1 or 2 per cent. solution of the acid has been alleged to dissolve the false membrane (Seiffert); and others have applied with a brush a mixture of equal parts of carbolic acid and glycerin, and limited its caustic action with iodoform (Garnett). Carbolized camphor has been used in the same manner with like results (Peraté). These methods may be of use as local palliatives, but diphtheria is not a merely local disease. The treatment of surgical *erysipelas* with hypodermic injections of a 3 per cent. solution of carbolic acid was practised by Hueter in 1878. The punctures were made at intervals upon the edge of the inflammation. Rothe used a liniment containing, besides carbolic acid, oil of turpentine and tincture of iodine, so that the share of the acid in the result cannot be estimated. Tassi applied a "saturated solution" of the acid; and Radcliffe, 1 part of the acid to 16 of olive oil as a liniment in an aggravated case of erysipelas of a lower extremity, with immediate relief and rapid amendment (*Philad. Med. Times*, April, 1881, p. 455). Dr. Squibb found, from extensive experience in his laboratory, that a ½ to 1 per cent. solution applied by means of thin cloths, frequently renewed, will relieve the pain of *burns* within 10 minutes, prevent the suppuration of superficial burns, and moderate that of deeper ones (*Ephemeris*, i. 307). In a gargle it may be used to cure affections of the *throat* accompanied with a fetid secretion. Its antiseptic virtues are displayed in fermentative or flatulent *dyspepsia*, although they are inferior to those of sulphurous acid and of salicylic acid. Several physicians (Rothe; Shelly) on theoretical grounds have used this acid in the treatment of *typhoid fever*, and with alleged excellent results. It has not yet been thoroughly tested, but the failure hitherto of all active methods of treatment, and the relative success of the expectant plan, indicate that the carbolic acid treatment is not worthy of confidence. It is said to be an efficient remedy for *ascarides* of the rectum, when administered by enema and sufficiently diluted to prevent excessive irritation. 6 ounces of the one-fortieth or one-sixtieth solution have been used for adults, but it is apt to occasion unpleasant symptoms. The medicine has been given by the mouth with alleged success for the expulsion of *lumbricoid worms*, and is reported to have destroyed *tænia* when administered in the dose of 6 grains in half a pint of water, four times a day (Bill), or of 2 grains in pill every 3 hours until 4 doses were taken (Brown), or of 2½ grains in half an ounce of water three times a day (Maxwell). The method does not seem to have proved acceptable. The corrugating and more or less caustic and yet anæsthetic operation of the acid has been employed in the treatment of *polypi*, *venereal vegetations*, *nævi*, *boils*, *carbuncles*, *whitlows*, *uterine ulcers*, etc. The injection of swollen and inflamed *hæmorrhoids* with a strong solution of concentrated carbolic acid has been recommended, but practised chiefly by irregular physicians; the method has been denounced as painful, and dangerous from the risk of causing peritonitis, pyæmia, or hepatic embolism. The latter view appears to be the more correct of the two. A 2 to 5 per cent. solution of the acid in olive oil or glycerin was used, of which from 2 to 4 drops were injected at intervals of from 4 to 10 days. The needle was sharp and the injection made slowly, and only one pile attacked at a time; the rectum was stuffed to prevent embolism, and the patient was kept in bed for 8 or 10 hours after each injection (Andrews). In *hydrocele* concentrated carbolic acid has been injected into the cavity (Levis), and the cure is represented to have been painless as well as radical. On the other hand, severe inflammation and non-success have been known to follow it (*Philad. Med. Times*, xi. 90). For *sore nipples* a 5 per cent. solution of the acid, applied by means of a fine brush to the fissures, has proved very efficient. According to Schwimmer, a paste composed of carbolic acid 4 to 10 parts, olive oil 40 parts, finely-powdered prepared chalk 60 parts, applied to the face on a linen mask, causes the pustules of small-pox to dry some days earlier than usual. A lotion of carbolic acid is convenient to lessen the discharge and correct the fetor of *otorrhœa*. There is reason for admitting the efficacy of a solution of 1 part of carbolic acid in 3 or 4 of alcohol in curing recent *acne rosacea*. That most obstinate of cutaneous affections, *prurigo*, is said to have been cured in some instances by carbolic acid (Geber), but as arsenic was given internally at the same time, the conclusion is not certain. The acid is, however, very efficient in allaying the itching of this affection when applied in a 2 per cent. solution, atomized or in lotion (Lailler). A mixture of 1 part of carbolic acid and 2 or 3 of glycerin has been advantageously applied several times a day by means of a mop to the crusts in *ringworm of the scalp* (A. Smith). The cure of alarming symptoms produced by the *sting of a bee* has been attributed to the hypodermic injection of 5 milligrams of this acid in solution (Klamann). A weak solution of the acid forms a suitable lotion for diphtherial and other forms of *sore throat* attended with fetid discharges. Like creasote, it is an efficient palliative for *toothache* due to an exposed nerve-pulp. Idiopathic *sciatica* and some other neuralgic and rheumatic pains are said by Schrumpf to have been cured by deep injections of from 1 to 3 per cent. solutions of this acid (*Med. News*, xlii. 386). It is known that similar injections of pure water have been followed by a like result. Kurz used this method for muscular *rheumatism* (*Med. Record*, xxiii. 208), but, we must believe, without necessity, considering the many ways in which this affection may be cured.

The power of the acid to check fermentation has led to its use in the treatment of *saccharine diabetes*, on the supposition that the disease is due to an increase of the ferment, which in the liver converts amyloid substance into sugar. The suggestion does not appear to have led to any confirmation of its value. It may be mentioned, only to condemn it, that carbolic acid has been administered as an antipyretic by Desplats.

The *dose* of carbolic acid is 1 or 2 grains or drops (Gm. 0.06–0.13). An atomized inhalation may be used, consisting of 2 or 3 drops of the acid in an ounce of water (Gm. 0.10–0.20 in Gm. 32) to which a little glycerin has been added. For a gargle, about 20 drops of the acid in from 2 to 4 fluidounces (Gm. 60–120) of water and glycerin may be employed. In the following solution the odor of the carbolic acid is masked: carbolic acid, 1 part; oil of lemon, 3 parts; alcohol, 100 parts. A preparation known as carbolized cotton is used as a surgical dressing.

Carbolic acid water (*U. S. P.* 1870) was intended to furnish a perfect solution of carbolic acid of determinate strength. 1 pint of it contained about 2 fluidrachms of the acid, and it was given internally in the dose of from ½ a fluidrachm to 1 fluidrachm (Gm. 2–4). It is a convenient preparation for use in atomization, as a gargle, and as a wash in various cutaneous diseases.

CRESYLIC ACID has been used successfully to mitigate the paroxysms of *whooping cough*, when its vapors were diffused through the chambers occupied by the patients (Merritt, *Med. Record*, xvi. 549).

ACIDUM CARBONICUM.—CARBONIC ACID.

Carbonic anhydride, *Carbon dioxide*, E.; *Acide carbonique*, Fr.; *Kohlensäure*, G.
Formula $CO_2 = OCO$. Molecular weight 44.

Formation and Preparation.—Carbonic acid gas, as it exists in certain mineral waters, was regarded by Libavius (1597) as a very volatile spirit. In the following century Van Helmont distinguished it and other irrespirable gases from atmospheric air as "spiritus sylvestris" or "gas sylvestre." In the beginning of the eighteenth century F. Hoffmann recognized the acid character of carbonic acid in mineral waters, and called it "spiritus mineralis." Joseph Black (1755) observed that this "fixed air" combines with alkalies and earths and increases their weight. Lavoisier (1775) proved this gas to be composed of carbon and oxygen.

Carbonic acid gas is a regular constituent of the atmosphere, in which it is present to the extent of .04 or .05 per cent. by volume or about .06 per cent. by weight. In certain localities it issues from fissures in considerable quantity; it is a product of respiration of animal life and of alcoholic fermentation, exists in combination in many minerals, and is formed on the complete combustion of carbon or organic compounds in the presence of an excess of oxygen; diamond and graphite require a high heat for their combustion. Many organic compounds are readily oxidized at the ordinary temperature by chromic or permanganic acid, with the production of carbonic acid gas. But the best sources for preparing carbonic acid in a pure state are whiting, marble-dust, or similar native carbonates, which are decomposed by dilute sulphuric acid in an apparatus provided with a stirrer to prevent the sulphate of calcium formed from enveloping the undecomposed carbonate. On a small scale, and for obtaining a uniform current of carbonic acid gas, fragments of marble and diluted hydrochloric acid are used, whereby calcium chloride is formed, together with some water, and remains in solution. $CaCO_3 + 2HCl$ yields $CaCl_2 + H_2O + CO_2$. Should the gas possess a disagreeable odor, it may be deprived of it, according to Stenhouse, by passing it over granular charcoal, or, according to Hager (1868), by conducting it successively through solutions of ferric sulphate, sodium carbonate, permanganate of potassium, and water, by which treatment it is freed from sulphuretted hydrogen and hydrocarbons.

A cheap source of carbonic acid is sodium bicarbonate, which yields about half its weight of the gas, and when decomposed by sulphuric acid gradually added will, in addition, produce 15 parts of crystallized sodium sulphate for every 4 parts of the bicarbonate used.

Properties.—Carbonic acid—or, more properly, carbonic anhydride—is a colorless, uninflammable gas, which has a slight pungent odor and pricking acidulous taste, colors moist litmus-paper transiently red, and does not support combustion. It is heavier than atmospheric air, its specific gravity at 0° C. being 1.524 as compared with atmospheric air, and 1 liter of it weighing 1.967 Gm. By pressure it is converted into a very mobile colorless liquid, which is lighter than water, and on the removal of the pressure boils rapidly, and is partly converted into white flakes of solid carbonic anhydride. It dissolves at 15° C. (59° F.) in an equal volume of water, and is more soluble in alcohol, absolute alcohol of 15° C. dissolving 3 volumes of the gas, which is partly expelled on dilution with water. It unites with most of the basic hydrates, forming salts which, with the exception of the alkaline carbonates, are insoluble in water, but dissolve to a slight extent in carbonic acid water and are decomposed by all mineral and most organic acids. Carbonic acid is bibasic; all the acid carbonates (bicarbonates) are decomposed by heat, carbonic anhydride being evolved.

Pharmaceutical Uses.—In pharmacy carbonic anhydride is almost exclusively employed in the preparation of carbonic acid water.

Aqua acidi carbonici, U. S. 1870; *Aqua acidula simplicior*, F. Cod.; *Aqua carbonica; Carbonic acid water*, E.; *Eau gazeuse simple*, Fr.; *Kohlensäure-Wasser*, *Brausewasser*, G.

This water is very extensively prepared in the United States and sold under the names of *soda-water* and *mineral-water*. Several apparatus have been constructed and patented for the convenient preparation of carbonic acid gas and for charging the water with this gas under pressure. They consist of a generator, a strong copper vessel into which the powdered marble, whiting, or sodium bicarbonate is introduced with some water, and which connects with another copper vessel containing the sulphuric acid, which is admitted in small quantities. The gas is first passed through a vessel containing water, to deprive it of impurities, and then to the bottom of the fountain, as the receiving vessel is called, containing the requisite quantity of water. The fountains are made either of cast iron, well protected on the inside by enamel, or of copper lined with block-tin; or stoneware fountains, secured by iron bands, are employed. The water, which is usually charged with from eight to ten times its volume of carbonic acid gas, is drawn off through block-tin pipes, which pass through a chamber containing ice.

Carbonic acid water has an agreeable acidulous and refreshing taste, and effervesces strongly. It produces white precipitates with lime- and baryta-water, and acts upon iron, lead, and copper, which metals are gradually dissolved; tin and silver are less affected; hence the importance of preventing the water from coming in contact with other metals except the last two mentioned. It should not be discolored by sulphuretted hydrogen or ammonia, and yields no precipitate with sulphate of sodium or with ferrocyanide of potassium.

Medical History.—The ancient practice of burning aromatic herbs, and conveying the fumes by means of tubes and appropriate apparatus into the vagina, is, in reality, an example of treatment by carbonic acid, for this gas is the chief product of the combustion of such substances. It is probable that from a remote period the anti-emetic action of natural mineral waters impregnated with carbonic acid was recognized. It is certain that more than two hundred years ago the effervescing draught of Riverius, which owes its virtues chiefly to this gas, was used for the same purpose, and so continues to be employed at the present time. After Priestley had isolated the gas, it was speedily introduced into medicine by the English physicians of the last quarter of the eighteenth century as a remedy for the low forms of fever called "putrid," and its use to check or prevent vomiting became general. It was also extensively employed by inhalation, and, like other new medicines, was proclaimed by zealous and incautious physicians to be a specific for nearly every disease, including pulmonary consumption.

Physiological Action.—*On Animals:* Dogs obliged to breathe a mixture of 1 part of carbonic acid with 9 parts of atmospheric air are thrown into an anæsthetic sleep, which leaves no ill effects behind; when the proportion of the former gas is increased to one-fifth, one-fourth, or one-third, the effects are more marked, muscular resolution is more complete, and when the largest proportion is used the blood in the arteries assumes a dull hue. When the gases are given in equal proportions, and until death ensues, the animal urinates, its pulse grows frequent, the breathing labored, and the surface of a wound livid; after which the respiration fails, the heart beats feebly, and complete muscular relaxation, interrupted by slight spasms, precedes death. The blood is found very dark; the heart contains but little of it, and without clots; the lungs are engorged; the bronchia are filled with bloody froth, and their vesicular structure presents many apoplectic infarctions. Finally, when the proportion of carbonic acid to air is as 3 to 1, the first effect is convulsion, followed by complete anæsthesia even of exposed nervous trunks, and slowness of the pulse; yet, if the inhalation is not continued, the animal revives. If, on the other hand, it is urged to a fatal result, death occurs as in the previous experiment, and the same lesions are found, except that the heart as well as the lungs is gorged with blood (Demarquay). It would appear that the gas has no direct influence upon the blood, and that the dark color acquired by this fluid is due to an arrest of respiration depending upon the action of the gas upon the brain and medulla oblongata. When it is slowly administered, and death is thereby retarded, the temperature of the body falls, and sugar is found in the urine. The respiration of pure carbonic acid is impossible, since an exchange of gases, which is the essence of the respiratory act, can no more take place in this gas than it can in water, and death by asphyxia is the immediate result.

On Man: Sufficiently diluted with atmospheric air, carbonic acid gas is more or less respirable. In the proportion of one-half or more its inhalation causes a prickling in the nostrils and larynx more agreeable than otherwise, together with a sense of constriction and oppression in the chest, headache, giddiness, and ringing in the ears, followed by unconsciousness, dilatation of the pupils, sometimes congestion of the face, and, if relief be not at hand, fatal congestion of the brain. Even when the proportion of the gas is smaller, it causes more or less giddiness, constriction of the præcordia, and feebleness of the legs; the pulse, which at first is fuller and stronger, becomes feebler, the respiration is slow and shallow, and the mind and senses are more or less confused. In moderate or medicinal portions the primary action of the gas is sensibly stimulant, but secondarily it inclines to repose and sleep. In such experiments on man no evidence has been given of the anæsthetic influence of the gas, and it is probably not developed until a state of dangerous narcotism is induced. Some cases of death are recorded from the emanations of certain fissures, like the Grotto del Cane. In the case of a young man who died in this manner in the Grotto of Pyrmont the appearance of the corpse was that of a person in natural sleep. There was no congestion of the face, the pupils were dilated and the cornea brilliant; the brain was deeply congested, the lungs distended and not engorged; the jugular veins were also distended, but the heart contained very little blood. These conditions are as opposite as possible to those induced by asphyxia by the fumes of charcoal, and do not perfectly harmonize with those produced in animals, as described above. When the body except the head is immersed in a vessel of this gas, a sense of heat and prickling is experienced over the entire surface, but especially where the integument is delicate, and is accompanied with perspiration and redness. The pulse, according to some, is quickened, according to others is retarded. If the operation is sustained for half an hour, the head throbs and the senses are dulled; the respiration is labored, and borborygmi and colic occur. When a limb is exposed for some time to the action of the gas, the sensibility of the skin is obtunded; and if the exposed surface is a wound, it becomes the seat of smarting pain, followed by impaired sensibility, but the tissues grow redder. Brown-Séquard has shown that in animals the sensibility and reflex excitability of the larynx can be completely obtunded by this gas. Water impregnated with it causes a prickling sensation in the mouth, fauces, and nostrils, a sense of warmth in the stomach, and a transient cerebral excitement. It also appears to quench thirst far better than water alone. The gas liberated in the stomach is mainly discharged by eructation, but it seems to stimulate the gastric secretions and promote digestion. Habitually used, carbonated water becomes laxative. It also increases the urine, and is said to augment the oxalates and carbonates in that secretion.

Medical Uses.—The administration of carbonic acid gas by inhalation was at one time in vogue as a remedy for pulmonary *phthisis*, *chronic bronchitis*, and *laryngeal diseases*. Many leading English physicians vouched for its efficacy, and very possibly it may have palliated the cough and lessened the secretions in these affections; but much more efficient remedies have supplanted it. The same remark may be made respecting *asthma*. One of the most useful internal applications of this gas is to allay *vomiting* caused by irritability of the stomach. It often subdues this symptom promptly when given in the effervescing draught, in plain carbonated water, in champagne wine, or in still and dry white wines mixed with such water. The liquid should always be cold, and, if possible, iced. Several cases of *intestinal obstruction*, the precise nature of which does not appear, have been relieved by allowing carbonic acid water to escape from a siphon bottle through a long tube into the bowel. In one case relief was obtained by injecting successively the two ingredients of a "soda-powder" in solution, and in another by allowing the contents of a "siphon-bottle" of carbonated water to escape into the bowel (*Med. News*, xl. 597).

The most important uses of carbonic acid are those in which it is applied in water as a local stimulant. There can be no doubt that in its combined stimulant and anæsthetic properties reside the virtues which have long been recognized in the yeast poultice and other fermenting cataplasms applied to *ulcers*, simple, cancerous, etc. Injections of carbonated water have been found to afford great relief in many cases of *cancer* of the uterus, rectum, and other parts; and a similar result has been obtained by maintaining a current of the gas in contact with the uterus in ulcerated states of that organ, and also in certain cases of uterine *leucorrhœa*, *dysmenorrhœa*, *amenorrhœa*, etc. The carbonic acid gas douche has also been successfully employed to induce *premature labor*. Whether it be owing to a stimulant action or to a slightly anæsthetic influence, carbonic acid water certainly aids in causing the stomach to retain what it might otherwise reject, as is shown in the familiar and popular habit of using it as a vehicle for magnesia and various saline medicines, and in febrile and other diseases attended with *nausea* or *vomiting*. It possibly promotes the diaphoretic action of the effervescing draught, and is perhaps more diuretic than simple water. Taken with the food, it forms one of the most efficient remedies for *flatulence*.

The treatment of poisoning by this gas consists in measures adapted to expel it from the lungs, to stimulate the nervous system, and to introduce atmospheric air or oxygen in its place. For the first purpose artificial respiration by mechanical and electrical means is indicated; for the second, active stimulation of the skin mechanically by warmth and by irritants, and the injection of a strong infusion of coffee into the rectum; if any oxygen gas can be procured, it may be forced through a laryngeal tube into the lungs.

ACIDUM CHROMICUM, *U. S., Br., P. G.*—CHROMIC ACID.

Chromic anhydride, E.; *Acide chromique*, Fr.; *Chromsäure*, G.
Formula CrO_3. Molecular weight 100.4.

Preparation.—This acid was discovered by Vauquelin (1797). Its preparation by means of sulphuric acid was first suggested by Fritzsche (1839), and is conveniently accomplished, according to Warrington, by pouring 3 measures of concentrated sulphuric acid into 2 measures of a cold saturated solution of bichromate of potassium in water, the reaction occurring as follows: $K_2Cr_2O_7 + 2H_2SO_4 = 2CrO_3 + 2KHSO_4 + H_2O$. More economical is the process of Bolley, modified by Traube (1848), which is as follows: 2 parts of potassium bichromate are dissolved with the aid of heat in 7 parts of sulphuric acid and 5 parts of water; the solution is set aside for a day, decanted from the crystals of acid potassium sulphate, and mixed with 8 parts of sulphuric acid. The French Codex gives the following directions: Dissolve, with the aid of heat, 1 part of bichromate of potassium in 10 parts of water; allow the solution to cool to 25° C. (77° F.), and add in small portions and with continued stirring 20 parts of sulphuric acid, spec. grav. 1.84; set the mixture aside for 24 hours, and then decant the liquid. Collect the crystals in a glass funnel, the neck of which is imperfectly closed with fragments of glass; drain and finally dry the acid by keeping it for two days upon porous tiles in a drying closet at 35° C. (95° F.). Bunsen (1868) employs 1 part of the bichromate and 10 parts each of water and sulphuric acid; the crystals are collected upon a filter of asbestos or pumice-stone in a cylindrical vessel, and are washed, under an air-pump, with nitric acid, which must be free from lower oxides, until free from adhering sulphuric acid. In 1881 the United States imported 124 pounds of chromic acid.

Properties.—Thus obtained, it occurs in needles or quadrangular prisms of a deep crimson-red color, inodorous, deliquescent, and very soluble in water; the concentrated solution is of a red-brown color, which changes to orange-yellow on being diluted; the dilute solution reddens blue litmus-paper and bleaches it on drying. Gradually heated, the crystals assume a blackish-brown color, and at a temperature of 180° to 190° C. (356° to 374° F.) fuse into a reddish-brown liquid, which on cooling becomes a dark-red, opaque, brittle mass. At about 250° C. (482° F.) the acid is decomposed into oxygen and dark-green chromic oxide. If strong alcohol is dropped upon the acid, a vigorous action takes place, accompanied with increase of temperature and ignition of the alcohol. A rapid ignition is likewise observed with benzol; but ether which is free from both alcohol and water dissolves this compound, and on spontaneous evaporation yields it again in minute crystals. Chromic acid dissolved in diluted alcohol is gradually deoxidized at the ordinary temperature, the alcohol being converted into aldehyd and acetic acid. Reduction takes place also in the presence of arsenious, sulphurous, and hydrosulphuric acids, and of organic compounds and deoxidizing agents generally. When heated with hydrochloric acid, chlorine and green chromic chloride are produced.

Chromic acid contains no water of crystallization; its salts have mostly a yellow or yellowish-red color; those of the alkalies and of magnesium are soluble in water; all others dissolve in nitric acid.

Tests.—Sulphuric acid and potassium salts are usually present in small quantity. The former is detected by adding to its hot aqueous solution some hydrochloric acid, deoxidizing with alcohol until the liquid becomes green, and then adding chloride of barium, when a white precipitate will be produced; the latter, by concentrating the green solution as much as possible, and adding a concentrated solution of tartaric acid, when crystalline bitartrate of potassium will be separated; or the chromic acid is, by ignition, converted into chromic oxide, and this is treated with water, which will dissolve potassium sulphate and chromate if present. The Pharmacopœia disregards the presence of the salts, and directs testing for sulphuric acid by barium chloride in a 1 per cent. solution of chromic acid strongly acidulated with hydrochloric acid, when merely a white turbidity should be produced.

Allied Acid.—Acidum perosmicum s. osmicum; Osmic acid, osmium tetroxide, OsO_4; mol. weight, 262.5. It is formed on heating metallic osmium in a current of oxygen, and is obtained in the preparation of iridium and allied metals as a by-product, to be purified by fractional distillation. The sublimed oxide is in colorless, glossy needles; after fusion it is a white, translucent, crystalline mass, which is pliable at about 38° C. (100° F.) and near the boiling-point of water melts and volatilizes without decomposition; at ordinary temperatures it sublimes slowly. It has a powerfully pungent and irritating odor, somewhat resembling that of chlorine, and a caustic taste. It dissolves slowly, but in considerable proportion, in water, forming a colorless acid solution, which by sulphurous acid is colored yellow, then red, green, and finally blue; the solutions in alkalies are orange-red, and on heating give off oxygen and osmium tetroxide, leaving an alkali osmite. It liberates iodine from iodides, is reduced from its solution by silver and other metals, and oxidizes organic compounds.

Pharmaceutical Uses.—In prescription chromic acid should never be combined with organic or deoxidizing mineral compounds. In liquid form it should be dissolved in distilled water. The *solution* of the French Codex is made of equal parts of chromic acid and distilled water, and has a specific gravity of 1.47.

Liquor acidi chromici, *Br.*—Chromic acid 1 part; distilled water 3 fluid parts. Spec. grav. 1.185.

Physiological Action.—Chromic acid is one of the most energetic of caustics. At a moderately high temperature it rapidly dissolves all animal tissues immersed in it, including even hair, bones, and teeth. When at ordinary temperatures it is applied to the skin, it renders that tissue moist, and then brown, and finally black, forming an eschar of 1 or 2 lines in thickness, which separates within 48 hours, leaving a granulating surface which tends to heal rapidly. According to the degree of its concentration it may be deeply or superficially caustic, or merely astringent and drying. When pure it is said not to be severely painful, but it becomes so when it is contaminated with sulphuric acid or arsenic.

Medical Uses.—Among caustics none is superior or even equal to chromic acid for the purpose of removing certain excrescences from the skin and the mucous membranes. *Condylomata*, *warty* growths, especially such as occupy a considerable surface, *vegetations* of the genital (and especially of the female genital) organs, are promptly destroyed by a solution of 1 part of it to 1 of water, and with far less pain than is inflicted by caustic potassa. Chromic acid is one of the best applications that can be made to the *gums* when they tend to ulceration and retraction in scrofulous patients and after mercurial salivation, as well as to scrofulous and syphilitic ulcers of the *pharynx* and the mouth. Similar affections of the interior of the *larynx*, œdema of this organ, and especially tumors of the vocal cords and adjacent parts, have been cured by skilful cauterization with chromic acid, aided by the laryngoscope. A mild solution may at first be used, but subsequently one containing 1 part of the acid to 8 of water, or even of twice that strength, may be applied by means of a small, fine, and compact piece of sponge. The solution of 10 grains of chromic acid in an ounce of water, recommended by Paget for ulceration of the *tongue*, has been similarly applied, and with striking success, to secondary syphilitic affections of the organ (ulcers, mucous tubercles, condylomata), but fails in the tertiary lesions. Various chronic affections of the skin, as *tineæ*, *sycosis*, and *lupus*, are appropriate for its use. It is an efficient remedy for *condylomata*. Its prompt and powerful action renders it one of the best applications for arresting surface *hæmorrhage*, and in a diluted state it is a valuable stimulant for indolent *ulcers*. Syphilitic and even tuberculous ulcers of the *pharynx* have been treated in this manner; and so has granular inflammation of this part, and *conjunctivitis* of a similar character. Uterine *hæmorrhage*, depending upon laxity of the tissues of the organ, has been successfully treated by the insufflation of a few drops of the acid. In the treatment of *uterine leucorrhœa* no other caustic is more efficient than this; but it should be introduced very cautiously by means of a syringe having a lateral opening near the end of its tube, and the superfluous liquid should be withdrawn when the syringe is removed. The previous dilatation of the neck of the uterus facilitates the operation and the cure. If the acid is too strong, it may give rise to permanent stricture of the canal of the cervix. This tendency to contraction of the tissues to which it is applied has sometimes been taken advantage of to relieve *incon-*

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tinence of urine in the female due to relaxation of the urethra. When this infirmity is connected with *irritable tumor* of the urethra, the acid will sometimes prevent the necessity of employing cutting instruments. In applying this powerful caustic in a concentrated state—the deliquescent crystals, for instance—great care should be taken to protect the adjacent sound tissues by means of adhesive plaster or a simple ointment. and all superfluous acid should be immediately removed with a pledget of moist lint. The pure acid should be applied by means of a wooden, glass, or porcelain rod or spatula. Diluted solutions may be used with a camel's-hair brush, which immediately afterward should be well washed with water. Chromic acid ought not be dissolved in glycerin, for if the mixture be made rapidly ignition occurs with explosion.

Osmic acid was used by Winiwarter in a 1 per cent. solution as an injection into a large *sarcomatous tumor* seated upon the neck. About 3 drops of the solution were injected daily for a fortnight, and at the end of that time the substance of the tumor had broken down and was evacuated. Similar treatment with like results was successful in other cases (*Med. News*, xlii. 495). But the same treatment when employed by Pfeilsticker entirely failed, and by causing adhesion of the tumors to adjacent parts rendered their subsequent removal by an operation more difficult (*Med. Record*, xxiv. 159).

ACIDUM CITRICUM, *U. S., Br., P. G.*—Citric Acid.

Acidum citri s. limonum s. limonorum.—Acide citrique, Acide du citron, Fr.; *Citronensäure*, G.

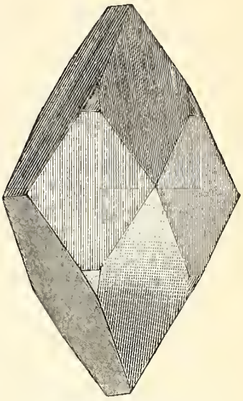
Formula $H_2O.H_3C_6H_5O_7 = C_3H_4(OH)(COOH)_3.H_2O$. Molecular weight 210.

Origin.—The acid properties of lemon-juice were observed at an early period, but the distinction of the acid from other vegetable acids was not recognized until Retzius (1776) proved it to differ both from tartaric and acetic acids. Scheele (1784) obtained citric acid in crystals. It was prepared artificially in 1880 by Grimaux and Adam from glycerin, and perhaps also by Andreoni and Kekulé from malic acid. Citric acid occurs in a large number of plants, either in the free state or combined with potassium or calcium, and frequently associated with malic acid. It has been found in the rhizomes of Asarum europæum and Sanguinaria canadensis, in the tubers of dahlia and Jerusalem artichoke, in the herb of lactuca and tobacco, and in many fruits, such as capsicums, tomatoes, tamarinds, cherries, gooseberries, raspberries, whortleberries, cranberries, blackberries, strawberries, etc. It occurs most abundantly, however, and as free acid, in the fruits of the Aurantiaceæ, and is prepared in large quantity from the juice of the lemon and the lime.

Preparation.—Citric acid is manufactured in England on a large scale from lemon- and lime-juice, which are obtained from Italy. The juice is exported, either in its natural condition or considerably concentrated by evaporation, or else in the form of a crystalline powder as citrate of calcium or magnesium. Recently, Messrs. Powers & Weightman have undertaken to prepare it in this country from sour oranges raised in Florida. The juice is clarified by ebullition, or, if obtained from unsound fruits, by allowing it to undergo the vinous fermentation. After decantation and straining an excess of chalk (carbonate of calcium) is added, and finally some milk of lime. The citrate of calcium thus formed being less soluble in hot than in cold water, the mixture is heated to boiling, and while hot the clear liquid is drawn off from the precipitated citrate of calcium, which is washed with boiling water for the purpose of removing all the extractive matter. The calcium citrate is now decomposed by diluted sulphuric acid in such a proportion as to form sulphate of calcium and to leave a little sulphuric acid in excess. 10 parts of citrate of calcium require about 9 parts of sulphuric acid diluted with from 50 to 60 parts of water. The solution of citric acid is drawn off from the precipitated sulphate of calcium, and the latter washed with very cold or with boiling water, in which gypsum is less soluble than in water of a medium temperature. The liquid, with the washings, is evaporated by steam-heat to a syrupy consistence, and then allowed to crystallize in suitable tanks lined with lead. The presence of a little sulphuric acid appears to favor crystallization, which is prevented or considerably retarded by acid citrate of calcium. The crystals are redissolved in a small quantity of water, and the solution is treated with animal charcoal, and then evaporated to crystallize. These directions agree in the main with those given in the British Pharmacopœia. Citric acid may be prepared by this process from the juice of other acidulous fruits; Græger (1873) described the manipulations necessary to obtain it advantageously from whortleberries. The importations of citric acid amounted in 1867 to nearly 83,000 pounds, and at present average about 33,000 pounds annually.

Properties.—Citric acid crystallizes in colorless rhombic prisms which have an agreeable acid taste. It dissolves in three-fourths of its weight of cold, and in half its weight of boiling, water, in 1.15 parts of 80 per cent. alcohol at 15° C. (Schiff), in 1.3 parts of absolute alcohol, and in 48 parts of pure ether (insoluble in pure ether, *Br.*). It is also soluble in methylic and amylic alcohols and glycerin, and is freely soluble in hot creasote, but insoluble in chloroform and in hydrocarbons, except in the presence of alcohol. When a solution is made by dissolving 40 grains of the crystals in 1 ounce of water, it resembles lemon-juice in strength and in the nature of its acid properties, and, like lemon-juice, it undergoes decomposition, acetic acid being among the products, and becomes mouldy by keeping. The crystals are permanent in dry air, but at a somewhat elevated temperature slowly part with their water of crystallization, and in a damp atmosphere they become moist and gradually deliquesce. They melt at 100° C. (212° F.) in their water of crystallization; the anhydrous acid fuses at 150° C. (302° F.), and at a higher heat is decomposed, evolving empyreumatic vapors of an odor resembling that of burnt sugar, and producing a bulky charcoal, which is finally burned without leaving any residue or not more than .05 per cent. of ash.—*U. S.*

Fig. 6.



Crystal of Citric Acid.

Citric acid is a tribasic acid having the formula $H_3C_6H_5O_7$, or, as met with in the crystallized condition, $H_3C_6H_5O_7 + H_2O$. The water of crystallization, amounting to 8.6 per cent., is expelled at 100° C., and at 155° C. (311° F.) another molecule of water is given off, *aconitic acid*, $H_3C_6H_3O_6$, remaining behind, which is identical with the acids that have been isolated from aconite, yarrow, and other plants. Like citric acid, it forms three series of salts, either 1, 2, or 3 atoms of hydrogen being replaceable by a basylous radical.

The citrates of the alkalies are all soluble in water; the neutral citrates of the heavy metals are mostly insoluble in water, but dissolve in nitric, and many also in citric, acid. Ferric and aluminium citrates are not precipitated by alkalies. That the calcium citrate is soluble in cold and insoluble in hot water has been already mentioned. If lime-water is not completely neutralized by solution of citric acid, no precipitate will occur until the liquid is heated to boiling. 70 grains of citric acid dissolved in distilled water are neutralized by 1000 grain-measures of the volumetric solution of soda (*Br.*), or 3.5 Gm. of the acid by 50 Ccm. of the soda solution (*U. S.*).

Impurities and Adulterations.—The impurities which may be present in citric acid in consequence of carelessness in its manufacture may be sulphuric acid, calcium, iron, lead, and copper. Minute fragments of metallic lead are occasionally observed adhering to some of the crystals. Sulphuric acid is readily detected in the aqueous solution of citric acid by the white precipitate occurring with chloride of barium; iron, by the blue color occasioned by ferrocyanide of potassium; and lead and copper, by the black coloration or precipitate resulting from sulphuretted hydrogen. For the detection of calcium it is advisable to neutralize the citric acid solution with ammonia, then to acidulate with acetic acid, and add oxalate of ammonium, when a white precipitate of oxalate of calcium will appear. Or the mineral impurities may be tested for in the ash after dissolving it in a little dilute nitric acid.

Tartaric acid is occasionally used as an adulteration, and oxalic acid and various crystallized salts are said to have been employed for the same purpose. Such frauds are usually accomplished by mixing the foreign compounds in a crystalline form with the acid, and it is therefore necessary to employ a larger quantity (say several ounces) of the large and small crystals, to be triturated in a mortar into powder. Many of the salts will be found to be insoluble in alcohol, and may thus be detected, or by the residue left on incinerating a portion of the powder upon platinum-foil. The aqueous solution of the powder is neutralized with ammonia, and then acidulated with acetic acid. Upon adding chloride of calcium, oxalic acid, if present, will be precipitated as white oxalate of calcium. The clear filtrate, neutralized with ammonia, will deposit in the cold white tartrate of calcium if tartaric acid be present, and the filtrate from it will, on boiling, throw down citrate of calcium. On dissolving some of the powder in diluted alcohol, and adding a concentrated solution of acetate of potassium, tartaric acid will yield a white crystalline precipitate of bitartrate of potassium. Oxalic acid, if present in sufficient quantity, will likewise cause a precipitate with this test. Or a number of crystals of different sizes are placed upon a glass plate in a little potassa solution, or preferably a strong solution of potassium acetate: the crystals of citric acid will remain transparent, while the crystals of tartaric acid will become opaque, in consequence of the formation of bitartrate of potassium. Cailletet (1877) observed the slow action in the cold of potassium bichromate upon citric acid, and recommends testing for tartaric acid by adding 1 Gm. of the suspected acid in powder to 10 Ccm. of a cold saturated solution of the bichromate, and stirring with a glass rod. Pure citric acid does not change the orange color of this solution in 10 minutes; but in the presence of 1 per cent. of tartaric acid the mixture will have acquired, in the time mentioned, the color of infusion of coffee, and with 5 per cent. of tartaric acid it will have become blackish-brown.

Pharmaceutical Uses.—PULVIS AD LIMONADUM. Triturate thoroughly white sugar 120 Gm., citric acid 10 Gm., oil of lemon 1 drop.—*P. G.* 1872.

Off. Prep.—Ferri et ammon. citras, Ferri et quiniæ citras, *Br.;* Ferri pyrophosphas, *U. S.;* Liquor ammonii citr., Liq. bismuthi et ammon. citr., *Br.;* Liq. ferri citr., Liq. potass. citr., *U. S.;* Liq. magnes. citr., Lith. citras, Potass. citras, *U. S.*, *Br.;* Sodæ citro-tartras effervescens, *Br.;* Syrupus acidi citrici, *U. S.*

Physiological Action.—Experiments with citric acid on cats, rabbits, and other animals illustrate the necessity of caution in founding opinions upon such grounds exclusively. To these creatures citric acid is a powerful poison, lowering sensibility and the heart's force and producing violent tetanic spasms. That these phenomena are not occasioned by gastric irritation is proved by the absence after death of all inflammatory lesions of the stomach. The blood appears to have been unusually liquid. In man, on the other hand, not only are no spasmodic or other alarming symptoms produced by citric acid, but it does not diminish the coagulability of the blood; so far from this, indeed, in the form of lemon-juice it is of all agents the most efficient in correcting that incoagulability of the blood which is characteristic of scurvy. When largely administered it increases the acidity of the urine, causing a deposit of free uric acid. According to Langfeldt, 1 part of this acid in 2000 parts of water is sufficient to destroy all the animalculæ in the liquid that are not protected by a thick epithelial covering. Citric acid used habitually is very apt to corrode the teeth.

Medical Uses.—The most useful application of lemon-juice and citric acid is to prevent and cure *scurvy*, a purpose which long and extensive experience has proved them admirably fitted to fulfil. Of the two, lemon-juice is by far the most efficacious, and the opinion that its efficiency is not due to the acid alone is shown not only by this comparison, but also by the well-known fact that many fresh vegetables are endowed with a similar power. The use of lemon-juice in the treatment of acute articular *rheumatism* was at one time confidently relied on, but is no longer in vogue, and the article is employed only as a means of assuaging the thirst and reducing the febrile heat in that disease, as well as in various other diseases of which *fever* is a prominent symptom. A physician has gone so far as to assert that if a fresh lemon is cut into pieces and boiled in 3 cups of water until reduced to one-third, the strained liquor will cure malarial affections as well as quinine, or still better (*Bull. de thérap*, ev. 76). Such credulity is worthier of the infancy of medicine than of the nineteenth century. Citric acid may be used with some advantage during *hæmorrhage*, but its direct effect upon this symptom is slight, indeed, when compared with that of the mineral acids. The practice of arresting post-partum hæmorrhage by squeezing out the juice of a cut lemon within the cavity of the uterus deserves attention, less from the coagulating action of the acid than from the stimulation exerted by it upon the interior of the womb, which is at the same time mechanically irritated. Lemon-juice is of some advantage in *jaundice* depending upon congestion of the liver, and may be employed as an antidote to alkaline and narcotic poisons. It forms an agreeable application in *diphtheritic angina* and in *gangrenous sore mouth*, and has been used with striking advantage to relieve *pruritus* of the genital organs.

ACIDUM FORMICICUM, *P. G.*—FORMIC ACID.

Acidum formicarum s. formicum.—*Acide formique*, Fr.; *Ameisensäure*, G.
Formula $HCHO_2 = HCOOH$. Molecular weight 46.

Origin and Preparation.—In the beginning of the sixteenth century Otto Brunfels observed the acid reaction upon blue vegetable colors of the air in the nest of the wood-ant (Formica rufa, *Linné*). By distilling ants John Wray (1670) obtained an acid liquid possessing properties similar to those of vinegar. Andrew Marggraf (1749) proved this acid to be not identical with acetic acid. Scheele (1774) obtained the acid artificially from gum and sugar, but considered it to be acetic acid, a view disproved by Doebereiner (1822).

Formic acid is found in ants, in some caterpillars, old oil of turpentine, nettles and other plants, and is formed by the oxidation of methylic alcohol; by the action of black oxide of manganese and sulphuric acid or of chlorinated lime upon sugar, starch, and other carbohydrates and allied compounds; by the decomposition of chloral hydrate and of chloroform by means of potassa; and by other reactions. Lorin (1865) observed that in the presence of glycerin and a little water oxalic acid is readily decomposed into formic acid and carbonic acid gas; $C_2H_2O_4$ yields $CH_2O_2 + CO_2$. Berthelot prepares it by heating in a retort 10 parts each of oxalic acid and glycerin and 1 or 2 parts of water to a little over 100° C. (212° F.); the oxalic acid is preferably added in portions of 2 or 3 parts. After about 12 hours the decomposition is complete, and the contents of the retort are repeatedly diluted with 5 parts of water and distilled; the residue in the retort is preserved for a future operation, while the distillate is neutralized with sodium carbonate and evaporated to dryness by means of a water-bath; 100 parts of dry sodium formate require 75 to 76 parts of sulphuric acid for decomposition, which may be diluted with water according to the strength of formic acid desired; the latter is obtained by distillation.

Properties.—Anhydrous formic acid is a colorless liquid of 1.235 sp. gr., crystallizing below the freezing-point of water, boiling near 99° C. (210° F.), having a pungent acid odor, and producing a burning sensation when applied to the skin. Its vapor is inflammable and burns with a blue flame. The acid is soluble in all proportions of water, alcohol, and glycerin. According to Roscoe (1862), the boiling-point of aqueous formic acid gradually rises until the temperature 107.2° C. (225° F.) is reached, when the boiling-point remains constant and the distillate contains 77.5 per cent. of formic acid. Its salts are soluble in water, and impart to solutions of ferric salts a dark brownish-red color which disappears on the addition of hydrochloric acid. When heated with solutions of the salts of mercury, silver, gold, and allied metals, these are reduced to the metallic state

The medicinal acid has the specific gravity 1.060 to 1.063, and yields with subacetate of lead a white crystalline precipitate. 10 Gm. of it neutralize 54.35 Ccm. of normal potassa solution, indicating 25 per cent. of absolute formic acid. If diluted with 5 parts of water, it should not be precipitated by silver nitrate (hydrochloric acid), nor be colored by sulphuretted hydrogen (metals), nor, after neutralization with ammonia, be precipitated by calcium chloride. On heating for 10 minutes 1 Gm. of the acid, 5 Gm. of water, and 1 Gm. of yellow mercuric oxide, the filtrate should have a neutral reaction (absence of other acids).—*P. G.*

SPIRITUS FORMICARUM, P. G. Mix alcohol 70 parts, water 26 parts, and formic acid 4 parts. It is a colorless liquid of an acid reaction, which, when mixed with one-twentieth of its weight of solution of subacetate of lead, becomes filled with feathery crystals.

AMMONII FORMIAS, NH_4CHO_2, is obtained by neutralizing the acid with ammonia and evaporating to crystallization. It is in colorless prisms of a refreshing pungent taste, fuses at about 100° C. (212° F.), and when rapidly heated to 180° C. (356° F.) is decomposed into hydrocyanic acid and water; NH_4CHO_2 yields $HCNO + 2H_2O$.

Physiological Action.—The experiments of Wolff show that formic acid is not an antiseptic, is only a feeble antifermentative, and is of no value as an antiputrid agent. Upon the skin this acid acts as an irritant and vesicant, and if its contact is prolonged it may produce a slough. Administered to rabbits, it produces inflammation of the gastro-intestinal mucous membrane and a discharge of bloody urine. 2 drachms in a pint of water occasioned excitement of the circulation, increased heat, hurried breathing, and diuresis in a horse. In man similar effects have been noted. In gouty patients it is reported to have caused a discharge of muddy and ill-smelling urine. According to Arloing, small doses of *formiate of sodium* increase the number and depth of respirations and cause irregular breathing in the dog and horse. Large doses render it rapid and shallow, and very large doses suspend it, the temperature meanwhile falling 2° or 3° C. Direct injection of a large dose of the salt into the right ventricle is followed by slower or suspended movements of the heart.

Medical Uses.—Formic acid was at one time used internally to stimulate, as ammonia is generally employed, and externally, like that irritant, for the relief of local *neuralgic* and *rheumatic* pains, etc. *Spiritus formicarum* (P. G.) is prescribed in doses of from 20 to 60 drops (Gm. 1.30–4.00). *Formiate of ammonia* has been used in chronic *paralysis* and in *epilepsy*, but uselessly. *Dose*, about 5 grains (Gm. 0.30).

ACIDUM GALLICUM, *U. S., Br.*—Gallic Acid.

Trioxybenzoic acid, Dioxysalicylic acid.—Acide gallique, Fr.; *Gallussäure*, G.
Formula $C_7H_6O_5.H_2O = C_6H_2(OH)_3.COOH$. Molecular weight 188.

Origin.—Gallic acid is found in nutgalls, sumach, uva ursi, and in a number of other astringent plants. It was for a time confounded with tannin, but its distinction from this was recognized by Scheele (1785), who obtained it in a pure state. It is most advantageously prepared from galls by Scheele's process, as modified by Pelouze and Robiquet, for which the Pharmacopœia of 1870 gave the following directions:

Preparation.—Take of Nutgall in fine powder 36 troyounces; purified Animal Charcoal and Distilled Water, each a sufficient quantity. Mix the nutgall with sufficient distilled water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient distilled water to preserve the semifluid consistence. Then submit the paste to expression, and, rejecting the expressed liquid, boil the residue in 8 pints of distilled water for a few minutes, and filter, while hot, through purified animal charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals be not sufficiently free from color, they may be purified by dissolving them in boiling distilled water, filtering through a fresh portion of purified animal charcoal, and again crystallizing.

The process of the British Pharmacopœia was, with the following modifications, essentially the same: The coarsely-powdered galls and water are exposed for 6 weeks at a temperature of between 15° and 21° C. (60° and 70° F.); the mass is then boiled with more distilled water; the crystals formed in the strained liquid are strongly pressed between bibulous paper, and then recrystallized from boiling distilled water without the use of animal charcoal.

Other processes have from time to time been suggested, the most important of which are based upon the observation of Liebig that when boiled for some time with somewhat diluted sulphuric or hydrochloric acid or for a few seconds with potassa solution, tannin is converted into gallic acid. The sulphuric-acid process is now recommended by *Br.*

The above directions are so clear that the preparation of gallic acid by them presents no difficulties, and the only additional precaution that deserves to be mentioned is the avoidance of its contact with iron and iron salts, which would impart to the acid a color difficult to remove. The conversion of the whole amount of tannin into gallic acid is readily proved by testing a small portion of the filtered liquid with solution of isinglass, which should cause no turbidity. The change takes place slowly at a low temperature; P. Weber (1880) found about 45° C. (113° F.) to be most suitable for the process given above. The yield must necessarily vary with the amount of tannin present in the galls.

Gallic acid has been obtained artificially by the action of alkalies upon diiodo-or dibromosalicylic acid (Lautemann, 1861), and upon bromdioxybenzoic or bromoprotocatechnic acid (Barth and Sennhofer, 1872).

Formation.—The conversion of tannin into gallic acid has been the subject of much controversy, involving numerous researches. It was at first supposed that gallic acid existed ready formed in galls; the experiments of Pelouze (1833) proved that most of it is formed from the tannin contained therein, and this conversion he supposed to be due to the oxidizing influence of oxygen, by which carbonic acid was eliminated. Robiquet (1837) found that the tannin of galls is converted into gallic acid without the admission of oxygen and without the evolution of gas. He ascribed this to the action of a ferment present in the galls, which was subsequently named *pectase*. Laroque's experiments (1841) supported this view. That the growth of mould upon the infusion of galls is without influence upon the production of gallic acid was proved by Winckler (1835). C. Wetherill (1847) advanced for the first time the opinion that gallic acid differs from tannin merely by containing additional water, and he was supported in this theory by the investigations of Mulder (1848). Meanwhile, Liebig had suggested that in the transformation of tannin into gallic acid a carbohydrate was liberated; and Strecker's experiments (1854) appeared to furnish conclusive proof that tannin is a glucoside, which on being boiled with diluted mineral acids yields theoretically 82.5 per cent. of gallic acid. The quantity obtained was, however, in excess of this figure, and Stenhouse, Knop, Rochleder, and others proved that gallic acid almost equalling the weight of tannin used could be thus obtained. Robiquet (1854) considered this result due to molecular change accompanied by hydration, whereby tannin is transformed into gallic acid just as cane-sugar under similar influences is transformed into grape-sugar. This view, however, did not explain why, on the treatment of tannin with diluted acids, glucose was obtained in variable quantities. Hlasiwetz (1867) suggested that it probably was not a true glucoside, owing to the difficulty with which the glucose is obtained. The relation of the two compounds to each other appears to be finally settled by the researches of H. Schiff, Sac, and J. Löwe (1871 and 1872), according to which pure tannin is *digallic acid*, an anhydride of gallic acid, the conversion of the former into the latter occurring as follows: $C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$; and the sugar observed in the preparation of gallic acid is referable to the glucose which naturally exists in galls, perhaps in combination with digallic acid, and from which tannin is with difficulty purified. Löwe prepared pure tannin from galls, and Schiff succeeded in converting gallic acid into tannin absolutely free from glucose.

Properties.—Gallic acid is in fine white or pale fawn-colored silky needles, which have a slightly acid and faint astringent taste, and are inodorous. It is soluble in 100 parts of cold and 3 parts of boiling water. The solution has an acid reaction, and gives no precipitate with ferrous sulphate. With ferric salts a bluish-black precipitate is obtained, which is easily soluble in acetic acid, and disappears on boiling. It is not precipitated by solution of gelatin or albumen except in the presence of gum, and yields no insoluble compounds with vegetable alkaloids. Gallic acid dissolves permanently in a solution of potassium citrate, to such an extent that, according to F. Long (1881), 15 grains of it, with 20 grains of the citrate, will yield a clear solution in 1 ounce of water. It dissolves at 15° C. in 2.6 parts of absolute alcohol, in 4.3 parts of 90 per cent. alcohol, and in 39 parts of pure ether (Bourgoin); it is also soluble in glycerin, and nearly insoluble in chloroform and benzin. At 100° C. (212° F.) it loses 9.5 per cent. of water of crystallization. Heated to between 200° and 215° C. (392° and 419° F.), or, according to Schiff (1879), to about 240° C. (464° F.), it melts, and then yields carbonic acid gas and a sublimate of pyrogallol $= C_6H_6O_3$, without leaving any residue.

Alkalies added to a solution of gallic acid rapidly color the liquid, which in the presence of very little potassa or soda gradually becomes green, but with an excess is at once yellow and turns red and brown; little ammonia causes a yellow, and an excess a reddish and red-brown, color. Alkaline carbonates produce similar colorations, but act less energetically; on the subsequent addition of hydrochloric acid the color is changed to red. Dudley (1879) observed that a dilute solution of ammonium picrate with excess of ammonia causes in solution of gallic acid a red color, rapidly changing to a beautiful green. Lime-water produces with gallic acid a flocculent precipitate, which turns rapidly blue and green, and is soluble in much lime-water with a pink color, and in excess of gallic acid with a brown color. Most of its salts, those with the alkalies excepted, are insoluble in water. When perfectly dry they keep unaltered, but in the presence of water, and particularly of alkaline liquids, they are speedily decomposed, becoming brown and black. Solutions of salts of silver, gold, platinum, and the allied metals are gradually reduced by gallic acid and its salts at the ordinary temperature.

Impurities and Adulterations.—Tannin is indicated in the aqueous solution of gallic acid by the white curdy precipitate produced on the addition of a solution of gelatin. Resinous substances would be insoluble in boiling water; sugar and dextrin would remain undissolved on treatment with spirit of ether; and mineral admixtures would remain behind upon heating the acid to redness.

Off. Prep.—Glycerinum (Glyceritum) acidi gallici, *U. S.*, *Br.*

Derivative of Gallic Acid.—ACIDUM PYROGALLICUM, Pyrogallol, Pyrogallic Acid, $C_6H_6O_3 = C_6H_3(OH)_3$; mol. weight 126.—On heating gallic acid to sublimation, it is decomposed into carbonic acid and pyrogallol; $C_7H_6O_5$ yields $CO_2 + C_6H_6O_3$. A cheaper method is to heat in an apparatus suitable for preparing benzoic acid (see page 34) well-dried and powdered extract of nutgall, and, if necessary, to resublime the sublimate. Pyrogallic acid is in thin, white, pearly crystals of a bitter taste, fusing at 115° C. (239° F.), boiling at 210° C. (410° F.), and decomposed at 250° C. (482° F.). It is soluble in 2½ parts of water, and dissolves also in alcohol and ether. The aqueous solution acquires a red-brown color with ferric salts, and a dark-blue color with ferrous salts.

The solutions of salts of *pyrogallic acid*, like the moist acid itself, become reddish- and dark-brown on oxidation, and readily reduce the salts of mercury, silver, gold, and platinum. The acid is used in connection with silver nitrate in photography, and for hair-dyes and marking-inks. Stains produced by this acid on linen are best removed by washing with alcoholic solution of oxalic acid and exposure to the sun.

Medical Action and Uses.—Although gallic acid does not display any astringency in its taste or in its application to raw or bleeding surfaces, it certainly exerts a powerful control over all forms of passive hæmorrhage when taken internally, as well as upon several of the secretions, and notably upon the urine and the sweat. Unlike tannic acid, it has no constipating effect upon the bowels. It is perhaps the first in value of the medicines used in *menorrhagia.* It should be given between the periods as well as during the flow, and in doses of from 10 to 20 grains a day, in pilular form. Of similar affections in which it is useful may be mentioned *purpura*, *epistaxis*, *hæmoptysis*, *hæmatemesis*, *hæmaturia*, and *intestinal hæmorrhage.* To the inordinate secretions which this acid tends to control belong *night-sweats* and other forms of profuse perspiration, and excessive secretion of urine in *polyuria* and in *Bright's disease.* Its influence in the last-named affection is often very prompt and salutary, since it not only reduces the total discharge of urine, but in a still larger proportion the loss of albumen. It is very efficient in correcting *pyrosis*, an annoying symptom of various dyspeptic conditions. Locally, it has been used in an ointment for the treatment of *alopecia.* The *dose* of gallic acid is from 5 to 20 grains (Gm. 0.30–1.20), repeated several times a day according to the urgency of the case. The glycerite is a convenient form for administering it.

Pyrogallic acid may act as an intense poison. Thus, in a case in which it was made into an ointment and rubbed freely into and bound upon the skin of a patient with psoriasis, it occasioned death in collapse, preceded by mucous vomiting and diarrhœa, rigors followed by fever, black and acid urine containing an abundance of globulin, and under the microscope the red corpuscles were found disorganized. Similar results were observed in experiments on animals by Neisser, who cautions those who may use the acid against corresponding dangers (*Zeitschrift f. klin. Med.*, i. 88). Besnier refers to four cases of psoriasis in which this acid produced toxical effects, and two ended fatally (*Med. News*, xlii. 128). In some experiments upon dogs and rabbits with this acid changes are said to have been found in the liver identical with those produced by phosphorus poisoning (E. Rousseau, *Inaug. Thesis.* Univ. of Penna., 1880).

Pyrogallic acid has been used with the best results, and without accident, in about 200 cases of *psoriasis* by Jarisch, and in a considerable number of these the application was made over a large portion of the body. It should not be applied too profusely to the diseased patches, and not at all to the sound skin (*Zeitschrift f. klin. Med.*, i. 631.). An ointment made with lard or with vaseline containing 10 per cent. of the acid was employed. But neither this nor any other topical application can effect a permanent cure of psoriasis, which is only the external and local manifestation of a systemic disease. It, however, stands hardly second to crysophanic acid as a remedy for psoriasis. It does not stain the hair or inflame the skin so much, although it colors the skin brown. It has the advantage, also, of being inodorous. Vidal used successfully in the treatment of phagedenic *syphilitic* ulcers an ointment made with 1 part of the acid to 5 of vaseline, and 1 part each of acid and of starch to 3 of vaseline. His results have been confirmed by Lermoyez and Hitier (*Bull. de thérap.*, c. 403). In *lupus* the ointment is said to attack the diseased nodules only, causing them to become necrosed and fall out, while the adjacent skin is not injured. In *epithelioma* the mode of action is the same in kind, but is slower and less complete (Jarisch, *Centralblatt f. Therapie*, i. 17).

ACIDUM HYDRIODICUM.—Hydriodic Acid.

Acidum iodhydricum.—Acide iodhydrique, Fr.; *Jodwasserstoffsäure*, G.
Formula HI. Molecular weight 127.6.

Origin.—Clement and Desormes (1813) recognized this acid, which was more fully investigated in the same year by Gay-Lussac. It is formed on the decomposition of metallic iodides by means of acids; on the ignition of a mixture of hydrogen and iodine vapors; and on the action of iodine upon various hydrogen compounds, or upon oxidizable bodies, like phosphorus and its lower oxides, arsenious acid, etc., in the presence of water.

Preparation.—As formerly officinal in the U. S. Pharmacopœia, it was prepared of such strength that 6 fluidounces contained the hydriodic acid from 480 grains of iodine. The process adopted was the one originally suggested by Gay-Lussac, modified by Le Royer and Dumas, according to which 30 grains of iodine are mixed with 5 fluidounces of water, and sulphuretted hydrogen is passed into the mixture until the color of iodine has disappeared. More iodine is now dissolved in the liquid, again sulphuretted hydrogen is passed into it until it is decolorized, and this process is repeated until all the iodine has been used. The liquid is then boiled until the odor of sulphuretted hydrogen is no longer perceived, filtered from the sulphur, and the filter washed with distilled water until the filtrate measures 6 fluidounces. It contains about 15 per cent. HI.

In the presence of water, iodine and sulphuretted hydrogen react with each other, the hydrogen uniting with the former, liberating sulphur; $2I_2 + 2H_2S$ yields $4HI + S_2$. The sulphur separates as a fine powder, which would cover the iodine and prevent the further reaction; to obviate this difficulty, a small quantity is first converted into hydriodic acid, which is a good solvent for iodine, and, with proper management, no iodine will be lost by remaining enveloped by the sulphur.

The process recommended by Buchanan (1837) consisted in dissolving 264 grains of tartaric acid and 330 grains of potassium iodide, each in 1½ fluidounces of water, mixing and cooling the solutions, agitating for some time, straining from the precipitated bitartrate of potassium, and diluting with water to obtain 6¼ fluidounces. This acid speedily decomposes, for which reason J. Murdoch (1855) proposed to preserve it by sugar. It contains about 8 per cent. HI.

Properties.—Pure hydriodic acid is a colorless irrespirable and uninflammable gas, having the density 4.37 and an odor resembling that of hydrochloric acid. The aqueous solution is colorless, has a strong acid reaction, and a pungent afterward styptic sour taste. The concentrated aqueous solution of the acid, saturated at 0° C. (32° F.), has the spec. grav. 1.99. The acid formerly officinal had the spec. grav. 1.112. The most concentrated acid obtainable by distillation boils at 127° C. (260.6° F.), contains 57.75 per cent. HI, and has the spec. grav. 1.708. Topsöe (1870) found an acid having at 13.5° C. (56.3° F.) the densities 1.077, 1.102 or 1.126 to contain respectively 10.15, 13.09, and 15.73 per cent. of HI. Exposed to the air, this acid is decomposed, the hydrogen being oxidized to form water, and iodine liberated, coloring the liquid red-brown. The addition of a small quantity of hyposulphite of sodium, as suggested by Dunn (1868), will for a time prevent the change. Pharmaceutically, hydriodic acid is a very unsatisfactory preparation.

Action and Uses.—According to Binz (*Arch. f. Pathol. u. Pharm.*, viii. 320), the poisonous phenomena produced by iodic acid proves that iodine is endowed with narcotic powers, and he quotes the assertion of Melsens, that hydriodic and iodic acids are equally operative. He and others also aver that the oxygen of the compound is its active element, and that the iodine is eliminated with the urine. The same authority maintains (*op. cit.*, xiii. 125), on the strength of his experiments, that iodic acid is an antipyretic, in that it reduces the pulse-rate; that its oxygen unites with and destroys "the decomposing products out of which the fever arises;" and that "the nascent iodine can only act upon the cells and ferment by reducing their activity." It is unnecessary to pursue these ingenious but unpractical suggestions, which, however, induced Luton (*Traité des injections sous cutanées*, Paris, 1875) in 1873 to employ tissue injections of iodic acid in the treatment of certain degenerations. He held that the preparation was caustic in virtue of its iodine and resolutive through its oxygen. He asserted it to be useful in certain ill-conditioned and especially cancroidal *ulcers*, and that it might be injected into *ganglions*, *goitres*, and various other *tumors;* that its action was not more painful than that of iodine itself; and that, according to the strength of the solution, it acted as a caustic or simply resolved the morbid growths. For the former purpose a saturated solution was employed; for the latter, one containing a tenth of the acid or less. Internally, Wylie employed "a syrup containing 40 minims of the dilute (hydriodic) acid to the ounce," of which 2 teaspoonfuls were given at a dose in chronic and subacute *bronchitis*, chronic *malarial poisoning*, and *Graves' disease* (*Medical Record*, xv. 454). Binz (*loc. cit.*, p. 131) refers to experiments in which sick rabbits illustrated the antipyretic virtues of the preparation, and urges that its poisonous qualities do not constitute a sufficient objection to its use. Yet he prudently advises that the sodium salt, and not the acid, should be employed.

ACIDUM HYDROBROMICUM DILUTUM, *U. S.*, *Br.*—Diluted Hydrobromic Acid.

Acidum bromohydricum.—*Acide hydrobromique*, Fr.; *Bromwasserstoffsäure*, *Hybrobromsäure*, G.

Formula HBr. Molecular weight 81 [80.8]. Strength 10 per cent. Sp. gr. 1.077.

Origin.—Hydrobromic acid was discovered by Balard (1826). It is formed by the direct union of its elements at a red heat, by the decomposition of sulphydric acid and other hydrogen compounds by bromine, by the action of bromine in the presence of water upon the lower oxides of sulphur, phosphorus, arsenic, and other elements, and by the action of water upon the sulphur, phosphorus, and other compounds of bromine. *Br.* recommends to pass H_2S into bromine kept under water.

Preparation.—Markoe (1875) recommended the following procedure: 1 pound of phosphorus is spread over the bottom of a one-gallon jar, covered with water, and the jar half filled with ice, after which a large funnel is inserted into the throat of the jar, a funnel-tube adjusted so as to reach a short distance above the phosphorus, and the jar surrounded with ice. 3 or 4 pounds of bromine may now be very slowly added through the funnel-tube, care being taken to prevent the accumulation in the jar of uncombined bromine, which would give rise to an explosion when reacting with the phosphorus. The two elements unite to form pentabromide of phosphorus, PBr_5; and this, reacting with water, forms phosphoric and hydrobromic acids; $PBr_5 + 4H_2O$ yields $H_3PO_4 + 5HBr$. After the reaction is completed the excess of phosphorus is removed, and the aqueous liquid distilled until hydrobromic acid ceases to come over. The syrupy residue left in the retort, when properly diluted, is utilized as phosphoric acid.

Fothergill's formula is an adaptation of that of Dr. D. C. Wade (1875). An acid of the strength required by the Pharmacopœia, but containing small quantities of potassium bitartrate and bromide, may be prepared extemporaneously by dissolving 8 parts of potassium bromide and 10 parts of tartaric acid, each in 25 parts of distilled water, mixing the solutions, cooling the mixture, and stirring it well; after the potassium bitartrate has precipitated the whole is thrown upon a small funnel, and the vessel and precipitate are washed with 10 parts of ice-cold water.

The difficulties of distilling hydrobromic acid by decomposing potassium bromide with sulphuric acid have been overcome by Dr. Squibb (1878) as follows: 7 parts by weight of sulphuric acid, sp. gr. 1.838 at 15.6° C. (60° F.), are added to 1 part of water, and the mixture allowed to cool, when it is slowly, and with constant stirring, added to a hot solution of 6 parts of potassium bromide in 6 parts of water. A decomposition into hydrobromic acid and sulphate of potassium will take place; $2KBr + H_2SO_4$ yields $2HBr + K_2SO_4$. On setting the mixture aside for 24 hours, the salt crystallizes, the liquid is poured off into a retort, and the crystalline mass broken up, transferred to a funnel, and washed with 2 parts of cold water to recover adhering hydrobromic acid. The washings are likewise poured into the retort, which is placed upon a sand-bath or set upon a wire gauze, and the whole is then distilled nearly to dryness. The distillate, which weighs about 10 parts, is assayed with normal solution of soda, and then diluted with distilled water so as to contain 34 per cent. of HBr. When of this strength, the acid represents one-half the bromine strength of an equal weight of potassium bromide, and should be dispensed only as *acidum hydrobromicum concentratum.* According to W. Grüning (1883) distillation of the acid is readily accomplished by using 100 parts of potassium bromide and 250 parts of phosphoric acid, sp. gr. 1.304.

Hager avoids distillation of the acid by operating as follows: 15.5 parts of potassium bromide are dissolved in 25 parts of hot water; the solution is mixed with 38 parts of sulphuric acid, spec. grav. 1.115, or 32 parts of water and 6.7 parts strong sulphuric acid, and the mixture cooled by immersing the flask in cold water; 40 parts of strong alcohol are added, and after 2 hours, when the potassium sulphate has separated, the liquid is filtered through glass-wool, and the vessel and filtrate washed with 15 or 20 parts of 60 per cent. alcohol; the clear filtrate is either evaporated or distilled at a temperature not exceeding 80° C. (176° F.) until the alcohol has been expelled. At the temperature named but very little hydrobromic acid is volatilized; the residue is diluted with water until it weighs 100 parts.

The process of Bruylants (1879) consists in carefully dropping bromine into oil of copaiva, and afterward applying heat; the reaction is very energetic.

Properties.—Pure hydrobromic acid is a colorless gas of a pungent and irritating odor, and produces dense white fumes in a moist atmosphere. Its aqueous solutions are colorless, odorless, limpid liquids of a strongly acid taste, which remain colorless on exposure to air. Dr. Squibb determined the acid of the strength suggested by him to have the specific gravity 1.274 at 15.6° C. (60° F.), and to contain 33.58 bromine, .42 hydrogen, and 66 water. When heated, water and a weak acid distil over, and the temperature rises to 125.5° C. (258° F.), when an acid passes over which, according to Topsöe (1870), has at 14° C. (57.2° F.) the specific gravity 1.490 and contains 48.17 per cent. HBr.

Hydrobromic acid liberates bromine on the cautious addition of chlorine-water or of nitric acid, the bromine being soluble, with a yellow or orange-red color, in chloroform, ether, and carbon bisulphide; and such a solution, agitated with starch paste, imparts to the latter a yellow color; excess of chlorine-water will destroy the color.

The density of aqueous hydrobromic acid at 15° C. (59° F.), according to Biel (1881), is as follows:

Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.
1	1.0082	11	1.085	21	1.172	31	1.270	41	1.388
2	1.0155	12	1.093	22	1.181	32	1.281	42	1.401
3	1.0230	13	1.102	23	1.190	33	1.292	43	1.415
4	1.0305	14	1.110	24	1.200	34	1.303	44	1.429
5	1.038	15	1.119	25	1.209	35	1.314	45	1.444
6	1.046	16	1.127	26	1.219	36	1.326	46	1.459
7	1.053	17	1.136	27	1.229	37	1.338	47	1.474
8	1.061	18	1.145	28	1.239	38	1.350	48	1.490
9	1.069	19	1.154	29	1.249	39	1.362	49	1.496
10	1.077	20	1.163	30	1.260	40	1.375	50	1.513

Tests.—Hydrobromic acid should evaporate without leaving any residue. It should not be precipitated by barium chloride, showing the absence of sulphuric acid. It yields, like hydrochloric acid, white precipitates with solutions of lead, mercurous and silver salts. Bromide of silver is nearly insoluble in *dilute* ammonia-water, which dissolves silver chloride readily; on the subsequent addition of nitric acid only a slight turbidity should be produced. If contaminated with hydriodic acid, the latter on exposure to air will liberate iodine, which gives a blue color with starch. On cautiously adding chlorine-water to such an acid, iodine will first be liberated, and dissolve in carbon bisulphide with a purple color; on the further addition of the reagent bromine will be liberated. The strength of hydrobromic acid may be determined by neutralization or by silver. 16.2 Gm. of the officinal acid require for neutralization 26 Ccm. of the volumetric solution of soda; and 10 Gm. of it, when treated with nitrate of silver in excess, will yield a precipitate which, after washing and drying, weighs 2.32 Gm., and when heated in chlorine gas is converted into chloride of silver weighing 1.72 Gm.

Physiological Action.—In its liquid and diluted state, and particularly when prepared by decomposing bromide of potassium with tartaric acid, it has an agreeable acidulous taste; but the pure acid is as corrosive as concentrated hydrochloric acid. The experiments of Reichert (1881) appear to prove conclusively that the action of hydrobromic acid is essentially the same as that of potassium bromide. Its operation is, however, more transient. It is of interest to note that, like other agents classed as narcotic, it is stimulant in small doses, and in large doses depressing. It is less apt than its potassium salt to provoke an acneiform eruption.

Medical Uses.—It was first employed to prevent the headache occasioned by quinine, and also by iron, by combining it with those medicines, as well as to palliate the nervous irritability or disorders for which they are often prescribed. It soon appeared to be, in many cases, an appropriate substitute for bromide of potassium, and at least equal that salt in the energy, if not in the duration, of its action upon the nervous system. In combination with quinine and iron, its own comparatively transient influence forms an appropriate preparation for their more permanent action. It especially seems to prevent the tinnitus aurium and the disorder of vision which sometimes follow the use of large doses of quinine. But as these phenomena are often the only guides in regulating the dose of quinia, a medicine capable of suppressing them is of questionable advantage unless the appropriate dose of quinine has been experimentally determined. It appears to co-operate with digitalis as well as with quinine and iron in improving the tone of the heart when weak and irritable. Like the bromides, it has been successfully employed in a variety of nervous disorders induced by reflex irritation, such as *vomiting*, *muscular spasm*, *whooping cough*, and *neuralgia*, and in *coughs* excited by *bronchial* or *laryngeal* irritation. In cases also of *cerebral hyperæmia* due to excessive mental activity in study, business, etc. it appears to have the same influence as the bromides. In *tinnitus aurium* and other subjective sensations in the ear, especially those of a throbbing or knocking character, depending upon vascular congestion, the medicine has proved very efficient. Unlike the bromides, it appears to be more injurious than useful in *epilepsy*, aggravating the attacks and rendering them more frequent. Such, at least, is the result of some clinical observation. But it is to be remembered that doses of the acid corresponding to full doses of the bromide must be very large indeed, and hence inconvenient. It has been suggested that the acid may be substituted wholly or partly for the salt to check the development of the bromide eruption and of the debilitating influence of its alkaline base. Dr. Squibb has called attention to the difficulty of administering the acid "in consequence of the large dilution necessary and the disagreeable effect of" setting the teeth on edge. "A dose of 50 grains requires not less than 8 fluidounces of dilution, which must contain not less than an ounce of sugar or 2 ounces of syrup to make it drinkable." Doses of about half this amount have been found necessary to produce a prompt sedative effect. Dr. Squibb has proposed the use of a syrup containing about 3 minims of his acid in each fluidrachm. Half an ounce of this syrup contains about 15 grains of the acid, and is reckoned to be equivalent to 12.5 grains of potassium bromide. It must be given diluted with from 2 to 4 ounces of water. Hydrobromate of quinine, being very soluble in water, is more suitable than the neutral sulphate for hypodermic use. It may be prepared thus: ℞. Potassii bromid. 162 gr.; Acid. tartaric. 198 gr.; Quininæ sulph. 60 gr.; Aquæ f ℥iij.—M. Filter. Dose, 30 minims to 1 fluidrachm (Gm. 2–4).

ACIDUM HYDROCHLORICUM, *U. S., Br., P. G.*—HYDROCHLORIC ACID.

Acidum muriaticum, s. hydrochloratum s. chlorhydricum.—Muriatic acid, E.; *Acide chlorhydrique s. muriatique,* Fr.; *Salzsäure, Chlorwasserstoffsäure,* G.

Formula HCl. Molecular weight 36.4. Strength 31.9 per cent. (25 per cent. *P. G.*). Spec. grav. 1.160.

Diluted Hydrochloric Acid: Strength 10 per cent. *U. S.*, 10.58 per cent. *Br.*, 12.5 per cent. *P. G.* Spec. grav. 1.049 *U. S.*, 1.052 *Br.*, 1.061 *P. G.*

Origin.—Hydrochloric acid occurs in the uncombined state among the gases emitted by active volcanoes, and in combination its radical, chlorine, is found in numerous minerals, prominent among which is chloride of sodium, or common salt, which is also one of the most important constituents of sea-water and the source of nearly all the hydrochloric acid of commerce. The acid was obtained in the fifteenth century by Basilius Valentinus, and was described as *spirit of salt*, a name which is occasionally used even at the present time. The correct composition of hydrochloric acid was first proved by Humphry Davy (1810).

Preparation.—Enormous quantities of hydrochloric acid are produced in the preparation of potash and of carbonate of sodium, for which purpose it is necessary to convert the chlorides into sulphates. The escaping gas is made to pass through long vertical cylinders, which are filled with coke, over which water is made to trickle. The water, dissolving the acid in its descent, is collected below or allowed to run to waste. If the acid is intended for uses in the arts, a purer article is required, and the gas is then made to pass through a series of stone receivers having the shape of large Woulfe's bottles, the first of which is empty, while the other five or six contain a certain quantity of water. The stills consist of horizontal iron cylinders, into which equal weights of common salt and sulphuric acid are introduced, after which heat is applied. The first receiver retains any sodium sulphate and sulphuric acid which may be mechanically carried over, the gas being absorbed by the water in the other receivers.

By this process 117 parts of chloride of sodium require 98 parts of concentrated (or a correspondingly larger quantity of a somewhat weaker) sulphuric acid. The first reaction results in liberation of one-half of the hydrochloric acid and production of acid sulphate of sodium; $2NaCl + H_2SO_4$ yields $HCl + NaCl + NaHSO_4$. The decomposition of the remaining chloride by the acid sulphate of sodium is effected at a temperature beyond 200° C. (392° F.), but on the large scale a much higher heat is found necessary; the reaction takes place as follows: $NaCl + NaHSO_4 = HCl + Na_2SO_4$. The salt cake remaining in the retort is worked up into Glauber's salt by dissolving it in water and crystallizing, or it is used for the preparation of soda. The acid thus obtained has a lighter or deeper yellow color, due to a small quantity of ferric chloride dissolved in it. If otherwise pure and of sufficient strength, it may be employed for preparing ferrous and ferric chlorides.

In a process recommended by Eschellmann (1882) the product obtained in preparing hydrochloric acid may be again utilized for the same purpose: calcium chloride and magnesium sulphate are mixed with water to form a soft mass, and then heated to dull redness. The reaction taking place is explained by the equation $CaCl_2 + MgSO_4 + H_2O = (MgO.CaSO_4) + 2HCl$. The basic calcium-magnesium sulphate may be used for generating ammonia from sal ammoniac, resulting in the formation of calcium sulphate and magnesium chloride, from which the above basic sulphate and hydrochloric acid gas may be again obtained. On treating in the same manner a mixture of chloride and sulphate of magnesium, the result is, besides hydrochloric acid, basic magnesium sulphate, $MgO.MgSO_4$, from which, on boiling with water, magnesium hydrate is precipitated, while magnesium sulphate remains in solution.

A pure acid, suitable for pharmaceutical purposes, is obtained by rectifying 12 parts of the crude acid in a glass retort in such a manner that the delivery-tube terminates at the surface of 3 parts of distilled water contained in the receiver, which is refrigerated with water; the heat is continued until about 7 parts have distilled over. The pure acid is usually prepared on a large scale by distilling chloride of sodium and sulphuric acid in the proportions given above, using glass retorts having a capacity of 5 or 6 gallons, and collecting the acid in suitable glass receivers; a number of these retorts are usually arranged in a properly constructed furnace having the requisite number of sand-baths, each of which is large enough to receive one retort, and may be sufficiently heated to recover all hydrochloric acid, with the production of sodium sulphate. In the pharmaceutical laboratory, however, it is usually preferable to employ the sulphuric acid in such a quantity that acid sulphate of sodium is formed, since the hydrochloric acid is then obtained at a lower temperature; $NaCl + H_2SO_4 = HCl + NaHSO_2$. For 3 parts of dry chloride of sodium but little more than 5 parts of concentrated sulphuric acid are required, and these are the proportions employed in the following process, which likewise contains the necessary details for successfully carrying on the operation:

Take of Chloride of Sodium, dried, 48 ounces; Sulphuric Acid 44 fluidounces (80 ounces); Water 36 fluidounces; Distilled Water 50 fluidounces. Pour the sulphuric acid slowly into 32 ounces of the water, and when the mixture is cooled add it to the chloride of sodium previously introduced into a flask having the capacity of at least 1 gallon. Connect the flask by corks and a bent glass tube with a three-necked wash-bottle furnished with a safety-tube and containing the remaining 4 ounces of the water; then, applying heat to the flask, conduct the disengaged gas through the wash-bottle into a second bottle containing the distilled water by a bent tube, dipping about half an inch below the surface, and let the process be continued until the product measures 66 ounces or the liquid has acquired a specific gravity of 1.16. The bottle containing the distilled water must be kept cool during the whole operation.—*Br.*

ACIDUM HYDROCHLORICUM (S. MURIATICUM) DILUTUM, U. S., Br.—*Diluted hydrochloric acid*, E.; *Acide chlorhydrique dilué*, Fr.; *Verdünnte Salzsäure*, G.—Add Hydrochloric Acid 6 parts to Distilled Water 13 parts, and mix.—*U. S.* The British Pharmacopœia adds to 3060 grains of hydrochloric acid sufficient distilled water, until the mixture, at 15.5° C. (60° F.), after it has been shaken, measures 1 imperial pint. The specific gravity of diluted hydrochloric acid is 1.049 *U. S.*, 1.052 *Br.*, 1.061 *P. G.*

Properties.—1. HYDROCHLORIC ACID GAS. It is colorless, has a pungent, acid, suffocating odor, and when inhaled is highly irritating, though less so than chlorine. Its specific gravity is 1.2844 (Thomson). It strongly reddens blue litmus-paper, does not support combustion, and in contact with the atmosphere produces grayish-white fumes by condensing the moisture of the air. It may be condensed into a colorless liquid by a pressure of 1 atmosphere and a refrigerating mixture of solid carbonic acid and ether. This liquid does not congeal at 110° C. (166° F.), and at 10° C. (50° F.) exerts a pressure equal to 40 atmospheres. Its composition is HCl, or equal volumes of hydrogen and chlorine united without condensation.

2. CRUDE HYDROCHLORIC ACID, *Acidum hydrochloricum crudum*, P. G.; *Spiritus salis.*—The German Pharmacopœia requires it to have a specific gravity of not less than 1.158, and to contain at least 29 per cent. of HCl. It is of a yellowish color, and usually contains traces of sulphuric and sulphurous acids, aluminium, and iron. It should, however, be free from arsenic, which may be detected, according to Bettendorff (1869), by adding 1 Gm. of stannous chloride to 10 Gm. of the acid, and either heating or setting aside for half an hour, when a brown turbidity or precipitate will occur, consisting of metallic arsenic. One-millionth part of arsenic may thus be detected, provided the acid has not been diluted. After the precipitate has settled the clear liquid may be carefully decanted or filtered, and afterward distilled, when it will be free from arsenic and tin.

3. OFFICINAL HYDROCHLORIC ACID.—It is a colorless liquid, having the specific gravity 1.160, and emitting white vapors in contact with the air. It gives with nitrate of silver a white curdy precipitate, which is soluble in ammonia and insoluble in nitric acid. The strength of the acid is determined, after suitably diluting it with distilled water, by neutralizing it with volumetric solution of soda. 3.64 Gm. of the former require 31.9 Ccm. of the latter (*U. S.*); or 114.8 grains of acid need 1000 grain-measures of the soda solution

(*Br.*). Pure hydrochloric acid of the German Pharmacopœia is required to have the density 1.124, and to contain 25 per cent. HCl.

Water absorbs at 0° C. (32° F.), the barometer being 760 Mm., 501.5 volumes of hydrochloric acid gas. The concentrated acid, on being heated, loses gas, becoming weaker on boiling until, at the barometric pressure given before, it has reached the specific gravity 1.101 at 15° C. (59° F.), contains 20.17 per cent. HCl, and distils at 110° C. (230° F.). On boiling a weaker acid it becomes stronger, the final density depending on the atmospheric pressure.

Hydrochloric acid of the specific gravity 1.01 at 25° C. (77° F.) contains, according to E. Davy, 2.02 per cent. of gas, and for every additional 2.02 per cent. increases in density at the ratio of 0.01, so that an acid of 1.10 specific gravity contains 20.20 per cent., and if of specific gravity 1.19 contains 38.38 per cent. of gas. These figures differ little from those ascertained by A. Ure, from whose results the following table is condensed, giving

Sp. grav.	Per cent. chlorine.	Per cent. HCl.	Per cent. aqueous acid.		Sp. grav.	Per cent. chlorine.	Per cent. HCl.	Per cent. aqueous acid.	
			S. g. 1.20.	20° B.				S. g. 1.20.	20° B.
1.2120	....	42.900	....	134.3	1.1041	20.632	21.203	52	
1.2100	....	42.400	....	132.7	1.1020	20.235	20.796	51	
1.2050	....	41.200	....	130.0	1.1000	19.837	20.388	50	
1.2000	39.675	40.777	100		1.1000	....	19.900	....	62.3
1.1990	....	39.800	....	124.6	1.0980	19.440	19.980	49	
1.1950	....	39.000	....	122.0	1.0960	19.044	19.572	48	
1.1900	....	37.900	....	118.6	1.0939	18.647	19.165	47	
1.1850	....	36.800	....	115.2	1.0919	18.250	18.757	46	
1.1822	35.707	36.700	90		1.0910	....	18.100	....	56.7
1.1800	....	35.700	....	111.7	1.0899	17.854	18.349	45	
1.1750	....	34.700	....	108.6	1.0879	17.457	17.941	44	
1.1721	33.724	34.660	85		1.0859	17.060	17.534	43	
1.1710	....	33.900	....	106.1	1.0838	16.664	17.126	42	
1.1701	33.328	34.252	84		1.0830	....	16.500	....	51.6
1.1681	32.931	33.845	83		1.0818	16.267	16.718	41	
1.1661	32.535	33.437	82		1.0798	15.870	16.310	40	
1.1660	....	33.000	....	103.3	1.0778	15.474	15.902	39	
1.1641	32.136	33.029	81		1.0758	15.077	15.494	38	
1.1620	31.746	32.621	80		1.0750	....	15.000	....	46.9
1.1610	....	32.000	....	100.0	1.0738	14.680	15.087	37	
1.1599	31.343	32.213	79		1.0718	14.284	14.676	36	
1.1578	30.946	31.805	78		1.0697	13.887	14.271	35	
1.1570	....	31.200	....	97.7	1.0677	13.490	13.863	34	
1.1557	30.550	31.398	77		1.0670	....	13.400	....	41.9
1.1537	30.153	30.990	76		1.0657	13.094	13.456	33	
1.1520	....	30.200	....	94.5	1.0637	12.697	13.049	32	
1.1515	29.757	30.582	75		1.0617	12.300	12.641	31	
1.1494	29.361	30.174	74		1.0600	....	12.000	....	37.6
1.1473	28.964	29.767	73		1.0597	11.903	12.233	30	
1.1452	28.567	29.359	72		1.0577	11.506	11.825	29	
1.1431	28.171	28.951	71		1.0557	11.109	11.418	28	
1.1430	....	28.400	....	88.9	1.0537	10.712	11.010	27	
1.1410	27.772	28.544	70		1.0520	....	10.400	....	32.6
1.1389	27.376	28.136	69		1.0517	10.316	10.602	26	
1.1369	26.979	27.728	68		1.0497	9.919	10.194	25	
1.1349	26.583	27.321	67		1.0477	9.522	9.786	24	
1.1340	....	26.600	....	83.3	1.0457	9.126	9.379	23	
1.1328	26.186	26.913	66		1.0440	....	8.900	....	27.8
1.1308	25.789	26.505	65		1.0437	8.729	8.971	22	
1.1287	25.392	26.098	64		1.0417	8.332	8.563	21	
1.1267	24.996	25.690	63		1.0397	7.935	8.155	20	
1.1250	....	24.800	....	77.6	1.0377	7.538	7.747	19	
1.1247	24.599	25.282	62		1.0360	....	7.300	....	22.8
1.1226	24.202	24.874	61		1.0357	7.141	7.340	18	
1.1206	23.805	24.466	60		1.0337	6.745	6.932	17	
1.1185	23.408	24.058	59		1.0318	6.348	6.524	16	
1.1164	23.012	23.650	58		1.0298	5.951	6.116	15	
1.1160	....	23.100	....	72.3	1.0290	....	5.800	....	18.1
1.1143	22.615	23.242	57		1.0220	....	4.500	....	14.1
1.1123	22.218	22.834	56		1.0200	3.968	4.078	10	
1.1102	21.822	22.426	55		1.0140	....	2.900	....	9.0
1.1082	21.425	22.019	54		1 0100	1.984	2.039	5	
1.1080	....	21.500	....	67.3	1.0070	....	1.500	....	4.7
1.1061	21.028	21.641	53						

the percentage of chlorine, of hydrochloric acid gas, and of the aqueous acid of specific gravity 1.200 contained in hydrochloric acid of different densities; we have also added the figures ascertained by J. Kolb (1872) for 15° C., giving the percentage of dry HCl and of the acid of 20° Baumé.

DILUTED HYDROCHLORIC ACID has the same properties as the strong acid, but contains only 10 per cent. (*U. S.*), 10.58 per cent. (*Br.*), 12.5 per cent. (*P. G.*) of HCl, and has the specific gravity of 1.049 (*U. S.*), 1.052 (*Br.*), 1.061 (*P. G.*). The amount of volumetric solution of soda required for neutralization is 10 Ccm. for 3.64 Gm. of the acid (*U. S.*), or 1000 grain-measures for 345 grains of the latter (*Br.*).

Impurities and Tests.—Hydrochloric acid evaporates completely without leaving any residue (saline impurities). When diluted with at least four times its volume of distilled water it yields no precipitate with sulphuretted hydrogen (lead, copper, arsenic, tin), chloride of barium (sulphuric acid), or ammonia in excess (lead, iron); nor does it acquire a blue color with the last test (copper), or a brown or black color on the subsequent addition of sulphydrate of ammonium (metals); it is not colored red by sulphocyanide of potassium (iron), or blue by a mixture of starch-paste and iodide of potassium (chlorine), and does not tarnish or alter the color of bright copper-foil when boiled with it (arsenic). To test it for sulphurous acid or arsenic, put a few pieces of pure zinc into a rather long test-tube and introduce the hydrochloric acid, diluted with 2 parts of water, which should fill about one-tenth part of the tube. In the upper part of the tube place a small bunch of cotton moistened with solution of acetate of lead, and cover the mouth of the tube with a piece of white filtering-paper moistened with solution of nitrate of silver. After the evolution of hydrogen gas has continued for half an hour neither the cotton nor the paper should be blackened, proving the absence of sulphurous acid in the former case and of arsenic in the latter. Under the conditions described sulphurous acid evolves sulphuretted hydrogen, which blackens the lead salt, and arsenic yields arseniuretted hydrogen, which does not affect lead acetate, but blackens nitrate of silver.

Pharmaceutical Uses.—Hydrochloric acid is employed in numerous processes, either on account of its properties as a solvent for decomposing certain compounds with the view of liberating certain constituents (sulphur, carbonic acid, hydrocyanic acid, etc.), or for the purpose of generating chlorine. It is used in the preparation of nitromuriatic acid and of the various officinal chlorides, and for promoting the precipitation of resin of podophyllum.

Physiological Action.—Injected into the veins of an animal, it coagulates the blood, but not so firmly as sulphuric acid. Given to man in small doses, it occasions a sense of warmth in the stomach and arterial excitement, with a decided tendency to cerebral intoxication. Its protracted use causes salivation. In a concentrated form it attacks the tissues as a caustic, but less powerfully than nitric or sulphuric acid. An ounce of the officinal acid has been taken without causing death. The symptoms of poisoning by hydrochloric acid are sunken features, dilated pupils, a white stain upon the tongue and fauces, a small, irregular, and feeble pulse, epigastric pain, and cold extremities. Vomiting and purging sometimes occur. After large doses, as 3 or 4 ounces, death takes place in from 3 to 6 hours. After death the pharynx is shrivelled and white, the œsophagus blackish-gray, the vessels are filled with coagulated blood, the gastric mucous membrane is dark and thinned, the walls of the stomach are sometimes perforated, and in that case there is peritonitis. In some instances fatty infiltration has been found. (For recent cases (1883) compare *Virchow's Archiv*, lxxxiii. 214; *Edinburgh Med. Jour.*, xxvi. 1093; *Med. Times and Gaz.*, Apr. 1883, pp. 471, 609.)

Medical Uses.—Hydrochloric acid was at one time extensively employed in *low fevers*, probably upon theoretical grounds which have disappeared along with the practice. It was vaunted in *dyspepsia*, *scrofula*, and other affections involving debility; but, as it was associated with cinchona, its share in whatever benefit accrued is more than doubtful. Perhaps upon better grounds it may be recommended for constitutional *syphilis* when mercury and iodine are inappropriate. But, not improbably, its use in this disease may be attributed to its sometimes causing salivation. It has been employed in *calculous* complaints, and perhaps advantageously in so far as they were associated with dyspeptic disorders. In this way, possibly, it may be found useful in eczema and psoriasis and other *diseases of the skin*, which sometimes depend upon digestive derangements. Hydrochloric acid was at one time regarded as a most valuable agent in the treatment of *diphtheria*, but recent experience has shown that the local affection is of subordinate importance, and that the mere removal of the exudation does not modify the disease. Moreover, chlorate of potassium and other agents are more eligible than the acid as palliatives of the pharyngeal inflammation. The same may be said, even more emphatically, of gangrenous, mercurial, scorbutic, and other forms of ulcerative *stomatitis*. According to Voltolini, *fish-bones* lodged in the pharynx are rendered flexible and may finally be broken up by a mixture of 4 parts of hydrochloric acid and 240 parts of water, the teeth being first protected by oil or lard. The method is probably not to be relied on. A poisonous dose of this acid should be counteracted by magnesia, soap, bicarbonate of sodium, or, in the absence of these, by albumen. The dose of the stronger acid is from 5 to 30 minims (Gm. 0.30–2.00); of the weaker acid, from 20 to 60 minims (Gm. 1.30–4.00), largely diluted and taken through a glass tube. As a gargle, 1 or 2 fluidrachms of the stronger acid may be diluted with 10 or 12 ounces (Gm. 4–8 in Gm. 350–400) of barley-water sweetened with honey.

ACIDUM HYDROCYANICUM DILUTUM, *U. S., Br.*—DILUTED HYDROCYANIC ACID.

Acidum hydrocyanatum s. borussicum.—Prussic acid, E.; *Acide cyanhydrique s. hydrocyanique*, Fr.; *Cyanwasserstoffsäure, Blausäure*, G.

Formula HCN = HCy. Molecular weight 27. Strength 2 per cent. HCy.

Origin.—Hydrocyanic acid was discovered by Scheele (1782); Berthollet (1803) ascertained it to be a compound of hydrogen, carbon, and nitrogen; and Gay-Lussac (1815) succeeded in analyzing it and in isolating the radical *cyanogen*, CN. The acid has been found in the root of Janipha Manihot, and in the bark, leaves, flowers, and seeds of many shrubs and trees belonging to the sub-orders Amygdaleæ and Pomeæ of the order Rosaceæ. It occurs in the free state only in some of the more juicy parts of these plants, but a larger quantity is formed on macerating the parts indicated in cold water, when the amygdalin contained therein is split by the action of emulsin or a similar ferment into sugar, oil of bitter almonds, and hydrocyanic acid; $C_{20}H_{27}NO_{11}$ (amygdalin) $+ 2H_2O$ yields $2C_6H_{12}O_6$ (glucose) $+ C_7H_6O$ (oil of bitter almonds) $+$ HCN (hydrocyanic acid). It is likewise found among the products of the reaction of nitric and nitrous acids upon many organic compounds, and of gaseous ammonia upon incandescent charcoal. For medicinal purposes it is mostly prepared by the decomposition of ferrocyanide of potassium by means of sulphuric acid.

Preparation.—Place 20 parts of ferrocyanide of potassium in a tubulated retort, and add to it 40 parts of water. Connect the neck of the retort (which is to be directed upward), by means of a bent tube, with a well-cooled condenser, the delivery-tube of which terminates in a receiver surrounded with ice-cold water and containing 60 parts of diluted alcohol. All the joints of the apparatus, except the neck of the receiver, having been made air-tight, pour into the retort, through the tubulure, 15 parts of sulphuric acid previously diluted with an equal weight of water. Agitate the retort gently, and then heat it in a sand-bath until the contents are in brisk ebullition, and continue the heat regularly until there is but little liquid mixed with the saline mass remaining in the retort. Detach the receiver, and add to its contents so much distilled water as may be required to bring the product to the strength of 2 per cent. of absolute hydrocyanic acid.—*U. S.*

The process of the British Pharmacopœia is similar to the foregoing, differing chiefly in distilling from a weaker solution and in collecting the distillate in distilled water. The proportions employed are 2½ ounces of potassium ferrocyanide dissolved in 10 ounces of water, and 1 fluidounce of sulphuric acid diluted with 4 ounces of water; the receiver contains 8 ounces of distilled water, and the distillation is continued until the liquid is increased to 17 fluidounces, when it is diluted with distilled water so as to contain 2 per cent. of hydrocyanic acid.

On mixing diluted sulphuric acid with the solution of ferrocyanide of potassium in the cold, only one-half of the latter salt is decomposed, with the formation of sulphate of potassium and hydro-ferrocyanic acid, thus: $K_4FeC_6N_6$ (ferrocyanide of potassium) $+ 2H_2SO_4$ yields $2K_2SO_4 + H_4FeC_6N_6$ (hydro-ferrocyanic acid). This last compound may be obtained by adding ether to the mixture, when the acid will be separated as a whitish powder or pearly scales. On the application of heat to the mixture this acid reacts with the remaining ferrocyanide of potassium and sulphuric acid, yielding hydrocyanic acid, which distils over, sulphate of potassium, which remains in solution, and ferrocyanide of iron and potassium (Everitt's salt), which precipitates as a white powder, rapidly turning green, and finally blue, in the presence of oxygen. The reaction is explained in the following: $H_4FeC_6N_6 + K_4FeC_6N_6 + H_2SO_4 = 6HCN$ (hydrocyanic acid)

$+ K_2SO_4 + K_2Fe(FeC_6N_6)$ (Everitt's salt). 2 molecules of ferrocyanide of potassium with 3 of sulphuric acid yield, therefore, finally, 6 molecules of hydrocyanic acid, 3 of potassium sulphate, and 1 of Everitt's salt, the latter having a white color, but turning rapidly blue on exposure.

The preparation of officinal hydrocyanic acid by the above process presents no difficulties. Distilling the acid over a naked fire would cause concussions endangering the safety of the retort. The Pharmacopœia very properly orders the retort to be placed in a sand-bath, or an ash-bath may be substituted for it. The complete decomposition of the potassium ferrocyanide and the distillation of the hydrocyanic acid are readily effected, the entire amount being obtainable at a temperature little exceeding that of boiling water. The contamination of the distillate with the contents of the retort, which may occur in consequence of spirting, is easily prevented by substituting a flask for the retort or by keeping the neck of the latter in a slightly elevated position.

The strength of the distillate may be determined by weighing 100 grains of it in a small beaker containing some distilled water, and precipitating completely with nitrate of silver; the precipitate of cyanide of silver is collected upon a tared filter, washed, dried at 100° C. (212° F.), and weighed. From the excess of this weight over 10 grains the amount of distilled water is easily calculated, which must be added to the distillate, the precise weight of which has been ascertained, in order to obtain it of the officinal strength. After proper dilution it should at once be put into clean small vials, well corked.

The amount of hydrocyanic acid contained in the distillate may also be determined volumetrically by diluting 6.75 Gm. of it with twice its bulk of water, adding to this volumetric solution of nitrate of silver as long as a white turbidity of AgCy is produced. Since, however, the termination of the reaction is not readily observed, the Pharmacopœia directs the addition to the acid of a few drops of potassium chromate as an indicator in producing a permanent red precipitate as soon as all the hydrocyanic acid has been converted into silver cyanide. If of the proper pharmacopœial strength the above quantity of HCy will require exactly 50 Ccm. of the silver solution; any excess of the latter which may be required will indicate by a simple proportion the amount of distilled water which must be added to the distillate.

Liebig's method depends upon the formation of a soluble double salt, KCy.AgCy, which is not decomposed by potassa or sodium chloride. As before, 6.75 Gm. of the distillate may be conveniently used; this is rendered slightly but distinctly alkaline by potassa, after which the silver solution is added until a permanent white turbidity appears. An acid containing 2 per cent. HCy will require 25 Ccm. of the test solution, and the excess above this quantity will furnish the proportion for diluting the distillate to its proper strength.

Diluted hydrocyanic acid may be advantageously prepared from several cyanides. Cyanide of potassium, however, is not well adapted for this purpose, owing to the difficulty of obtaining it absolutely pure; but even if the salt were decomposed by the requisite quantity of tartaric acid to form bitartrate of potassium, the portion of the latter salt remaining in solution would tend to speedily decompose the acid, unless distillation were resorted to. A convenient method for obtaining an acid suitable for immediate use is the following:

Take of Cyanide of Silver 6 parts (50 grains); Hydrochloric Acid 5 parts (42 grains); Distilled Water 55 parts (1 fluidounce). Mix the hydrochloric acid with the distilled water, add the cyanide of silver, and shake the whole together in a glass-stoppered vial. When the precipitate formed has subsided pour off the clear liquid.—*U. S.*

The hydrochloric acid decomposes the silver cyanide, forming insoluble silver chloride and hydrocyanic acid; thus, $AgCy + HCl = AgCl + HCy$.

The French Codex employs a mixture of cyanide of mercury and chloride of ammonium, the latter being used to produce readily soluble and fusible double salts. The mixture is treated with hydrochloric acid, and the resulting gas passed first over marble to remove hydrochloric acid, and then over chloride of calcium to remove water, into a narrow tube placed in a refrigerating mixture. The anhydrous acid is condensed, and is diluted with nine times its weight of distilled water. This process presents no advantages whatever. On the contrary, owing to the concentration of the acid as at first condensed, precautions are necessary to avoid dangerous results in handling this volatile liquid.

Properties.—Anhydrous hydrocyanic acid is a colorless mobile liquid which congeals at −15° C. (5° F.) to feathery crystals, has the density .697 at 18° C. (64.4° F.), boils at 26.5° C. (79.7° F.), and when ignited burns with a slightly luminous flame to carbonic anhydride and nitrogen. It has a strong odor, resembling that of oil of bitter almond, and is extremely poisonous. It is the hydride of the radical cyanogen, and its composition is expressed by the formula HCN = HCy. It reddens litmus-paper slightly and transiently, and with alkalies yields crystallizable salts having a strong alkaline reaction, and producing with an acidulated mixture of ferrous and ferric salts a precipitate of Prussian blue. Most of its salts, on being treated with diluted mineral or many organic acids, yield hydrocyanic acid, and are decomposed by strong nitric acid, with the evolution of nitrogen and other gases; cyanide of silver dissolves in boiling nitric acid, the solution containing silver nitrate. A solution of an alkaline cyanide mixed with solution of picric acid and heated to about 60° C. (140° F.) acquires a deep-red color, from the production of a salt of *isopurpuric* or *picrocyanic acid*, $C_8H_5N_5O_6$ (Hlasiwetz. 1859).

Hydrocyanic acid is soluble in water, alcohol, and ether in all proportions. The medicinal acid contains 2 per cent. of anhydrous acid; the aqueous solution of this strength has the spec. grav. 0.997 (*Br.*). The methods for ascertaining the strength have been given above. Minute quantities of hydrocyanic acid may be detected by Schœnbein's (see GUAIACUM) or by Liebig's test (1847); the latter is applied by adding a little sulphydrate of ammonium, evaporating at a moderate heat to dryness, and adding to the residue a drop of diluted ferric chloride, when the blood-red color of ferric sulphocyanide will appear.

Under various circumstances hydrocyanic acid is decomposed on keeping, evolving ammonia and depositing a brown or blackish substance containing paracyanogen, C_3N_3 or C_6N_6. The causes of these changes have not been fully explained; it is, however, well known that the presence of alkalies and exposure to the light favor decomposition; and since, by heating hydrocyanic acid in the presence of free mineral acids, formiate of ammonium is apt to be produced, it will be seen that even recently prepared dilute hydrocyanic acid may be prone to change, and that, if altered, the decomposition cannot be arrested by distillation except after the previous addition of sufficient sulphuric acid. The addition of a minute quantity of hydrochloric acid, and of alcohol in place of a portion of the water, to the recently prepared acid, appears to retard that change, but does not altogether prevent it. The stronger the hydrocyanic acid is, the more liable it is to decomposition. The acid known as Scheele's acid, which contains 5 per cent. of HCy, is therefore not adapted for medicinal use.

Another difficulty in preserving the strength of hydrocyanic acid must be attributed to its volatility and the loss suffered by the medicinal acid on the frequent opening of the vial containing it. This has recently (1873 and 1874) been the subject of investigation by A. Towerzey and others. J. Williams states that an addition of 20 per cent. of glycerin will preserve acid up to the strength of about 5 per cent., and J. U. Lloyd (1878) observed that alcoholic hydrocyanic acid could be kept in partially-filled bottles unaltered and without material loss of acid for three years. The formula of the U. S. Pharmacopœia has been modified in accordance with this observation; but it appears better by far to abandon the present medicinal hydrocyanic acid altogether, as suggested by G. A. Zwick, and to adopt in its place, like the Prussian Pharmacopœia of 1862, a still more diluted acid, containing $\frac{1}{10}$ per cent. of HCy, which has been admitted into the German Pharmacopœia (1872 and 1882) under the name of *Aqua amygdalarum amararum*. This will preserve its strength even in partly-filled bottles for several months.

Impurities.—On adding a few drops of solution of corrosive sublimate, and heating to boiling, a reduction of the mercuric salt to calomel or to mercury will indicate the presence of formic acid. Sulphuric acid is recognized by the white precipitate produced on the addition of chloride of barium. Hydrochloric and phosphoric acids are detected by adding solution of borax, evaporating to dryness, and dissolving the residue in diluted nitric acid; a white precipitate with nitrate of silver will indicate the former, and a yellow precipitate with molybdate of ammonium the latter impurity.

Off. Prep.—Vapor acidi hydrocyanici, *Br.*

Derivative.—HYDROCYANIC ETHER, *ethylcyanide* or *propionitrile*, $C_3H_5N = C_2H_5CN$. Prepared according to Pelouze's process (1834), by distilling sulphovinate of barium with potassium cyanide, it has a garlicky odor, which is due to the isomeric *ethylcarbylamin*, and is difficult to remove. A purer product is obtained, according to Williamson (1853), by digesting iodide of ethyl with 4 parts of alcohol containing an equivalent quantity of potassium cyanide until decomposed, and then distilling. When perfectly pure, it is a colorless liquid of the density 0.787, has an agreeable ethereal odor, suggesting that of hydrocyanic acid, is almost insoluble in water, and boils at 97° C. (206.6° F.). It is poisonous, but less so than hydrocyanic acid.

Physiological Action.—This acid is hostile to all forms of life. However absorbed into the tissues of vegetables, it arrests their functions more or less completely. Under its influence woody stems shrink and grow dry, and succulent plants exude their moisture through the integument. All animals are affected by it, but birds and mammals more than reptiles and fishes. Of all poisons, it produces its effects most rapidly—sometimes too rapidly to be analyzed or even accurately observed. The following summary represents them in their usual order: 1. Difficult breathing, slow and full pulse, giddiness, and loss of muscular power. 2. Spasms, dilated pupils, loss of consciousness, vomiting, muscular rigidity, with cessation of the pulse and heart's action. 3. Muscular relaxation and collapse, with abolished or impaired sensibility, feeble pulse, and death by asthenia or in convulsions induced by peripheral irritation. If the dose is not fatal, the animal passes from complete resolution to exaggerated reflex irritability and apparent sensibility; this condition is usually followed by deep sleep. After death the eyes have a glassy lustre, the pupils are usually dilated, and cadaveric rigidity is very marked. If death has been gradual, the blood is found dark and uncoagulated, distending both sides of the heart; but if the poison has been rapidly fatal, the left side of the heart is empty and contracted, but the right is filled with blood. In rapid death from this poison the blood of both systems may exhibit the arterial hue. The cause of this phenomenon is undetermined. The extreme rapidity of the action of the poison and the nature of its effects, as well as the results of special experiments, render it probable that they are due to its direct influence upon the heart itself, and not upon the blood alone, nor upon that and the cerebro-spinal centres primarily. The nervous symptoms appear to be secondary, and due to the withdrawal of blood from the nervous centres. Experiments upon the horse and the hyena show that those animals are nearly insusceptible to the influence of the poison; the elephant, on the other hand, is destroyed by a relatively small dose of it.

In man, the acid, when taken in medicinal but still over-active doses, may produce the following symptoms: irritation of the throat, salivation, warmth at the epigastrium, lightness of the head, dizziness, buzzing in the ears, headache, numbness, a dusky countenance, staggering, constriction of the chest, palpitation of the heart, a frequent or abnormally slow pulse, weariness, and drowsiness. Poisonous but not fatal doses have produced the following effects: insensibility, usually a feeble pulse, dilated pupils, a turgid and dusky face, heat of head, convulsions or rigidity, or both in succession, but no paralysis. Consciousness and muscular power return rapidly, considering the gravity of the initial symptoms. In fatal cases it is remarkable that there are no convulsions, but relaxation rather. The pupils are usually dilated and the eyes lustrous, and the pulse sometimes grows slower until extinction. After death the skin is purplish and all the internal veins are gorged with blood which is dark and uncoagulated. The eyes retain their peculiar glistening aspect. The mucous membrane of the stomach is usually congested.

Medical Uses.—The dangerous potency of this acid necessarily restricts its use in medicine. It has been employed with a certain advantage in the treatment of *whooping cough*, but is at best a palliative merely. The same may be said of its influence in cases of purely *nervous cough*, spasmodic *dysphagia*, and *angina pectoris*. It is related that in a case of the *night cough of children* which had resisted every other treatment the attacks ceased almost abruptly on the administration of this acid in doses of from one-half to three-quarters of a minim every 3 hours (Macdonald). In *gastralgia* there is perhaps more reason to anticipate advantage from its use, and, as the disease is often rebellious, the possibility of relieving it by prussic acid should not be overlooked. Most of the cases supposed to illustrate its efficacy were clearly not examples of pure gastralgia, but of painful dyspepsia, and very possibly instances of gastric ulcer were included among them. Probably in all the element pain was most beneficially influenced; in some, *vomiting* was palliated or arrested. These effects appear to indicate an anæsthetic action in the acid, which is more distinctly manifested by the topical use of the medicine in various *diseases of the skin* in which tingling, itching, and other distressing sensations exist.

The average *dose* of diluted hydrocyanic acid is 2 or 3 minims (Gm. 0.10–0.20), given several times a day in some neutral vehicle with the addition of a few drops of alcohol. It should be dispensed in vials covered with black paper or varnish, to prevent the decomposing action of the light; and a minimum dose should be directed when a fresh prescription is made. From 30 minims to a fluidrachm (Gm. 2–4), in a fluidounce (Gm. 32) of distilled water or rose-water, forms an appropriate lotion, which, however, should not be applied to the skin unless it is perfectly unbroken.

Although the experiments of Preyer upon guinea-pigs demonstrate that hydrocyanic acid and atropia are mutually antidotal when given simultaneously or in quick succession, and in duly-proportioned doses, it is nevertheless practically true that as regards man there is no antidote to the poisonous action of hydrocyanic acid. The most efficient remedy consists in the stimulation produced by the shock of cold water dashed at intervals upon the chest and spine. Subordinate in efficiency, but not to be neglected, are the application of ammonia to the nostrils, the stimulus of induced electricity, artificial respiration, and the judicious agitation of the patient.

ACIDUM HYDROFLUORICUM.—Hydrofluoric Acid.

Acidum fluorhydricum.—Hydrogen fluoride, E.; *Acide fluorhydrique, Acide phtorique*, Fr.; *Fluorwasserstoffsäure*, G.

Formula HF. Molecular weight 20.

Origin.—Fluorine exists in nature in combination with calcium as *fluor-spar*, also in *cryolite* (kryolite) and other minerals; small quantities of fluorine have been found in some mineral and potable waters, in bones, and in the ashes of various plants. The use of fluor-spar for etching on glass was known in the seventeenth century, but hydrofluoric acid was discovered by Scheele (1771), and first prepared pure by Gay-Lussac and Thénard (1808).

Preparation.—Powdered fluor-spar (or cryolite) which is free from silica is heated with sulphuric acid in a retort of platinum or lead, and the gas is conducted into distilled water contained in a well-cooled receiver of the same metal. Great caution is necessary to prevent contact with the vapors and avoid inhaling them.

Properties.—Pure hydrofluoric acid forms a thin, colorless fuming liquid which is lighter than water, does not solidify at −35° C. (−31° F.), boils at 19.4° C. (67° F.), and is freely soluble in water. The aqueous solution, which is sometimes called *fluoric acid, acide fluorique*, is heavier than water; a solution having the density 1.15 contains 35.37 per cent. HF, and boils constantly at 120° C. (248° F.) (Bineau). Like the pure acid, it is extremely caustic, and causes severe ulceration when applied to the skin. It corrodes glass and attacks most organic and inorganic compounds, but does not act upon paraffin; it is best preserved in bottles made of lead or of gutta-percha.

The element *fluorine*, owing to its intense affinities for other elements, has not been obtained in a pure state; it appears, however, to be gaseous, and to possess an odor resembling that of chlorine.

Uses.—Hydrofluoric acid in the gaseous state and its aqueous solution are used for etching glass. *Ammonium fluoride* has a similar effect; it forms white or colorless scales or prisms, which are deliquescent and should be kept in a gutta-percha bottle. According to F. L. Slocum (1880), a mixture suitable for writing on glass, like that sold at one time as *diamond ink*, is made by mixing barium sulphate 3 parts, ammonium fluoride 1 part, and sulphuric acid sufficient to form a semifluid mixture; if kept in glass this should be coated on the inside with paraffin, wax, or gutta-percha.

Medical Uses.—Hydrofluoric acid was used by Woakes in twenty cases of *goitre*, of which seventeen are said to have been cured. The acid was given in doses of from 15 minims to 1 drachm, thrice daily, largely diluted with water. It is true that injections of iodine and the administration of iron and bitter tonics formed part of the treatment (*Lancet*, 1881, i. 497). Dr. Da Costa concluded from clinical observation that the fluorides are prompt emetics without depressing, and relieve pain without producing sleep. But they readily derange the stomach, and even in small doses produce anorexia (*Med. Record*, xx. 168). This acid has been applied as a caustic.

ACIDUM LACTICUM, *U. S., Br., P. G.*—Lactic Acid.

Isolactic, Ethidene-lactic, or Oxypropionic Acid, E.; *Acide lactique*, Fr.; *Milchsäure*, G.

Formula $HC_3H_5O_3$. Molecular weight 90. Strength 75 per cent. Sp. gr. 1.212.

Acidum lacticum dilutum, *Br.*—Lactic acid, 3 fluidounces; water sufficient for 20 fluidounces. Sp. gr. 1.040.

Origin.—Lactic acid was discovered by Scheele (1780) in sour milk, in which it results from the spontaneous fermentation of the sugar of milk under the influence of the casein; $C_{12}H_{24}O_{12}$ (milk-sugar) yields $4HC_3H_5O_3$ (lactic acid). This transformation of the former into the latter is called the *lactic fermentation*. A similar change is produced in dextrin, glucose, cane-sugar, etc. by the action of casein and other protein compounds; lactic acid is therefore met with in many vegetable products which have turned sour. T. and H. Smith's *thebolactic acid* of opium is identical with the lactic acid of milk; but the *sarcolactic acid* of meat-juice, discovered by Berzelius (1807), and recognized by Liebig as differing in several respects from the lactic acid of milk, consists of two acids, one of which, known as *paralactic acid*, has the composition given above, but is dextrogyre, and the solutions of its salts have a levogyre action. The second lactic acid of flesh is like that of milk, optically inactive, but is *ethenelactic acid*, having the composition $CH_2OH.CH_2.COOH$, and its zinc salt is soluble in absolute alcohol. Strecker (1858) observed that by heating sarcolactic acid for some time to 130° or 140° C. (266° or 284° F.) the anhydride is produced, which, dissolved in boiling water, yields ordinary lactic acid. During lactic fermentation, alcohol, several acids, a peculiar gum, and mannit are formed in variable proportions, more particularly if the temperature be allowed to vary much from about 45° C. (113° F.).

Preparation.—100 parts of sugar are dissolved in sufficient water to yield a solution of 8° or 10° B.; 8 or 10 parts of fresh cheese and 50 parts of prepared chalk are added, and the mixture placed for several weeks in a sunny place, when lactate of calcium will be found crystallized (Pelouze). Boutron and Frémy dissolve 300 Gm. of milk-sugar in 4 liters of skimmed milk, expose the mixture to a temperature of from 20° to 30° C. (68° to 84° F.), and neutralize every other day with bicarbonate of sodium. When it ceases to acquire an acid reaction the liquid is boiled, filtered, and carefully evaporated to a syrupy consistence; this is dissolved in strong alcohol, the sodium precipitated by sulphuric acid, and the lactic acid converted into lactate of calcium by the addition of chalk. Wackenroder operates in the same manner, except that an excess of chalk is added before fermentation begins, and the mixture is kept at 24° C. (75.2° F.), and the lactate of calcium is recrystallized from boiling water. This salt, obtained by one of the foregoing processes, is then decomposed by an ascertained accurate amount of sulphuric or oxalic acid. If during fermentation the lactic acid is neutralized by commercial zinc-white, lactate of zinc is obtained, which may be decomposed by sulphuretted hydrogen. Lautemann, who proposed this modification (1860), followed in the main Bensch's directions, dissolving 6 pounds of cane-sugar and ½ ounce of tartaric acid in 35 pounds of boiling water, adding after 2 days 4 ounces of old cheese diffused in 8 pounds of sour milk, and exposing the mixture to a temperature of 40° C. (104° F.). Below 20° C. (68° F.) the production of lactic acid is impeded; above 40° C. (104° F.) butyric acid begins to be formed.

A more expeditious method for the preparation of lactic acid has been described by H. Kiliani (1882): 500 Gm. of cane-sugar, dissolved in 250 Gm. of water, are converted into invert-sugar by boiling with 10 Ccm. of sulphuric acid; 450 Ccm. of solution, made of equal parts of caustic soda and water, are gradually added, and the mixture is heated to 60° or 70° C., until it ceases to react for sugar with Fehling's solution. The liquid is neutralized with sulphuric acid, the sodium sulphate allowed to crystallize, and the remainder precipitated by alcohol; one-half of the clear alcoholic liquid is heated, neutralized with zinc carbonate, mixed with the other half, and cooled, when zinc lactate will crystallize, from which the acid may be obtained in the usual manner.

Properties.—Officinal lactic acid is a syrupy, colorless or pale wine-yellow liquid, having a slight bland or no odor, a very sour taste, and the specific gravity 1.212; the pure acid is colorless, inodorous, and has the specific gravity 1.215 at 20.5° C. (68.9° F.), or, according to Mendelejeff, 1.2485 at 15° C. (59° F.). It unites in all proportions with water, alcohol, and ether, but is insoluble in chloroform, carbon bisulphide, and benzin. It forms with cold concentrated sulphuric acid a clear liquid, which on heating becomes brown and black. On warming the acid with potassium permanganate the odor of aldehyd is given off. When kept at ordinary temperature over sulphuric acid, Wislicenus (1870) obtained *dilactic acid*, an amorphous bitter anhydride of the composition $C_6H_{10}O_5 = C_3H_4O_2.C_3H_6O_3$. The same compound is formed from lactic acid at from 110° to 130° C. (230° to 266° F.), and at about 150° C. (302° F.) the anhydride *lactide*, $C_3H_4O_2$, is obtained in volatile, fusible rhombic plates. Both anhydrides are insoluble in water, but on prolonged boiling with it, or more rapidly by dissolving in alkaline liquids, yield lactic acid. When distilled at a higher temperature or when heated in the open air, lactic acid decomposes, giving off a suffocating odor and leaving a spongy charcoal, which is finally completely consumed. It coagulates milk and albumen, and displaces carbonic and acetic acids from their compounds, yielding salts which are soluble in water, and mostly also in alcohol. Lactic acid on being oxidized by nitric acid yields oxalic acid, and by treatment with chromic acid formic and acetic acid are produced. On oxidizing ethene lactic acid large crystals of *malonic acid*, $C_3H_4O_4$, are obtained. 90 grains of the officinal acid are neutralized by 75 grains of bicarbonate of potassium, or 4.5 Gm. of the acid by 37.5 Ccm. of volumetric solution of soda, indicating 75 per cent. of $HC_3H_5O_3$.

Impurities.—Treated with a hot solution of potassa, lactic acid is not materially colored; if it readily becomes brown, extractive matters are present. Dissolved in strong alcohol, gum and some mineral salts are left behind. Glycerin, glucose, mannit, tartaric acid, and most salts remain undissolved by ether. Acetic and butyric acids are recognized by their odor, which becomes more apparent on warming. For detecting other organic and mineral acids their special tests may be applied. In the diluted acid calcium salts are indicated by oxalate of ammonium; lead, by hydrosulphuric acid; zinc, after neutralization with ammonia, by sulphydrate of ammonium; sulphuric acid, by chloride of barium; hydrochloric acid, by nitrate of silver; and oxalic acid, by chloride of calcium, after previously diluting the acid with twenty times its quantity of water and neutralizing with ammonia. On saturating the acid with zinc carbonate, and treating with absolute alcohol, zinc sarcolactate will be dissolved; also glycerin and mannit if present.

Off. Prep.—Ferri lactas, *U. S.*

Medical Action and Uses.—Lactic acid is normally secreted by the stomach, and may be detected in the sweat and urine. Its excess in the system seems to be one of the most striking phenomena of rheumatism, and several cases have been published in all of which its free administration during diabetes occasioned an attack of articular rheumatism. According to Mendel, it is hypnotic in large doses. Lactic acid has been employed in the treatment of various forms of *dyspepsia*, but chiefly in those presumed to depend upon debility of the stomach, and then as a solvent for pepsin. Some years ago Cantani suggested that, in addition to the use of an exclusively animal diet in *diabetes*, an agent ought to be employed which would prevent the waste of the tissues by furnishing an appropriate substance in their stead. For this end he proposed lactic acid, which he believed would supply the very product which the deranged liver was no longer capable of furnishing. Whatever may be thought of the theory, it appears certain that, in the hands of the physician named and in those of Dr. Balfour and Dr. Foster, several cases of diabetes treated by this medicine were improved by it more than by any other means whatever, the secretion of urine falling to the normal standard, while it became free from sugar and the patients regained their flesh and strength. From 2 to 4 drachms, diluted in from 8 to 10 ounces of water (Gm. 8–16 in Gm. 250–320), were taken during the day. The remarkable solubility of false membranes in lactic acid led to its use in *diphtheria* and in *croup* (pseudo-membranous laryngitis); and the reports of several observers appear to prove that when the acid is applied with a mop in the former, and by atomization or the syringe in the latter disease, it contributes in a remarkable degree to the cure. For the purpose last described a solution was used of 1 part of the acid in 20 parts of water.

Mendel claims that lactic acid relieves *insomnia* produced by nervous excitement, and especially by fright. He recommends that from 1 to 2 fluidrachms (Gm. 4–8) be given in lemonade, or that much larger doses be administered by enema; *e. g.* from 2 fluidrachms to half a fluidounce (Gm. 8–16). In such cases the acid should be neutralized by bicarbonate of sodium. The results of Maragliano's use of the medicine in the insane hardly justify a belief in its hypnotic virtues.

ACIDUM NITRICUM, *U. S.*, *Br.*, *P. G.*—NITRIC ACID.

Acidum nitri s. azoticum, *Spiritus nitri acidus.*—*Acide azotique s. nitrique*, Fr.; *Salpetersäure*, G.

Formula $HNO_3 = NO_2.OH$. Molecular weight 63. Strength 69.4 per cent. (30 per cent. *P. G.*). Spec. grav. 1.42 (1.185 *P. G.*).

Diluted Nitric Acid. Strength, 10 per cent. *U. S.*, 17.44 per cent. *Br.* Spec. grav. 1.059 *U. S.*, 1.101 *Br.*

Origin.—Nitric acid occurs chiefly in combination with the alkalies and alkaline earths, and in localities where vegetable or animal matter has undergone putrefaction. It is found in the juice of many plants and in small quantities in rain- and snow-water. A process for preparing this acid was first made public by Geber in the eighth century, and its composition was determined by Cavendish (1785) and Davy (1816). For medicinal and technical purposes nitric acid is made by decomposing nitrate of sodium or of potassium by sulphuric acid.

Preparation.—1. ACIDUM NITRICUM. It is prepared on the large scale in apparatus constructed similar to that used in the manufacture of hydrochloric acid. The sulphuric acid acts upon nitrate of potassium, forming acid sulphate of potassium and liberating the nitric acid; thus, $KNO_3 + H_2SO_4 = KHSO_4 + HNO_3$. The resulting acid salt does not decompose another molecule of potassium nitrate, except at so high a temperature that most of the nitric acid then given off will be decomposed into nitrous acid and oxygen. 1 molecule or 101 parts of potassium nitrate will therefore require 1 molecule or 98 parts of concentrated sulphuric acid. The same amount of nitric acid may be obtained from 1 molecule or 85 parts of sodium nitrate; but, according to Wittstein (1838), the sulphuric acid requires to be diluted with one-fourth its weight of water to prevent the mass in the retort from being carried over into the receiver, the foaming being prevented by supplying the acid sodium sulphate with the necessary water of crystallization. Graham showed that the reaction of acid sodium sulphate upon sodium nitrate occurs at a much lower temperature than between the corresponding potassium salts; hence, all the nitric acid may be obtained from 2 molecules or 170 parts of sodium nitrate with 98 parts of sulphuric acid, the decomposition furnishing sulphate of sodium; $2NaNO_3 + H_2SO_4$ yields $2HNO_3 + Na_2SO_4$. The violent foaming of the residue toward the close of the operation is prevented by the addition of a little water or by the use of weaker sulphuric acid. Stieren recommends (1865) the employment of 21 pounds of sulphuric acid, specific gravity 1.717, for 24 pounds of nitrate of sodium, as a charge for a retort of 5 or 6 gallons capacity; about one-fourth of the residue in the retort consists of acid sulphate of sodium, the remainder being neutral sulphate.

In the manufacture of nitric acid from nitrate of sodium, sulphuric acid may be replaced by manganous chloride, sulphate of iron, sulphate of magnesium, and similar salts, the metals of which remain as oxides in the retort with the sodium salt; but in most cases the heat necessary to effect the reaction is sufficient to decompose a considerable portion of the nitric acid.

As obtained on the large scale it usually contains some hyponitric acid, which imparts to it a red or yellow color. This is removed by applying to it a moderate heat, and after the red vapors have escaped the acid is diluted to the desired strength.

The nitrates of sodium and potassium, as they occur in commerce, contain variable quantities of chlorides, from which, if used in the above process, hydrochloric acid is liberated, and this, reacting with some of the nitric acid, produces chlorine, which, for this reason, may contaminate the nitric acid. If the acid is desired in a pure state, the nitrates must be previously purified by repeated recrystallization, or the impure acid rectified either by itself or over some nitrate. The first portion of the distillate contains the chlorine, and the receiver is changed when the condensed liquid ceases to produce a curdy precipitate with nitrate of silver. Iodine, if present from the nitrate of sodium, will likewise be found in this part of the distillate. The distillation is continued into the new receiver until about one-fifth or one-sixth is left in the retort, from which, if the heat is continued, hyponitric acid is again produced. Formerly the chlorine and iodine were removed from the crude acid by nitrate of silver; the acid was carefully decanted from the precipitate and rectified. The process of direct rectification, as already described, is more advantageous, from one-half to three-fourths being obtainable in the pure state, according to the purity of the crude acid used.

2. Acidum Nitricum Fumans, *P. G.;* Acidum nitroso-nitricum, Spiritus nitri fumans.—Fuming nitric acid, Nitroso-nitric acid, *E.;* Acide azotique fumante, *Fr.;* Rauchende Salpetersäure, *G.*

If one-half the amount of sulphuric acid is employed as stated above for the preparation of nitric acid from potassium nitrate, and the heat is finally increased until the reaction between the acid sulphate and the remaining nitrate of potassium has been completed, the distillate will be nitric acid containing a considerable quantity of hyponitric acid, or nitrogen tetroxide, N_2O_4, and nitrous anhydride or nitrogen trioxide, N_2O_3; in the presence of water these two compounds may decompose, with the formation of nitric acid and of nitrous acid, HNO_2, and nitrogen dioxide, N_2O_2. Fuming nitric acid therefore contains, besides HNO_3, variable quantities of lower nitrogen oxides.

3. Acidum Nitricum Dilutum, *U. S.*, *Br.*—Diluted nitric acid, *E.;* Acide azotique dilué, *Fr.;* Verdünnte Salpetersäure, *G.*

Mix 1 part of nitric acid with 6 parts of distilled water.—*U. S.* Dilute 6 fluidounces of nitric acid with sufficient distilled water, so that at a temperature of 60° F. it shall measure 31 fluidounces, or dilute 2400 grains of nitric acid with distilled water, so as to obtain 1 imperial pint of the mixture.—*Br.*

Properties.—1. Nitric Anhydride. This was discovered by St. Clair Deville (1849) in decomposing pure crystallized nitrate of silver by absolutely dry chlorine gas.

It forms colorless shining prisms, which fuse at about 30° C. (86° F.) into a liquid boiling near 50° C. (122° F.), and deliquesce rapidly when in contact with moist air. Its composition is N_2O_5, molecular weight 108; combining with 1 molecule of water, H_2O, it forms 2 molecules of nitric acid, $2HNO_3$.

2. Crude Nitric Acid. As met with in commerce, it is either colorless or of a pale yellowish color, and contains the impurities mentioned above, together with a little iron. It is often called *aqua fortis;* the weaker kind is of about 1.21 specific gravity, being known as single aqua fortis, and the stronger, of specific gravity 1.37, as double aqua fortis. Crude nitric acid is extensively used in many chemical processes.

3. Pure Nitric Acid. It is a colorless liquid, wholly volatilized by heat. The concentrated acid or hydrogen nitrate, corresponding in composition to the formula HNO_3, has at 0° C. (32° F.) the specific gravity 1.559. When exposed to the light or heated to near its boiling-point, 36° C. (186.8° F.), it is decomposed partly into water and hyponitric acid, so that its boiling-point is not constant. Nor is the boiling-point of weaker acids constant. Those below and those above the specific gravity 1.42 boil at a constantly rising temperature, until the acid in the retort has been raised or lowered in strength to correspond to the formula $2HNO_3.3H_2O$, when its boiling-point will be stationary at 121° C. (250° F.), and it will have at 15.5° C. (60° F.) the specific gravity 1.42 (Graham). This strength of nitric acid has been adopted as the officinal standard in the United States, British, and French Pharmacopœias. According to Roscoe, nitric acid containing between 70 and 65 per cent. of hydrogen nitrate yields, after continued boiling, a liquid the boiling-point of which is 120.5° C. (249° F.) at a barometer pressure of 735 Mm., and the specific gravity of which is 1.414 at 15.5° C. (60° F.) It contains 68 per cent. of hydrogen nitrate, while Graham's acid should contain 69.96 per cent. The existence of a definite hydrate having a constant boiling-point appears, therefore, somewhat doubtful. The strength is determined by diluting the acid with four or five times its weight of water, and neutralizing with volumetric solution of soda; 6.30 Gm. of the acid require 69.4 Ccm. of the alkali (*U. S.*), or 90 grains of the former and 1000 grain-measures of the latter (*Br.*), indicating respectively 69.4 and 70 per cent. HNO_3, or 59.96 and 60 per cent. N_2O_5. The acid of the German Pharmacopœia is much weaker, its spec. grav. being 1.185.

Nitric acid is a powerful oxidizing agent, converting most metals into oxides or nitrates and decomposing most organic compounds. At the same time orange-red vapors are given off, which are either the trioxide, N_2O_3, or the dioxide, NO_2, the latter being colorless, but acquiring a deep-red color in contact with oxygen. Exposed to the direct or diffused sunlight, even if of less than the officinal strength, it is partly decomposed, becomes red, and then contains lower nitrogen oxides. It is monobasic and combines with most of the basylous radicals, all its compounds being soluble in water, with the exception of a few so-called basic nitrates, such as subnitrate of bismuth.

Per cent. HNO_3.	Specific gravity.		Per cent. HNO_3.	Specific gravity.		Per cent. HNO_3.	Specific gravity.	
	At 0° C.	At 15° C.		At 0° C.	At 15° C.		At 0° C.	At 15° C.
100.00	1.559	1.530	56.10	1.371	1.353	35.00	1.234	1.218
90.00	1.522	1.495	55.00	1.366	1.346	33.86	1.226	1.211
85.00	1.503	1.478	54.00	1.359	1.341	32.00	1.214	1.198
80.00	1.484	1.460	53.81	1.358	1.339	31.00	1.207	1.192
75.00	1.465	1.442	53.00	1.353	1.335	30.00	1.200	1.185
73.00	1.457	1.435	52.33	1.349	1.331	29.00	1.194	1.179
69.96	1.444	1.423	50.99	1.341	1.323	28.00	1.187	1.172
69.20	1.441	1.419	49.97	1.334	1.317	27.00	1.180	1.166
68.00	1.435	1.414	49.00	1.328	1.312	25.71	1.171	1.157
67.00	1.430	1.410	48.00	1.321	1.304	23.00	1.153	1.138
66.00	1.425	1.405	47.18	1.315	1.298	20.00	1.132	1.120
65.07	1.420	1.400	46.64	1.312	1.295	17.47	1.115	1.105
64.00	1.415	1.395	45.00	1.300	1.281	15.00	1.099	1.089
63.59	1.413	1.393	43.53	1.291	1.274	13.00	1.085	1.077
62.00	1.404	1.386	42.00	1.280	1.264	11.41	1.075	1.067
60.00	1.393	1.374	41.00	1.274	1.257	7.22	1.050	1.045
59.59	1.391	1.372	40.00	1.267	1.251	4.00	1.026	1.022
58.88	1.387	1.368	39.00	1.260	1.244	2.00	1.013	1.010
58.00	1.382	1.363	37.95	1.253	1.237	0.00	1.000	.999
57.00	1.376	1.358	36.00	1.240	1.225			

The density of pure nitric acid varies with its strength. In taking its specific gravity the absence of notable quantities of hyponitric acid should be ascertained, since they increase the density. The foregoing table, drawn up J. Kolb (1866), agrees nearly with the older one of Ure, which is based upon a maximum density of 1.500 at 15.5° (60° F.), and an acid having, according to him, a composition represented by the formula $4HNO_3.H_2O$.

4. Fuming Nitric Acid has a brown-red color, and when in contact with the air emits vapors of the same color, which are of a suffocating odor. It requires to be kept in a cool place, and caution should be exercised in removing the stopper, lest a portion of the liquid should be violently ejected with the escaping vapors. The German Pharmacopœia requires for this preparation a specific gravity of from 1.45 to 1.50. The so-called *nitrous acid* of our commerce is a similar but weaker article, consisting of nitric acid, which is colored red by variable quantities of hyponitric acid. If nitrous acid gas, N_2O_3, is conducted into nitric acid, a corresponding quantity of hyponitric acid, N_2O_4, is formed; thus: $N_2O_3 + 2HNO_3 = 2N_2O_4 + HO_2$. This compound is colorless at —10° C. (14° F.), orange-red at 10° C. (50° F.), and darker red above this temperature.

5. Diluted Nitric Acid is colorless, has the specific gravity 1.059, and 12.6 grains of it are neutralized by 20 Ccm. of the volumetric solution of soda, corresponding to 8.57 per cent. N_2O_5 or 10 per cent. HNO_3, *U. S.* That of the British Pharmacopœia has the specific gravity 1.101, and 361.3 grains of it (6 fluidrachms) require for neutralization 1000 grain-measures of the volumetric solution of soda, corresponding to 14.95 per cent. N_2O_5 or 17.44 per cent. HNO_3.

Impurities.—Such as are likely to be present have been mentioned above. Mineral impurities are left behind as a fixed residue on evaporation, and may then be recognized by appropriate tests. Iodine is detected by agitating the acid with chloroform, which will acquire a reddish color and impart to starch a blue color. If the color appears only after the careful addition of sulphuretted hydrogen, iodic acid has been present; with an excess of sulphuretted hydrogen the iodic acid would be converted into colorless hydriodic acid, $2HIO_3 + 6H_2S = 6H_2O + 2HI + 3S_2$. Diluted with 5 volumes of distilled water, nitric acid should not produce any precipitate with nitrate of silver (chlorine or hydrochloric acid), nitrate of barium (sulphuric acid), or sulphuretted hydrogen, either before or after neutralization with ammonia (metals). The diluted acid should not be colored blood-red by sulphocyanide of potassium (iron) or blue by starch-paste (iodine). Traces of arsenic are best detected by Fleitmann's test (see page 28), and the lower nitrogen oxides by the decolorization of solution of potassium permanganate or the liberation of iodine from solution of potassium iodide. As stated above, such lower oxides are formed on exposure to sunlight.

Pharmaceutical Uses.—Nitric acid is largely used for dissolving metals (bismuth, iron, mercury, and silver), for the oxidation of ferrous to ferric compounds and of phosphorus to phosphoric acid, and in the preparation of nitrous ether and nitrite of amyl.

Physiological Action.—When injected into the blood-vessels of animals it is said not to coagulate the blood, or to do so very imperfectly. Upon the tissues with which the strong acid (33 per cent.) comes in contact it exerts a caustic action, staining the skin yellow, rendering the pharynx and œsophagus white, and causing erosions and ulcers, some of the latter perforating, in the stomach. The small intestine is generally intact, but the glands of the large intestine are ulcerated, showing, perhaps, the excretion of the acid partly through them. A 10 to 15 per cent. solution does not stain the tissues, but produces swelling, œdematous or hæmorrhagic, and gives the blood of the part a brownish tint. If medicinal doses are long continued, unless precautions are taken the acid impairs and may destroy the enamel of the teeth. It increases the appetite and augments the secretion of urine. A white coating generally covers the tongue; the mouth at first grows dry, but later the salivary secretion may become profuse, when the gums grow spongy and bleed, and the teeth ache and are loosened. If continued, it occasions dyspepsia, colic, foul breath, headache, feverishness, debility, and derangement of the bowels. These symptoms are said to be occasioned by nitric acid baths as well as by the internal use of the acid. They rapidly subside when the medicine is suspended.

Medical Uses.—Formerly used as a *disinfectant*, it was abandoned on account of the irritating quality of its fumes and of the introduction of chlorine and various other more efficient and less annoying agents. It was given internally in *typhus* and other low types of *fever* with presumed, but by no means demonstrated, advantage. In periodical, and especially *intermittent*, fevers, it has been proved to be one of the most efficient substitutes for cinchona, and indeed to cure many cases in which quinine was inoperative. From 6 to 8 drops of the acid, properly diluted, should be given every 6 hours without regard to remissions or exacerbations. It was formerly used in the treatment of *dysentery* and other bowel affections on the recommendation of Hope, who employed nitrous acid ♏xxx, and laudanum ♏xx, in camphor-water f℥iv, of which mixture a tablespoonful was given every 2 hours. At one time it enjoyed a certain reputation in *whooping cough*, for which very large doses were administered. As far as it did good, the effect was probably due to the stimulant and substitutive action of the acid upon the fauces. By the same agency it doubtless palliates the cough of *bronchitis* and *hoarseness* due to over-exertion of the voice; it also promotes the cure of syphilitic and other *ulcers* of the throat. When used long enough to excite ptyalism it is reputed to have cured constitutional *syphilis.* In the last-named disease it has been seldom prescribed since the introduction of iodide of potassium. It would seem to allay the thirst of *diabetes*, and the daily administration of from 1 to 3 or 4 drachms of the acid in a quart of water has certainly cured several cases of *diabetes insipidus* (Kennedy). This treatment should be persevered in until the affection of the mouth produced by the medicine, and above described, is distinctly developed. In chronic enlargement of the *liver* in scorbutic, strumous, and syphilitic subjects, as well as in *jaundice* depending upon hepatic congestion, and in *scrofula* of the lymphatic glands, it appears to have been often efficacious. In chronic *impetigo* it has sometimes proved successful when other medicines were ineffectual. Externally, nitric acid has been much employed as a caustic for the *bites of rabid animals*, *poisonous serpents* and *insects*, etc. As already intimated, it forms an excellent ingredient of gargles for the treatment of syphilitic and other obstinate *ulcers* of the throat, as well as for sloughing sores in the mouth. It is an efficient application to ulcerated gums produced by mercury. In both of the last-mentioned cases it has been superseded by chlorate of potassium. Commercial nitric acid has been applied (T. G. Thomas) to ulcers of the rectum in *chronic dysentery.* The patient should first be etherized, the bowel exposed by means of a duck-bill speculum, and commercial nitric acid lightly applied by means of a small piece of wet cotton wrapped around the end of a whalebone rod. This method was used in imitation of a similar application of nitrate of silver. Lotions or foot-baths containing nitric acid are useful in the treatment of *chilblains*, and general baths feebly acidulated by its means have been recommended for *infantile jaundice.* It is a very useful application to *periostoses* when used so as to maintain a slight irritation of the skin; and as a caustic it is often resorted to for the destruction of *warts*, venereal and non-specific, and of *condylomata* and *hæmorrhoids.* For these purposes its action should be limited to the diseased structure by means of cerate; or lint saturated with concentrated nitric acid, and adapted to the part in shape and size, may be allowed to remain in contact with it for a sufficient time. The tissue may have its sensibility blunted by carbolic acid, by rhigolene or other anæsthetic vapor, or by cold; or the patient may be etherized during the operation. In *caries* of the bones and *sloughing* of the soft parts the acid may be used to hasten the separation of the diseased tissue. The *dose* of the stronger acid is from 5 to 20 minims (Gm. 0.30–1.30), and of the diluted acid from 25 to 50 minims (Gm. 1.60–3.30), three or four times a day, largely diluted. It should always be taken through a glass tube, and immediately afterward the mouth should be washed with a solution of bicarbonate of sodium.

ACIDUM NITROHYDROCHLORICUM, *U. S.*—NITROHYDROCHLORIC ACID.

Acidum chloro-nitrosum, *Acidum nitromuriaticum*, *Aqua regia*, *Aqua regis.*—*Nitromuriatic acid*, E.; *Acide chloro-azotique s. chloro-nitreux*, *Eau régale*, Fr.; *Salpetersalzsäure*, *Königswasser*, G.

Preparation.—Take of Nitric Acid 4 parts (1 oz. av. = 5½ fluidrachms); Hydrochloric Acid 15 parts (3¾ oz. av. = 25 fluidrachms). Mix the acids in an open glass vessel, and when effervescence has ceased pour the product into glass-stoppered bottles, which should not be more than half filled, and keep them in a cool place.—*U. S.*

The French Codex directs 1 part of nitric acid, spec. grav. 1.32, and 3 parts of hydrochloric acid, spec. grav. 1.17. This preparation has been dismissed from the new German Pharmacopœia.

ACIDUM NITROHYDROCHLORICUM DILUTUM, *U. S.*, *Br.*—DILUTED NITROHYDROCHLORIC ACID.

Acidum nitromuriaticum dilutum.—*Diluted nitromuriatic acid*, E.; *Acide chlorazotique dilué*, Fr.; *Verdünnte Salpetersalzsäure*, G.

Preparation.—Take of Nitric Acid 4 parts (1 oz. av.); Hydrochloric Acid 15 parts (3¾ oz. av.); Distilled Water 76 parts (19 oz. av. = 18¼ fluidounces). Mix the acids in a capacious open glass vessel, and when effervescence has ceased add the distilled water. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

According to the British Pharmacopœia, 3 fluidounces of nitric acid are mixed with 4 fluidounces of hydrochloric acid, and allowed to remain for a day in a bottle the mouth of which is partially closed; 25 fluidounces of distilled water are then added in successive portions, the bottle shaken after each addition, and the mixture is preserved in a stoppered bottle.

On mixing nitric with hydrochloric acid a decomposition takes place, resulting in the liberation of chlorine and the formation of water and chlorinated nitrogen oxides. This preparation has received the name of *aqua regia* from its property of dissolving gold, the king of metals, which is due to the presence of free chlorine; for the same reason are dissolved platinum, calomel, and all other metals and compounds which yield soluble chlorides. Its activity therefore depends upon the amount of free chlorine contained in it. The British Pharmacopœia employs the two acids very nearly in the proportion of $6HNO_3$ to $5HCl$, while the proportion directed by the U. S. Pharmacopœia is $1HNO_3$ to $3HCl$. The chlorinated compounds formed in the two processes must therefore differ to some extent; in the latter case the reaction may take place as follows: $HNO_3 + 3HCl = Cl_2 + NOCl$ (chloronitrous acid) $+ 2H_2O$, or according to this equation: $2HNO_3 + 6HCl = Cl_2 + 2NOCl_2$ (chloro-hyponitric acid) $+ 4H_2O$. A third compound, *chloronitric acid* or *nitrylic chloride*, NO_2Cl, is likewise formed, particularly if a larger proportion of hydrochloric acid be used; it is a yellow liquid, boiling at 5° C. (41° F.), and decomposed by water into nitric and hydrochloric acids. *Chloronitrous acid* or *nitroxylic chloride* is a yellowish-red liquid which boils at $-5°$ C. (23° F.), and with water yields hydrochloric and nitrous acids. Gay-Lussac, its discoverer, described the *chloro-hyponitric acid* as boiling at $-7°$ C. (19.4° F.), forming a lemon-yellow gas, and with water decomposing into hyponitric and hydrochloric acids. According to the older views, nitromuriatic acid is essentially a mixture of chlorine and hyponitric acid, NO_2, the reaction being explained as follows: $HCl + HNO_3 = Cl_2 + NO_2 + H_2O$.

As the stability of these compounds is influenced by temperature and by water, it is obvious that the composition of nitromuriatic acid must vary with the proportion and the strength of the acids employed, and with the temperature at which they have been mixed; at a low temperature this mixture may be kept without evolution of gas, but at ordinary or a somewhat elevated temperature a variable mixture of gas is given off, hence the necessity of not dispensing this preparation until after effervescence has ceased, and of keeping it in vials not quite filled.

Properties.—Nitrohydrochloric acid is a liquid having a deep golden-yellow color and the odor of chlorine. It readily dissolves gold-leaf, liberates iodine and bromine from their salts, and is wholly volatilized by heat. It should be kept in a cool and dark place, and dispensed in dark- or yellow-colored bottles. It should not be kept on hand for a long time, and is preferably made extemporaneously, provided that the reaction between the acids has been completed and the effervescence has ceased before it is dispensed.

In the diluted nitrohydrochloric acid the chloronitrous acid has probably been decomposed by the water into hydrochloric and nitrous acids; thus: $2NOCl + H_2O = 2HCl + N_2O_3$. On account of the free chlorine contained in it, it should likewise be kept in a cool place and protected from the light.

Physiological Action.—Like its constituent acids, it acts as a powerful corrosive poison when taken pure and in large quantities. In smaller doses it is very apt to disagree with the stomach, and it readily attacks the enamel of the teeth. When mixed with the water of a warm bath, so as slightly to acidulate it, it is absorbed by the skin, greatly increasing the acidity of the urine, and after several repetitions of the bath exciting a burning sensation in the mouth and throat, a considerable flow of saliva, superficial ulcers of the mouth, and redness and swelling of the gums. The bowels are more frequently moved, and there is sometimes an increased tendency to urination. The secretion of bile is said also to be augmented. From an experiment upon a dog performed by Rutherford he concluded that dilute nitromuriatic acid is "a hepatic stimulant of considerable power."

Medical Uses.—Diluted nitrohydrochloric acid has been employed for many of the same purposes as nitric acid, such as diseases of the *liver*, *scrofula*, *syphilis*, *cutaneous affections*, and chronic *rheumatism*, but there does not appear to be any sufficient ground for preferring it to the simpler nitric or muriatic acid, at least as an internal medicine. As originally used, it was applied in the form of a general warm bath which contained no less than 32 fluidounces of the acid. A foot- and a sponging-bath of like strength were also employed, and several folds of flannel immersed in the liquid of the bath were wrapped around the body. The use of this regimen for at least 2 months was recommended. At the present time the literal application of nitrohydrochloric baths is seldom resorted to, but there is good reason to believe that in a much less energetic form they are sometimes of marked utility. Foot-baths and lotions, as well as cloths wet with acidulated water applied over the hepatic region, we have several times employed with decided advantage in cases of slight *jaundice* accompanied with *dyspepsia*, hepatic tenderness and fulness, and hypochondriasis in persons who use alcohol to excess.

The risk of its injuring the teeth should render physicians very circumspect in the internal use of this acid; and fortunately there are no conditions in which it is appropriate that cannot as well be treated by safer medicines. The *dose* of the stronger acid is 3 or 4 drops (Gm. 0.20–0.25), and of the diluted acid from 10 to 20 drops (Gm. 0.60–1–30), largely diluted and imbibed through a glass tube. The antidotes are the same as those employed for its component acids.

ACIDUM OLEICUM, *U. S., Br.*—OLEIC ACID.

Acidum oleinicum s. elainicum.—Elaic acid, E.; *Acide oleïque*, Fr.; *Oelsäure*, G.
Formula $HC_{18}H_{33}O_2 = C_{17}H_{33}.COOH$. Molecular weight 282.

Origin and Preparation.—Oleic acid exists as triolein in most of the solid and non-drying liquid fats. It was isolated by Chevreul (1811), and by Gottlieb (1846) obtained in the chemically pure state.

Large quantities of oleic acid are obtained in the manufacture of stearic acid for candles. (See OLEA PINGUIA.) This acid is usually of a brownish-yellow or red-brown color, and not entirely transparent at a temperature of 12° or 15° C. (53° or 59° F.), in consequence of the presence of solid fatty acids, which, according to Ch. Rice (1873), may be mostly removed by cooling to 4.5° C. (40° F.) and subjecting the soft mass to pressure; or the acid may be mixed with an equal bulk of strong alcohol, and the solution kept at a temperature of 7° or 8° C. (45° F.), when most of the solid fatty acids will be deposited, and the oleic acid may be further purified by combining with lead and treating as stated below.

Bromeis (1842) obtained oleic acid by saponifying almond or olive oil with potassa, decomposing the soap with hydrochloric acid, combining the fatty acids with lead by digesting with oxide of lead, dissolving the oleate of lead in ether, and agitating the ethereal solution with hydrochloric acid. This process has been improved by Dr. L. Wolff (1877, 1879), by saponifying almond oil directly with oxide of lead, and substituting petroleum benzin for ether, which dissolves the lead oleate equally well. After decomposing this solution with dilute hydrochloric acid the benzin is evaporated and the remaining oleic acid washed with water.

C. T. George (1881) recommends dry white Castile soap, of which 30 parts are dissolved in 100 parts of hot water; the solution is decomposed by slowly adding, with constant stirring, 6 parts of sulphuric acid; the oily layer is washed with warm water, combined with 2 parts of powdered litharge, the warm lead oleate dissolved in 10 parts of petroleum benzin, and this solution decomposed by 1 part of hydrochloric acid diluted with 12 parts of water; after evaporating the benzin, about 15 parts of oleic acid are left.

To free oleic acid thus obtained from the products of oxidation, Bromeis recommends cooling it slowly to about − 6.6° C. (20° F.) and expressing it in thin layers between absorbent paper: after repeating this several times it is remelted, a little alcohol added, cooled as before, and again expressed.

Properties.—Pure oleic acid is a colorless, inodorous, and tasteless oily liquid of neutral reaction, having at 19° C. the density .898 (Chevreul), congealing to a white crystalline mass at 4° C. (39.2° F.), and crystallizing from alcohol in dazzling white needles melting at 14° C. (57.2° F.) (Gottlieb). The solid acid is but little affected by exposure to air, but in the liquid state it rapidly absorbs oxygen on exposure, becoming yellow and brown and acquiring a rancid odor, lower congealing-point, and an acid reaction. Commercial oleic acid is somewhat oxidized, and has a yellow or brownish color, a fatty odor, and a distinct acid reaction. It may be distilled *in vacuo* without decomposition, but if distilled in contact with air yields carbonic acid, hydrocarbons, and an oily distillate containing *sebacic acid*, $C_{10}H_{18}O_4$. With melted potassa it is decomposed into palmitic and acetic acids. It is a solvent for fats and fatty acids, is insoluble in water, and dissolves in all proportions of alcohol, ether, chloroform, benzin, and other hydrocarbons, volatile and fixed oils. It unites with bases, and when heated slowly decomposes the alkaline and earthy carbonates, forming soaps. Many of the oleates are soluble in alcohol, several also in ether; the normal lead oleate is white, melts at 80° C. (176° F.), and dissolves in ether and benzin. Oleic acid left in contact with nitrous acid is converted into the isomeric *elaidic acid*, which crystallizes in pearly plates and melts at 44° C. (111.2° F.). When oxidized by nitric acid, succinic and several other acids are obtained.

Impurities.—The solution of oleic acid in an equal weight of alcohol should at 25° C. (77° F.) be perfectly transparent and not separate a layer of fixed oil, and at 7.2° C. (45° F.) should not yield a crystalline deposit of stearic or palmitic acid.

Pharmaceutical Uses.—For the preparation of Oleata.

Medical Uses.—Oleic acid is used in medicine only in combination. Two of its compounds are officinal, but many others have been employed, especially since attention was called to them by Marshall in 1872. It is claimed that they will not decompose like ointments, and do not act as irritants on the skin. They are also more cleanly in their application, and are credited with penetrating the skin more deeply than ointments. Marshall claims for the oleates of morphia and atropia a powerful action in allaying *pain* and *nervous irritation*, and for the oleate of mercury special advantages in the treatment of diseases of the skin, including *sycosis*, *chloasma*, *pediculi*, *syphilitic* affections, etc. Dr. Shoemaker (*Trans. Med. Soc. of Penna.*, xii. pt. ii. p. 709) confirms these statements, and claims that oleate of atropia has a marked influence in *seborrhœa* and *erysipelas*, and that oleate of mercury is an invaluable application to the scalp in general thinning and *loss of hair.* Of oleate of lead he states that he has obtained remarkably good results from its use in *eczema*, in *acne rosacea* after depletion of the parts, in *burns*, and in *erythema.* Oleate of copper he found capable of rapidly curing *ringworm* of the scalp and body; and he used it for *indolent ulcerating surfaces*, as well as on hard and horny *warts*, *corns*, and *bunions.* Oleate of aluminium he used in checking muco-purulent discharges in *eczema*, and as a dressing in foul *ulcers*, *abscesses*, *sinuses*, *burns*, and *scalds.* Oleate of bismuth he found efficacious in superficial *erysipelas* and *sunburn*, and, applied by means of a bougie, in *gleet*, and oleate of arsenic in *lupus*, *epithelioma*, *warts*, and various similar growths. Oleate of silver, in the form of a fine powder or in an ointment, was valuable in the treatment of chronic *ulcers*, *bed-sores*, *exuberant granulations*, etc. In most of these cases the oleate was associated with lard in varying proportions (*Philad. Med. Times*, xii. 758).

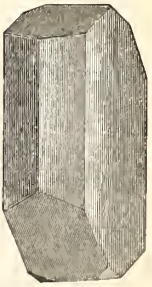
ACIDUM OXALICUM.—OXALIC ACID.

Acide oxalique s. carboneux, Fr.; *Oxalsäure*, *Kleesäure*, G.

Formula $H_2C_2O_4,2H_2O = (COOH)_2.2H_2O$. Molecular weight 126.

Origin and Formation.—Oxalic acid occurs in combination with ammonium in guano, and with calcium in a large number of plants, among which may be mentioned the following officinal drugs: rhubarb, curcuma, ginger, squill, orris, valerian, quassia, etc. It is found as acid potassium oxalate in the leaves and stalks of phytolacca, belladonna, and several species of rumex (sorrel), rheum, and oxalis (wood-sorrel), taking its name from the last-named genus. Some urinary calculi consist of oxalate of calcium, which is also found in the gall-bladder, in uterine mucus, and in some urinary sediments, in most lichens, and in many vegetable tissues. It is formed by the action of nitric acid upon many organic compounds, and sugar, gum, sawdust, and other organic bodies yield oxalates when gradually heated to redness with excess of potassium or sodium hydrate (Gay-Lussac, 1829). The chemical behavior of salt of sorrel was investigated by Savary (1773), and its acids recognized by Wiegleb (1779) as being distinct from others then known. Scheele (1776) prepared the acid from sugar, and proved (1778) it to be identical with that in sorrel, rhubarb, and other plants.

FIG. 7.



Crystal of Oxalic Acid.

Preparation.—1 part of sugar, molasses, or starch is mixed in a retort with 8 parts of nitric acid, spec. grav. 1.38; a gradually increased heat is applied until the liquid finally boils, and red nitrous acid vapors cease to be given off; it is then concentrated by evaporation to one-sixth of its volume and set aside to crystallize. The crystals are drained from the mother-liquor and recrystallized from hot water. This is the process of Scheele and Bergman (1776), modified in the strength of nitric acid by Schlesinger (1841). L. Thompson (1848) recommended the use of a weaker nitric acid, of 1.245

density, in order to avoid the generation of formic acid by the decomposition of oxalic acid. Schlesinger obtained from 100 parts of sugar 58 to 60 parts of handsomely crystallized oxalic acid; Thompson, from the same quantity of sugar, 63 parts of acid, and, by utilizing the mother-liquor in each subsequent charge of the retort, from 107 to 115 parts of oxalic acid. If the nitric acid employed is insufficient in quantity, a corresponding amount of the sugar will be converted into *saccharic acid*, $C_6H_{10}O_8$.

E. Stieren (1865) used the dark mother-liquors obtained in the preparation of tartaric acid as a source for oxalic acid. They are advantageously worked up for this purpose by adding to 20 parts thereof, previously warmed, 2 parts of nitric acid, spec. grav. 1.33. After the extrication of the nitrous acid vapors more nitric acid is gradually added until red vapors are no longer given off. The liquid is suitably concentrated and crystallized, and the crystals are purified by recrystallization.

Most of the oxalic acid is made by a process based upon Gay-Lussac's observations, mentioned above. Dale observed that caustic soda would not produce it from sawdust until it was mixed with potassa. 2 molecules of the former and 1 of the latter are dissolved in water to form a solution of 1.35 spec. grav., which is mixed with sufficient sawdust to obtain a pasty mass, and then heated, with constant stirring, upon iron plates. After it has been kept at a temperature of 204.5° C. (400° F.) for 1 or 2 hours, the heat is extended until the mass is quite dry, care being taken that no charring takes place. The gray powder contains 28 to 30 per cent. of oxalic acid combined with the alkalies; it is washed with solution of carbonate of sodium, by which the potassium is removed as carbonate; the oxalate of sodium is boiled with milk of lime, whereby caustic soda and oxalate of calcium are formed, and the latter is decomposed by sulphuric acid; the oxalic acid is purified by recrystallization. By this process sawdust yields about half its weight of oxalic acid (*American Journal of Pharmacy*, 1863, p. 359). 323,366 pounds of oxalic acid were imported into the United States in 1867, and over 1,000,000 pounds in 1880.

For analytical purposes oxalic acid requires purification by several recrystallizations from distilled water; this acid is dissolved in hot alcohol, the solution filtered and allowed to crystallize; the crystals, containing ethyloxalate, are boiled with water, the solution on cooling yielding the pure acid.

Properties.—Oxalic acid crystallizes from its aqueous solution in flat, oblique, rhombic prisms, which are colorless, transparent, not deliquescent, inodorous, of a strongly acid taste and reaction, and soluble in about 8 parts of water at ordinary temperature, and in nearly all proportions of boiling water. Nitric acid increases their solubility in cold water. They dissolve in 2½ parts of cold and 1.8 parts of boiling strong alcohol, and are but little soluble in ether. Oxalic acid fuses at 98° C. (208.4° F.), and at about 160° C. (320° F.) sublimes partly unaltered, and is partly decomposed into carbonic anhydride and carbonic oxide without leaving any residue. The same decomposition takes place when oxalic acid is heated with strong sulphuric acid, but when dissolved in the latter at a moderate heat large oblique octahedra of anhydrous oxalic acid are gradually deposited (Villiers, 1880). The commercial acid usually leaves upon platinum-foil a little charcoal, which is finally consumed, a small residue of alkaline carbonate often remaining. Heated with glycerin to a little above the temperature of boiling water, it is decomposed into carbonic and formic acids. In chemical affinity it is one of the strongest acids, yielding normal and acid salts which, with the exception of the normal alkaline oxalates, are mostly insoluble or slightly soluble in water, but which dissolve in diluted nitric acid. Oxalic acid yields with lime-water, and the soluble oxalates with all soluble calcium salts, a white precipitate which is insoluble in oxalic and acetic acids. The acid potassium oxalates are popularly called *salt of sorrel*, also *salt of lemon*, and are employed for removing iron stains from paper, linen, leather, etc.; but at present oxalic acid is usually substituted for this purpose.

The composition of oxalic acid, dried at 100° C. (212° F.) or obtained by sublimation, is expressed by the formula $C_2H_2O_4$; crystallized from water, it is $C_2H_2O_4.2H_2O$.

Impurities.—Mineral impurities are left behind on incinerating the oxalic acid upon platinum-foil; organic impurities will blacken concentrated sulphuric acid on boiling. Sulphuric acid, if present, will produce with nitrate of barium a white precipitate which is insoluble in diluted nitric acid.

Pharmaceutical Uses.—As a test for calcium salts and for preparing ferri oxalas.

Poisonous Action.—From its resemblance to Epsom salt many cases of poisoning by oxalic acid have occurred. Its taste is intensely sour; when swallowed, it, in general, soon occasions vomiting, with burning pain and constriction of the throat and stomach; the ejected matters are dark-colored, and may contain blood. When the pain is very severe collapse may speedily ensue, with drowsiness or stupor. Sometimes these symptoms are unaccountably delayed. For several days the urine abounds in oxalates. In some cases death is rapid, occurring in from 3 to 20 minutes; in others it has been postponed until the 23d day; in others still an excessive dose has been promptly vomited, and, after comparatively slight symptoms, the patients have recovered. The quantity of the acid fatal to life is equally indeterminate. The usual *post-mortem* lesions are: dark discoloration of the œsophagus and stomach, gelatiniform softening of the mucous membrane, and even perforation of the coats of the stomach. The blood is said to present an unusually bright color. The uriniferous tubes are filled with oxalates (Fraenkel). The appropriate antidote to this poison is lime in the form of powdered chalk mixed with water. If this is not at hand, slaked lime, as dried whitewash, may be resorted to until the better preparation can be procured. Binoxalate of potassium causes similar symptoms, which require the same treatment as those of oxalic acid. Oxalic acid and the oxalates appear to be poisonous through a special action upon the nervous system and the blood, as well as by producing gastro-intestinal inflammation; but Koch ranks it with the potassium salts as a heart-poison (*Archiv f. Exp. Pathol.*, etc., xiv. 153).

Uses.—According to Cornilleau (*Practitioner*, xxv. 486), a secret remedy for diphtheria which had proved very successful was found to contain oxalic acid in combination with potash and traces of tannin. He accordingly used the following: Oxalic acid Gm. 1.50; infusion of green tea Gm. 120; syrup of bitter orange-peel Gm. 30; of which mixture a dessertspoonful was given every 3 hours. Each dose would therefore contain about three-quarters of a grain of oxalic acid. The alternative method suggested by him—viz. a decoction of fresh sorrel-leaves—is certainly safer, and either is probably as useful as infusion of sumac-berries and other acidulous preparations used as palliatives of the throat affection in diphtheria. Eltinge reports a case of *epithelioma* of the lip cured by the application of the inspissated juice of Oxalis acetosella. It occasioned intense pain, lasting for half an hour (*Philad. Med. Times*, xii. 159).

ACIDUM PHOSPHORICUM, *U. S., Br., P. G.*—PHOSPHORIC ACID.

Acide phosphorique, Fr.; *Phosphorsäure*, G.

Officinal Phosphoric Acid: Formula $H_3PO_4 = PO.(OH)_3$. Molecular weight 98. Strength 50 per cent., *U. S.*, *F. Cod.*; 66.3 per cent., *Br.* Spec. grav. 1.347, *U. S.*; 1.349, *F. Cod.*; 1.5, *Br.*

Diluted Phosphoric Acid: Strength 10 per cent., *U. S.*; 13.8 per cent., *Br.*; 20 per cent., *P. G.* Spec. grav. 1.057 *U. S.*, 1.080 *Br.*, 1.120 *P. G.*

Varieties and Origin.—Phosphoric (metaphosphoric) anhydride is obtained in snow-white flakes on burning dry phosphorus in dry oxygen or atmospheric air. That this new body has a greater weight than the phosphorus from which it was prepared was noticed by Marggraf (1743); but Gay-Lussac (1772) showed this increase in weight to be due to the combination with air (oxygen). The anhydride has the composition P_2O_5, and attracts moisture with avidity, whereby it is converted into monobasic *metaphosphoric acid*, HPO_3, which is the formula of glacial phosphoric acid. This acid is, however, not prepared in the manner indicated, but is obtained from bones, which are the calcium compound of the tribasic *orthophosphoric acid*, H_3PO_4, discovered by Gahn (1769) and isolated by Scheele (1771). A third modification is the bibasic *diphosphoric* or *pyrophosphoric acid*, having the formula $H_4P_2O_7$. Rother (1876) regards the following as the correct formulas: metaphosphoric acid, $H_2P_2O_6$; pyrophosphoric acid, $H_4P_2O_7$; and orthophosphoric acid, $H_6P_2O_8$. The three acids differ from each other in the following reactions of their aqueous solutions: *Metaphosphoric acid* coagulates albumen, and produces white precipitates with chloride of barium and chloride of calcium, and a transparent gelatinous precipitate with nitrate of silver. *Pyrophosphoric acid* does not affect albumen, chloride of calcium, or chloride of barium, but produces a white precipitate with nitrate of silver on the addition of a little ammonia. *Orthophosphoric acid* does not affect albumen, chloride of calcium, or chloride of barium, and produces with nitrate of silver a yellow precipitate on the addition of a little ammonia. The reaction of silver salts with orthophosphates was first described by Marggraf (1746), and with pyrophosphates by Clark (1828); and the difference in the behavior to albumen was noticed by Berzelius and Engelhart (1826). But the exact chemical relations of these different compounds was first explained by Thomas Graham (1833).

Phosphoric acid, met with in the combined state in the mineral, vegetable, and animal kingdom, is orthophosphoric acid. Pyrophosphates are obtained by heating to redness orthophosphates containing 1 atom of basylous hydrogen or ammonium. (See Sodii Pyrophosphas.) Metaphosphoric acid is produced on heating ortho- or pyrophosphoric acid or their ammonium compounds to redness.

Preparation.—1. Acidum Phosphoricum Glaciale.—Glacial Phosphoric Acid, *E.;* Acide phosphorique glacial, *Fr.;* Glasige Phosphorsäure, *G.*

Formula HPO_3. Molecular weight 80. About equal parts of bones burned to whiteness, and sulphuric acid diluted with 15 parts of water, are digested for some time until the insoluble part has been converted into white smooth sulphate of calcium; the liquid, containing sulphuric and phosphoric acids, and holding calcium and magnesium phosphates in solution, is removed by filtration and washing with water, neutralized with ammonia or carbonate of ammonium, separated from the precipitated phosphates, and evaporated to dryness. The ammonium phosphate is then heated in a platinum crucible to redness until the ammonia has been completely driven off. Porcelain capsules are corroded in this last operation. The fused acid is poured upon polished iron plates, and, when cool, put into bottles.

Thus prepared, phosphoric acid contains a little sodium, to free it from which Neustadtl (1861) proposes to neutralize the acid with ammonia, precipitate with barium chloride, and decompose the resulting phosphate of barium, after it has been thoroughly washed, with sulphuric acid; the acid filtrate is then evaporated and heated to redness.

2. Acidum Phosphoricum, U. S.—*Phosphoric Acid*, E. Phosphorus 16 parts (4 oz. av.); Nitric Acid, Distilled Water, each a sufficient quantity. Mix 100 parts (25 oz. av. = 17 fluidounces) of nitric acid with 100 parts (25 oz. av. = 24 fluidounces) of distilled water in a glass retort having the capacity of 400 parts. Having placed the retort upon a sand-bath or wire-gauze support, connect it loosely with a well-cooled receiver, and add to the acid in the retort the phosphorus, previously cut into fine pieces. Insert a funnel through the tubulure of the retort, and then gradually apply heat until the reaction is seen to commence. Regulate the heat carefully, so as to prevent the reaction from becoming too violent, or, if necessary, check it by the addition of a little distilled water through the funnel. From time to time return the acid liquid, which collects in the receiver, into the retort, until all the phosphorus is dissolved. Then transfer the liquid to a weighed porcelain capsule, and continue the heat, at a temperature not exceeding 190° C. (374° F.), until the excess of nitric acid is driven off, and an odorless, syrupy liquid remains. Test small portions for nitric, phosphorous, and arsenic acids by the methods indicated below. If nitric acid be present, evaporate the liquid until no reaction for nitric acid can be obtained. If phosphorous acid be present, add to the liquid a mixture of 6 parts of nitric acid and 6 parts of distilled water, and again evaporate until no reaction for phosphorous or nitric acid can be obtained. Then, having cooled the acid, add sufficient distilled water to make the product weigh 100 parts. If arsenic acid be present, dilute the acid with 150 parts of distilled water, heat to about 70° C. (158° F.), and pass through the liquid a stream of hydrosulphuric acid gas for half an hour; then remove the heat and continue passing the gas until the liquid is cold. Close the vessel tightly, set it aside for 24 hours, filter the liquid, heat it until all odor of the gas has been driven off, again filter, and evaporate until the residue weighs 100 parts (25 oz. av. or 17¾ fluidounces). Preserve the product in glass-stoppered bottles.—*U. S.*

When phosphorus is treated with a weak nitric acid no action will take place in the cold, but at an elevated temperature it is oxidized into phosphorous and phosphoric acids, according to the strength of the acid employed. Concentrated nitric acid oxidizes it at once into phosphoric acid. The reaction, which is moderate in the beginning, rapidly becomes violent, the phosphorus is ignited, and nitrous acid vapors are so copiously disengaged that an explosion is likely to occur, particularly if the operation is performed in a retort, shattering the vessel and throwing the hot acid and burning phosphorus in all directions. The danger is avoided by the use of a diluted nitric acid, as directed above, the oxidation of the phosphorus taking place uniformly and with perfect safety when an acid of 1.20 or 1.22 specific gravity is used, or obtained by mixing equal weights of the officinal acid and distilled water. It is important, however, that a *moderate* heat only be applied, sufficient to fuse the phosphorus and to induce the reaction; about 50° C. (122° F.) will suffice. No advantage results from cutting the phosphorus into fine pieces, since at ordinary temperature the reaction proceeds very slowly. Considerable heat being produced by the oxidation, the subsequent heating should be carefully watched; it is unnecessary to heat the mixture to boiling until after the phosphorus has been dissolved. With nitric acid of less strength a higher degree of heat is requisite to commence and sustain the reaction, and much nitric acid will either distil over or be lost. But even at a more moderate heat a little nitric and phosphorous acid will be vaporized, and this should be returned by keeping the neck of the retort elevated, or by pouring the liquid which may have collected in the receiver back into the retort. If the operation is skilfully performed, an inverted funnel over a capacious porcelain capsule, as recommended by Procter, commends itself for convenience and simplicity of arrangement in the place of a retort. No nitric acid will be lost by spirting, and most of that volatilized during the process will be condensed within the funnel and fall back into the capsule if the heat has not been raised too high. The operation may be considered successful if no particles of the fused phosphorus are carried to the surface of the liquid and nitrous acid vapors are regularly extricated. After the phosphorus has been completely dissolved, the funnel is removed or the liquid poured from the retort into a porcelain capsule, and the heat gradually raised to boiling, when the phosphorous acid contained in the liquid will be oxidized to phosphoric acid, red vapors being often evolved quite copiously as soon as a sufficient concentration has been attained. The amount of nitric acid ordered by the Pharmacopœia is about sufficient for oxidizing the phosphorus to phosphoric acid. But should a loss be occasioned from overheating or insufficient condensing, the liquid will contain phosphorous acid, and likewise arsenious acid in case the phosphorus was contaminated with arsenic; on applying heat, this metal will be now deposited as a black powder, and the phosphorous be oxidized to phosphoric acid, but at the same time phosphorus trihydride is given off (Liebig). To avoid this loss of phosphorus the liquid should be completely oxidized, heated to 188° C. (370.4° F.), at which temperature, according to Wittstock, all nitric acid is expelled, then diluted with water, and while warm saturated with sulphydric acid, so as to reduce the arsenic to arsenious acid, the latter being more readily precipitated as sulphide than the former. In this manner the contamination with sulphuric acid from the oxidation of the reagent by nitric acid is avoided, and if the cold liquid, kept in a closed bottle for 1 or 2 days, retains the odor of sulphuretted hydrogen, all the arsenic will be found in the precipitate, and by decanting, filtering, and evaporating the liquid pure phosphoric acid will be obtained. In the absence of arsenic only phosphorous and nitric acids may remain as impurities, the former of which requires oxidation with nitric acid, while the latter is expelled by heating to 188° C., as stated above, and until a glass rod moistened with ammonia ceases to produce white fumes when held over the capsule. At a higher heat, notably between 210° and 213° C. (410° and 415° F.), pyrophosphoric acid would be produced.

Prof. Markoe (1875) proposed a process in which the oxidation of the phosphorus is effected through the intervention of iodine and bromine and at a low temperature. 2 troyounces of phosphorus and 12 troyounces of water are put into a flask or stone jar; 10 grains of iodine are added, and then 60 grains of bromine by drops; when the reaction has ceased, add 12 troyounces of nitric acid; set the vessel in cold water, and when in about 24 hours the solution has been effected evaporate the liquid until all the iodine, bromine, and nitric acid has been expelled. In this process some bromide and iodide of phosphorus is formed and decomposed by the water, with the formation of phosphoric, hydrobromic, and hydriodic acids, from the last two of which, reacting with the nitric acid present, bromine and iodine are again produced, which again act upon the phosphorus, etc. It is very important to follow the above directions strictly, since the incautious addition of bromine to phosphorus and nitric acid may cause a dangerous explosion. The solution is tested and finished in the manner described above.

Prof. W. T. Wenzell (1882) has again suggested a process, which was originally proposed by Bucholz, and was formerly much employed. When phosphorus is partly immersed in water in such a manner that the sticks are not in contact with one another, and the apparatus is arranged so that the air has access to the phosphorus, the latter will be gradually oxidized in the moist atmosphere to phosphorous acid, and this is subsequently oxidized by nitric acid. It is obvious that a considerable amount of the latter may be saved by utilizing atmospheric oxygen, but it is necessary to adopt the precautions indicated above, and thus prevent the exposed phosphorus from igniting. The mixture of phosphorous and phosphoric acids obtained by spontaneous oxidation was formerly known as *phosphatic acid*.

3. ACIDUM PHOSPHORICUM DILUTUM, U. S., Br.; Diluted Phosphoric Acid, *E.;* Acide phosphorique médicinal, *Fr.;* Verdünnte Phosphorsäure, *G.*

Mix Phosphoric Acid 20 parts with Distilled Water 80 parts.—*U. S.*

Mix concentrated Phosphoric Acid 3 fluidounces with distilled water sufficient for 20 fluidounces, *Br.*

Acidum phosphoricum, *P. G.*, is the diluted acid, sp. gr. 1.120. The French Codex does not recognize a dilute phosphoric acid.

Properties.—1. Glacial Phosphoric Acid. The commercial acid is in colorless transparent, glass-like masses, which are slowly deliquescent in the air, and soluble in water and in alcohol; the solution has a strongly acid taste. It is metaphosphoric acid mixed with variable proportions of pyrophosphoric acid, according to the degree and duration of the heat used in preparing it; its aqueous solution yields gradually a bulky precipitate with tincture of ferric chloride. Chemically pure metaphosphoric acid is a soft gum-like mass, which melts at an elevated temperature, is volatilized at a red heat, and becomes solid and glass-like in the cold only through the presence of some sodium or other phosphates (Brescius, 1867). We found (1860) commercial glacial phosphoric acid to contain from 76.46 to 83.48 per cent. of phosphoric anhydride against the calculated quantity of 88.75, the impurities consisting of excess of water and of calcium and magnesium phosphates. Prescott obtained (1872) from the commercial acid an amount of soda corresponding to from .023 to .038 per cent. of sodium phosphate. Brescius found in a sample 15.3 per cent. of soda. These impurities render it unfit for the preparation of the medicinal phosphoric acid which was permitted by the Pharmacopœia of 1870. When dissolved in water it is gradually converted into orthophosphoric acid, the change being hastened by boiling; the solution best adapted for this purpose, according to Littleton Thompson (1874), is made of 1 part of the glacial acid and 2 parts of water, when boiling for about 15 minutes was found to be sufficient. The presence of a small quantity of nitric acid favors the change.

Several series of salts are known of both metaphosphoric acid and pyrophosphoric acid, all of which are converted into orthophosphates by boiling with diluted acids, by heating with water to 280° C. (536° F.), and by fusing them with an excess of alkali. The soluble metaphosphates have a neutral or slightly acid reaction; the normal pyrophosphates are faintly alkaline, and the acid pyrophosphates of a weak acid reaction.

The insoluble salts of both acids are mostly soluble in dilute acids. Ferrous, ferric, and mercurous pyrophosphates, and those of copper, zinc, lead, and silver, dissolve also in solution of sodium pyrophosphate.

2. Phosphoric Acid.—The acid now recognized under this name is a colorless, inodorous acid liquid having the specific gravity 1.348, but the German Pharmacopœia recognizes as acidum phosphoricum an acid of the density 1.120, and of exactly double the strength of acidum phosphoricum dilutum, *U. S.* If evaporated at a temperature not exceeding 160° C. (320° F.), a syrupy liquid is obtained, which gradually on standing, more rapidly on the addition of a crystal of phosphoric acid, yields colorless, flattish, hexagonal prisms, melting at about 40° C. (104° F.), deliquescing in a damp atmosphere and completely soluble in alcohol and in water. The following table, by H. Schiff, indicates the strength of aqueous solutions in phosphoric acid and phosphoric anhydride; it agrees nearly with the results obtained by Watts:

Specific gravity.	Percentage		Specific gravity.	Percentage		Specific gravity.	Percentage	
	H_3PO_4.	P_2O_5.		H_3PO_4.	P_2O_5.		H_3PO_4.	P_2O_5
1.0054	1	0.726	1.1262	21	15.246	1.2731	41	29.766
1.0109	2	1.452	1.1329	22	15.972	1.2812	42	30.492
1.0164	3	2.178	1.1397	23	16.698	1.2894	43	31.218
1.0220	4	2.904	1.1465	24	17.424	1.2976	44	31.944
1.0276	5	3.630	1.1534	25	18.150	1.3059	45	32.670
1.0333	6	4.356	1.1604	26	18.876	1.3143	46	33.496
1.0390	7	5.082	1.1674	27	19.602	1.3227	47	34.222
1.0449	8	5.808	1.1745	28	20.328	1.3313	48	34.948
1.0508	9	6.534	1.1817	29	21.054	1.3399	49	35.674
1.0567	10	7.260	1.1889	30	21.780	1.3486	50	36.400
1.0627	11	7.986	1.1962	31	22.506	1.3573	51	37.126
1.0688	12	8.712	1.2036	32	23.232	1.3661	52	37.852
1.0749	13	9.438	1.2111	33	23.958	1.3750	53	38.578
1.0811	14	10.164	1.2186	34	24.684	1.3840	54	39.304
1.0874	15	10.890	1.2262	35	25.410	1.3931	55	40.030
1.0937	16	11.616	1.2338	36	26.136	1.4022	56	40.756
1.1001	17	12.342	1.2415	37	26.862	1.4114	57	41.482
1.1065	18	13.068	1.2493	38	27.588	1.4207	58	42.208
1.1130	19	13.794	1.2572	39	28.314	1.4301	59	42.934
1.1196	20	14.520	1.2651	40	29.040	1.4395	60	43.660

The salts of orthophosphoric acid, with the exception of those of the alkalies, are mostly insoluble in water; the insoluble ones dissolve in nitric acid, likewise in acetic acid, with the exception of the phosphates of lead, iron (ferric), uranium, and aluminium. The reaction of normal alkaline orthophosphates is strongly alkaline, of the monohydric salts slightly alkaline, and of the dihydric salts distinctly acid. The solution of an orthophosphate rendered alkaline by ammonia yields a white precipitate with a mixture of magnesium and ammonium salts. This precipitate is insoluble in ammonia, sparingly soluble in water, freely soluble in acids, and at a red heat is converted into magnesium pyrophosphate; this reaction is often used for the gravimetric estimation of phosphoric acid. (See Magnesii sulphas.) For its volumetric estimation a solution of ferric chloride, lead acetate, or uranic acetate is employed, the precipitates by the three salts being soluble in nitric acid, but insoluble in acetic acid. The strength of medicinal phosphoric acid, which has been proved to be free from other acids and from salts, is conveniently ascertained by combining with lead, using an excess of the pure oxide, evaporating to dryness, and igniting, when the increase of weight indicates the amount of phosphoric anhydride. 100 parts H_3PO_4 yield 72.449 parts P_2O_5; therefore 5 Gm. of the 50 per cent. phosphoric acid, after treatment with 10 Gm. of pure oxide of lead in the manner stated, must yield a residue weighing 11.8112 Gm.

3. Diluted Phosphoric Acid corresponds in all respects to the preceding, except that it contains only 10 per cent. of H_3PO_4 and has the density 1.057. When 10 Gm. of this acid are treated with 5 Gm. of pure oxide of lead, as described above, the residue should weigh 5.7245 Gm. The British Pharmacopœia requires 355 grains of its acid to yield with 180 grains of oxide of lead a residue weighing 215.5 grains; 6 fluidrachms (*Br.*) of this acid correspond to 35.5 grains P_2O_5 or 49 grains H_3PO_4.

Impurities.—Pure glacial phosphoric acid dissolves completely in distilled water, and this solution is not precipitated on standing for 2 days, after having been saturated with hydrosulphuric acid (arsenic, lead). When boiled for some time, and then supersaturated with ammonia, no precipitate is produced, with the exception of a slight turbidness (calcium, magnesium), and the further addition of ammonium sulphydrate causes no change (iron and similar metals). With caustic potassa in excess ammonia is not evolved. If completely precipitated by acetate of lead, the filtrate, after the excess of lead has been removed by sulphuretted hydrogen, leaves, on evaporation, only a very minute residue (potassium, sodium). Medicinal phosphoric and diluted phosphoric acid are tested in the same manner as the preceding, except that for the detection of calcium and magnesium boiling is not required before supersaturating with ammonia. The presence of nitric acid is determined by the black or dark-brown color appearing on the addition of a crystal of ferrous sulphate, followed by the careful addition, without agitation, of concentrated sulphuric acid. In applying the following tests the stronger phosphoric acid should be diluted with 4 or 5 volumes of distilled water: Hydrochloric acid is detected by the curdy-white precipitate insoluble in nitric acid occurring with nitrate of silver; sulphuric acid, by a white precipitate with barium chloride; and phosphorous acid, by the speedy decoloration of a drop of solution of potassium permanganate or by the precipitate of calomel when warmed with solution of corrosive sublimate. Sulphuretted hydrogen should not produce either a white turbidity of sulphur (phosphorous acid), or, after standing, a colored turbidness or precipitate (arsenic, lead). Arsenic is most conveniently detected by Fleitmann's test (see page 28) after supersaturating the acid with potassa or soda. The German Pharmacopœia directs the evolution of hydrogen by means of sulphuric acid and zinc, and to proceed as described for the detection of arsenic in hydrochloric acid. (See page 65.)

Off. Prep.—Ammon. phosphas, Syrupus ferri phosphatis, *Br.*

Physiological Action and Medical Uses.—The views expressed by different writers in regard to the degree and mode of action of phosphoric acid are not easily harmonized. According to J. Ashburton Thompson, "the complete oxidation of the phosphorus is calculated to destroy its therapeutical properties entirely." Burness declares that "it is not astringent, but forms soluble compounds with albumen and fibrin," while Hoffman states that as a hæmostatic "it is better than other astringents." Burness further asserts that "if continued for some time it causes cough and expectoration, passive congestion, especially in the extremities, pain in the bones, a febrile state with profuse perspiration, followed by diarrhœa, depression of the mental powers, and pain in the generative organs;" and, in opposition to all of these, Dr. J. B. Andrews affirms that although it is a powerful stimulant of the brain and nervous system, "in no case does it disturb the digestion or prove an irritant to the stomach, even when its administration is prolonged" (*Amer. Jour. of Insanity*, Oct. 1869). According to Sundelin, it is a powerful excitant of the genital organs; while Andrews agrees with Neligan that it exerts no direct influence upon the generative function.

According to Andrews, the sensations produced by a dose of from 40 drops to 3 drachms of the acid were those of moderate alcoholic stimulation. When a larger dose was taken there was a feeling of drowsiness and inertness that continued for some hours. It was employed by this physician in many cases of insane *melancholy* and of persons whose minds had been overtaxed and who had become nervous and timid, with a sense of weariness and inability to continue any occupation. But as its use was supplemented by "relaxation from business and labor" and "some suitable tonic," and, especially in some popular medicines, with iron, potassa, magnesia, and lime, the share of phosphoric acid in the patient's improvement is more than problematical. It has been used, on theoretical grounds, in the treatment of *dyspepsia*, with an excessive proportion of earthy phosphates in the urine; in *scrofulous caries* and in *exostoses* of the bones; to correct *night-sweats* in phthisis and other hectical diseases; in *hæmoptysis* and in *catarrhal affections* of the lungs and of the genito-urinary organs; in *jaundice* and in *diabetes*. In the last-named disease it has a remarkable power of diminishing thirst, and consequently of lessening the harassing secretion of urine. At the same time it affords an agreeable acidulous beverage. The *dose* of medicinal phosphoric acid is from 20 minims to a fluidrachm (Gm. 1.30–4.00), sufficiently diluted to be agreeable to the taste.

ACIDUM PICRICUM.—Picric Acid.

Acidum carbazoticum.—Carbazotic or Nitrophenisic acid, Trinitrophenol, E.; *Acide picrique, carbazotique, nitroxanthique, etc.; Jaune-amer*, Fr.; *Pikrinsäure, Trinitrocarbolsäure, Welter'sches Bitter*, G.

Formula $C_6H_2(NO_2)_3OH$. Molecular weight 229.

Origin and Preparation.—A solution of this compound, as obtained from indigo, was recognized as a dyeing material by Woulfe (1771). Hausmann (1788) prepared picric acid from the same material as a bitter mass; Welter (1799) obtained it in crystals from silk, and subsequently its composition was investigated by Liebig, Dumas, and others. It may be obtained by the action of nitric acid upon salicin and its derivatives, phloridzin, indigo, aloes, benzoin, silk, and other substances, and is best prepared by dropping 1 part of carbolic acid into 3 parts of warm nitric acid, adding, after the violent reaction has ceased, 3 parts of fuming nitric acid, heating the mixture, and finally evaporating it, when, on cooling, the new compound will crystallize, and may be purified by washing with cold water and recrystallizing from boiling water or diluted alcohol; $C_6H_6O + 3HNO_3$ yields $C_6H_3(NO_2)_3O + 3H_2O$.

Properties.—Picric acid crystallizes in bright-yellow, inodorous needles or scales, which melt at 122.5° C. (252.5° F.), and when cautiously heated sublime without decomposition, forming yellow suffocating vapors which condense again to crystals; but on being rapidly and strongly heated in a test-tube picric acid is decomposed with detonation, while upon platinum-foil it burns with a sooty flame, without leaving any residue. It has an acid and extremely bitter taste, dissolves at 5° C. (41° F.) in 160 parts, at 15° C. (59° F.) in 86 parts, and at the boiling temperature in 25 parts of water, forming a bright-yellow solution, and is readily soluble in alcohol, ether, chloroform, benzol, and petroleum benzin. Its solutions stain the skin and other organic matter permanently yellow; hence its use in dyeing. The aqueous solution precipitates gelatin. It unites with bases, forming salts which are mostly yellow, crystallizable, have a bitter taste, and are explosive by percussion or when heated. The potassium picrate requires 260 parts of water of 15° C. (59° F.), but only 14 parts of boiling water, for solution.

Tests.—The above-described properties are sufficient for recognizing the acid. Its purity is shown by the complete solubility in the solvents mentioned before. On heating an aqueous solution of picric acid with chlorinated lime, very pungent and irritating vapors of the so-called *chloropicrin* are given off—a compound more properly known as *nitrochloroform* and *nitrotrichlormethane*, $C(NO_2)Cl_3$.

Pharmaceutical Uses.—A solution of 1 part of picric acid in 100 parts of water forms a convenient test for alkaloids, nearly all of which are precipitated from their diluted acidulated solutions, except aconitine, caffeine, cocaine, coniine, hyoscyamine, morphine, and theobromine.

Picric acid is much employed for dyeing wool and silk yellow, also for staining wood.

Physiological Action and Uses.—When given continuously to rabbits it causes emaciation, diarrhœa, ecchymosis in the intestine, yellowness of the conjunctiva and of the urine, and in large doses nausea, diarrhœa, flatulence, depression, and twitching of the cutaneous muscles. After death the red blood-disks are found dissolved in part, and in the white corpuscles the nuclei exhibit a lively molecular movement. The acid, and also its salts, given to man induce a yellowness of the conjunctiva, skin, and urine. This fact is of interest as illustrating the mode of production of jaundice in certain cases, as in yellow fever and acute yellow atrophy of the liver. It has been prescribed in doses of from one-sixth of a grain to 2 or 3 grains (Gm. 0.01–0.20) in alcoholic solution. Picrate of ammonium has been used in the treatment of *intermittent fever* and of *intestinal worms* in doses of about a quarter of a grain, and upon theoretical grounds, but fruitlessly. It has been applied with alleged advantage to *fissured nipples* in solutions containing 13 parts, and also 1 part in 1000 of distilled water. At present it does not appear to possess much therapeutical value. It has been used as a test for albumen (*Med News.*, xliii. 458).

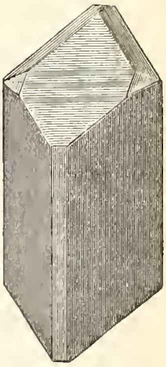
ACIDUM SALICYLICUM, *Br., F. Cod.*—SALICYLIC ACID.

Ortho-oxybenzoic acid, E.; *Acide salicylique*, Fr.; *Salicylsäure*, G.
Formula $HC_7H_5O_3 = C_6H_4.OH.COOH$. Molecular weight 138.

Origin and Formation.—It occurs in the free state in the flowers of Spiræa Ulmaria, and as methyl-salicylic ether in the leaves of Gaultheria procumbens and Andromeda Leschenaultii, and is formed from salicin, indigo, and some other organic matters by adding them to hydrate of potassium heated to fusion. It was discovered by Piria (1838) as a derivative of salicin; its presence in oil of wintergreen was proven by Procter (1848), and in several species of viola by Mandelin (1881).

Preparation.—It may be prepared from oil of wintergreen by heating it with strong solution of potassa as long as methylic alcohol is given off, and decomposing the resulting potassium salicylate by hydrochloric acid. But it is at present extensively prepared, according to Kolbe (1874), from carbolic acid. As the first step, dry sodium carbolate is prepared, which is introduced into a retort; dry carbonic acid gas is passed through it while heat is applied, gradually increased from 100° C. (212° F.) to 220° C. (428° F.), and not over 250° C. (464° F.). By this operation carbonic anhydride is made to enter into the molecule of phenol, producing sodium salicylate and sodium carbonate, while one-half of the carbolic acid distils over; $2(NaC_6H_5O) + CO_2$ yields $Na_2C_7H_4O_3 + C_6H_6O$. The residue in the retort is now dissolved in boiling water, filtered if necessary, and decomposed by hydrochloric acid, when, on cooling, impure salicylic acid, having a brown or reddish-brown color, is precipitated in the form of a crystalline powder; this reaction occurs as follows: $Na_2C_7H_4O_3 + 2HCl = 2NaCl + C_7H_6O_3$ (salicylic acid), sodium chloride remaining in solution. The impure acid thus obtained is further purified by dissolving it in boiling water or weak alcohol, treating the solution with animal charcoal, and crystallizing the filtrate after the addition of a little hydrochloric acid. A. Rautert recommends (1875) the purification of it by distillation with steam previously heated to 170°C. (338° F.), by which some black resin is left as a residue; by recrystallization from boiling water a little carbolic acid is removed. Contact with iron or with materials containing iron is to be avoided, since a reddish color is thereby imparted. According to Squibb (1877), it is best purified by subliming it with the aid of steam-heat.

FIG. 8.



Crystal of Salicylic Acid.

Properties.—Thus obtained, salicylic acid is in small acicular crystals, white, inodorous, of a sweetish, acidulous, somewhat acrid taste, and of the spec. grav. 1.45. The commercial article frequently has a yellowish or brownish tinge and a slight odor. It fuses at 155.5° C. (312° F.), and if carefully heated sublimes unaltered, and without boiling, at about 200° C. (392° F.). When rapidly heated to between 220° and 230° C. (428° and 446° F.), it is decomposed into carbonic dioxide and phenol; $C_7H_6O_3$ yields $CO_2 + C_6H_6O$. According to Bourgoin (1879), 1000 parts of distilled water dissolve

At	0°	5°	10°	15°	20°	30°	50°	60°	70°	80°	90°	100° C.
in	1.50	1.65	1.90	2.25	2.70	3.90	8.00	12.25	19.90	32.55	51.80	79.25 parts salicylic acid.

The hot solution, when slowly cooled, yields long, slender needles. The solubility in water is considerably increased by the addition of phosphates, citrates, and acetates of the alkalies and of borax, the solution made with the latter gradually acquiring a bitter taste. It dissolves freely at ordinary temperatures in wood spirit, in 2 parts of absolute and 2.4 parts of 90 per cent. alcohol, in 3.5 parts of amylic alcohol, in 2 parts of ether, in 80 parts of chloroform, in 80 parts of benzol, and in 60 parts of fixed oils. Its solution in 5 parts of boiling oil of turpentine congeals on cooling. C. Becker (1875) observed that 1 part of salicylic acid and 2 parts of olive oil, heated together, form a homogeneous mixture. The alcoholic solution evaporated spontaneously yields the acid in large oblique quadrangular prisms. The aqueous or alcoholic solution acquires a deep violet color with ferric chloride, provided alkalies, alkaline salts, and most acids are absent. The aqueous solution yields with bromine-water a crystalline precipitate sparingly soluble in water, and when boiled with Millon's reagent of mercuric nitrate gives a red color. A blood-red color, changing to brown and black, is produced by adding an excess of sulphuric acid to a mixture of salicylic acid and sugar, and applying a gentle heat. Sulphate of copper produces an emerald-green color in very dilute solutions of normal salicylates or salicylic acid. Potassium chlorate and hydrochloric acid convert it, like phenol, quinone, and allied compounds, into *chloranil* or tetrachloroquinone, $C_6Cl_4O_2$, which forms yellow crystals soluble in ammonia with a deep-red color. Salicylic acid effervesces with carbonates, behaving as a monobasic acid; but under certain circumstances a second hydrogen atom may be replaced by metals, yielding Piria's neutral salicylates (1855), which are decomposed by carbonic acid. Combined with alkalies, the solution of salicylic acid turns brown in contact with the air. On dry distillation the salicylates are decomposed, yielding carbonic dioxide and phenol.

Impurities.—According to J. Williams (1878), salicylic acid prepared by Kolbe's process is contaminated with another acid, which he provisionally named *cresyl-salicylic acid*, and which remains in the mother-liquor on neutralizing a solution in hot water with carbonate of calcium; if the precipitated salicylate of calcium be purified by recrystallization from boiling water and afterward decomposed by hydrochloric acid, pure salicylic acid is obtained. It should be absolutely free from the odor of phenol, the presence of which lowers its melting-point, and its aqueous solution, to which a little nitric acid has been added, should not be precipitated by chloride of barium (sulphuric acid) or by nitrate of silver (hydrochloric acid). Heated upon platinum foil, salicylic acid should evaporate without leaving any residue (mineral impurities). It should dissolve in cold concentrated sulphuric acid without imparting any or only a faint yellow-color (organic impurities). Kolbe (1876) has given the following practical test: It should be completely soluble in absolute alcohol, and the solution, if allowed to evaporate spontaneously and without contact with iron, should yield a white residue of aggregated crystals, the points of which are colorless and transparent. In the presence of iron the ends will be reddish or purplish, and with organic coloring matter will appear yellowish or brown.

Two other oxybenzoic acids are known, which melt at 200° and 210° C. (392° and 410° F.) and do not give a violet-red color with ferric chloride. The para-acid is more freely soluble than the others, and is obtained in Kolbe's process for salicylic acid by using potassium instead of sodium phenate and increasing the heat to above 150° C. (302° F.).

Pharmaceutical Uses.—ACIDUM BOROSALICYLICUM, Borosalicylic acid. Dissolve 1 part of boric acid in 5 parts of boiling water, and 2 parts of salicylic acid in 10 parts of alcohol; mix the solutions, and evaporate slowly by means of a water-bath (Hager). It is a white crystalline powder or small needles, soluble in 200 parts of cold water, 40 parts of hot water, and 10 parts of alcohol, and has a persistently bitter taste. It possesses antiseptic properties.

SALICYLIC COLLODION. Dissolve salicylic acid 6 parts and extract of cannabis 1 part in collodion 48 parts (Gezon). It has been recommended for the removal of corns, and is applied for 4 or 5 consecutive nights and mornings, followed on the next day by a warm bath.

Salicylic acid is used for the preparation of salicylated cotton, of sodium salicylate, *U. S.*, and other salts.

Salts of Salicylic Acid.—SALICYLATE OF SODIUM is prepared by adding salicylic acid to a cold solution of pure soda containing 10 per cent. of caustic soda as long as it is dissolved, filtering, and evaporating to dryness. Or 10 parts of salicylic acid are mixed with water into a thin paste, and to this mixture 10 parts of pure crystallized carbonate or 6 parts of pure bicarbonate of sodium are added; after the evolution of carbonic acid gas has ceased the solution is perfectly neutralized with a little caustic soda and evaporated to dryness. The salt forms a white powder, has a sweet afterward acrid taste, dissolves in rather less than its own weight of cold water, and is soluble in alcohol, but sparingly soluble in absolute alcohol. Prepared by the second process, it has the composition $NaHC_7H_4O_3$; but if made by the first process Hager (1876) found it to yield 33 per cent. of residue when incinerated; its composition will therefore be nearly $Na_2C_7H_4O_3$.

Salicylate of Ammonium is prepared, like the preceding salt, by neutralizing salicylic acid with ammonia or carbonate of ammonium, and evaporating, when the monobasic salt crystallizes in scales or needles; but on rendering the concentrated liquid alkaline with ammonia the bibasic salt is obtained. Both have a sweet taste and are readily soluble in water.

Medical History.—As long ago as 1855, Bertagnini is said to have studied the action of salicylic acid upon himself; and in 1874, Kolbe, besides producing the acid synthetically, illustrated its anti-putrid and anti-fermentative actions.

Physiological Action.—*On Vegetables, etc.:* Plants watered with a solution of this acid speedily die. It prevents various reactions in organic products; *e. g.* hinders the development of prussic acid in a mixture of amygdalin and almond emulsion, of the acrid principle of mustard on the addition of water, the souring of beer, milk, etc. It prevents the putrefactive fermentation of urine, and arrests this process after it has commenced. When given internally or injected into the bladder as an acid or in saline combination, it prevents the fermentation of urine in that organ, and restores its acid reaction when it is lost. It has no strictly deodorizing action, and therefore is not available in a great many cases in which foul smells, and not their cause, must be attacked. It, however, deodorizes ammoniacal urine, probably by a chemical action.

On Animals: About a grain of salicylate of sodium introduced under the skin of a frog renders the animal languid, and then occasions complete motor paralysis and arrest of the heart. Guinea-pigs after a dose of from 60 to 70 grains grow rapidly weak, lie on the belly, and drag their limbs, which are moved spasmodically; then respiration grows shallower until it ceases. From such experiments Rochefontaine concluded that the acid (1) impairs general and reflex sensibility by its action on the brain and spinal marrow; (2) muscular contractility and excito-motility are suspended later; (3) respiratory movements are arrested; and (4) the heart ceases to beat. The experiments of Laborde, furnishing the same general results, led him also to conclude that the salt acts upon the nerve-centres and not upon the nerves. But he also found that common sensibility and the perception of pain were both blunted, as well as muscular power, and, indeed, so conspicuously that he concluded the virtue of the medicine as an anti-rheumatic remedy to be mainly, if not exclusively, in its analgesic or anodyne power. Other experimenters found that the acid does not reduce the pulse-rate or the temperature in healthy animals, nor modify their sensibility. More definite conclusions were deduced by Lahalle from his experiments upon dogs (*Thèse de Nancy*, 1878). Their chief points are contained in the following propositions: 1. Moderate doses of salicylate of sodium occasion nausea, salivation, vomiting, and diarrhœa. Larger doses may cause bloody stools and tenesmus and vomit with streaks of blood. 2. The senses of sight and hearing appear to be somewhat dull. 3. The central nervous system is affected only by large doses, which abolish together sensibility, motility, and reflex excitability, and tetanic spasms precede death. 4. The pulse remains either quite undisturbed or is slightly lowered; exceptionally it becomes more frequent. 5. The primary and chief action of the salt is upon the respiration, which is quickened even by small doses. 6. It not only does not lower the temperature, but raises it by several tenths of a degree (C.) unless fever is present, in which case the temperature falls about 1° C. and the pulse becomes less frequent. 7. Sodium salicylate is not a diuretic; on the contrary, in excessive doses it renders the urine albuminous and lessens its quantity. It is excreted, however, by the kidneys chiefly (as Feser and Friedeberg had already shown). It increases the flow of saliva and bile. (This statement agrees with that of Rutherford, who says that sodium salicylate "is a very powerful hepatic stimulant in the dog.") It is also found in the biliary secretion. 8. After death the stomach, the duodenum, and more generally the whole intestine, are deeply congested, sometimes with sub-mucous hæmorrhage and desquamation of the epithelium; the liver and kidneys are also congested, as well as the meninges, which present spots of extravasation; the brain and spinal cord appear to be congested; the lungs are unaffected and the blood seems unchanged. As complementary to these conclusions, and confirmatory of them, it may be stated that those of Blanchier (1879) include the following: Sodium salicylate displays decided physiological effects only in large doses, which first stimulate and then paralyze the central nervous system, exciting through it gastro-intestinal phenomena and fatal disorder of the respiration; it does not act directly upon the nerves, but does so upon the nervous ganglia and the glands and upon the muscular fibre, inhibiting their respective functions. In this connection it may be added that Prudden (*Amer. Journ. of Med. Sci.*, Jan. 1882, p. 69) concluded from his experiments that salicylic acid restrains the emigration, and in strong solutions is inimical to the life, and in dilute solutions to the activity, of the white blood-cells.

On Man: Among the most usual effects of salicylate of sodium in full medicinal doses are subjective auditory phenomena consisting of buzzing, humming, whistling, rushing, and knocking noises, accompanied with more or less deafness. They are seldom absent when the quantity of the medicine taken in 24 hours exceeds 150 grains. Occasionally vision is disturbed, and objects appear to oscillate or to revolve. Gatti reports the case of a patient who while using this medicine remained blind for about 10 hours. Headache is not unusual, and may be attended with slight excitement or with dulness and an uncertain gait. When fever exists delirium is readily induced by the medicine, especially in nervous patients. It is apt to be accompanied with phantasms and violence, as in delirium tremens. Difficulty of breathing and palpitation of the heart are ordinary effects of the medicine, and the former symptom has been repeatedly observed in phthisical patients. Pulmonary hæmorrhage has been caused by it even in healthy persons (Wattelet). Hence it should be a rule never to prescribe the medicine in cases involving cardiac or pulmonary disease, and equally so, whenever it is used, to watch its influence upon the circulation and respiration. Apart from febrile states, the pulse and the temperature are not reduced by it, according to Gedl, Riegel, and others; and Lürmann having given salicylic acid to a person affected with nodosity of the joints saw the pulse-rate rise to 160 and the temperature to 105.8° F. Analogous effects were produced in healthy persons under the direction of G. Sée, who, like other observers, noted no change in the arterial tension, the pulse-rate, or the temperature, unless fever already existed. Marigliano's experiments confirm these observations (*Practitioner*, xxx. 52). The large elimination of salicylic acid and its compounds by the kidneys explains their various effects upon these organs. If they are sound, and if the dose is not excessive or too long continued, the urine either remains normal in quantity or is more or less increased; but if the kidneys are diseased or the dose of the medicine is excessive, the secretion diminishes, vesical irritation occurs, and albumen, and even blood, may be found in the urine (*Centralblatt f. d. g. Therapie*, i. 527; *Med. Record*, xxv. 12). Sodium salicylate, but still more the uncombined acid, acts as an irritant upon mucous membranes. It occasions a sense of rawness in the fauces, and even vesicles and ulcers there, nausea, vomiting, and gastric distress, and sometimes diarrhœa. Like many other irritants, salicylic acid and its compounds occasionally produce an eruption on the skin, usually in the form of urticaria. But it is also stated to have occasioned numerous and large petechiæ and vibices. Besides these superficial lesions, it has happened that gangrene has been produced by this medicine, as in cases seen by Wattelet, Potain, and Gubler in France; while in England it is recorded that in a case of acute articular rheumatism it produced ecchymosis, gangrene, disorganization of the eyes, and the death of the patient (*Times and Gaz.*, Sept. 1879, p. 339). During the use of salicylic acid and its compounds the urine gives a violet color on the addition of solution of perchloride of iron. Its passage through the system is very rapid, for in a case of extrophy of the bladder its presence in the urine was demonstrated in about 8 minutes after 75 grains of salicylate of sodium had been taken. But its excretion does not cease for several days after the medicine has been suspended. It appears, however, to undergo a change before elimination, since the urine containing it does not check the fermentation of yeast. According to Byasson, salicylic acid appears in the urine "partly unchanged." It increases (?) the elimination of uric acid and nitrogenous compounds. In numerous cases the urine has apparently responded to the copper test for grape-sugar, but the precipitate was found not to be cuprous. Besides its elimination with the urine, it is also excreted in a small proportion with the sweat and with the serum of blisters; it is generally thought not to be discoverable in the saliva, but one observer (Musy) found it there.

The occasional toxical effects produced by salicylic acid and its compounds are partly local and partly general. The former consist mainly of the irritations already referred to, but they are by no means usual, and often excessive doses are employed without injury. Thus a patient affected with rheumatism took 6 drachms of salicylate of sodium in the course of 22 hours; he suffered no pain in the stomach, but, on the contrary, his appetite was improved (Ewald). Feltz reports the case of a man who took more than 6 ounces of the salt in 1 month. In the last 17 days the dose was 120 grains three times a day. The symptoms were chiefly vomiting and headache, preceded by congestion of the neck, face, and head. The pupils were contracted. The symptoms continued for 17 days after the last dose had been taken, and the acid could be detected in the urine for 16 days. But in other cases the effects were fitted to inspire anxiety. Ewald reports that a woman became affected with alarming symptoms after using the acid or its sodium salt. After a drachm of the latter there was repeatedly observed delirium like that from alcohol, but more frequently extreme jactitation, and even maniacal fury; also roaring in the ears, disorders of vision, and loss of muscular power in the limbs. The last symptom sometimes reaches the degree of complete resolution, and the gastric disturbance may resemble that produced by a corrosive poison. In children it occurs most frequently, as well as the prostration of the nervous system. In a case of acute articular rheumatism a rapid cure appeared about to take place, when, besides buzzing in the ears and profuse sweats, extreme prostration came on, and the patient died suddenly on sitting up to eat (Empis). Jaccoud soon afterward reported three cases of sudden death in young rheumatic patients treated by this medicine in doses not exceeding 150 grains a day; and Goodhart one in which death followed the use of four doses of 15 grains each, given at intervals of 3 hours (*Times and Gaz.*, Jan. 1880, p. 105). Lahalle (*Thesis* cited) ventures to say that although the avowed number of fatal cases in France is considerable, yet probably others have occurred that have not been published. In the cases now referred to the phenomena seem to have been due to a derangement of the nervous system, but there have been others in which the heart was affected or the lungs; in the latter the symptoms were those of asphyxia. In another case, a girl of 15 took by mistake 7 drachms of salicylate of sodium within a few hours; besides the symptoms already mentioned she had dilated pupils, impaired vision, and strabismus, and became melancholic. Red spots appeared transiently on the skin; there was vomiting, but no diarrhœa; the urine contained albumen (Peterson). It sometimes contains blood or casts. Abelin states that acute nephritis may occur during the use of the medicine. It follows from the above that salicylic acid, and in a less degree its salts, should not be given in large doses to persons having a weak heart or who are otherwise greatly debilitated, or, at least, not without counteracting their toxical tendencies with nutrients and diffusible stimulants.

Medical Uses.—*Acute Articular Rheumatism.* If salicylic acid and its compounds are curative of any disease, it is this. That it reduces the pulse-rate, and in a much greater degree the temperature (from 103° F. to 98° F.), the latter in nearly all cases, there is no doubt. Whether it removes the disease as well as, or better than, some other remedies is not quite so certain. For acute articular rheumatism is a general disease, in which not only the joints, but several internal organs, and especially the heart, are apt to be involved. Now, it is on all hands admitted that salicylic acid and its compounds neither exert any preventive influence on these complications nor prevent relapses; and some even go so far as to maintain that their development or occurrence is favored by these medicines. This opinion is probably due in part to the rapid relief obtained in many cases from pain and fever and the imprudent exposure which is apt to follow. It is very certain that when complications do occur the medicines in question exert no control over them. Not only so, but heart affections may arise while the patient is under their fullest influence. It is therefore altogether probable that they have no anti-rheumatic virtues, and that they relieve inflammatory rheumatism merely by repressing two of its symptoms, very much as quinia, and aconite, and veratrum, and opium may do. In a series of over one hundred cases of rheumatism the average time during which the acid was administered was a little over 6 days, the extremes being 1 and 31 days. The average quantity of salicylic acid taken by each patient was about 400 grains. This result does not bear out the claim of the medicine to be a specific remedy for the disease in question. Moreover, it is certain that the anti-febrile influence of the medicine is not specific, for in certain cases of hyperpyrexia occurring in rheumatism it not only failed to reduce the temperature, but during its use the temperature rose from 101° to 107°. It would be unfair, in presenting a summary of this subject, to withhold the positive declarations of some of the most competent advocates of the medicine. Dr. Broadbent says: “I have yet to see the case of genuine acute rheumatism without complication in which the pain is not entirely gone and the temperature normal after six consecutive doses of 20 grains at intervals of an hour on 2 successive days.” Mr. Sharkey remarks: “One must, I think, allow that its discovery as a cure for acute rheumatism is a triumph of empirical therapeutics which has probably had but few parallels in the history of medicine.” Dr. Jacob gives, as a result of its use in 150 cases, the recovery of 103 within three days. More or less analogous results have been obtained in Germany by Traube, Stricker, Bälz, Lebert, and others, and, according to Dr. Ackland, out of nearly 425 cases only 21 deaths occurred. In France, Sée declares that “we may promise with almost certainty the cure of febrile or apyretic acute rheumatism in from 2 to 4 days." Like other physicians, Blachez (1878) met with cases in which, under this medicine, the pains ceased "in from 36 to 48 hours." But he cautions against suspending its administration when the pains subside, and insists that relapses are common, although not severe. On the other hand, Guéneau de Mussy expresses a general dissent from these conclusions; and that eminent clinician, Jaccoud, while admitting that in febrile articular rheumatism, unaccompanied by any complication, it produces a cure more rapidly than any other medicine, denies that a uniform duration can be assigned to the treatment and that it tends at all to prevent or modify complications; and he holds that when these exist the medicine ceases to influence the rheumatic element of the attack. So, too, Dr. V. Y. Bowditch (1879) concluded from a series of records that the medicine is not a specific, yet that in acute cases, if used at the outset of the disease, pushed vigorously, and not abruptly suspended, "the most satisfactory results may be obtained." In 1879 and 1880, Drs. Andrew Clark and R. Southey fully corroborated the judgment of Jaccoud, the latter by an analysis of 51 cases (*St. Bart's Hosp. Rep.*, xv. 6). Findlay and Lucas, by a like study of 158 typical cases, in 60 of which the salicylous treatment was used, in 60 the alkaline, and in 38 a combination of alkalies and quinine, found that although the duration of the primary attack was rendered shorter by the first-named than by the other methods, yet it was attended with far more cardiac complications, relapses three times as frequently, and a more usual return of pain without pyrexia (*Lancet*, Sept. 20, 1879). Dr. Greenhow concludes, from a careful analysis of 50 recorded cases, that although the pain and distress of the patient are undoubtedly assuaged, for a time, by the salicylate of sodium, the duration of his illness is not shortened, neither is his recovery as rapid as under other modes of treatment. He moreover calls attention to the marked weakening of the first sound of the heart observed in so many cases, and suggests its immediate danger, as well as its remoter significance, as showing a degenerative influence on the structure of that organ (*Clin. Soc. Trans.*, xiii. 346). With clinical results so ample and positive on record (consult, further, "Summary" in *Boston Med. and Surg. J.*, April, 1882, p. 315; *Ephemeris*, i. 56) one is obliged to regret the errors of statements like those first quoted, and of such as these, that "by the brevity of the febrile condition the chances of the occurrence of cardiac complications are immensely diminished" (Moore), or that the medicine "immensely lessens the chances of heart disease or other complication" (Paul). As we have seen, the heart-complications form a special danger of the salicylous method of treatment. On the whole, it may be concluded that this method is anti-pyretic rather than anti-rheumatic. That in certain cases it should have appeared to be "prompt and decisive," or to have "acted like a charm," or to be "the only radical remedy for acute rheumatism," leaves out of view entirely the natural history of the disease, which in thousands of cases runs its course to cure within a week without any specific treatment. It also overlooks the well-known clinical fact that in one form the disease runs a steady course toward cure, and in another is broken up into a succession of remissions and relapses. The observations of Marrot throw some light on the nature of the influence exerted by the acid upon the blood and upon nutrition in this disease, and on their modification by the salicylate of sodium. Under its administration the excretion of urea and uric acid, which is so excessive in articular rheumatism, immediately declined, and the proportion of water was greatly augmented. One can hardly doubt that the sodium base of the medicine had a share in this result. The treatment by salicylic acid may be compared to that by opium, which was once in vogue, and which was vaunted to control the pain and fever of rheumatism, but, as was soon discovered, at the expense of the heart's integrity. A case of rheumatic *tetanus* is alleged to have been cured by salicylic acid. It is useless in *chronic rheumatism*. According to Abadie, salicylate of sodium greatly excels all other medicines in the rapidity of the cure of rheumatic *irido-choroiditis sclerotitis*. He recommends the dose of 15 grains four times a day (*Bull. de thérap.*, xcvii. 385).

In *gout* the salicylates are said by Sée to display even more wonderful powers than in rheumatism, and to promptly arrest even the most painful paroxysms, as well as to prevent relapse and promote the removal of tophaceous deposits. Apparently, other physicians—Murchison, for example—have been less fortunate, for their results prove nothing in its favor.

If we cannot say that authors are unanimous in asserting the uselessness of salicylic acid in *intermittent fever*, we can at least declare that there is no proof of its utility, either by authority or by demonstration. In this case is presented an apt illustration of the error of deducing the therapeutical uses of a medicine from its apparent physiological action; for this acid and its compounds, whose physiological operation seems so closely to resemble that of quinia, is powerless to cure the disease for which quinia is a specific remedy. Salicylate of quinia has been recommended as an anti-periodic medicine, and doubtless it is such as far as it contains quinia. In *scarlatina* and *variola* salicylic acid neither mitigates the disease nor tends to prevent its complications or sequelæ. As to *typhoid fever*, in which a full trial of the medicine has been made, the general result appears to be that it does not improve the typhoid state, nor reduce the splenic swelling, nor diminish the stools nor alter their qualities, nor lessen the customary debility and emaciation, nor improve the patient's feelings, nor shorten the attack, nor lessen the mortality of the disease. On the other hand, it is charged with causing hæmorrhage from the bowels. Reporters are not agreed even as to its influence upon the pulse and temperature; and some among them charge that it excites or exaggerates delirium, and produces nausea, prostration, albuminuria, and even suppression of urine (Sée; Murchison). These conclusions have been substantially confirmed by Filatow and by Weiss (1880), and no doubt remains of the inefficacy of this medicine, as of all others, in controlling typhoid fever. In *intermittent fever*, like many other agents, it may, as already stated, prevent or mitigate a paroxysm, but it has no influence on the disease. The medicine has been used in *relapsing fever*, with the alleged effect of lessening the duration and severity of the relapse (Riess. 1880); but as in one case the patient died with cerebral symptoms, a very rare occurrence in the disease, the share of the medicine in the catastrophe is open to suspicion. Dr. Bowyer claims that about 3 grains of salicylic acid every 6 hours aborts the eruption of *small-pox!* (*Practitioner*, xxvi. 456); another, that it is peculiarly efficacious, topically and internally, in *erysipelas* (*Amer. Jour. of Med. Sci.*, Jan. 1882, p. 255); and a third, that it is a prophylactic against *yellow fever!*

In *acute inflammations* the evidence respecting the medicine in question is very contradictory; for while, on the one hand, they are affirmed to be "wholly uninfluenced by it," that it does "not in the least degree prevent the supervention of fresh inflammation," and that, "while it reduces the temperature, it does not in the least modify the local processes," it is alleged, on the other hand, to be the "surest antiphlogistic." It is true that the latter judgment is qualified by the statement that it even "excels quinia;" which is quite conceivable, since it is now well settled that there is no constant relation between the reduction of the pulse in febrile affections and the cure of the disease which renders the pulse frequent. In regard to *diphtheria*, while one reports that in thirty-one cases it was "uniformly curative," and another that it "modifies favorably the exudation," and a third that it also "arrests the fever," a fourth (Abelin) "derived none of the advantages from its use which various physicians ascribe to it, and found that, except in reducing the temperature and the pulse-rate, its results were entirely negative, or else that it irritated the throat, and occasioned diarrhœa, albuminuria, or congestion of the lungs;" and Sée could discern no appreciable influence exerted by it on the disease. In a word, there is no ground whatever for believing in its efficacy. Even in the case of *aphthæ*, which some declare that it causes to heal rapidly, and of *thrush*, for which it has been vaunted as a specific, others allege that it is neither better nor worse than chlorate of potassium or than the alkaline solutions in general. Enemas containing 1 part of the acid to 300 parts of water, with a little alcohol to perfect solution, are said to lessen the frequency, correct the fetor, and improve the quality of the stools in *dysentery*. Ridder (1879) and Tlyin (1880) have reported the expulsion of *tæniæ* by salicylic acid. A purgative dose of castor oil was given, the patient kept on low diet for 24 hours, and a second dose of oil administered, followed by one of 12 grains of the acid, which was repeated hourly until 60 grains had been taken. Finally, half an hour later another half ounce of castor oil was given. The method is not recommended by its simplicity or its pleasantness. Experience has not determined its value. The medicine has been used in the hectic fever of *phthisis*, because it is capable of reducing the temperature, without regard to the serious injury it causes by deranging the digestion and its absolute nullity as a palliative of any symptom peculiar to pulmonary consumption. Very probably it may be profitable in correcting the fetor of the breath in certain cases of this disease; for it does so in *fetid bronchitis*, and even in *gangrene of the lung*, when administered by the stomach, and still better when inhaled from an atomized solution. Sachse recommends a solution of 2 parts of borax, 2½ parts of salicylic acid, and 100 or 150 parts of hot water for an inhalation in ulcerating phthisis. It is scarcely necessary to say that as a stimulant and deodorizing agent this mixture, if useful at all, is not so through the salicylic acid only which it contains. V. Toeplitz has vaunted the application of this acid to the larynx in *whooping cough*. Various stimulants and irritants have been used for the same purpose, including nitric acid, nitrate of silver, ammonia, etc., but have obtained little permanent credit. It has been found efficient in preventing the development of acute *coryza* when given in doses of from 20 to 40 grains, and also in mitigating the symptoms of *hay-fever*. It has been thought to moderate the pain of *lumbago*. In *neuralgia* of a periodical type, and not amenable to quinia, it is said to have been very efficient in doses of from 20 to 40 grains, given every hour for 3 or 4 hours. Abbott (1879) has reported several cases of *sciatica* and of trifacial *neuralgia* in which its effects were prompt and permanent, and Labbé still others (1881), but he was of opinion that the medicine is only useful in cases of rheumatic neuralgia. Others regard its effects as very uncertain, and large doses of sodium salicylate as unsafe (Dujardin-Beaumetz). One or two cases of *chorea* of rheumatic origin appear to have been cured by this medicine. Schaetzke in 1879 published three cases of the rapid cure of *diabetes* by salicylic acid, given in doses of from 15 to 30 grains three times a day, and Sawyer (1881) three others with nearly as favorable an issue, in which sodium salicylate was associated with laudanum. Some years ago (1878) Barclay claimed that the value of salicylic acid in acute *gout* occurring in a previously healthy person was second only to that of colchicum. He does not, however, claim for it that prompt and decided action which it so often manifests in rheumatism, but he insists that in both diseases its use should be gradually, and not abruptly, discontinued. We have not met with any evidence that confirms the estimate of this physician.

As a topical remedy, salicylic acid has been employed in a powder mixed with silicate of magnesia (1 : 10), with which the skin is dusted to prevent *night-sweats*; and a powder made with 1 part of the acid to 6 or 8 of burned alum has been found efficient in correcting fetid *sweating of the feet*, when freely applied several times a day to the part, previously washed with soapsuds and wiped very dry. It is said that in the Russian and Italian armies a powder is used to prevent sweating and *chafing of the feet*, which is composed of salicylic acid 3 parts, starch 10 parts, and powdered talc 87 parts. An alcoholic solution of this acid (1 : 16) is recommended for removing the scales of *psoriasis*, for the treatment of *chloasma* and *freckles*, and as an anti-pruritic remedy. A solution of 1 part of the acid in 6 of glycerin has been found an efficient application to ulcerating *lupus*. Plasters containing salicylic acid have been used with great advantage to soften and remove various forms of *epidermal* thickening, including *corns*, *warts*, etc. The plaster especially recommended is composed of the acid incorporated with gutta-percha. Collodion has also been used as an excipient for the acid. An ointment recommended by Hager as an innocent cure for scalled head (*favus*) and an exterminator and preventative of lice is made by reducing salicylic acid 10.0 Gm. and borax 3.3 to a fine powder, adding yellow wax 50.0 and lard 250 Gm., previously melted together and colored with alkanet, balsam of Peru 10 Gm., oil of bergamot 50 drops, oil of star-anise 20 drops, and rose-water 30.0, and stirring until the ointment solidifies. *Eczema* and *intertrigo* may be cured by a 4 per cent. ointment of this acid. A lotion made with 1 grain of the acid to an ounce of water has removed the eruption and ulcers that sometimes are produced by *bromide of potassium*. Three cases of *urticaria* are recorded which were cured by about 20 grains of salicylate of sodium three times a day. The following mixture has been recommended in *ozæna*: Borax ʒiij; salicylic acid ʒij; glycerin ℥iiss; water to ℥iij. 1 or 2 drachms of this mixture to half a pint of water may be used as a nasal douche and as a gargle. As an external application it has also been a good deal used in dressing *wounds* and *ulcers*, and especially such as tend to *gangrene*. Sometimes the acid is applied as a fine powder, sometimes in a 1 per cent. solution. Indeed, a claim has been made that it is a perfect substitute for carbolic acid, over which it has the advantage of being inodorous, unirritating, and, when absorbed, not poisonous. It is, however, very irritating unless in a weak solution. Its somewhat styptic qualities have caused it to be used topically in *uterine catarrh*, *leucorrhœa*, and *chronic dysentery*, and even to arrest slight *hæmorrhages*. A salicylate of iron has been employed for like purposes. 1 part of the powdered acid mixed with 5 parts of starch is said to correct *fetor* of the axillæ, feet, etc. It has been applied with alleged advantage to soft *chancres* and to remove *corns* and *warts*. For the latter purpose it may be mixed with collodion. Salicylate of lime has been particularly recommended for chancres and syphilitic sores (*Am. Jour. Med. Sci.*, July, 1880, p. 286). An ointment made with vaseline, and containing from 2 to 4 per cent. of salicylic acid, is recommended by Lassar as the best of all applications in *eczema*. If this ointment is found to be too soft it can be stiffened with oxide of zinc (*Centralbl. f. d. ges. Ther.*, i. 389). Given by the mouth or rectum, it tends to diminish fetor of the *stools* in diarrhœa and dysentery. The addition of salicylic acid to vegetable infusions, solutions of bromide of potassium, quinia, atropia, morphia, etc. prevents the formation in them of fungous growths. Dr. J. G. Richardson recommends for hypodermic injection the following solution of morphia: ℞. Morphiæ acet. vel sulph. gr. xvi; acid. acetic (No. 8) gtt ij; acid. salicylic. gr. iss; aquæ destillat. f℥j. If, on standing in a conical glass, any sediment is observed, the clear liquid should be decanted.

Administration.—It is probable that salicin, salicylic acid, and salicylate of sodium are equally active physiologically. Salicin, although not very soluble, may be given in water in the dose of from 10 to 40 grains (Gm. 0.60–2.60), and salicylic acid in wafers and in similar doses. It is better to give the smaller dose and repeat it frequently than to administer a full dose at once. These substances may also be administered in powdered liquorice extract. Salicylate of sodium is now generally preferred to other forms of salicylic acid, on account of its solubility, but its alkaline base is probably not immaterial to the result. Not less than 60 or 70 grains (Gm. 4.00–4.60) should be given in divided doses at half-hour intervals, or 20 grains may be administered every 2 hours until six doses are taken, and on each of the two following days every 4 hours. If it disagrees with the stomach, tincture of orange-peel, of cardamom, or of ginger, or a drop or two of chloroform, may be added to each dose, or it may be dissolved in an aromatic infusion. It is said that ergot removes the cerebral symptoms caused by this medicine (Schilling).

Various formulæ for administering salicylic acid are really solutions of its salts: *e. g.* ℞. Salicylic Acid 120 grs.; Solution of Acetate of Ammonium f℥ij; Water f℥vj.—M. Each fluidounce contains 15 grs. of the salt. Or, ℞. Salicylic Acid 100 grs.; Borax 80 grs.; Water f℥xvj.—M. Or, ℞. Salicylic Acid 120 grs.; Borax 60 grs.; Glycerin q. s.—Mix the acid and borax with fʒiv of glycerin, heat until solution is complete, and add glycerin to make the whole measure f℥j. This contains 25 per cent. of the acid. Or, again: ℞. Peppermint-water, f℥iv; acetate of potassium, ʒiss; salicylic acid, ʒss; lemon syrup, f℥ij. Dissolve the acetate of potassium in the peppermint-water, introduce the acid gradually with agitation until dissolved, and then add the syrup. Of this solution each dessert-spoonful contains 10 grains of salicylic acid, free or combined. For external use a solution of 1 part of the acid in 300 parts of water is recommended. Cotton saturated with a hot solution of the acid, from 3 to 10 per cent. strong, and properly dried, has been used as a surgical dressing.

ACIDUM SUCCINICUM.—Succinic Acid.

Sal succini volatile.—Acide succinique, Fr.; *Bernsteinsäure*, G.

Formula $H_2C_4H_4O_4 = (CH_2)_2.(COOH)_2$. Molecular weight 118.

Origin.—Succinic acid exists in amber, in unripe grapes, in different species of Lactuca, Artemisia, and other plants, and in many animal liquids. It is formed in the oxidation of wax, spermaceti, butyric, stearic, and some other fatty acids; of valerianic acid, benzoic acid, and other organic compounds; in the vinous fermentation of sugar; by the deoxidation or under the influence of casein as a ferment from asparagin, tartrates, malates, aconitates, fumarates, etc. It was observed by Agricola (1550), and recognized as an acid by Lemery (1675).

Preparation.—For medicinal use, succinic acid is prepared by the dry distillation of coarsely-powdered amber from a glass retort, which is entirely imbedded in sand and the short neck of which is connected with a large receiver. The heat is gradually increased to about 280° C. (536° F.), and kept at this temperature as long as white vapors are evolved. The distillate consists of succinic acid crystallized in the neck of the retort, while the receiver contains oil of amber and an aqueous liquid which, according to Marsson (1850), contains, besides succinic acid, also acetic, propionic, butyric, valerianic, and caprionic acids. On concentrating this solution more succinic acid is obtained. (See Oleum succini.)

Properties.—The impure acid is in yellowish or brownish prismatic crystals, which have the odor of oil of amber and an acid, empyreumatic taste. It begins to volatilize at 100° C. (212° F.), fuses between 160° and 180° C. (320° and 356° F.), and boils at 235° C. (455° F.), giving off acrid vapors, dissolves in 2 parts of boiling and 28 parts of cold water, and is freely soluble in warm alcohol, slightly in ether, and insoluble in oil of turpentine. The pure acid is inodorous, is scarcely affected by oxidizing agents, and by fusing potassa is converted into oxalic acid. With the alkalies and magnesia it forms salts which are readily soluble in water; the salts with most other metals are less freely or not at all soluble in water, but dissolve in solution of potassium acetate. The neutral solutions produce, with ferric chloride, red-brown precipitates.

Tests.—A concentrated aqueous solution of the acid should not produce a precipitate with potassium acetate (absence of tartaric acid), nor with chloride of barium (sulphuric acid), chloride of calcium (oxalic acid), sulphuretted hydrogen, nor, after neutralization, with sulphydrate of ammonium (metals). When treated with soda in excess an ammoniacal odor should not be generated, and when heated upon platinum-foil the odor of caramel should not be observed (sugar), nor should finally any fixed residue be left (salts).

Pharmaceutical Uses.—It is employed for preparing

Liquor ammonii succinatis (succinici, *P. G.* 1872), *s. Liq. cornu cervi succinici.* 1 part of succinic acid is dissolved in 8 parts of warm water, and neutralized by 1 part or a sufficient quantity of pyro-oleous carbonate of ammonium; the solution is set aside for 24 hours and then filtered. It has a brownish or brown color, remains clear when mixed with three times its weight of alcohol, and when evaporated and ignited leaves no residue. Pure ammonium succinate is sometimes used for estimating the iron in ferric salts.

Medical Action and Uses.—There is no reason to believe that this acid possesses any active properties or medicinal virtues. It has been taken in doses of from 60 to 120 grains without any definite effects. It is excreted partly by the skin, but chiefly with the urine either unchanged, or, as has been asserted, in the form of hippuric acid. It has been alleged to raise the pulse, promote diaphoresis and the bronchial secretion, and augment the activity of the nervous centres; and has been prescribed in *rheumatism, bronchitis*, and *hysteria* and various other spasmodic affections. Even if its apparent utility had been demonstrated, the objection may fairly be made that the acid was not used alone, but as a succinate of ammonium and with empyreumatic oils, etc. The *dose* of the acid may be stated to be between 5 and 15 grains (Gm. 0.30–1.00).

ACIDUM SULPHURICUM, *U. S., Br.*—SULPHURIC ACID.

Acidum sulfuricum, P. G.—*Oil of vitriol*, E.; *Acide sulfurique, Huile de vitriol*, Fr.; *Schwefelsäure, Vitriolöl*, G.

Formula H_2SO_4. Molecular weight 98. Strength 96 to 98 per cent. Spec. grav. 1.840 to 1.843.

Diluted Sulphuric Acid. Strength 10 per cent. *U. S.*, 13.65 per cent. *Br.* Spec. grav. 1.067 *U. S.*, 1.094 *Br.*

Origin.—Sulphuric acid is found in the free state in certain springs emanating from volcanoes and in the salivary glands of some mollusks, but it mostly occurs combined with various bases both in the mineral and organic kingdoms. At an early date the acid was known to the alchemists, but its preparation from "calcined vitriol" (ferrous sulphate) was first described by Basilius Valentinus in the fifteenth century. Lavoisier (1777) determined it to be composed of sulphur and oxygen, and Richter (1795) ascertained the percentage of the two elements nearly correct. In the manufacture of sulphuric acid Roebuck and Garbett (1746) replaced the glass vessels by a lead chamber, and Lafolie (1774) introduced the use of steam.

Preparation.—1. SULPHURIC ACID. Sulphur or iron pyrites is burned in a furnace arranged in such a manner that the sulphurous acid gas is mixed with atmospheric air; in the same furnace, by the heat of the burning sulphur, nitric acid is generated from a mixture of nitrate of sodium and sulphuric acid, the vapors of nitric acid being carried with the mixed sulphurous acid and air into a large leaden chamber, where the current of these gases comes in contact with a jet of steam. The sulphurous acid, in the presence of water, acts upon the nitric acid thus: $3SO_2 + 2HNO_3 + 2H_2O = 2NO + 3H_2SO_4$. Nitric oxide and sulphuric acid are produced; the latter, being condensed, dissolves in the water, which covers the floor of the lead chamber to the depth of about 2 inches. The nitric oxide, at the moment of its formation, is at once oxidized by the oxygen, which entered the lead chamber with the sulphurous acid gas, into nitrous and hyponitric acids, N_2O_3 and NO_2, both of which are decomposed in the presence of sufficient water into nitric acid and nitric oxide, the reaction being explained by the following equations: $3N_2O_3 + H_2O = 2HNO_3 + 4NO$ and $3NO_2 + H_2O = NO + 2HNO_3$. The nitric acid regenerated in this manner again reacts upon some sulphurous acid gas, oxidizing it to sulphuric acid and becoming reconverted into nitric oxide. It will be observed that, theoretically, a given quantity of nitric acid is capable of oxidizing an unlimited amount of sulphurous acid; the limit in practice is occasioned by the loss of the nitrogen compounds which remain dissolved in the diluted sulphuric acid finally drawn from the chambers. If the nitric acid could be used once only, it is obvious that 170 parts or 2 molecules of the nitrate of sodium could furnish sufficient merely to oxidize the sulphurous acid resulting from 96 parts or 3 atoms of sulphur, while practically about 5 or 6 parts of sodium nitrate are sufficient.

Through the condensation of the sulphuric acid in the chamber, room is made for a fresh quantity of sulphurous acid gas and air, while the nitrogen contained in the air accumulates and is removed through a chimney after it has finally passed through a lead chamber filled with coke, over which sulphuric acid is made to trickle, thus dissolving the nitric oxide contained in the nitrogen. The acid, thus charged with this gas, most likely in the form of a nitro-sulpho-compound, is passed in the form of spray into another smaller chamber placed near the furnace, so that the sulphurous acid and air, in passing through this, may carry the nitric oxide into the first large lead chamber, there to be utilized in effecting the oxidation of the sulphurous acid. Instead of introducing nitric acid vapors with the mixed sulphurous acid and air, as described above, the apparatus is sometimes arranged in such a manner that in the second chamber a number of earthen vessels nearly filled with nitric acid by means of a tube from the top of the chamber are placed upon shelves above each other; or where nitrous acid is obtained in sufficient quantity, as in the manufacture of oxalic acid, this is used in place of nitric acid, with the same success.

The number of lead chambers varies from 4 to 7, and the gases are made to pass through all in succession. The central one is larger, and placed several feet lower than the others, so that the sulphuric acid condensing in the latter will flow into the former. When the acid in the chamber, often designated as *chamber acid*, has attained the specific gravity 1.52 to 1.58, it is drawn off and evaporated in shallow leaden pans until it has reached a density of 1.70 to 1.75. In this operation sulphurous, nitrous, and nitric acids are expelled, and sulphates of iron, lead, and calcium deposited, the salts resulting from the corrosion of the vessels and the impurities of the water. The acid is now usually dark-colored, due to accidental organic admixtures. If further evaporated in the lead pans the metal would be corroded and much acid volatilized. The final concentration must therefore be effected in platinum stills or glass retorts placed in a sand-bath, the distillation being continued as long as a weak acid passes over or until the residue has the desired density. For the preparation of a *pure* sulphuric acid, however, the commercial acid must be distilled from a glass retort, which is placed in a deep sand-bath surrounded by sand and covered with a metallic hood; the neck of the retort is connected without luting with a suitable receiver, which is changed when about one-eighth or one-sixth of the acid has come over; the subsequent portion will have the required specific gravity. It is important that an acid free from arsenic should be selected for distillation.

2. NORDHAUSEN OIL OF VITRIOL, so named because it was first manufactured near Nordhausen in Saxony, is obtained from ferric sulphate, which is made by allowing ferrous sulphate to oxidize in the air. It is distilled in small earthen retorts, which are placed horizontally in a furnace and connected with earthen receivers. Each retort is charged with from 2 to 3 pounds of the dry salt, and yields about 50 per cent. of acid, which consists of about 1 molecule each of sulphuric anhydride and hydrogen sulphate, $SO_3.H_2SO_4$. Ferric oxide remains behind, and is used under the name of *colcothar* or *rouge* for polishing glass and metals.

3. ACIDUM SULPHURICUM DILUTUM, *U. S.*, *Br.* Diluted Sulphuric Acid, *E.;* Acide sulfurique dilué, *Fr.;* Verdünnte Schwefelsäure, *G.*—Take of Sulphuric Acid 1 part; Distilled Water 9 parts (5 parts, *P. G.*). Add the acid gradually, with constant stirring, to the distilled water.—*U. S.*, *F. Cod.*

The direction of the Pharmacopœias to add *the acid to the water* must be observed in all cases, and more particularly if large quantities of acid are to be diluted. During the mixing of the two liquids, which is best performed in a porcelain dish or beaker-glass, a considerable elevation of temperature takes place, causing a portion of the water to evaporate; the weight of the cooled mixture should therefore be made up to 10 parts by the addition of distilled water. Filtration through paper or decantation is necessary only when pure sulphuric acid has not been used, to remove the sulphate of lead, which is deposited from the commercial acid on diluting with water. The British Pharmacopœia dilutes 7 fluidounces of sulphuric acid with sufficient water to make the liquid, when cooled to 15.5° C. (60° F.), measure 83½ fluidounces, or 1350 grains of the acid are diluted as before to measure 1 pint (Imperial). The German Pharmacopœia admits for diluted sulphuric acid a specific gravity varying between 1.110 and 1.114.

Purification.—To remove nitrogen compounds from strong sulphuric acid, Maxwell Lyte recommends (1864) the addition to it of ¼ or ½ per cent. of oxalic acid, and then exposure to heat until this compound is completely decomposed. To remove arsenic, Busy and Buignet (1863 and 1864) oxidize this metal, if present as arsenious acid, to arsenic acid, and then distil nine-tenths of the sulphuric acid after having previously added some sulphate of ammonium. A. Buchner (1863) avoids distillation in such a case by reducing the arsenic, if present as arsenic acid, to arsenious acid by heating the sulphuric acid with a little charcoal. Hydrochloric acid gas is then passed through the liquid, and the arsenic is entirely eliminated from the hot acid as chloride of arsenic.

Properties.—1. SULPHURIC ANHYDRIDE OR ANHYDROUS SULPHURIC ACID. This distils first when Nordhausen oil of vitriol is heated. At a low temperature it forms long, colorless prisms having in quantity somewhat the aspect of asbestos. It fuses at about 20° C. (68° F.) to a colorless liquid, boils above 35° C. (95° F.), and dissolves in all proportions of oil of vitriol. When kept at a temperature below 25° C. (87° F.) it is gradually converted into a modification which is slightly soluble in oil of vitriol and melts slowly above 50° C. (122° F.), at the same time passing into the former kind. Both kinds attract moisture with great avidity, and in contact with the air give off white fumes. Its composition is SO_3.

2. NORDHAUSEN OIL OF VITRIOL. This was officinal in Germany under the name of *Acidum sulfuricum fumans.* It is an oily liquid, emitting white suffocating fumes, and having a specific gravity of from 1.860 to 1.900. It is usually of a brownish color, due to organic matter. Near 0° C. (32° F.) it forms colorless flat crystals, and between 40° and 50° C. (104° and 122° F.) it commences to boil, sulphuric anhydride distilling over; on continuing the heat an acid is finally obtained which boils at 338° C. (see below).

3. COMMERCIAL SULPHURIC ACID, ACIDUM SULFURICUM CRUDUM, *P. G.* It forms a colorless or brownish, inodorous, oily liquid, intensely acid and corrosive, and having a specific gravity of not less than 1.830 (*P. G.*). It holds a small quantity of lead sulphate in solution, which, however, does not render it unfit for pharmaceutical purposes if it is otherwise pure, more particularly free from arsenic, since that salt is precipitated when the acid is diluted with water or alcohol. It is also liable to contain small quantities of nitric, hydrochloric, and sulphurous acid, iron and other metals, lime, ammonia, and other alkalies.

4. PURE SULPHURIC ACID. It resembles the colorless crude acid in its physical properties, and, like it, is very hygroscopic. When cooled to about —35° C. (—31° F.) it congeals, and heated to 338° C. (640° F.) it boils, yielding a colorless gas producing dense white fumes when in contact with the atmosphere, and finally evaporates without leaving any residue. The boiling is usually accompanied with violent concussions. Weaker acids boil at a lower temperature, the strength and density being increased until the boiling-point mentioned above has been reached, when the acid contains 1.5 per cent. H_2O and 98.5 per cent. H_2SO_4 (Marignac, 1853). Pure hydrogen sulphate melts, according to Marignac, at 10.5° C. (51° F.), and has at 0° C. (32° F.) the density 1.854, and at 12° C. (53.6° F.) 1.842, in both cases compared with water of the same temperature. The affinity of concentrated sulphuric acid for water is so great that organic compounds left in contact with it are charred, while the acid at the same time acquires a brown color.

Per ct. H_2SO_4.	Specific gravity.	Per ct. SO_3.	Per ct. H_2SO_4.	Specific gravity.	Per ct. SO_3.	Per ct. H_2SO_4.	Specific gravity.	Per ct. SO_3.	Per ct. H_2SO_4.	Specific gravity.	Per ct. SO_3.
100	1.8426	81.63	75	1.6750	61.22	50	1.3980	40.81	25	1.1820	20.40
99	1.8420	80.81	74	1.6630	60.40	49	1.3886	40.00	24	1.1740	19.58
98	1.8406	80.00	73	1.6510	59.59	48	1.3879	39.18	23	1.1670	18.77
97	1.8400	79.18	72	1.6390	58.77	47	1.3700	38.36	22	1.1590	17.95
96	1.8384	78.36	71	1.6270	57.95	46	1.3610	37.55	21	1.1516	17.14
95	1.8376	77.55	70	1.6150	57.14	45	1.3510	36.73	20	1.1440	16.32
94	1.8356	76.73	69	1.6040	56.32	44	1.3420	35.82	19	1.1360	15.51
93	1.8340	75.91	68	1.5920	55.59	43	1.3330	35.10	18	1.1290	14.69
92	1.8310	75.10	67	1.5800	54.69	42	1.3240	34.28	17	1.1210	13.87
91	1.8270	74.88	66	1.5780	53.87	41	1.3150	33.47	16	1.1136	13.06
90	1.8220	73.47	65	1.5570	53.05	40	1.3060	32.65	15	1.1060	12.24
89	1.8160	72.65	64	1.5450	52.24	39	1.2976	31.83	14	1.0980	11.42
88	1.8090	71.83	63	1.5340	51.42	38	1.2890	31.02	13	1.0910	10.61
87	1.8020	71.02	62	1.5230	50.61	37	1.2810	30.20	12	1.0830	9.79
86	1.7940	70.10	61	1.5120	49.79	36	1.2720	29.38	11	1.0756	8.98
85	1.7860	69.38	60	1.5010	48.98	35	1.2640	28.57	10	1.0680	8.16
84	1.7770	68.57	59	1.4900	48.16	34	1.2560	27.75	9	1.0610	7.34
83	1.7670	67.75	58	1.4800	47.34	33	1.2476	26.94	8	1.0536	6.53
82	1.7560	66.94	57	1.4690	46.53	32	1.2390	26.12	7	1.0464	5.71
81	1.7450	66.12	56	1.4586	45.71	31	1.2310	25.30	6	1.0390	4.89
80	1.7340	65.30	55	1.4480	44.89	30	1.2230	24.49	5	1.0320	4.08
79	1.7220	64.48	54	1.4380	44.07	29	1.2150	23.67	4	1.0256	3.26
78	1.7100	63.67	53	1.4280	43.36	28	1.2066	22.85	3	1.0190	2.445
77	1.6980	62.85	52	1.4180	42.45	27	1.1980	22.03	2	1.0130	1.63
76	1.6860	62.04	51	1.4080	41.66	26	1.1900	21.22	1	1.0064	0.81

The specific gravities of sulphuric acid of different strength, as ascertained by Vauquelin, Darcet, Bineau, Dalton, Ure, and Kolb, vary in some cases considerably. The foregoing is Bineau's table for a temperature of 15° C. (59° F.).

Pure sulphuric acid unites with water and alcohol in all proportions, forming transparent liquids; a white turbidity indicates lead sulphate, which becomes black with hydrosulphuric acid. Arsenic would be indicated by a yellow precipitate occurring in the diluted acid with sulphuretted hydrogen, or more rapidly by nitrate of silver in applying Marsh's test or by Fleitmann's method (see page 28). A cold concentrated solution of ferrous sulphate poured upon the surface of the concentrated acid does not develop a purplish-brown color where the two liquids unite, showing the absence of nitrogen oxides.

The pharmacopœias require the officinal acid to contain between 96 and 97 per cent. of H_2SO_4; 49 parts of it, or ½ molecule, will be exactly neutralized by between 96 and 97 parts of potassium bicarbonate, or 4.9 Gm. of the acid by not less than 96 Ccm. of the volumetric solution of soda. The British Pharmacopœia requires for 1000 grain-measures of the latter 50.6 grains of the acid, which corresponds to 96.8 per cent. of H_2SO_4, equal to 79 per cent. SO_3.

Sulphuric acid is one of the strongest of acids. It is bibasic, and forms normal and acid salts, which are generally crystallizable and soluble in water. The sulphates of barium and lead are entirely insoluble in water and diluted acids; hence their soluble salts furnish the best reagents for sulphuric acid in its uncombined and combined state.

5. Diluted Sulphuric Acid. It has the general properties of the strong acid, but is not of an oily consistence, and is less caustic. It differs from the other diluted mineral acids in containing 10 per cent. of the officinal, but not of absolute, sulphuric acid; accordingly, 4.9 Gm. of it are neutralized by not less than 9.6 Ccm. of the volumetric solution of soda. The British Pharmacopœia requires the diluted acid to contain 11.14 per cent. of SO_3, equal to 13.65 per cent. of H_2SO_4; of it, 359 grains are neutralized by 1000 grain-measures of the volumetric solution of soda.

Impurities.—The most important impurities, arsenic, lead, and nitrogen oxides, have been mentioned before. Saline additions, sometimes made to increase the specific gravity of weaker acids, are recognized by the fixed residue left on evaporating a small quantity from a platinum dish or crucible. Sulphurous and nitrous acid rapidly decolorize potassium permanganate. For the detection of the former Warington recommends (1868) the suspension in a quart bottle, half filled with the sulphuric acid, of a strip of paper colored blue by iodide of starch, which will be bleached by the sulphurous acid; a paper covered with starch and iodide of potassium, suspended in a similar manner, becomes blue in the presence of nitrogen oxides.

Arsenic is found principally in sulphuric acid manufactured from pyrites, more rarely if made from sulphur; for this reason the sulphuric acid manufactured in the United States is often free from this contamination.

Pharmaceutical Uses.—Sulphuric acid is largely used in numerous pharmaceutical processes for the liberation of acids (hydrocyanic, hydrochloric, nitric, citric, tartaric); in the preparation of alkaloids, pyroxylon, ether, and oil of wine; for generating hydrogen with zinc and water; for decomposing certain organic compounds, as in the purification of chloroform; and for the preparation of sulphurous acid, the medicinal sulphates, and of *Acidum sulphuricum aromaticum.*

Mixtura sulfurica acida, *P. G.*, *s. Elixir acidum Halleri.* It is prepared by dropping 1 part of pure sulphuric acid into 3 parts of alcohol, and stirring continually; it is a colorless liquid, having nearly the specific gravity of water. It is an alcoholic solution of sulphovinic acid, into which the sulphuric acid is gradually converted. Colored by red poppy-petals, it is *Eau de Rabel* of the French Codex.

Mixtura vulneraria acida, *s. Aqua vulneraria Thedenii.*—Theden's vulnerary water, *E.;* Eau d'arquebusade, *Fr.;* Theden's Wundwasser, *G.* It is a mixture of diluted sulphuric acid 1 part; vinegar 6 parts; alcohol (sp. grav. .892) 3 parts; and clarified honey 2 parts.—*F. Cod.*

Michel's paste is a mixture of powdered asbestos 1 part and concentrated sulphuric acid 3 parts. It should be freshly prepared when needed. Similar are the caustic pastes of Rust, Velpeau, and Ricord, in which the asbestos is replaced by saffron, liquorice-root, and powdered charcoal respectively.

Physiological Action.—In a concentrated state sulphuric acid abstracts water from organized matter, turning it black and exposing its carbonaceous elements in the form of charcoal. Injected into the veins, it coagulates the blood and carbonizes it. When swallowed in a concentrated form it destroys all the tissues it touches, and in this condition, as well as when somewhat less strong, it produces severe pain in the throat, œsophagus, and stomach, with violent efforts at vomiting, and collapse. The urine is sometimes albuminous or bloody. The mind remains clear. Even when death does not directly occur, it often does so at a later period, owing to stricture of the œsophagus or intestine resulting from ulceration of the mucous membrane. In medicinal doses it diminishes thirst, restrains sweats depending on debility, improves the appetite, probably by stimulating the stomach, acidifies the secretions, and reduces the frequency of the pulse. Its action upon the teeth, even when it is greatly diluted, is exceedingly injurious, and by continued use it exhausts the digestive functions and causes diarrhœa, with debility and emaciation.

Medical Uses.—The corrosive action of sulphuric acid has been made use of to correct inversion and also eversion of the eyelid (*ectropion* and *entropion*) by forming an eschar upon the convex or projecting surface of the part, which in cicatrizing contracts the tissues and corrects the deformity. It has sometimes been employed as an escharotic application to various infecting or ill-conditioned *ulcers*, particularly in *gangrene* of the mouth and in *caries* of the bones, and also for the extirpation of *cancers*. In the last case a paste is applied to the tumors formed of asbestos and powdered sulphate of zinc, or saffron, saturated with sulphuric acid. The operation is tedious, very painful, and as uncertain as any other for the same purpose. An ointment composed of 1 part of the acid to 8 parts of lard has been recommended for *tinea capitis;* and in the treatment of *scabies* it is often successful either in ointment or lotion, and has the advantage over sulphur ointment of being free from any unpleasant smell. Internally, sulphuric acid in the diluted or aromatic form is much used in chronic diseases with a tendency to a dissolution of the blood, such as *scurvy* and *purpura*, as well as in other and especially uterine passive *hæmorrhages*. It is thought to be particularly useful in mucous hæmorrhages and fluxes, because the acid is eliminated by the mucous membranes; but this explanation would not apply to blood diseases, whether chronic or acute, and especially to *fevers* of a low type, in which it is reputed to be efficient. Still less would it apply to *colliquative sweating*, for which this medicine is one of the very best remedies. Nor can it be assumed to explain the efficacy of the acid in *diarrhœa*, *cholera morbus*, and even *epidemic cholera*. In the last-mentioned cases the most probable view is that its operation is local and in its nature astringent. So far as it acts by being taken into the blood, it probably does so in the same manner, but from within instead of from without. Its apparent power of preventing as well as of curing epidemic cholera appears distinctly to be owing to the astringent influence by which it prevents the absorption of the cholera poison from the alimentary canal, the ordinary channel of its introduction, and at the same time limits the transudation of the contents of the blood-vessels into the bowels. Its value as a prophylactic against cholera is not so well authenticated. Its efficacy in *painter's colic* is generally admitted. It is administered with water, in the proportion of about 2 fluid-drachms (Gm. 8) in 3 pints of water in the course of 24 hours. If it is useful, as alleged, in curing *gravel* and *stone*, its utility is probably due to a tonic action upon the stomach. It has sometimes appeared to remove *tape-worms*, perhaps by its physical action upon these parasites.

As *antidotes* to poisoning by sulphuric acid, chalk, magnesia, carbonate of magnesia, and the alkaline carbonates may be administered.

The *dose* of the strong acid is 1 or 2 drops (Gm. 0.06–0.13) dissolved in not less than 4 ounces of water; of the diluted acid, from 10 to 30 drops (Gm. 0.60–2.00) may be given in the same way.

ACIDUM SULPHURICUM AROMATICUM, *U. S., Br.*—AROMATIC SULPHURIC ACID.

Tinctura aromatica acida, Elixir vitrioli Mynsichti.—Elixir of vitriol, E.; *Elixir vitriolique, Teinture (Alcoolé) aromatique sulfurique*, Fr.; *Saure aromatische Tinctur, Mynsicht's Elixir*, G.

Strength of H_2SO_4: 19.2 per cent. *U. S.*, 13.4 per cent. *Br.* Spec. grav. .955 *U. S.*, .027 *Br.*

Preparation.—Add gradually Sulphuric Acid 200 parts (4 oz. av.) to Alcohol 700 parts (14 oz. av., or 16½ fluidounces), and allow the mixture to cool. Then add to it Tincture of Ginger 45 parts ($\frac{9}{10}$ oz. av., or 1 fluidounce), Oil of Cinnamon 1 part (8¾ grains, or 8 minims), and enough Alcohol to make the product weigh 1000 parts (20 oz. av., or 20⅛ fluidounces).—*U. S.*

Take of Strong Tincture of Ginger 2 fluidounces; Spirit of Cinnamon 2 fluidounces; Rectified Spirit 36 fluidounces; Sulphuric Acid 3 fluidounces (or 2419 grains). Mix the sulphuric acid gradually with the spirit, and add the spirit of cinnamon and tincture of ginger.—*Br.* Spec. grav. 0.911; contains about 12.5 per cent. of H_2SO_4.

This preparation has been dismissed from both the French and German Pharmacopœias.

Properties.—The first formula is essentially that suggested by T. N. Jamieson in 1867 as a substitute for one directing, like the last two formulas, the maceration of the aromatics in the mixture of alcohol and sulphuric acid, whereby a preparation of a deep brown-red color is obtained, which in the course of time deposits an unsightly precipitate, due perhaps to modified tannin. The preparation obtained by the new pharmacopœial process is of a light-straw color, and, while it yields only a slight precipitate, has about the same aromatic properties as the former.

On mixing sulphuric acid with alcohol the temperature rises and some sulphovinic (ethylsulphuric) acid is produced, the quantity of which slowly increases with the age of the preparation. For the same amount of sulphur this acid has only one-half the saturating power of sulphuric acid; the acidimetric test must therefore vary with the age of this preparation, and when fresh and made at a low temperature 9.8 Gm. of the acid, properly diluted with water, will require for complete neutralization 38.4 (*U. S.*), 25.0 (*Br.*) Ccm. of the volumetric solution of soda; the U. S. Pharmacopœia says "not less than 3.6 Ccm.," which will probably be the limit after keeping for several months. The British Pharmacopœia requires 500 grain-measures of the soda solution for the neutralization of 195 grains by weight of its aromatic sulphuric acid.

Medical Uses.—This preparation is preferable to any other form of sulphuric acid for internal administration. It is peculiarly adapted to the treatment of *gastro-intestinal disorders*, for which the simple acid is also appropriate, and of the *colliquative sweats* of phthisis and other hectical affections. Dose, from 10 to 20 drops (Gm. 0.60–1.30).

ACIDUM SULPHUROSUM, *U. S., Br.*—SULPHUROUS ACID.

Sulphurous anhydride, Sulphur dioxide, E.; *Acide sulfureux*, Fr.; *Schweflige Säure*, G.

Formula, SO_2. Molecular weight 64. Strength 3.5 per cent. *U. S.*, 5 per cent. *Br.* Specific gravity, 1.022 *U. S.*, 1.025 *Br.*

Origin and Production.—Sulphurous acid was first distinguished from sulphuric acid by Stahel (1697); its properties in the gaseous state were studied by Priestley (1775), and Lavoisier (1777) showed that it contains less oxygen than sulphuric acid. It is met with in the exhalations of active volcanoes, and is produced on the burning of sulphur and when concentrated sulphuric acid is heated with charcoal or with organic matters, with copper, mercury, or other metals. The officinal process is as follows:

Preparation.—Take of Sulphuric Acid 14 parts; Charcoal in coarse powder 2 parts; Distilled Water 100 parts. Pour the acid upon the charcoal previously introduced into a glass flask, and mix the two well together. By means of a glass tube and well-fitting corks connect the flask with a wash-bottle, which is one-third filled with water and fitted with a cork having three perforations. Into one of these perforations insert a safety-tube, which should reach nearly to the bottom of the bottle; into the remaining perforation fit a glass tube and connect it with a bottle which is about three-fourths filled by the distilled water. This tube should dip about an inch below the surface of the water. By means of a second tube connect this bottle with another bottle containing a dilute solution of carbonate of sodium, to absorb any gas which may not be retained by the distilled water. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask until the evolution of gas has nearly ceased, and during the passage of the gas keep the bottle containing the distilled water at or below 10° C. (50° F.) by surrounding it with cold water or ice. Finally, pour the sulphurous acid into glass-stoppered, dark amber-colored bottles, and keep them in a cool and dark place.—*U. S.*

In these directions neither the size of the wash-bottle nor the amount of water to be used for washing the gas is given; an 8-ounce or 12-ounce bottle containing 2 or 3 ounces of water will be found to answer the purpose if about 10 ounces of sulphuric acid are used; and if a safety-tube be inserted in the apparatus the delivery-tube may be allowed to reach to near the bottom of the distilled water. The gas which is not absorbed must, to avoid inconvenience, be conveyed either into the open air, into a flue, or, as directed above, into an alkaline solution, where it will be retained.

The process of the British Pharmacopœia is essentially the same: the gas evolved from

4 fluidounces of sulphuric acid and 1 ounce of wood charcoal is washed by passing it through 2 ounces of water and conducted into 20 fluidounces of distilled water.

The charcoal acts as a reducing agent upon the sulphuric acid, generating carbonic and sulphuric anhydrides and water; thus: $C_2 + 4H_2SO_4 = 2CO_2 + 4SO_2 + 4H_2O$. The gas is therefore contaminated with carbon dioxide, which will likewise be retained by the distilled water to a slight extent. A purer acid is obtained by heating copper clippings with concentrated sulphuric acid, when sulphate of copper and sulphurous acid will be produced; $Cu_2 + 4H_2SO_4 = 2CuSO_4 + 2SO_2 + 4H_2O$. Double the quantity of sulphuric acid will be necessary to produce the same amount of sulphurous acid as is produced by the officinal process.

Properties and Tests.—Sulphur dioxide consists of 1 measure of gaseous sulphur and 2 of oxygen, condensed to 2 measures; it is a colorless, irrespirable gas, has a pungent and suffocating odor, and condenses to a liquid at −17.8° C. (0° F.) or under a pressure of 4 or 5 atmospheres; this liquid boils briskly on coming into contact with ice. Water dissolves at 10° C. (50° F.) 51 volumes, and at 20° C. (68° F.) 36 volumes, of sulphur dioxide; the solution contains sulphurous acid, $H_2SO_3 = (OH)_2SO$, and when saturated at ordinary temperature has, according to Anthon (1860), the density 1.046 and contains 9.54 per cent. SO_2. The density of sulphurous acid of different strength has been ascertained as follows:

Per ct. SO_2.	Specific gravity.			Per ct. SO_2.	Specific gravity.			Per ct. SO_2.	Specific gravity.		
	Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.		Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.		Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.
10.00	……	1.052	1.044	6.68	1.027			3.82	1.016		
9.54	1.046			6.50	……	1.035	1.027	3.50	……	1.019	1.014
9.50	……	1.049	1.041	6.00	……	1.033	1.025	3.00	……	1.017	1.012
9.00	……	1.047	1.039	5.72	1.023			2.86	1.013		
8.59	1.036			5.50	……	1.030	1.023	2.50	……	1.014	1.010
8.50	……	1.045	1.037	5.00	……	1.027	1.021	2.00	……	1.011	1.008
8.00	……	1.042	1.035	4.77	1.020			1.90	1.009		
7.63	1.031			4.50	……	1.025	1.019	1.50	……	1.008	1.006
7.50	……	1.040	1.033	4.00	……	1.022	1.017	0.95	1.005		
7.00	……	1.037	1.030								

Strength and density, as given by the British Pharmacopœia, correspond with the above table, but not the figures given by the U. S. Pharmacopœia. Both authorities determine the strength by iodine, 1 atom of which will be converted into hydriodic acid by ½ molecule of sulphur dioxide; hence 3.2 Gm. of the pharmacopœial sulphurous acid, properly diluted, will not acquire a permanent blue color with starch-paste, until at least 50 Ccm. (*Br.*), 35 Ccm. (*U. S.*) of the volumetric solution of iodine have been added, or 1000 grain-measures of the latter should oxidize 64 (*Br.*), 91.43 (*U. S.*) grains of sulphurous acid; $I_2 + H_2SO_3 + H_2O$ yield $H_2SO_4 + 2HI$.

The aqueous solution of sulphurous acid evaporates by heat without leaving any residue; in contact with air it is oxidized to sulphuric acid, and when exposed to light it acquires the property of precipitating sulphide of silver from nitrate of silver. Chloride of barium, slightly acidulated with hydrochloric acid, yields no precipitate with it, or only a slight turbidity. The gas remains with the water when the solution freezes, and at the boiling temperature some time must elapse before it is entirely expelled.

Sulphurous acid is a powerful deoxidizing agent, abstracting oxygen from permanganic, chromic, iodic, arsenic, nitric, and other acids, from ferric, mercuric, argentic, and other salts, and from most vegetable colors, thereby bleaching the latter. It yields hydrogen sulphide and water when in contact with nascent hydrogen. It displaces carbonic acid from its saline compounds, and yields salts which generally are sparingly soluble in water, except the alkaline sulphites; they are inodorous, have a somewhat acrid taste, and on ignition are converted into sulphate and sulphide, or sulphur dioxide is given off, the metallic oxide remaining.

Pharmaceutical Uses.—Sulphurous acid is employed in the preparation of sodium, calcium, and other sulphites, and of calomel by the wet process, and serves as a powerful reducing agent. In pharmacy and the arts it is used for bleaching sponges, bones, straw, and other organic matters, for removing fruit-stains, and for arresting or preventing fermentation and putrefaction.

Medical Uses.—Sulphurous acid is chiefly used for the purpose of destroying or preventing the development of those low forms of cryptogamic life which are supposed to be the essential element of certain diseases and of the process of fermentation. *Favus* of the scalp and hairy portions of the face is treated by means of lotions containing 1 part of the acid to 3 of water, after the crusts have been removed by means of emollient poultices. It has also been used successfully in the cure of *scabies*. As a lotion for recent *wounds* it has been thought to allay pain, diminish suppuration, and promote cicatrization; and as a gargle it is recommended for ulcerated and gangrenous *pharyngitis*. In many other local affections requiring a stimulant and antiseptic treatment it may be used with advantage. It may be given internally in the treatment of *urticaria* and to prevent the *flatulence* depending upon dyspeptic fermentation, but for the latter purpose the sulphites are preferable. This acid, as it is formed by burning sulphur, has been much used for *disinfecting* shops, hospital wards, etc. which have been occupied by the sick or which are contaminated by foul odors.

The *dose* of sulphurous acid is from 1 to 3 fluidrachms (Gm. 4–12), largely diluted.

ACIDUM TANNICUM, *U. S., Br., P. G.*—TANNIC ACID.

Acidum gallo-tannicum, Tanninum.—Tannin, E.; *Acide tannique, Tannin,* Fr.; *Gerbsäure, Tannin,* G.

Formula $C_{14}H_{10}O_9 = (C_6H_2)_2.(OH)_5.OCO.COOH$. Molecular weight 322.

Origin and Varieties.—Compounds having acid properties and an astringent taste, producing dark-colored solutions or precipitates with salts of iron, and precipitating gelatin and albumen from their solutions, are called by the generic name of tannins. The reaction of tannins with metallic salts, and one of their principal products, leather, were known in ancient times; but Deyeux (1793) and Seguin (1795) first proved tannin to be a distinct compound. The tannins are conveniently arranged into two groups, according to the color produced with ferric salts, which is either dark-green or dark-blue. A large number of plants contain tannin of the latter group, differing, however, from the officinal tannic acid in not furnishing gallic or pyrogallic acid. The tannin obtained from nutgalls is, for this reason, distinguished from the others by the prefix *gallo*. Gallotannic acid has been found in the officinal galls, in Chinese and Japanese galls, in the cups of the fruit of some oaks, and in the leaves of Italian sumach, Rhus Coriaria, *Linné*.

Preparation.—Take of Nutgall in fine powder, Ether, each a sufficient quantity. Expose the nutgall to a damp atmosphere for 2 or 3 days, and afterward add sufficient ether to form a soft paste. Let this stand in a well-closed vessel for 24 hours; then, having quickly enveloped it in a linen cloth, submit it to strong pressure in a suitable press, so as to express the liquid portion. Reduce the pressed cake to powder, mix it with sufficient ether, to which one-sixteenth of its bulk of water has been added to form again a soft paste, and express as before. Mix the expressed liquids, and expose the mixture to spontaneous evaporation until, by the aid subsequently of a little heat, it has acquired the consistence of a soft extract; then place it on earthen plates or dishes and dry it in a hot-air chamber at a temperature not exceeding 212° F.—*Br.*

The process adopted by the pharmacopœias is that proposed by Dominé in 1844, and based upon that of Leconnet, first published in 1836, the important modification being the exposure of the powdered galls to a damp atmosphere, and the addition of water to the ether in order to supply the water requisite for rendering the tannin soluble in the ether. That water is absolutely necessary was noticed by Pelouze (1834), who percolated powdered nutgalls with commercial ether containing water—a process suitable for preparing tannin on a small scale; the percolate separates into two slightly-colored layers, the lower of which is a very concentrated solution of tannin. Dominé's plan brings about the same result in less time and with much less ether, for which reasons it is well adapted for the preparation of tannin on a large scale. Mohr, Guibourt, and others used a mixture of ether, alcohol, and water.

Gallotannic acid is insoluble in absolute ether, but in the presence of a little water a definite compound appears to be formed of tannin and ether, or with water in addition thereto, which is insoluble in ether, but may be dissolved in water; the ether retained in this syrupy liquid is larger in quantity than would be dissolved by the same amount of water. The complete drying of the tannin is effected at a somewhat elevated temperature, by which the volatile ingredients of the syrupy liquid cause the latter to froth up, leaving the tannin behind in loose, porous masses somewhat sponge-like in appearance. It is scarcely necessary to state that during the entire process contact with most metals, notably with iron, must be avoided; the operations are best performed in glass, porcelain, or earthen vessels.

Properties.—Tannic acid, thus prepared, has a yellowish-white color, frequently of a slight greenish tint. It has a strongly astringent taste, and is freely soluble in water, alcohol, acetone, oil of bitter almond, and in 6 parts of glycerin; but remains pulverulent when in contact with anhydrous ether which is free from alcohol, and is likewise insoluble, or nearly so, in chloroform, petroleum benzin, benzol, carbon bisulphide, and in most fixed and volatile oils. The solutions have an acid reaction. Tannin being less soluble in acidulated water and in solutions of certain salts than in pure water, its aqueous solution is precipitated by mineral and certain organic acids, by the chlorides and several other salts of the alkalies, these precipitates being again soluble in water. Tannin renders iodine soluble in water, and prevents the reaction of the latter upon starch; this behavior has been recommended by F. Jean for the estimation of tannin. It yields precipitates with the alkaloids and many so-called neutral principles, with lime-water, most metallic salts, with starch, albumen, and gelatin. The latter precipitate is soluble in solutions of gelatin and of tannin, but insoluble in water and aqueous solutions of certain salts (see GELATINA); this tannate of gelatin is formed in the tanning of hides, and is an important constituent of leather. With solutions of pure ferrous salts no change takes place in the absence of oxygen, but ferric salts give at once in diluted solutions a deep-blue color, and in more concentrated solutions a bluish-black precipitate, with a reduction to ferrous compounds. In the presence of alkalies and in contact with air solutions of tannin rapidly assume a brown color. On the application of heat tannic acid is decomposed, and pyrogallol sublimes at 215° C. (419° F.), leaving metagallic acid behind, which is a black, tasteless substance, insoluble in water, soluble in alkalies, and by heat finally consumed without leaving any residue. The odor adhering to tannic acid may, according to Procter (1864), be removed by benzin, together with some coloring matter.

Composition.—The impossibility of obtaining tannic acid in the crystallized state has rendered the determination of its composition very difficult. A brief review of the widely-differing views held by various chemists will be found under ACIDUM GALLICUM. The latest investigations on the subject appear to furnish conclusive proof that chemically pure tannin must be viewed as an anhydride of gallic acid, and that 1 molecule of it represents 2 molecules of the latter, minus 1 of water. This relation is seen from the following equation: $2(C_6H_2(OH)_3.COOH)$, gallic acid, $-H_2O=(C_6H_2)_2.(OH)_5.OCO.COOH$, tannin $=C_{14}H_{10}O_9$, which is the formula of Mulder (1848). The officinal tannin is contaminated with an odorous principle, some coloring matter, and variable quantities of glucose combined with tannin.

Tannin dissolved in water or in diluted alcohol is gradually converted into gallic acid; occasionally *ellagic acid*, $C_{14}H_8O_9$, is also formed. The latter is insoluble in ether, only sparingly soluble in hot water and alcohol, and in contact with excess of potassa becomes dark-red, and finally black.

Impurities.—Tannic acid should burn from platinum-foil without leaving any residue (mineral impurities), and be completely soluble in 5 parts of alcohol (dextrin insoluble) and the same proportion of warm water (resin insoluble), both solutions being nearly transparent.

Pharmaceutical Uses.—Tannin is employed in the preparation of various proximate principles, such as digitalin.

Off. Prep.—Glycerinum acidi tannici, *Br.*; Trochisci and Unguentum acidi tannici, *U. S.*; Collodium stypticum, *U. S.*

Estimation.—The estimation of tannin and the valuation of the various tanning materials is connected with considerable difficulty, and often requires to be modified according to the nature of other organic compounds present. The following methods may be mentioned:

Precipitation with Gelatin.—This method with a freshly standardized solution of tannin was recommended by Fehling (1853), but, the end-reaction not being readily observed, G. Mueller (1859) recommended the addition of alum to the solution, whereby the gelatin tannate is readily separated. Still better for this purpose, according to F. Schulze (1866), is ammonium chloride, with which the tannin solution is saturated in the cold, and in a saturated solution of which salt the gelatin is dissolved. Schulze's method, according to Buechner (1867), is also applicable in the presence of pectin (1860).

Hammer's method depends upon a similar reaction. Powdered animal skin, obtained by rasping, is soaked in water, then strongly expressed and left in contact with the tannin solution; the amount of tannin is calculated from the difference in specific gravity before and after this treatment.

Precipitation with Alkaloid.—R. Wagner (1866) recommended for this purpose a standardized solution of cinchonine sulphate acidulated with sulphuric acid and tinged with rose-aniline acetate; the addition is made until the liquid acquires a red color.

Precipitation with Ferric Acetate.—Handtke (1861) employed a titrated solution of this salt, containing also sodium acetate and free acetic acid; the blue-black precipitate settles readily.

Precipitation with Cupric Acetate.—Fleck (1860) precipitated with excess of this salt, and determined the excess of copper volumetrically with potassium cyanide; gallate of copper, being soluble in ammonium carbonate, may thus be removed from the tannate. Wolff (1861) considered incineration of the precipitate as preferable; 1 part CuO obtained corresponds with 1.304 parts of tannin.

Precipitation with Tartar Emetic.—Gerland (1863) recommended a volumetric solution of tartar emetic containing ammonium chloride, whereby the precipitate is readily separated.

Colorimetric Method.—Wildenstein (1863) recommended filtering-paper impregnated with ferric citrate; the amount of tannin is estimated by comparison from the depth of color produced on dipping the paper into the solution.

Estimation by Oxidation.—Titration with potassium permanganate until the production of a permanent red color was recommended by Monier (1858). This method was improved by Loewenthal (1860): a definite quantity of indigo solution is added to the tannin, afterward the volumetric solution of the permanganate; the same quantity of indigo is then oxidized, and by subtraction from the previous result the amount of permanganate used for the oxidation of the tannin is ascertained.

Purification of the Tannin Solution.—The pectin compounds are conveniently removed, according to J. Loewe (1865), by slightly acidulating the infusion or decoction with acetic acid, evaporating, and dissolving the tannin by strong alcohol. Buechner (1867) recommended the repetition of this treatment with the undissolved portion for extracting all the tannin.

Neubauer (1871) showed that animal charcoal in contact with the solution removes completely the tannic and gallic acid, but no pectin; titration before and after this treatment with potassium permanganate gives the amount required for tannic and gallic acids.

Physiological Action.—From experiments upon animals (rabbits) with very large doses, it appears that this acid renders the gastric mucous membrane pale and lustreless and coagulates its mucus. Injected into the blood-vessels, it coagulates the albumen of the blood. To the former of these actions, as well as to its inherent astringency, must be attributed the dryness and sense of constriction which it produces in the mouth and fauces. When administered in moderate doses it causes constipation, at least at first, but the state is not made permanent by a continuance or even an increase of the dose, nor does it seem to derange the digestive function, as a general rule. Occasionally, however, it excites pain in the stomach and bowels, thirst, and eructation, and causes a coated tongue, with tenesmus in defecation. The stools are generally without fecal odor. Tannic acid appears not to be absorbed, and not to circulate as such, but to be converted into gallic acid. In this form alone is it found in the blood and urine. Indeed, it could not remain in the blood without coagulating it, as experiments on animals demonstrate. But as gallic acid is not an astringent, and as one of the best uses of tannic acid is to control internal hæmorrhages, it is difficult, while admitting the conversion of the one acid into the other, to explain the therapeutic operation of the latter in the affections named. Several theories have been proposed for this purpose, but all of them are unsatisfactory. Lewin has shown that the coagula of albuminous substances formed by tannic acid are soluble in an excess of albumen, and tannic acid, if made slightly neutral, loses its coagulating power. Thus, an albuminate of tannin formed in the blood is dissolved again in an excess of that alkaline liquid. A small portion of tannin escapes neutralization, and is discharged with the urine unchanged; and hence, according to Lewin, tannin, as such, may exert its power in all parts of the system. It would appear also that the hæmostatic and analogous qualities of tannic acid are due, not to an action upon the blood, but upon the blood-vessels, by which they become constringed and the flow of the blood through them is checked.

Medical Uses.—The astringent property of this substance renders it useful in relaxed states of the gastro-intestinal mucous membrane, such as exist in certain forms of *dyspepsia* (with excessive acid, mucous, or watery secretion, or with flatulence), but still more in chronic *diarrhœa*, *dysentery*, *lientery*, etc. The presence of fever usually contraindicates it. It is less used, although hardly less efficient, in chronic fluxes of other organs, which it can influence only through the blood, as *chronic bronchitis*, *whooping cough*, and *phthisis*. It often moderates, or even suspends, the *night-sweats* of the last-named disease and those of other hectical states. But it is in *hæmorrhages* that tannic acid especially shows its power. Employed originally to restrain *menorrhagia*, it was afterward used successfully in other forms of uterine hæmorrhage, including those produced by organic diseases of the womb. The more passive forms are the most improved by it. In *hæmaturia*, even of organic origin, in passive hæmorrhage from the *stomach* and *bowels*, in some cases of *hæmoptysis*, and also of *hæmophilia*, it has displayed remarkable efficacy. In hæmoptysis it is best employed in an atomized solution. Not only in forms of *albuminuria* with copious urination, but in those in which the secretion is scanty, or perhaps chiefly in these, it is said to have been useful. Hiller, who tested the tannate of sodium in these cases, found it to be quite unavailing to lessen the albuminuria (*Zeitsch. klin. Med.*, vi. 489).

It is very efficient as a direct or local hæmostatic when finely powdered and applied to a bleeding part. It is neither painful nor irritating. It is, therefore, a convenient application in *hæmorrhage* from the nose, vagina, or rectum, from leech-bites, varicose veins, etc. Its constringing operation is of great value in producing the contraction of various soft tissues.* A concentrated solution, made with an ounce of fresh tannin and 6 drachms of water, has a syrupy consistence, and is preferable to tannin itself for many topical applications. It is adapted to the treatment of wounds, ulcers, and mucous surfaces. A solution of tannic acid in tincture of benzoin (1 part to 4) tends to repress the development of *variolous* pustules. A powder made with 1 grain of tannin and 30 grains of orris- or marshmallow-root has been used as a snuff to arrest acute *coryza* in its forming stage; and an ointment containing 1 grain of tannin and 2 drachms of simple ointment has been applied to the nostrils, on a roll of soft linen or paper, for the same purpose in infants. Powdered tannin may be used as a snuff in chronic *coryza*, and in the treatment of nasal *polypi* a 10 per cent. solution in water has also been used. A watery solution is a useful application to sore *nipples*, and an ointment of tannin, or suppositories containing it, is a useful palliative in *anal fissure*, *hæmorrhoids*, and *prolapsus ani*. A solution of from 15 to 60 grains of tannin in about 4 fluidounces of water, injected into the bladder, has sometimes cured obstinate *vesical catarrh*. Aphthous *ulcers of the mouth*, *mercurial salivation*, *spongy gums*, and a relaxed condition of the mucous membrane of the *pharynx*, are all benefited by this astringent. Introduced into a carious cavity, it often allays *toothache*. In coryza and the other forms of chronic mucous inflammation mentioned the glycerite of tannin has been employed, but it is probably less efficient than the watery solution. Injections of a solution of tannic acid have been successfully used in *gleet* and *leucorrhœa*; in the latter disease they are very useful, but less so than the more prolonged application of tampons or sponges saturated with the solution. Tannic acid hip-baths have been recommended as more eligible than these injections, etc. The latter method often cures *prolapsus of the uterus* due to relaxation of the vagina. Chronic inflammations of the *conjunctiva*, especially the granular form, and pannus, have been successfully treated with very finely-powdered tannin; and injections of a solution of this substance into vascular *erectile tumors* have been followed by their permanent contraction. A dentifrice containing tannin and charcoal in equal proportions is very efficient in removing the discoloration of the *teeth* produced by preparations of iron.

The *dose* of tannic acid is from 3 to 10 grains (Gm. 0.20–0.60). It is best administered in pill, except in cases of hæmorrhage, when it should be given dissolved in water sweetened and flavored. Lewin recommends, in order to lessen the tendency of tannic acid to disorder the digestive organs, that it be given as follows: ℞. Solut. of tannic acid in water (2 per cent.) f℥v; the white of one egg. Incorporate by shaking. The energy of this mixture appears to be very slight if a prompt astringent action is desired; it may be useful in the few cases which call for a continuous administration of the medicine. Externally, tannic acid is employed in a watery solution containing from 3 to 10 grains to the ounce (Gm. 0.20–0.60 to Gm. 30). Its incorporation in an ointment or with glycerin impairs its astringent action.

ACIDUM TARTARICUM, *U. S.*, *Br.*, *P. G.*—TARTARIC ACID.

Sal essentiale tartari.—*Acide tartrique*, *Acide du tartre*, Fr.; *Weinsäure*, *Weinsteinsäure*, G. Formula $H_2C_4H_4O_6 = (CHOH)_2.(COOH)_2$. Molecular weight 150.

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* *Styptic colloid*, which consists of a saturated solution of tannin in alcohol, to which ether and then gun-cotton are added to saturation, when applied to a part rapidly condenses and grows firm, so as to arrest the discharge of blood, serum, or pus. It is also used after the surfaces of wounds, fractures, etc. have been coaptated, to keep their edges from being displaced.

Origin.—It is met with either free or in combination with bases in grapes, sumach-berries, tamarinds, pineapples, and other acidulous fruits; also in other parts of many plants. It was first isolated by Scheele (1769), and by Retzius (1770) obtained in crystals.

Preparation.—The British Pharmacopœia gives the following directions: Take of Acid Tartrate of Potassium 45 ounces; Distilled Water a sufficiency; Prepared Chalk 12½ ounces; Chloride of Calcium 13½ ounces; Sulphuric Acid 13 fluidounces. Boil the acid tartrate of potassium with 2 gallons of the water, and add gradually the chalk, constantly stirring. When the effervescence has ceased add the chloride of calcium dissolved in 2 pints of the water. When the tartrate of calcium has subsided pour off the liquid and wash the tartrate with distilled water until it is rendered tasteless. Pour the sulphuric acid, first diluted with 3 pints of the water, on the tartrate of calcium, mix thoroughly, boil for half an hour with repeated stirring, and filter through calico. Evaporate the filtrate at a gentle heat until it acquires the specific gravity 1.21, allow it to cool, and then separate and reject the crystals of sulphate of calcium which have formed. Again evaporate the clear liquor till a film forms on its surface, and allow it to cool and crystallize. Lastly, purify the crystals by solution, filtration if necessary, and recrystallization.

This process is the one which in its main features is followed in preparing tartaric acid on the large scale. An excess of sulphuric acid is necessary for the decomposition of the tartrate of calcium to ensure the complete removal of the calcium, since tartaric acid does not crystallize properly from a solution of acid tartrate of calcium. Boiling the precipitate with the sulphuric acid is avoided, and digestion for 2 or 3 days substituted. After concentration in the vacuum-pan the liquid is heated with wood charcoal or pure animal charcoal to remove coloring matter, filtered, and crystallized. The last crystallizations are more or less colored, and, like the mother-liquor, are purified by digestion with wood charcoal. Should the free sulphuric acid accumulate in the mother-liquor, its partial removal with milk of lime will be necessary. Where chloride of calcium cannot be used as a waste product for the decomposition of the tartrate of potassium the cheaper sulphate of calcium is used for the purpose.

The rationale of this process is as follows: Acid tartrate of potassium yields with calcium carbonate insoluble calcium tartrate and soluble potassium tartrate. The solution of the latter reacts with the calcium chloride or sulphate, furnishing an additional quantity of insoluble calcium tartrate and soluble potassium chloride or sulphate, which is removed by washing. The calcium tartrate, when digested with sulphuric acid, yields sparingly soluble sulphate of calcium, which precipitates, and tartaric acid, which, being freely soluble in water, remains in solution and is recovered by crystallization. Large clear and colorless crystals are best obtained in the presence of a minute quantity of free sulphuric acid.

A process was patented by Goldenberg in 1878, according to which 226 parts of normal potassium tartrate, dissolved in 1800 parts of water, are mixed with 112 parts of burned lime previously slaked with 16 parts of water; the decomposition is effected at ordinary temperatures, the greater part of the calcium tartrate being deposited as a powder, from which the potassa solution is easily filtered; the filtrate retains calcium tartrate, which on boiling is separated in flocks.

The decomposition of argols by lime is effected by heat, when the nitrogenous principles present are decomposed, with the evolution of ammonia, and the calcium tartrate is separated in a gelatinous form, changing, however, to finely pulverulent on neutralizing the alkaline liquid with hydrochloric or sulphuric acid. The brown calcium tartrate is collected on a filter, washed, expressed, and decomposed by sulphuric acid, and the solution of tartaric acid treated with boneblack, or once more converted into the calcium salt by boiling with lime and chalk, whereby a much lighter colored precipitate is obtained.

Tartaric acid is now largely manufactured in the United States; in 1867 over 212,000 pounds were imported; in 1882, only 8 pounds.

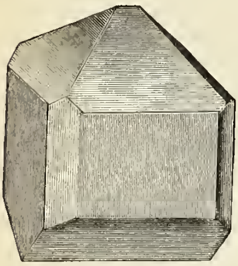
Properties.—Tartaric acid crystallizes in colorless, oblique, rhombic prisms or tables, which are inodorous and have a strongly acid but agreeable taste. They have the specific gravity 1.764, dissolve at 17° C. (62.6° F.) in 0.6 parts of water, 2 parts of 85 per cent. alcohol, 3.6 parts of absolute alcohol, 23 parts of ether, and 250 parts of absolute ether; are more freely soluble in the same liquids at the boiling temperature, and are likewise soluble in methylic alcohol and in glycerin, but insoluble in chloroform and benzin.

We found (1863) the density of aqueous solutions of tartaric acid at 16° C. (60.8° F.) to be as follows:

Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.
1.00	1.0044	15.00	1.071	30.00	1.153	45.00	1.240
2.50	1.0114	17.50	1.083	32.50	1.167	47.50	1.255
5.00	1.023	20.00	1.097	35.00	1.181	50.00	1.271
7.50	1.035	22.50	1.111	37.50	1.195	52.50	1.287
10.00	1.047	25.00	1.125	40.00	1.209	55.00	1.304
12.50	1.059	27.50	1.139	42.50	1.224	57.75	1.325

The crystals contain no water of crystallization, are not deliquescent in the air, and may be heated to 135° C. (275° F.) without losing weight (see below), but they melt, and on heating the mass to about 200° C. (392° F.) it is decomposed, with disengagement of water, carbon dioxide, acetic acid, and other compounds, gives off the odor of burning sugar, and leaves a charcoal which ultimately burns without leaving any residue. In American commerce tartaric acid is usually found in the state of powder. The aqueous solutions of tartaric acid and of its salts deviate the plane of polarized light to the right; hence the name of *dextrotartaric acid.* Some grapes appear to contain naturally an acid isomeric with the foregoing, which is called *racemic, uvic, or paratartaric acid.* The same acid is obtained by heating for several days in closed vessels tartaric acid with about 15 per cent. of water to 175° C. (347° F.); its solutions do not affect polarized light, but some of its salts crystallize in two distinct hemihedric forms, one of which contains the ordinary or dextrotartaric acid, while the other contains *lævotartaric acid*, another isomeric form, turning the plane of polarized light to the left. When dextrotartrate of cinchonine is heated to 170° C. (338° F.), it is converted into paratartrate, but at the same time a fourth isomeric modification is obtained, the calcium salt of which crystallizes after the calcium paratartrate. This new acid is *meso-* (or *inactive*) *tartaric acid*, so called because its solutions have no effect upon polarized light, and the acid cannot be resolved into dextro- and lævotartaric acids under the same circumstances as racemic acid. Finally, a fifth isomeric acid may be obtained from tartaric acid by fusion, which occurs between 170° and 180° C. (338° and 356° F.), when without loss in weight *metatartaric acid* is formed, whose solution has the same influence upon polarized light as that of the acid from which it was made; but it is deliquescent, and its salts dissolve more freely in water and crystallize in forms different from the dextrotartrates. L. Pasteur was engaged during the years 1847 to 1853 in investigating most of these facts. These isomeric compounds are, however, little known.

Fig. 9.



Crystal of Tartaric Acid.

Tartaric acid is a strong bibasic acid, forming normal and acid salts, most of which are readily obtained in crystals; all are blackened by heat, and evolve an odor similar to that of burning sugar.

The normal tartrates, with the exception of those with an alkaline base, are nearly all insoluble or slightly soluble in water, but dissolve in diluted nitric acid. Calcium tartrate is almost insoluble in water, but dissolves in chloride of ammonium, acetic acid, and cold potassa solution, being precipitated from the latter on boiling. Tartaric acid, added to the concentrated solution of a potassium salt, produces a precipitate of acid tartrate of potassium; a similar precipitate, which is rather more soluble in water, is produced with ammonium salts; the same precipitates are obtained with solutions of acid tartrates or with neutral tartrates dissolved in diluted hydrochloric acid.

Impurities.—Tartaric acid, heated upon platinum-foil, should be consumed without leaving more than a trace of ash (mineral impurities). It should completely dissolve in 3 parts of alcohol (saline impurities). Its solution in 10 parts of water is not precipitated or colored dark by hydrosulphuric acid (lead, copper, etc.), and is not precipitated by chloride of barium (sulphuric acid), by sulphate of calcium (oxalic or racemic acid) or by oxalate of ammonium (calcium salts). 1.50 Gm. of tartaric acid dissolved in alcohol, and the solution mixed with half its bulk of water and of concentrated solution of potassium tartrate, yields a precipitate of potassium bitartrate, which, after washing with diluted alcohol and drying, weighs 1.88 Gm. A mixture of solutions of 1 part each of tartaric acid and of potassium acetate, in 3 parts of cold water, on being mixed with an equal bulk of alcohol, yields a precipitate which, if collected after 2 hours and washed and dried as stated before, should weigh between 1.25 and 1.26 parts (*U. S.*). A solution of 0.75 Gm. of tartaric acid requires for exact neutralization 9.9 Ccm. of the volumetric solution of soda, or 75 grains of the former need 990 grain-measures of the latter (*Br.*).

Off. Prep.—Ferri et ammonii tartras, Pulvis effervescens compositus, *U. S.*; Sodæ citro-tartras effervescens, *Br.*

Physiological Action.—Given to dogs in large and concentrated doses, it acts poisonously, quickening the pulse and respiration, and causing debility, spasm, paralysis, and death, after which the blood remains liquid, but the stomach is not inflamed. It is in part excreted unchanged with the urine. It has been given to cats in large doses without striking consequences. In man, an ounce of tartaric acid dissolved in half a pint of warm water is said to have acted like a corrosive poison, causing violent burning pain in the throat and stomach, followed by obstinate vomiting, and death at the end of 9 days. Nearly the whole of the alimentary canal was found highly inflamed. But in another case 6 drachms of the acid were taken within 24 hours without the least inconvenience. The alleged poisonous action in the first case is therefore open to doubt.

Medical Uses.—Tartaric acid is hardly ever prescribed in medicine alone, but generally in combination with alkalies or their carbonates or with carbonate of magnesium. It may be used to prepare whey, which is thought to be febrifuge and diuretic, and it is said to modify the unpleasant taste of the liquid preparations of cinchona, senna, and rhubarb. Associated with sugar, mucilage, and some flavoring extract, it serves to moisten the throat in *pharyngitis and pulmonary catarrh;* and it is even alleged to be capable of dissolving the false membranes of *diphtheria* (*Med. News and Abstract*, Sept. 1881, p. 536). It is said to correct the *fetor of the feet* to which some persons are subject when it is strewn as a dry powder in the stockings. Dose, 10 to 30 grains (Gm. 0.50–2.00).

ACIDUM VALERIANICUM.—VALERIANIC ACID.

Acidum valericum.—*Acide valérianique*, *Acide valérique*, Fr.; *Baldriansäure*, *Valeriansäure*, G.

Formula $HC_5H_9O_2 = (CH_3)_2.CH.CH_2.COOH$. Molecular weight 102.

Origin and Formation.—Valerianic acid has received its name from valerian-root, from which it was obtained and recognized as a distinct acid by Grote (1830); it has been found in the flowers of Anthemis nobilis, in wormwood, angelica-root, etc., and in dolphin oil, obtained from Delphinus globiceps, *Cuvier*, by Chevreul (1817), who named it *delphinic acid;* it is found among the products of oxidation of a large number of organic substances, and is prepared for medicinal purposes almost exclusively by oxidizing amylic alcohol with bichromate of potassium and sulphuric acid, a process recommended by Balard (1845).

Preparation.—Valerian-root is distilled with water, the oil is removed from the acid distillate, the latter neutralized with soda, and evaporated to dryness. 5 parts of this residue are, according to Wittstein (1845), dissolved in 5 parts of water, and distilled with 4 parts of sulphuric acid diluted with 8 parts of water. The oily portion of the distillate is purified by fractional distillation. The yield is increased if bichromate of potassium and sulphuric acid are added to the water distilled with the root (Lefort, 1846).

In the preparation of valerianic acid from fusel oil valerianate of sodium is prepared as the first step (for details see SODII VALERIANAS), and this is then distilled with sulphuric acid. To obtain a concentrated acid B. J. Crew (1860) manipulates as follows: 8 parts of sodium valerianate and 3 parts of water are mixed, and 3½ parts of sulphuric acid gradually added to the mixture. Sulphate of sodium is formed, and the liberated valerianic acid rises as an oily layer to the surface. The latter is separated, and repeatedly agitated with small portions of oil of vitriol to deprive it of water, which cannot be separated by distillation. When the specific gravity of the oily layer has been reduced to below 0.950, it is distilled, and that portion of the distillate having the specific gravity 0.940 or more is collected by itself, to be dehydrated by sulphuric acid as before. The remaining portion of the distillate, rather more than half the quantity of the whole, will have the required specific gravity, 0.935. The weaker but heavier acid comes over first, and may be readily brought to the specific gravity 0.945 by oil of vitriol, when it is again ready for fractional distillation (F. C. Musgiller, 1868).

Properties.—Valerianic acid is a colorless, thin, oily liquid, of a disagreeable odor resembling that of valerian and of old cheese, and has a sour, acrid, unpleasant taste, producing upon the lips and tongue the sensation of burning; diluted with water, the taste is less disagreeable, with a sweet after-taste. When heated, valerianic acid evaporates without residue, and ignited burns with a luminous flame. It is soluble at 15° C. in 30 parts of water, and by agitation with a small quantity of that liquid takes up about 20 per cent. of its weight, without losing its oily consistence. It dissolves in all proportions in alcohol, ether, chloroform, carbon bisulphide, and volatile oils, the hydrated acid, however, producing a turbid mixture with the last-named liquids. The specific gravity is 0.935, which increases if the acid becomes more hydrated; its boiling-point is 175° C. (347° F.). Musgiller ascertained that an acid of 0.933 specific gravity boils between 177.2° and 178.9° C. (351° and 354° F.); if of greater density the boiling-point is lower. The hydrate, $C_5H_{10}O_2.H_2O$, has the density 0.945, and requires only 25 parts of cold water for solution.

The composition of valerianic acid, $C_5H_{10}O_2$, bears to amylic alcohol, $C_5H_{12}O$, the same relation as acetic acid does to ordinary alcohol. (See Acetum.) Hydrogen being eliminated from the alcohol in the form of water under the influence of oxidizing agents, the remaining molecule is oxidized to the acid; $C_5H_{12}O + O_2$ yields $HC_5H_9O_2 + H_2O$. The officinal acid is *isopropylacetic acid.* Three other acids of the same ultimate composition may be prepared, which, however, differ from the preceding in their specific gravities, boiling-points, behavior to polarized light, and the solubility in water of their barium and silver salts.

The *normal salts* of valerianic acid, when perfectly dry, are inodorous; in the presence of moisture, and still more in contact with carbonic acid, they have the odor of the acid; their taste is decidedly sweet. Most of the salts are soluble in water, several dissolve also in alcohol; from these solutions valerianic acid is liberated by nearly all the mineral and organic acids, even by acetic acid.

Impurities.—The solubility of valerianic acid, in not less than twenty-six and not over thirty times its weight of water, affords a ready means of discovering the presence of certain impurities. Alcohol decreases, and water, acetic acid, and butyric acid increase, the density of valerianic acid, and render it more soluble in water, while it becomes less soluble and of less density through the presence of amylic alcohol, amylic aldehyd, amyl valerianate, and fixed oils. On adding ammonia-water slightly in excess to valerianic acid a clear solution should be produced; this is turbid or separates an oily layer in the presence of one or more of the four compounds last mentioned. Butyric acid, if present, will, according to Laroque and Huraut, produce with concentrated solution of acetate of copper pale-blue scales of copper butyrate, while pure valerianic acid mixed with the same solution yields a mixture which is transparent for several minutes, then separates oily drops of copper valerianate, which are gradually converted into a greenish-blue crystalline powder. Acetic acid is readily detected by neutralizing the acid with ammonia and adding to the cold clear liquid a slight excess of diluted ferric chloride or subsulphate, when ferric valerianate will be precipitated and ferric acetate form a deep brown-red solution. Admixtures of hydrochloric or sulphuric acid are detected in the aqueous solution of valerianic acid, after adding a little nitric acid, by the nitrates of silver and of barium.

Off. Prep.—Ammonii valerianas, Quiniæ valerianas, *U. S.*

Physiological Action and Medical Uses.—According to Reissner's experiments on animals, it coagulates albumen, blood-serum, and milk, and is slightly irritating to the integuments. Its odor is not imparted to the urine or the blood, but may be perceived in the peritoneal cavity. It quickens but weakens the heart's action and the respiration, produces debility and then paralysis of the limbs, and spasms before death; after which, if it takes place rapidly, the gastric mucous membrane is pale, but if slowly this membrane and that of the intestine are inflamed, the kidneys congested, and the urine is turbid and bloody. The acid is not used in medicine except in combination, but it is very doubtful if it gives any special properties to the bases with which it is associated, unless it does so in valerianate of ammonium.

ACONITINA, *Br.*—Aconitine.

Aconitia, Aconitinum.—*Aconitine*, Fr.; *Aconitin*, G.
Formula $C_{33}H_{43}NO_{12}$. Molecular weight 645.

Preparation.—The outlines of the process recognized by the British Pharmacopœia are as follows: Coarsely-powdered aconite-root is exhausted with alcohol by heating to ebullition, then cooling, and finally percolating; the tincture is completely freed from alcohol by distillation and evaporation; the extract is mixed with twice its weight of boiling distilled water; the mixture allowed to cool and filtered; the filtrate is precipitated by ammonia in slight excess, and the mixture heated gently over a water-bath, whereby the precipitate forms a mass which is readily separated by a filter, and after drying reduced to a coarse powder, which is exhausted with pure ether; the ethereal liquid is distilled, the impure alkaloid dissolved in warm distilled water acidulated with sulphuric acid, and when the solution is cold ammonia diluted with four times its bulk of distilled water is cautiously added; the precipitate is collected on a filter, washed with a small quantity of distilled water, and dried by slight pressure between folds of filtering-paper.

The process proposed by Prof. Procter (1861) as a modification of that previously suggested by Headland was adopted by the U. S. Pharmacopœia previous to 1880, and is as follows: The tincture obtained by digesting and displacing powdered aconite-root with alcohol is concentrated by distillation to one-third of the weight of the root; the liquid is mixed with an equal bulk of water acidulated with sulphuric acid; oil and resin which separate are removed; the remaining liquid, containing aconitine sulphate, is concentrated to a small bulk, and agitated with ether to remove more of the oil and impurities; a slight excess of ammonia is added to liberate the alkaloid, which is exhausted by agitation with ether; lastly, the ether is evaporated spontaneously and the dry residue powdered.

Neither of these processes yields *pure* aconitine, the product being always amorphous and of variable composition. Duquesnel (1872) showed that the use of mineral acids in the preparation of aconitine causes the production of amorphous alkaloids, while aconitine is not decomposed by tartaric acid; his process, modified by Wright (1876, 1880), is as follows: Powdered aconite-root is exhausted with alcohol containing 0.5 per cent. of tartaric acid; the alcohol is distilled and evaporated at a low temperature or *in vacuo;* the extract is diluted with its own bulk of water, filtered from the oil and resin, agitated with ether or petroleum naphtha, whereby more resin is removed, and then precipitated by excess of potassium carbonate; the alkaline liquid retains the amorphous bases in solution, while the washed precipitate, after dissolving in ether, mixing this solution with petroleum naphtha, and evaporating, yields crystallized aconitine, which still retains a small proportion of the amorphous alkaloids, from which it can be completely freed only by a tedious and very wasteful process.

Hottot and Liégeois's process (1864), which has been largely followed in France, differs from the preceding one mainly in the substitution of sulphuric for tartaric acid, and in the precipitation of the alkaloids by magnesia.

According to Wright (1876), the amount of pure aconitine obtainable from aconite-root is .03, or possibly .04, per cent., being about one-third of the total yield of alkaloid (Groves).

Properties.—Aconitine, as obtained by the process of the British Pharmacopœia, is a white, usually amorphous solid, soluble in 150 parts of cold and 50 of hot water, and much more soluble in alcohol and in ether; it is strongly alkaline to reddened litmus, neutralizing acids and precipitated from them by the caustic alkalies, but not by carbonate of ammonium or the bicarbonates of sodium or potassium. It melts with heat and burns with a smoky flame, leaving no residue when burned with free access of air. When rubbed on the skin it causes a tingling sensation, followed by prolonged numbness. Aconitine is colored orange-yellow by sulphuric acid, changing to brown and colorless; its solution in diluted phosphoric acid, carefully evaporated, becomes violet-colored; mixed with sugar, aconitine becomes rose-red with sulphuric acid. As seen in commerce, aconitine is always a mixture of several alkaloids. (See ACONITUM, p. 115.)

From his researches reported to the British Pharmaceutical Conference (1866 to 1874) Mr. T. B. Groves concluded that pure aconitine occurs in two modifications, a crystalline and an amorphous, both of which, when precipitated with ammonia and heated to boiling, do not fuse, but become quite brittle. Amorphous aconitine dissolves in 1000 parts, crystallized nitrate of aconitine in 520 parts, of water containing 1¼ per cent. of ammonia; the latter solution gradually heated becomes turbid, and when near the boiling-point separates microscopic crystals of aconitine, while the ammoniacal solution containing the amorphous alkaloid becomes clear again near the boiling-point of the liquid. The ammoniacal solutions of both modifications speedily decompose, the amorphous aconitine being somewhat more stable. Pure aconitine gives no characteristic color-reactions with acids or oxidizing agents. Its nitrate crystallizes readily from neutral solutions (Groves).

These investigations were continued by C. R. Alder Wright (1875 to 1880), who found the physiologically active and crystallizable aconitine to have the composition above given, and when heated with water to 140° or 150° C. (284° or 302° F.), or saponified with an alkali, to be decomposed into benzoic acid (18.92 per cent.), and amorphous *aconine*, $C_{26}H_{39}NO_{11}$, which is bitter, not acrid, almost insoluble in ether, dissolves readily in water, alcohol, and chloroform, and is identical with acolyctine and napelline. On heating aconitine to 100° C. with strong solution of tartaric acid, it yields *apoaconitine* $C_{33}H_{41}NO_{11}$, which crystallizes from ether and melts at 185° C. Both derivatives may be present in commercial aconitine. These and the other amorphous bases are with great difficulty removed by repeated crystallization from ether or ether and petroleum naphtha, and are best eliminated by crystallization as nitrate or hydrobromate. The pure alkaloid has an acrid and faintly bitter taste, is nearly insoluble in water and benzin, but dissolves readily in chloroform, benzol, ether, and alcohol, and melts in a capillary tube at 183° to 184° C., the melting-point being lowered and the color more darkened by the presence of amorphous bases; on being dissolved in ether, and the solvent allowed to evaporate spontaneously, the last drop of it should dry up to crystals; the acid obtained on saponification, on being fused at 250° C. with potassa, the mass treated with hydrochloric acid and ether, and the ethereal solution evaporated, should not give a green color to ferric chloride (absence of pseudaconitine). The figures, ascertained by elementary analysis, are the only reliable means of distinguishing aconitine from japaconitine.

Pseudaconitine, $C_{36}H_{49}NO_{12}$ (see p. 115), which has been sometimes sold for aconitine, closely resembles the latter base in appearance and behavior, but may be distinguished from it by requiring about 230 parts of chloroform, 100 parts of boiling ether, and 1500 to 2600 parts of diluted ammonia of $1\frac{1}{4}$ per cent. strength for solution; by its lower melting-point (104° to 105° C.); and by yielding on saponification with alcoholic potassa 26.49 per cent. of veratric acid. Its nitrate crystallizes only from strongly acid solutions (Groves).

Liégeois and Hottot found that aconitine precipitated by ammonia from cold solutions contains 25 per cent. of water, which is given off at 85° C. (185° F.), and Hager (1875) has directed attention to this as a source of the variable strength of commercial aconitine. According to Wright, however, the process adopted for its preparation is evidently of primary importance.

That commercial aconitine varies greatly in strength has been repeatedly observed. Dr. Squibb (*Ephemeris*, i. 135) suggests that no aconitine should be accepted which will not give within 15 minutes a distinct aconite sensation, not amounting to tingling, but very suggestive of it, from $\frac{1}{800}$ of a grain (.0008 Gm.) diluted to the measure of 1 fluiddrachm (3.7 Ccm.), after holding the solution for 1 minute in the anterior part of the previously well-rinsed mouth. Tested in this manner, he found 1 grain of good aconite-root to be represented by 1, $\frac{1}{8}$, $\frac{1}{83}$ (Merck's pseudaconitine), and $\frac{1}{111}$ (Duquesnel's crystallized aconitine) grain of different commercial samples of aconitine. The last-named sample (Duquesnel's) was ascertained (*Ephemeris*, i. 167) to be a nitrate containing not more than 80.7 per cent. of the hydrated alkaloid.

Off. Prep.—Unguentum aconitiæ, *Br.*

Physiological Action.—When applied to the sound skin in an ointment or in alcoholic solution it produces itching and prickling, followed by anæsthesia of the part, without redness or heat. In contact with the derm it causes an intense and prolonged burning, and it violently irritates the conjunctiva. Its local action on the tongue, fauces, and stomach produces burning and tingling sensations. Several experimenters have thrown doubt upon the identity in action of aconite and aconitine, some expressing their views of the differences between them by saying that the former is acro-narcotic and the latter narcotic. The acro-narcotic principle, sometimes called napellina, appears to be feebler than aconitine, but to resemble it in all respects except that it does not poison the heart of batrachians (Murray). In regard to the action of aconitine experimenters are not agreed. Some maintain that it paralyzes the central nervous system; others, that it paralyzes the peripheral motor nerves; still others, that it affects simultaneously the cerebral nervous system and the muscles, paralyzing both; and, finally, it is held to act essentially on the centres of the medulla oblongata and spinal cord proper, first exciting and then paralyzing them. The centres of voluntary movement are affected before the sensory centres become involved. The order in which the different organs are paralyzed is said to be the sensory, and then the motor nerves, the sympathetic nerve, and finally the muscles. The respiratory apparatus and the heart are affected through the nervous system, and death is due to a suspension of the respiration caused by the action of the poison upon the medulla oblongata. These results have been substantiated by Mackenzie. They also agree essentially with those of Harley, the most interesting and lucid of all. His experiments were performed on the horse, dog, cat, and on man. Their results in the lower animals were, summarily, these: Paralysis of the external muscles of respiration which dilate the chest; intermittent spasm of the muscles attached to the upper part of the chest and of those of the respiratory passages; incomplete paralysis of the diaphragm;

increased frequency of the heart-beat proportioned to the impediment to the circulation; persistence of the heart-beat after respiratory death; spasm of the pharynx and œsophagus; and general debility, but no muscular paralysis. These conclusions have been confirmed by Ringer (1880). On dissection the lungs are collapsed and pale; the heart retains its irritability for some time; its left cavities are empty and contracted; and the right side, as well as the large veins leading to it, is distended with dark blood.

Fothergill's experiments on rabbits, guinea-pigs, and cats show that a lethal dose of aconitine ceases to be so if the animals have had an appropriate dose of digitalin from 5 to 9 hours previously. In like manner, the lethal effects of aconitine are prevented by atropia and also by strychnia: "while aconitine kills by paralyzing the respiration, atropine and strychnia, which act very powerfully on the respiratory centres, are potent to prevent death." According to Oulmont, aconitine displays physiological and therapeutical action in the dose of a quarter of a milligram (gr. $\frac{1}{256}$), but may be gradually increased to 1 and even 2 milligrams (gr. $\frac{1}{64}$ to $\frac{1}{32}$) a day without injury.

The action of aconitine upon man is illustrated by Harley's observations. One-two-hundredth of a grain of aconitine taken internally caused slight tingling in the mouth and face, lasting for several hours. The one-hundred-and-fiftieth of a grain occasioned also a sense of glowing and numbness and a tendency to sleep. One-fiftieth of a grain produced the following effects: languor, giddiness, sleepiness, hazy vision, nausea in the erect posture, dysphagia, pain in the back of the neck and behind the jaws, a glowing, tingling feeling over the whole body, and burning heat in the gullet. The sense of muscular weakness is comparable to that induced by conium. To these symptoms may be added colic, spasmodic vomiting, and dysphagia; in some cases darting pains in the branches of the fifth nerve; dilatation of the pupils; acceleration, followed by progressive irregularity and debility, of the heart, and a corresponding infrequency of the respiratory movements and lowering of the temperature. In fatal cases the pulse is small, weak, and, above all, irregular; the rate and rhythm of the respiratory movements are similarly affected; the skin is cold and clammy, the pupils contracted; vision is impaired; there is a burning pain in the mouth, extending along the gullet, a swollen tongue, dysphagia, and great præcordial anxiety; vomiting usually occurs and convulsions, and consciousness is more or less impaired. Post-mortem examination shows hyperæmia of the stomach and small intestines, and the viscera generally are charged with blood. Cases of fatal poisoning by aconitine are very rare (Stevenson, *Guy's H. R.*, xli. 307; Laborde et Duquesnel, *Des Aconits et de l'Aconitine*, 1883). Napelline appears to be identical with aconitine in the nature of its effects, but their intensity is "incomparably less" than those of crystallized aconitine.

Medical Uses.—The internal employment of this alkaloid ought rarely to be resorted to, on account of its dangerous activity as a poison. Aconitine has been administered in febrile diseases for the same reason that aconite and other sedatives of the heart have been employed, and the result has been that, although the medicine lessened the frequency of the pulse, it exerted no appreciable influence upon the course or issue of the disease. Such was a result of Harley's use of the medicine in *scarlet* and *typhus fevers*, although it appeared to him that in typhus treated by this medicine the crisis occurred early. It has also been administered advantageously for the cure of *neuralgia* in the dose of $\frac{1}{125}$ gr. (Gm. 0.0005), and probably in neuralgia of the fifth pair there is no remedy more efficient. It is said to have arrested the paroxysms in cases which had resisted all other remedies. The cure of some extremely aggravated cases of facial neuralgia has been accomplished by doses of aconitine, beginning with $\frac{1}{140}$ gr. (Gm. 0.0004), and gradually increased to $\frac{1}{96}$ gr. (Gm. 0.007), three times a day (*e. g.* Weir, *Philad. Med. Times*, x. 48). But it is chiefly in recent cases produced by cold that its efficacy is displayed. According to Oulmont and Gubler, the pain and fever of acute articular *rheumatism* are rapidly reduced by aconitine given daily to the amount of $\frac{1}{120}$ gr. (Gm. 0.0005). The efficacy of the medicine is not, however, accepted as proven, and its dangerous qualities should deter from its unnecessary use, which we hold the treatment of rheumatism by its means to be. Owing to the varying degrees of strength of the alkaloid as found in the shops, the primary dose should not exceed gr. $\frac{1}{250}$. It may be repeated two or three times a day, and given less or more frequently and in smaller or larger doses, according to its effects. Its efficiency is, however, much greater in the form of an ointment, which may contain 2, or from that to 5, grains in a drachm of lard (Gm. 0.13–0.30 in Gm. 4), or in the form of a solution made by dissolving 1 grain of aconitine in 2 fluidrachms (Gm. 0.06 in Gm. 8.00) of alcohol. Its mixture or solution is facilitated by chloroform. Either preparation should be applied with a soft brush or with the finger protected by a glove. Gubler has used the medicine hypodermically in the dose of gr. $\frac{1}{128}$ twice a day.

ACONITUM, *U. S.*—Aconite.

Monkshood, *Wolfsbane*, E.; *Aconit*, *Coqueluchon*, Fr.; *Eisenhut*, *Sturmhut*, G.

Aconitum Napellus, *Linné*, s. Ac. variabile, *Hayne*, s. Ac. vulgare, *De Candolle*. Bentley and Trimen, *Med. Plants*, 5, 6, and 7.

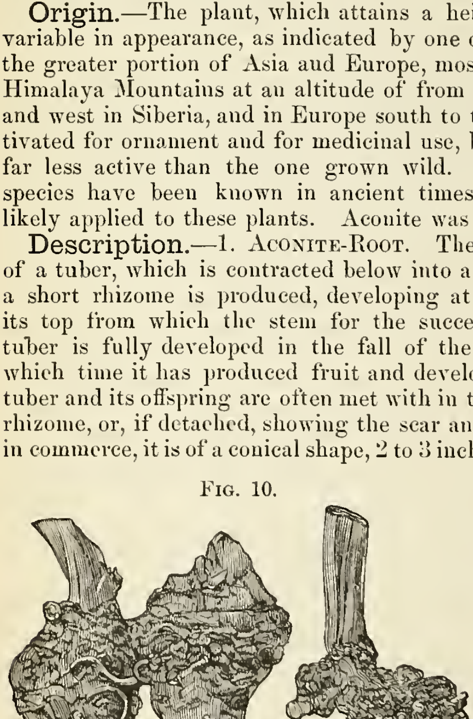
Nat. Ord.—Ranunculaceæ, Helleboreæ.

Officinal Parts.—1. Aconitum, *U. S.*, *s. Aconiti radix*, *Br.*, *U. S.* 1870; *Tubera aconiti*, *P. G.*—Aconite root, *E.;* Racine d'aconit, *Fr.;* Akonitknollen, *G.* The tuberous root. —2. Aconiti Folia, *Br.*, *U. S.*, 1870, *s. Herba aconiti.*—Aconite-leaves, *E.;* Feuilles d'aconit, *Fr.;* Akonitblätter, *G.* The leaves and tops, gathered when about one-third of the flowers are expanded.—*Br.*

Origin.—The plant, which attains a height of 3 to 4 feet (.9 to 1.2 M.) and is very variable in appearance, as indicated by one of its specific names, is met with throughout the greater portion of Asia and Europe, mostly in mountainous regions. It grows in the Himalaya Mountains at an altitude of from 10,000 to 16,000 feet, and from there north and west in Siberia, and in Europe south to the Alps and Pyrenees. It is frequently cultivated for ornament and for medicinal use, but Schroff (1853) found the cultivated plant far less active than the one grown wild. The poisonous properties of this and allied species have been known in ancient times, and the Greek name, *akoniton*, was most likely applied to these plants. Aconite was introduced into medicine by Stoerck (1762).

Description.—1. Aconite-Root. The subterraneous portion of the plant consists of a tuber, which is contracted below into a conical root; from a lateral bud of the tuber a short rhizome is produced, developing at its end again into a tuber, bearing a bud at its top from which the stem for the succeeding year will be produced. This second tuber is fully developed in the fall of the first year, and withers a year afterward, by which time it has produced fruit and developed another (the third) tuber. The parent tuber and its offspring are often met with in the commercial article still united by the short rhizome, or, if detached, showing the scar and often a portion of this branch. As met with in commerce, it is of a conical shape, 2 to 3 inches (50 to 75 Mm.) in length, and about an inch (25 Mm.) in thickness at the crown; the numerous rootlets are mostly broken off, giving the tuber a tuberculated appearance from the remnants of the radicles. At the top it is crowned with a short portion of the stem or with the terminal bud. It is of a dark-brown color externally, longitudinally wrinkled, and breaks with a short, non-fibrous fracture; internally, it is compact and whitish if of latest growth, or brownish, porous, and often hollow if of the previous year's growth. The transverse section shows a thick bark, enclosing a star-shaped six to eight-rayed pith, having a thin, vascular bundle in each ray. The radish-like odor of the fresh root disappears on drying; the taste is at first sweetish, then acrid and burning, with a persistent sense of numbness; which effect furnishes a good criterion of the quality of aconite-root; the shrivelled and porous tubers are usually less efficient. The degree of impression produced upon the tongue by aconite-roots taken at random from a larger quantity is regarded by Dr. Squibb as an approximate test of its value. Dr. A. B. Lyons (1882) has modified this test by preparing a tincture representing 10 per cent. of the root, and applying a single drop of this to the tongue. By the intensity and the duration of the effect produced one can judge pretty correctly of the value of a given sample.

Fig. 10.



Tubers of Aconitum napellus, *Linné*, with a transverse section.

Admixtures.—The tubers of the allied blue-flowering species of aconitum are sometimes dug up and mixed with the officinal. The tubers of Aconitum Cammarum, *Jacquin* (s. Ac. variegatum, *Linné*), are globular-ovate, smaller than the preceding, the central pith about five-rayed and the rays rounded. Those of Aconitum Stoerckeanum, *Reichenbach* (s. Ac. Cammarum, *Linné*, s. Ac. Napellus, *Stoerck*), are often 3 to 5, attached to the parent tuber, of a slender conical shape, and with the pith roundish pentagonal in outline. The root of Imperatoria Ostruthium, *Linné*, or European masterwort, resembles aconite-tubers in shape, but has an aromatic odor and pungent taste, and exhibits upon transverse section numerous oil-cells arranged in several circles.

2. ACONITE-LEAVES. They are alternate, smooth, petiolate, 2 to 3 inches (50–75 Mm.) in length, nearly orbicular in outline, somewhat heart-shaped at the base and divided to the base, the lower into five, the upper into three, segments, each of which is again three or sometimes five-cleft, the last divisions being linear-lanceolate, often toothed, show a prominent rib beneath and a furrow above, which extends into the petiole, this being of about the length of the leaf. The texture of aconite-leaves is somewhat leathery, their color rather bright-green, and somewhat shining above and paler beneath. In the dry state they have a slight herbaceous odor and a taste which soon becomes bitter and acrid, producing tingling upon the tongue. The leaves are usually mixed with a portion of the handsome purplish-blue flowers, which grow in terminal racemes, have the upper sepal helmet-shaped, ending in a short point curved upward, and enclosing two long-stalked but short-bladed petals, and contain numerous hypogynous stamens and three short, slightly divergent ovaries.

The leaves of Aconitum Stoerckeanum, *Reichenb.*, are similar in appearance, but the segments are broader; those of Ac. Cammarum, *Jacq.*, are less deeply incised and have nearly rhomboid segments.

Other Species of Aconite.—BISH OR BIKH ROOT, also called Nepaul aconite-root, obtained from Aconitum ferox, *Wallich*, s. A. virosum, *Don*, and perhaps from other species of aconitum indigenous to the Himalayas, is occasionally met with in commerce. It is conical in shape, 2 to 4 inches (5–10 Cm.) long, about 1 inch (25 Mm.) and over in its upper diameter, longitudinally wrinkled, externally of a brownish-black color, internally whitish and somewhat spongy, or compact and of a resinous somewhat translucent appearance upon the smooth and short fracture. Its taste is intensely acrid.

ACONITUM HETEROPHYLLUM, *Wallich*. The conical or fusiform roots of this Himalayan species have a mucilaginous bitter taste without acridity, and are used in India, under the name of *atis*, for their tonic and anti-periodic properties. They are of a yellowish-gray color, rough from the numerous root-scars, internally white and mealy, and contain about $\frac{1}{12}$ per cent. of a bitter non-poisonous alkaloid, *atisine*, which appears to be combined with aconitic acid; the alkaloid was discovered by Broughton.

ACONITUM LYCOCTONUM, *Linné*. Von Schroff (1875) recalled attention to the fact that the aconite-leaves which are used in Lapland as a potherb are from a blue-flowering variety of this species, the *Ac. septentrionale* of Koelle, which contains only a very minute quantity of bitter alkaloid in the leaves, though more in the rhizome and rootlets.

ACON. ANTHORA, *Linné*, a yellowish or white-flowering species of Europe, has bitter roots, which were formerly used as a tonic, and, according to Hooker, the roots of the allied *Acon. multifidum*, as also those of *Acon. rotundifolium*, indigenous to India, are eatable.

ACONITUM CHINENSE, *Siebold*, AC. JAPONICUM, *Thunberg*, and perhaps other species, yield Chinese and Japanese aconite-root, which vary in shape, size, and poisonous properties, and appear in the Eastern market in the dried and salted condition and preserved by steeping in vinegar. Their poisonous properties and their constituents vary according to origin and mode of preservation. Geerts (1880) states that the most toxic Japanese aconite-root consists of the young tubers of Ac. Fischeri, *Reich.* Paul and Kingzett have isolated *japaconitine*, which was found by C. R. A. Wright to closely resemble his aconitine, and it is regarded by Mandelin (1885) as being identical with *benzoyl-aconine*.

Constituents.—The important medicinal constituent of both aconite root and leaves is the acrid alkaloid *aconitine* or *napaconitine*, combined with aconitic acid associated with bitter amorphous alkaloids, one of which, *napelline*, was discovered by Hübschmann (1857), and subsequently (1867) found by him to be identical with *acolyctine*, one of the alkaloids obtained by him from Aconitum Lycoctonum, *Linné*, which plant contains a second alkaloid, *lycoctonine*, but no aconitine. Wright has shown (1877) that these two alkaloids should be regarded as decomposition-products—namely, acolyctine from aconitine, and lycoctonine from the principal acrid alkaloid of bikh-tubers, which has been named *pseudaconitine*. The last-named alkaloid is also present in very small quantity in aconite-root, from which T. and H. Smith obtained (1864), by almost neutralizing the acid solution of crude aconitine with carbonate of sodium, a crystallizable non-poisonous alkaloid, bearing in its behavior a close resemblance to narcotine, and for which the name of *aconelline* has been proposed. Groves failed (1866) to obtain it, and Wright did not observe it; but the latter proved the existence of two amorphous alkaloids which are soluble in solution of potassium carbonate. One of these, *picraconitine*, has a bitter taste free from acridity; its composition is represented by the formula $C_{31}H_{45}NO_{10}$, and upon saponification with an alkali it splits into benzoic acid and *picraconine*, $C_{24}H_{41}NO_9$, the latter resembling the analogous derivative of aconitine. The salts of picraconitine are crystallizable.

Wright's total yield of crystalline and non-crystalline alkaloids from 200 cwt. of aconite-root was 0.07 per cent. Hottot (1864) obtained 0.06, and Hager (1863) between 0.64 and 1.25 per cent. Procter (1863), by testing with Mayer's solution, showed a total of 0.93 per cent. of alkaloids from aconite-root cultivated at New Lebanon, N. Y., and 0.44 per cent. from commercial European aconite-root, but by actual experiment he obtained only 0.42 and 0.20 per cent. respectively.

The herb from which Geiger and Hesse (1833) first isolated the mixed alkaloids usually contains a small percentage thereof, the fresh herb yielding to Wright 0.011 per cent., equal to about 0.05 per cent. of total alkaloids from the dry herb.

Aconite-leaves contain also albumen, gum, chlorophyll, extractive matter, and salts. In aconite-tubers resin, fat, mannit, cane- and grape-sugar have been found; the absence of a volatile alkaloid was demonstrated by Groves (1866).

Aconitic acid, $H_3C_6H_3O_6$, has been obtained also from Delphinium Consolida. Equisetum fluviatile, and by the decomposition of citric acid by heating it rapidly in a retort until oily streaks make their appearance in the neck, when the residue is exhausted with ether to free it from the undecomposed citric acid. By this process citric acid is deprived of 1 molecule of water; $C_6H_8O_7$ (citric acid) yields H_2O and $H_3C_6H_3O_6$. Aconitic acid crystallizes in colorless laminæ, or warts, which are easily soluble in water, alcohol, and ether, and which fuse at 140° C. (284° F.). Aconitate of calcium $= Ca_3(C_6H_3O_6)_2 6H_2O$, dissolves with difficulty in water after it has been in the crystalline state.

Nepaul aconite contains an alkaloid which was at first supposed to be identical with aconitine, but was afterward described under various names, like *acraconitine* (Ludwig, 1869), *napelline* (Wiggers, 1857), and *nepaline* (Flückiger, 1869). The name *pseudaconitine* or *feraconitine* is now given to this substance, which, according to Groves (1870–74), exists in two modifications, one crystalline, but yielding uncrystallizable salts, the other amorphous; the latter becomes sticky in boiling water, while the former coheres and becomes plastic only if treated with boiling water immediately after having been precipitated by ammonia. Another alkaloid, resembling Hübschmann's napelline, but probably differing from it, is likewise met with in bikh-root. Duquesnel (1871) and Patrouillard (1872) regarded pseudaconitine and aconitine as identical, differing from each other merely in the amount of other inert constituents contained in them. C. R. A. Wright (1875–80), however, proved the former to have the composition $C_{36}H_{49}NO_{12}$, and when acted upon by alcoholic solution of soda at 100° C. (212 F.) observed it to be decomposed into *dimethyl-protocatechuic* (*veratric*) *acid*, $C_9H_{10}O_4$, and an uncrystallizable base, *pseudaconine*, $C_{27}H_{41}NO_9$, which prevents also the crystallization of pseudaconitine; the latter is closely related to the opium alkaloids narceine and narcotine, which give rise to derivatives of dimethyl-protocatechuic acid. The same author regards Hübschmann's lycoctonine merely as a mixture of these two alkaloids, pseudaconine predominating.

Off. Prep.—Of the leaves: Extractum aconiti, *Br.* *Of the root:* Aconitia, *Br.;* Extract. aconiti (fluid.), *U. S.;* Liniment. aconiti, *Br.;* Tinctura aconiti (radicis), *U. S.*, *Br.*

EMPLASTRUM ACONITI.—Emplâtre d'aconit, *Fr.;* Akonitpflaster, *G.*—Exhaust by percolation Aconite-root in fine powder, 16 troyounces, with Alcohol. Distil from the tincture the greater part of the alcohol, and evaporate the residue to a soft uniform extract by means of a water-bath. Add to this sufficient resin plaster, previously melted, to make the mixture weigh 16 troyounces, and then mix them thoroughly.—*U. S.* 1870.

This is an efficient plaster if prepared from good aconite-root, which it represents weight for weight, and the alcoholic extract of which is easily and uniformly incorporated with the resin plaster.

Physiological Action.—Experiments upon fish, serpents, earth-worms, frogs, birds, etc. show that in all these animals aconite causes loss of sensibility, and paralysis terminating in death. The same general effects are exhibited by dogs, but in some instances it is evident that general sensibility is obtunded, if not suspended, even while locomotion is unimpaired. The first effects of a poisonous dose are staggering and weakness of the limbs, then disordered breathing, paralysis of the limbs, general anæsthesia, blindness, imperfect respiration, spasms, and death. Associated with these phenomena are slow pulse and breathing and lowered temperature, followed by rapidity and irregularity of the action of the heart and lungs. After death the stomach is not inflamed and the vessels of the cerebral meninges are gorged with blood. It is inferred from these and other results of experiment that aconite acts primarily upon the extremities of the nerves, and especially of the motor nerves. Upon *man* the following effects have been noted, chiefly in the very numerous cases in which it has been prescribed in an overdose or been taken by mistake: After a dose of 5 minims of the tincture there is felt a tingling, numb sensation in the lips and tongue and in the tips of the fingers, with a sense of muscular weakness and depression; the pulse falls in frequency and force and the breathing is somewhat slower. A dose of 10 minims produces the same symptoms greatly intensified and more prolonged. Beyond this dose the effects become poisonous; besides tingling of the skin there may be lancinating pains in the joints; there is vertigo with dimness of vision, alarming debility, and a pulse of between 30 and 40 in a minute, which afterward grows frequent and irregular. The skin is cool and moist, nausea and vomiting occur, and the sickness and depression may last for several days. (For illustrative cases see *Edinb. Med. Jour.*, xxviii. 653; Reichert, *Phila. Med. Times*, xii. 105.) In poisonous doses which yet have not proved fatal the preceding symptoms occur in an intensified degree. If the dose is a fatal one, there is complete loss of sight, hearing, and speech, yet consciousness may still be retained; the pupils are dilated, the muscles are tremulous or convulsed, the pulse is imperceptible at the wrist, and may be so even in the axilla; the skin is cold, and death usually takes place by syncope. No characteristic lesions are found after death, but the heart is generally arrested in diastole, and most frequently is filled with dark blood. Large doses of aconite are said to leave behind them general debility, tremulousness, photophobia, feverishness, impaired digestion, and sometimes a tendency to jaundice. Experiments made to determine the influence of aconite on the secretion of urine (Mackenzie, *Practitioner*, xxiv. 1) appear to show that in obstructive heart or kidney disease it neither maintains the action of the kidneys nor evacuates dropsical fluid, but that where these conditions do not exist, and in certain febrile states, it has a tendency to increase the urinary secretion. (Further information regarding the action of this drug will be found under Aconitia.)

Medical Uses.—Aconite has been proclaimed by not a few writers of authority to be a potent remedy for *rheumatism;* it may be admitted to possess some value as a sedative of arterial action, and thereby as an indirect anodyne, but it is in no proper sense a remedy for the disease. Indeed, it falls so far short of alkalies in the articular, and of iodide of potassium in the muscular, variety of rheumatism that its practical value is next to nothing, and it does not enter into the catalogue of remedies which are prescribed for the disease by judicious practitioners. It is of still less utility in *gout* than in rheumatism. But in both affections it may be employed as a topical application for mitigating pain. So far as the internal use of aconite in *neuralgia* is concerned, a somewhat analogous judgment may be given. Undoubtedly it sometimes palliates severe suffering in this disease affecting the nerves of the face or the chest, especially when it is at the same time applied, in the form of a strong tincture, over the superficial and painful nervous branches. Aconite plaster, which is no longer officinal, may be used in a similar manner, and as a sedative of local pain in chronic *rheumatism*, *white swelling*, etc. In the greater number of cases of neuralgia, not the direct effect of external causes, the affection depends upon states of the system which must be remedied by quinia, arsenic, iron, etc., and in which the sole indication for aconite is fulfilled by its local application. It is sometimes very efficient in relieving *toothache* when introduced into a carious cavity. But the risk of poisoning in such cases outweighs the advantages of the medicine. The same reflection is suggested by its use in *palpitation* of the heart, whether nervous or arising from organic disease of that organ, in *dysentery*, *amenorrhœa*, etc. In traumatic *tetanus* a like consideration should forbid its use, in spite of certain cases in which it seems to have been advantageous.

The statements which have been made respecting the virtues of aconite in purely inflammatory affections and fevers—*e. g. pneumonia*, *tonsillitis*, *rheumatism*, *erysipelas*, *typhoid fever*, *puerperal fever*, *remittent fever*, and *traumatic fever*—have not been supported by concurrent experience. Probably the medicine is more efficient in acute *tonsillitis* than in the other diseases enumerated. But if certain reports of its use in *pneumonia* (*e. g.* Spark, *Practitioner*, xxii. 196; Dobie, *ibid.*, p. 401) were to be taken as a guide, it has effected what no other medicine can do. It is said to have cut short the disease within from 1 to 3 or 4 days of its commencement. Evidently, the reporters have overlooked the fact that pneumonia sometimes does not go beyond the first or congestive stage. Like various other sedatives and more numerous stimulants, aconite will sometimes prevent the development of certain diseases, such as coryza, tonsillitis, laryngeal and bronchial catarrhs, and even nervous asthma Walshe has commended the use of aconite in *pericarditis* when the general conditions are sthenic and the disease is at its onset; and yet he admits that an overdose of it will dangerously accelerate the heart's action and lessen its power.

The risks greatly outweigh the benefits of its administration in this as in all other internal diseases. It seems to rest upon the same error which led to the employment on the one hand of digitalis and on the other of white and green hellebore in such affections, and which consisted in mistaking a reduction of the pulse-rate for the cure of the disease which caused its increase. It should constantly be borne in mind. in reference to the two last-mentioned medicines, and still more in regard to aconite, that the lowering effect upon the pulse is brought about at the expense of the power of the heart. When employed in fevers and inflammations, it should always be given in very small and frequently repeated doses, such as half a minim every quarter or half hour until some of its characteristic effects appear, when the dose should be diminished or given at longer intervals.

The treatment of *poisoning* by aconite consists in evacuating the stomach with mechanical emetics and the stomach-pump, and sustaining vitality by means of the galvanic battery and by the administration of stimulants, including alcoholic liquids, coffee, and external heat. Oxygen has apparently tended to revive failing life, and hence artificial respiration is indicated. Strychnia is regarded as indicated physiologically; and digitalis, or, preferably, digitalin and atropia, may be given for their sustaining operation upon the heart. (For the use of these agents in poisoning by aconite see ATROPINA and DIGITALIS.) Two cases occurred (O'Brien, *Med. Record*, xv. 128; Clark, *ibid.*, xvii. 6) which demonstrate the power of *morphia*, hypodermically administered, to rescue from impending death persons poisoned by aconite, and others have been recorded. To assist in preventing syncope the patient's head should be kept low. According to Harley, death results from asphyxia and progressive collapse of the lung, the former being due to the spasmodic closure of the respiratory passages and paralysis of the muscles of inspiration, and notably of the diaphragm.

Dose.—Of the powdered leaves or root 1 or 2 grains (Gm. 0.06–0.13) are a minimum dose, but aconite is seldom employed in this form. The extract and tincture are preferable for internal administration, and for the local effects of the medicine either the tincture, aconite plaster, or aconitia may be employed. It must not be forgotten that alarming symptoms have been produced by a dose of 3 drops (Gm. 0.02) of the saturated tincture of aconite-root.

Napelline (probably Hübschmann's) is alleged by Laborde to produce essentially the same effects as aconitia, but only when given in a much larger dose than the latter. Thus, while half a milligram (gr. $\frac{1}{120}$) of aconitine fatally poisons a dog, it requires 3 or 4 centigrams (gr. $\frac{1}{2}$ to $\frac{3}{4}$) of napelline to produce any effect on a similar animal. It is also asserted that napelline induces a calm and refreshing sleep, like that occasioned by narceine (*Bull. de thérap.*, ciii. 94). It would be a singular fact if a derivative of aconite should possess soporific qualities that do not belong to the drug itself (see p. 115). In doses of half a grain napelline is said to have been a very efficient palliative of *neuralgia* of the fifth nerve. It has also been given for the relief of this affection in doses of one-twenty-fourth of a grain every 2 hours (*Bull. de thérap.*, cv. 220).

ACTÆA SPICATA, *Linné.*—BANEBERRY ROOT.

Radix Christophorianæ.—Racine de Saint-Christophe, Fr.; *Christophswurz, Wolfswurz*, G.

Nat. Ord.—Ranunculaceæ, Cimicifugeæ.

Origin.—The plant is a native of Central and Northern Europe, and a variety with red berries (A. rubra, *Bigelow*) is indigenous to the Northern United States and Canada. The leaves are twice or thrice ternately compound, with ovate or oblong, sharply cleft or toothed leaflets. The whitish flowers are in short, dense racemes. The fruit of the European variety is glossy black. Another American species, A. alba, *Bigelow*, is taller and has longer racemes and white berries.

Description.—The rhizome and rootlets closely resemble the corresponding parts of cimicifuga, but are shorter, thinner, and of a blackish-gray color. When dry they are nearly inodorous; their taste is bitter, afterward acrid and sweetish. The constituents are similar to those of cimicifuga.

Physiological Action and Medical Uses.—A. spicata, or baneberry, and A. alba and rubra, are sometimes used in domestic medicine where they flourish—the first in Europe, the others in this country. They are probably very analogous, if not identical, in their mode of action, which is that of an irritant emeto-cathartic. The berries of the European species are said to occasion violent and even fatal delirium, as well as gastro-intestinal disorder. They destroy the life of hens and ducks, but sheep, asses, and goats devour the green leaves without injury. The powder and decoction are used to kill *fleas* and *lice*. The fresh root of the plant has been used in veterinary medicine, and was formerly regarded as a remedy for *asthma*. Whatever virtues belong to either of these species probably exist more perfectly in cimicifuga. A. spicata is administered in an infusion made with 30 grains (Gm. 2), to be taken in 1 day.

ADANSONIA DIGITATA, *Linné*.—BAOBAB.

Baobab, E., Fr., G.

Nat. Ord.—Sterculiaceæ, Bombaceæ.

Description.—The tree is indigenous to tropical Africa, and has been introduced and naturalized in various parts of the East and West Indies. It is remarkable for its enormous size, the trunk being about 15 feet (4.5 M.) high up to the branches, but attaining a circumference of 100 feet (30 M.) and more, and being divided into branches 50 to 70 feet (15–21 M.) long. It has a smooth, gray bark; palmate leaves, with 5 to 7 obovate or elliptic rather acute and somewhat dentate leaflets, which are about 5 inches (12 Cm.) long. The flowers are about 4 inches (10 Cm.) long and wide, have 5 thickish, obovate, white petals, and numerous stamens, with the lower half of the filaments united into a tube, and produce a roundish, oblong fruit about 10 to 12 inches (25–30 Cm.) long and containing about 50 blackish, subreniform seeds, which are covered with a whitish, acidulous pulp. The bark, leaves, and flowers have a mucilaginous taste. The fruit is known as *monkey-bread* (*Pain de singes*, Fr.; *Affenbrot*, G.), *Ethiopian sour-gourd*, and in Southern Africa as *cream-of-tartar fruit*. The pulp surrounding the seeds contains, according to F. L. Slocum (1880), acid potassium malate, pectin, and glucose.

The Australian species, A. Gregorii, *F. v. Mueller*, is of smaller dimensions.

Medical Uses.—The bark of the baobab does not appear to affect any of the functions, except perhaps by increasing the appetite. The natives of Senegal are said to use it for its emollient qualities, and to mix the powder of its leaves with their food. It at first attracted attention in consequence of its alleged power of curing *intermittent* fever, but no confirmation of the original assertion is accessible, and it is quite improbable that a mucilaginous plant should possess such a virtue. A decoction is made with an ounce of baobab-bark and a quart of water (Gm. 32 in 1000), reduced by boiling to a pint and a half.

ADEPS, *U. S.*—LARD.

Adeps præparatus, Br.; *Adeps suillus*, P. G.; *Axungia*, *Axungia porci s. porcina.*—*Prepared lard*, *Hog's lard*, E.; *Axonge*, *Graisse de porc*, *Saindoux*, Fr.; *Schweineschmalz*, G.

The prepared or purified internal fat of the abdomen of the hog, Sus scrofa, *Linné*. Class Mammalia; order Pachydermata.

Preparation.—For medicinal purposes the fat attached to the mesentery, omentum, and kidneys of the hog killed during the winter or spring should be selected, as this has a higher fusing-point than if obtained during the summer or from other parts of the body. It is that portion which is ordinarily called the "leaves," and should be as free from blood as possible. Hogs which have been fed on corn and similar amylaceous food appear to yield a more solid lard than hogs fed on the refuse of the kitchen. The British Pharmacopœia gives the following directions for preparing lard: Take of the internal fat of the abdomen of the hog, perfectly fresh, any convenient quantity. Remove as much of the external membranes as possible, and suspend the fat so that it shall be freely exposed to the air for some hours; then cut it into small pieces, and beat these in a stone mortar until they are thus, or by some equivalent process, reduced to a uniform mass in which the membranous vesicles are completely broken. Put the mass thus produced into a vessel surrounded by warm water, and apply a temperature not exceeding 130° F. (54.4° C.) until the fat has melted and separated from the membranous matter. Finally, strain the melted fat through flannel.—*Br.*

Perfumers obtain it inodorous, or nearly so, by adding to every pound of the fused lard about 15 grains of powdered alum and 30 grains of table-salt, and continuing the heat until a scum rises, which is to be carefully removed, and the fat is uniform in appearance; it is then allowed to cool, and worked upon a slab or in a mortar while a slow stream of clear water passes over it, whereby the salts are completely removed. The fat is then remelted and the heat maintained until the water has completely separated or evaporated.

Properties.—Lard is a soft white fat, having a faint odor entirely free from rancidity, a bland taste, and a neutral reaction; like other fats it dissolves completely in ether, benzin, benzol, carbon disulphide, chloroform, and volatile oils. It has a density of about 0.938, fuses near 35° C. (95° F.) to a clear, nearly colorless liquid, and at or below 30° C. (86° F.) is a soft solid. In contact with the air, particularly when exposed to the light, it speedily oxidizes and becomes rancid, acquiring an acid reaction, a disagreeable odor, and an acrid taste; this change is accelerated by the presence of alkalies.

As met with in commerce, lard often has a rancid odor, and is then unfit for medicinal use. Salt is often added to prevent it from becoming rancid, but should be carefully removed by fusing the lard and stirring it in hot water, and afterward washing it until the fat is tasteless or nitrate of silver ceases to produce a precipitate with the washings. Carbonate of potassium is used to impart an artificial whiteness to commercial lard and to incorporate with it considerable proportions of water; such lard is to be purified by remelting and washing with water. Adulterations with mucilaginous jellies are removed in the same manner.

Constituents.—Lard is a mixture of olein, palmitin, and stearin, the last two fats being obtainable to the amount of 30 to 40 per cent. by subjecting the lard to pressure near the freezing-point of water. The expressed liquid is known in commerce as *lard oil*, and is extensively used for various purposes; it furnishes a cheap adulterant for some of the more costly non-drying oils. The solid portion is called *stearin*, and is employed for making candles, soap, etc. When melted lard is allowed to cool slowly a portion of the solid fats separates in granules; hence lard and all its preparations should be constantly stirred while cooling, to obtain them of uniform smoothness.

Preservation and Tests.—Lard should be preserved in glass, porcelain, or other well-glazed vessels, which must be entirely impervious to fat; the vessels should be well filled and protected from the access of air and light. Rancidity is readily ascertained by the acid reaction which alcohol acquires on being agitated with melted lard. On melting lard in a narrow test-tube, the oily liquid should be perfectly transparent and not separate a stratum of water. The adulterations mentioned above are detected by ether or chloroform, in which they are insoluble; distilled water, on being boiled with lard, should not acquire an alkaline reaction (alkaline carbonates), and after separating the fat the liquid should not form a precipitate with nitrate of silver (sodium chloride) or assume a blue color on the addition of compound solution of iodine (absence of starch).

ADEPS BENZOINATUS, *U. S.*—BENZOINATED LARD.

Adeps benzoatus, Br.; *Unguentum benzoini*, U. S. 1870; *Axungia balsamica s. benzoinata s. benzoata.*—*Benzoated lard*, *Ointment of benzoin*, E.; *Axonge (Graisse) benzoinée (balsamique)*, Fr.; *Benzoinirtes Schmalz*, G.

Hog's lard impregnated with benzoic acid and the odorous principle of benzoin.

Preparation.—Benzoin, in coarse powder, 2 parts; Lard, 100 parts. Melt the lard by means of a water-bath, and, having loosely tied the benzoin in a piece of coarse muslin, suspend it in the melted lard, and, stirring them together frequently, continue the heat for 2 hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, having removed the benzoin, strain the lard, and stir while cooling.—*U. S.*

Take of prepared Lard 1 pound; Benzoin, reduced to coarse powder, 160 grains. Melt the lard by the heat of a water-bath, add the benzoin, and, frequently stirring them together, continue the application of heat for 2 hours; finally, remove the residual benzoin by straining.—*Br.*

The result of both processes is practically identical, though the first formula directs for 1 pound avoirdupois only 140 grains of benzoin. By enclosing the latter in a muslin bag and regulating the temperature the benzoin is more thoroughly exhausted than if it was allowed to melt, and empyreuma is prevented. As prepared by the U. S. Pharmacopœia of 1870, by mixing 2 fluidounces of tincture of benzoin with 16 troyounces of melted lard, it was necessary to strain after the evaporation of the alcohol, so as to remove the resin, which has an irritating effect on tender surfaces.

Fixed oils dissolve the benzoic acid and odorous principles contained in benzoin. Pure benzoic acid has no preservative influence on lard; that property appears to be due solely to the balsamic principle of benzoin and similar bodies. Hence the rancidity of lard may be prevented by impregnating it with the balsamic principles of storax, Peru or Tolu balsam, in the proportion of 1 or 2 parts of balsam to 100 parts of lard: the latter constitutes the so-called *balsamic lard* (Procter, 1863). In a similar manner *populinated lard*

(*Unguentum populi s. populeum*) is obtained by digesting 1 part of poplar-buds and 2 parts of lard until the moisture has evaporated, when the undissolved matter is removed by expressing and straining. B. F. Scholl (1883) ascertained that for the preservation of fats a larger amount of storax is required than of benzoin. Groves found (1866) that volatile oils generally preserve fats from rancidity to some extent, and that the oils of cloves, allspice, and sassafras are best adapted for this purpose, in the proportion of 4 drops to 1 ounce of fat.

Pharmaceutical Uses and Preparations.—Lard and benzoinated lard are used as ingredients in ointments, cerates, and sometimes also in plasters as a substitute for olive or other oil. The base of the following ointments is lard only: Ung. aconitiæ, Ung. atropiæ, Ung. belladonnæ, Ung. hydrargyri subchloridi, Ung. iodi, Ung. potassæ sulphuratæ, Ung. potassii iodidi, Ung. sulphuris iodidi, Ung. veratriæ, *Br.*

The following ointments are made with benzoinated lard for their base: Ung. acidi gallici, Ung. acidi tannici, Ung. belladonnæ, Ung. chrysarobini, *U. S.;* Ung. gallæ, *U. S.*, *Br.;* Ung. hydrargyri ammoniati, Ung. iodi, Ung. iodoformi, *U. S.;* Ung. plumbi acetatis, *Br.;* Ung. plumbi carbonatis, Ung. plumbi iodidi, Ung. potassii iodidi, Ung. stramonii, *U. S.;* Ung. sulphuris, *U. S.*, *Br.;* Ung. sulphuris alkalinum, Ung. veratrinæ, *U. S.;* Ung. zinci oxidi, *U. S.*, *Br.* Benzoinated lard enters also into the suppositories of the British Pharmacopœia.

Lard is also an ingredient in the following: Ceratum, *U. S.;* Ceratum (emplastrum) cantharidis, *U. S.*, *Br.;* Cerat. extr. canthar., Cerat. resinæ, *U. S.;* Unguentum (simplex), Ung. hydrargyri, *U. S.*, *Br.;* Ung. mezerei, *U. S.;* Ung. sabinæ, Ung. terebinthinæ, *Br.*

Physiological Action and Uses.—Lard is used in medicine chiefly on account of the property it possesses in common with all unctuous substances of facilitating manual and mechanical operations by its lubricating qualities, and also because it shares the same property of protecting exposed tender surfaces from the action of the air. Like other fats and oils, it is difficult of digestion, and therefore is sometimes used as a laxative for children and for its protective power in *diarrhœa*, *dysentery*, etc. Enemata of melted fresh lard are extremely soothing in acute dysentery. It has been proposed as a substitute for cod-liver oil in the treatment of *phthisis*, but its indigestible nature unfits it for this purpose. It has been employed externally in the same disease by inunction of the chest, and probably with the advantage of protecting the lungs from the external impression of cold. In the treatment of bronchial and laryngeal *catarrh* in children, and indeed of all pulmonary affections of early life, this simple application is valuable, not only for the reason assigned, but because it seems, when the cough is dry and urgent, to render expectoration freer. The same may be said of its use in *coryza*, in which the ointment should be applied on the bridge of the nose. In *scarlet fever* inunction of the whole body protects the skin from the atmosphere, and thereby lessens the burning and itching, and both directly and indirectly lowers the temperature and the pulse-rate. It also tends to prevent a sudden chill on exposure to the air, and hence diminishes very much the occurrence of scarlatinous *dropsy*. But with this end in view the application must be continued for some time after the acute febrile symptoms have disappeared. It is thought that the anginose symptoms of scarlet fever may be moderated by keeping the neck enveloped in well-greased flannel cloths, but of this the evidence is slender. In *measles* it is probable that the *bronchitis* may be moderated by similar applications upon the chest. The best form in which lard can be used for the above purposes is simple ointment. The strongest objections to its use are the necessity of soiling much body- and bed-clothing, and the repugnance which is generally manifested by patients to its frequent repetition. Benzoated lard, especially with a modicum of glycerin, is preferable to prepared lard or simple ointment when a mild stimulant action is desired besides the protective influence.

ADIANTUM.—MAIDENHAIR.

Herba capillorum veneris.—*Capillaire*, Fr.; *Frauenhaar*, *Venushaar*, G.

The frond of Adiantum capillus Veneris, *Linné*, and A. pedatum, *Linné*.

Nat. Ord.—Filices.

Origin.—The first species is indigenous to Southern Europe, and grows in moist rocky places; the second is common in rich moist woods of North America.

Description.—The European maidenhair has a polished, blackish-brown stipe about a foot (30 Cm.) high, tri- or bipinnate below, pinnate above; the leaflets are short-stalked, irregular, roundish wedge-shaped, oblique at the base, obtusely lobed, and with linear marginal fruit-dots. The American species has the stipe forked at the summit, each branch recurved and with 6 or 7 pinnate branches; the leaflets are triangular oblong, on the lower margin entire, the upper margin cleft and fruit-bearing; otherwise resembling the preceding. Both have a faintly astringent, sweetish, and slightly bitter taste; the American maidenhair has also a faint aromatic odor. Their constituents are a small quantity of tannin, a bitter principle, mucilage, sugar, and a trace of volatile oil.

Pharmaceutical Uses.—SYRUPUS ADIANTI, S. CAPILLORUM VENERIS.—Syrup of maidenhair, *E.* As employed in Europe, it is prepared by making an infusion with 1 part of the drug and 10 parts of boiling water, and dissolving in the strained liquid 19 parts of sugar.

Allied Species.—Other species indigenous to Mexico and South America are employed there for similar purposes. Asplenium Adiantum nigrum, *Linné*, was formerly known in Europe as *black maidenhair*, and Aspl. ruta muraria, *Linné*, as *white maidenhair:* the latter is also a native of the United States.

Medical Uses.—The indigenous species of maidenhair is reputed to be useful in the same affection for which its European congener has long been celebrated—viz. in *pulmonary catarrh;* and a syrup made with the latter species is, in France, an ordinary flavoring addition to expectorant mixtures. It is demulcent and slightly stimulant.

ÆTHER, *U. S., Br., P. G.*—ETHER.

Æther sulphuricus, Naphtha vitrioli.—*Sulphuric ether*, E.; *Ether hydrique s. vinique s. sulfurique*, Fr.; *Æther, Schwefeläther*, G.

Ether of the specific gravity 0.750 (*U. S.*), 0.735 (*Br.*), 0.724–0.728 (*P. G.*), 0.720–0.725 (*F. Cod.*).

Stronger or pure ether has a specific gravity not exceeding 0.725 (*U. S.*), 0.720 (*Br.*). Formula $(C_2H_5)_2O$. Molecular weight 74.

Preparation.—Take of Rectified Spirit 50 fluidounces; Sulphuric Acid 10 fluidounces; Chloride of Calcium 10 ounces; Slaked Lime ½ ounce; Distilled Water 13 fluidounces. Mix the sulphuric acid with 12 fluidounces of the spirit in a glass matrass capable of containing at least 2 pints, and, not allowing the mixture to cool, connect the matrass, by means of a bent glass tube, with a Liebig's condenser, and distil with a heat sufficient to maintain the liquid in brisk ebullition. As soon as the ethereal fluid begins to pass over, supply fresh spirit through a tube into the matrass in a continuous stream, and in such quantity as to equal the volume of the fluid which distils over. For this purpose use a tube furnished with a stopcock to regulate the supply, connecting one end of the tube with a vessel containing the spirit raised above the level of the matrass, and passing the other end through a cork fitted into the matrass. When the whole of the spirit has been added and 42 fluidounces have distilled over the process may be stopped. Dissolve the chloride of calcium in the water, add the lime, and agitate the mixture in a bottle with the impure ether. Leave the mixture at rest for 10 minutes, pour off the light supernatant fluid, and distil it with a gentle heat until a glass bead of specific gravity 0.735, placed in the receiver, begins to float. The ether and spirit retained by the chloride of calcium and by the residue of each rectification may be recovered by distillation and used in a subsequent operation.—*Br.*

The details of the process of the U. S. Pharmacopœia of 1860 and 1870 were elaborated by Dr. Squibb in 1858, and may be briefly stated as follows: 36 troyounces of sulphuric acid are gradually added to 2 pints of strong alcohol contained in a 6-pint tubulated retort; by means of a sand-bath the liquid is rapidly heated to between 130° and 138° C. (266° and 280° F.), and 4 pints of strong alcohol are then run into the retort in a continuous stream, the flow being regulated so that the temperature of the boiling liquid shall be maintained between the limits mentioned, and the distillation being finally discontinued when the temperature rises to 141° C. (286° F.). The distillate is well agitated with a solution of 360 grains of potassa in 3 fluidounces of distilled water; after 24 hours the supernatant liquid is decanted into a retort, and with a gentle heat distilled until the distillate attains the required specific gravity. Yield, about 3½ pints.

Etherification.—When alcohol and sulphuric acid are mixed, 1 molecule of each compound unites to form sulphovinic acid and water; $C_2H_6O + H_2SO_4$ yields $C_2H_5HSO_4$ (sulphovinic acid) + H_2O. On the application of heat and in the presence of a fresh portion of alcohol a further reaction takes place, whereby sulphuric acid is reproduced and ether formed, the latter distilling over; $C_2H_5HSO_4 + C_2H_6O$ yields H_2SO_4 and $(C_2H_5)_2O$. The apparent result of the entire reaction, it will be noticed, consists in the abstraction of 1 molecule of water from 2 molecules of alcohol, the remaining elements forming

1 molecule of ether, while the sulphuric acid remains free, merely determining by its affinity for water the decomposition of the alcohol. The incorrectness of such an explanation of etherification is readily demonstrated by the different products of decomposition obtained in case the supply of alcohol is insufficient or the sulphuric acid is used in excess, when oil of wine, sulphurous acid, olefiant and other gases, are generated. (See OLEUM ÆTHEREUM.)

By calculation upon the above equation for the production of sulphovinic acid, it will be found that 2 parts of sulphuric acid require nearly 1 part of strong alcohol for the formation of sulphovinic acid, and subsequently the same weight of alcohol is required to decompose all the sulphovinic acid, with the production of ether. However, if the whole amount of the alcohol is added at once, a considerable portion of it will distil over before the temperature of etherification has been attained. In practice, the addition of about 10 per cent. of the second part of alcohol has been found most advantageous, making the proportion of acid and alcohol 9 parts of the former to 5 parts of the latter. This proportion has been adopted in the British Pharmacopœia; in the United States authority a somewhat larger amount (about 6 parts) of alcohol was directed for 9 parts of sulphuric acid. If the quantity of alcohol is increased beyond the proportions given, the boiling-point of the mixture will be lowered and a proportionate amount of alcohol will distil over with the ether. On the other hand, a reduction of the alcohol below the proportions indicated will result in an increase of the boiling temperature and the production of a larger or smaller amount of the decomposition-products mentioned above.

As the ether distils over, a sufficient amount of alcohol is admitted into the retort, so as to maintain the original proportion of the two liquids. This part of the process requires careful attention, and is determined either by comparing the bulk of the alcohol added with that of the distilled ether, or, more practically, by keeping the boiling-point of the liquid in the retort between the limits given above. If the boiling-point should rise abeve 138° C. (280° F.), the supply of alcohol is insufficient, and if the temperature should fall below 130° C. (266° F.), alcohol has been added too freely, and the excess must be removed by cutting off its flow, either partly or entirely, until the proper temperature has again been reached.

Since in the formation of ether sulphuric acid is continually regenerated, its power of etherification is theoretically unlimited; practically, however, it ceases when about five or six times its weight of alcohol has been subjected to its influence. The main cause for this limit is found in the water which in the course of the process accumulates in the retort and weakens the sulphuric acid. In the beginning of the distillation a considerable proportion of the liberated water comes over with the ether, so that the distillate separates into two layers. As the acid in the retort becomes weaker, a larger proportion of alcohol evaporates with the ethereal and aqueous vapors, so that after some time the distillate will be found to be a clear and uniform mixture of ether, alcohol, and water. The pharmacopœias do not direct the preparation of ether to be pushed to the utmost limit of the etherizing power of the sulphuric acid, but when about double its weight of alcohol has been used the process is discontinued.

The crude ether obtained by the Pharmacopœia process consists of ether, alcohol, and water, but contains, besides these, variable proportions of other decomposition-products, among which sulphurous acid, oil of wine, and occasionally acetic acid, are found. The acids are removed by agitating the crude product with an alkali—potassa or lime—in the presence of water, the latter serving also the purpose of abstracting much of the alcohol from the ethereal liquid. To avoid the loss of too large a quantity of ether, the potassa is dissolved in a small quantity of water, or, as directed by the British Pharmacopœia, a larger proportion of a nearly concentrated solution of calcium chloride containing slaked lime is used, which dissolves the alcohol, but only a small quantity of ether. When the aqueous liquid after sufficient agitation has subsided, the ether is drawn off and rectified until the distillate has the proper specific gravity, which is conveniently ascertained, according to the British Pharmacopœia, by keeping in the receiver a glass bead of the proper density, which will begin to float as soon as the density of the distillate is the same. This rectification is best performed by placing the retort in a water-bath, then heating the bath and carefully regulating the heat, so that the ebullition never becomes violent, in which case the vapors are apt to escape condensation and to become ignited. The condenser should be capacious and well cooled whenever ether is distilled.

Older Theories.—Ether, or a mixture of ether and alcohol, was probably obtained by the alchemists in the thirteenth century, but a process for its preparation from equal parts of oil of vitriol and alcohol was first devised, in the sixteenth century, by Valerius Cordus, who called it *oleum vitrioli dulce verum.* The name "ether" (spiritus æthereus) was first used for this liquid by Frobenius in England (1730). Fourcroy and Vauquelin (1797) regarded ether as alcohol deprived of water by the action of sulphuric acid, and Valentin Rose proved (1800) that ether contains neither sulphur nor an acid. Berzelius explained the action of sulphuric acid upon alcohol by catalytic force. Liebig regarded sulphovinic acid as a double sulphate of water and ethylic oxide (ether), which is decomposed by heat, with the liberation of ether. Rose explained this decomposition by water displacing the ether from the compound mentioned. Graham ascribed the result to the polymerizing power of sulphuric or sulphovinic acid, whereby alcohol $= C_2H_2 + HO$ (old notation) is converted into ether $= C_4H_4 + HO$. According to Robiquet (1854), carbylic sulphate $= C_2H_42SO_3$ and water are first formed, and these, with alcohol, yield ether and sulphuric acid; thus: $C_2H_42SO_3 + 2H_2O + C_2H_6O = C_4H_{10}O + 2H_2SO_4$. The theory explained at the beginning of this article was first advanced by Williamson (1850–54), and is supported by the discovery of ethers containing two distinct alcohol radicals.

STRONGER (PURE) ETHER.—Æther fortior, *U. S.;* Æther purus, *Br.;* Æther, *P. G.*—Stronger ether, Pure ether, *E.;* Ether hydrique pur, *Fr.;* Reiner Æther, *G.*

Take of Ether and Distilled Water, each 2 pints; Lime recently burned ¼ ounce; Chloride of Calcium 4 ounces. Put the ether with 1 pint of the water into a bottle, and shake them together; allow them to remain at rest for a few minutes, and when the two liquids have separated decant off the supernatant ether; mix this with the remainder of the water, and again, after separation, decant as before. Put now the washed ether, together with the lime and chloride of calcium, into a retort to which a receiver is closely attached; let them stand for 24 hours, then distil with the aid of a gentle heat.—*Br.*

The process of the U. S. Pharmacopœia of 1870 differed from the preceding one in this, that the ether was agitated with an equal bulk of water, then decanted, agitated with calcium chloride and lime in powder, set aside for 24 hours, decanted, and distilled until about one-half had been recovered, the remainder yielding a weaker distillate.

The object of these processes is the removal of alcohol by agitating the ether with water, the last portions of which, together with nearly the whole of the remaining alcohol, are afterward separated by the calcium chloride and lime, the latter of which should be used unslaked. The distillation may be continued as long as ether of the proper specific gravity is obtained. The weaker ether, recovered by continuing the distillation, may be reserved for a subsequent operation.

Properties.—1. ABSOLUTE ETHER. It is a colorless, very limpid, not solidifiable liquid, of a strong refractive power, and having a specific gravity of 0.710 at 20° C. (68° F., Richter), to 0.712 at 25° C. (77° F., Gay-Lussac). It has a peculiar penetrating odor and a sweetish, pungent taste. It boils at 34° to 35° C. (93° to 95° F.), the vapors having a specific gravity of 2.58, and volatilizes very rapidly at ordinary temperature, thereby producing a considerable diminution of temperature. It is easily ignited, and burns with a bright flame, yielding water and carbonic acid. Its vapor, mixed with a large quantity of air, if ignited explodes with great violence. In consequence of this property and of the great density of its vapor great care should be exercised in handling ether or manipulating with it in the vicinity of a flame. It dissolves phosphorus, sulphur, iodine, bromine, some metallic sulphides, chlorides, bromides, and iodides, bromoform, iodoform, chloroform, alcohols, benzol, benzin, fats, volatile oils, many resins, most alkaloids, and some organic acids. W. H. Greene (1879) observed that on mixing 20 Gm. of absolute ether with 43 Gm. of chloroform the temperature rises 15° C. and little contraction in volume takes place; the mixture begins to boil at 50° C., and may be separated into its constituents by repeated fractional distillation. When shaken with an equal bulk of water, absolute ether loses one-fourteenth of its volume, which is dissolved by the water, a little of this liquid being dissolved by the ether (Boullay). The presence of water and alcohol is detected by mixing the ether with an equal bulk of carbon bisulphide, which should result in a perfectly clear liquid; a piece of potassa kept in the ether for 24 hours becomes coated with a yellowish film and imparts a yellowish color to the liquid if alcohol be present (Boettger, 1872). Aniline-violet is insoluble in absolute ether, but in the presence of 1 per cent. of alcohol colors the liquid distinctly (Stefanelli, 1875). Well-dried powdered tannin remains pulverulent in absolute ether, but in the presence of water forms a tough mass or thick solution. Frederking (1870) recommended glycerin for the detection of water and alcohol.

Ether has a neutral reaction to test-paper, but when kept for a long time in partly-filled bottles acquires an acid reaction from free acetic acid; this is regarded as the result of oxidation, facilitated by the presence of moisture, or, as suggested by N. E. Henry, to the decomposition of a little acetic ether assumed to be present in ether. According to Lieben (1873), alcohol is very slowly regenerated when ether is left in contact with water. That ether is capable of forming a hydrate was shown by Tanret (1878), who on filtering an ethereal liquid observed on the upper part of the filter a frost-like congelation having the temperature −3.5° C. (25.7° F.), and, after removing adhering ether by blowing upon it, yielding 17 to 18 parts of water for 37 of ether; the formula $(C_2H_5)_2O.2H_2O$ requires 18 parts.

2. Stronger or Officinal Pure Ether has a density of not over 0.725 at 15° C. (59° F.) or 0.716 at 25° C. (77° F.), and is composed of about 94 per cent. of ethyloxide (absolute ether) and about 6 per cent. of alcohol containing a little water; it boils at 37° C. (98.5° F.), and dissolves in 8 times its volume of water at 15° C. (59° F.). The specific gravity of ether required by other pharmacopœias is not exceeding 0.720 at 60° F. (*Br.*), 0.720 to 0.725 at 15° C. (*F. Cod.*), 0.724 to 0.728 at 15° C. (*P. G.*); the last-named authority requires that water after agitation with an equal volume of ether should not be increased in volume more than 10 per cent.

If a piece of pale-blue litmus-paper moistened with water be immersed 10 minutes in a portion of the ether, the color should not change. On evaporating at least 50 Ccm. in a glass vessel no fixed residue should appear, and on evaporating a portion dropped upon blotting-paper no foreign odor should be developed. When 10 Ccm. are agitated with an equal volume of glycerin in a graduated test-tube, the ether layer, when fully separated, should not measure less than 8.6 Ccm. It should boil actively, in a test-tube half-filled with it and held a short time in the hand, on the addition of small pieces of broken glass.—*U. S.*

3. Officinal Ether. Its specific gravity is 0.750 (0.735, *Br.*). It evaporates without residue, does not redden litmus, and when 10 Ccm. of it are shaken with an equal bulk of glycerin it should not be reduced to less than 7.5 Ccm.

Hager gives the following table, showing the percentage by weight of ether of the specific gravity 0.7185, contained in the alcoholic distillates obtained in the rectification of ether; temperature 17.5° C. (68.5° F.):

Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.
99	0.7198	89	0.7290	79	0.7397	69	0.7516	59	0.7640
98	0.7206	88	0.7300	78	0.7408	68	0.7528	58	0.7653
97	0.7215	87	0.7310	77	0.7420	67	0.7540	57	0.7666
96	0.7224	86	0.7320	76	0.7432	66	0.7552	56	0.7680
95	0.7233	85	0.7331	75	0.7444	65	0.7564	55	0.7693
94	0.7242	84	0.7342	74	0.7456	64	0.7576	54	0.7707
93	0.7251	83	0.7353	73	0.7468	63	0.7588	53	0.7721
92	0.7260	82	0.7364	72	0.7480	62	0.7601	52	0.7735
91	0.7270	81	0.7375	71	0.7492	61	0.7614	51	0.7750
90	0.7280	80	0.7386	70	0.7504	60	0.7627	50	0.7764

According to the same author, 100 measures of water dissolve the following measures of ether of the densities stated: 8 meas. ether, sp. gr. 0.719–0.721; 10 meas. ether, sp. gr. 0.724–0.726; 13 meas. ether, sp. gr. 0.729–0.731; 16 meas. ether, sp. gr. 0.733–0.735; 20 meas. ether, sp. gr. 0.738–0.741; 23 meas. ether, sp. gr. 0.743–0.746; 26 meas. ether, sp. gr. 0.748–0.750.

The purity of the officinal ethers is determined by their properties, which must agree with those given above.

Pharmaceutical Uses and Preparations.—Ether, or pure ether, is used as a solvent for the removal of inert matter in preparing Digitalinum, Extract. ergotæ liquidum, Ext. stramonii (*Br.*), and Tinct. opii deodorata (*U. S.*); and as a solvent for obtaining Acid. tannicum and the officinal Oleoresinæ (Extracta ætherea), *U. S.*, *Br.* It is also an ingredient in the different collodions; in Liquor epispasticus (*Br.*); Oleum æthereum (*U. S.*); Spiritus ætheris (*U. S.*, *Br.*); Spir. ætheris compositus, *U. S.*

Physiological Action.—Plants confined in an atmosphere of ethereal vapor lose their irritability, their color, and then their life. Insects are rapidly benumbed, apparently die, and, if the exposure is prolonged, die in reality. In birds and quadrupeds an excited intoxication is followed by oppression of the cerebral functions, anæsthesia with loss of muscular co-ordination, muscular relaxation, and complete insensibility, during which the urine and feces may escape; the capillaries are everywhere distended with blue or venous blood, respiration is suspended, and finally death takes place by arrest of the heart. In this series of phenomena cerebration is first impaired, then anæsthesia precedes loss of motility, and last of all the movements of the respiratory muscles and those of the heart cease. Indeed, Knoll (1876) inferred from his experiments that the toxical effects of ether are never so intense as those of chloroform, and that it is hardly possible to arrest the heart's action by the direct action of this preparation. Among the effects which, in common with chloroform, it produces may be mentioned rigidity of the thoracic muscles, which, however, is slight and transient if it occurs at all; the period of slow respiration is briefer, and that of hurried respiration never so considerable as in the case of chloroform; and while chloroform may arrest respiration abruptly, ether never has that effect, even when its administration is prolonged. Ether diminishes the pressure against the heart, and lessens the labor of that organ, while chloroform has an opposite effect. The real danger of ether, as proved both experimentally and clinically, lies in its embarrassing the respiration (Arloing, 1879). Again, Newman (1880) found that while chloroform in 75 seconds stops the pulmonary circulation and requires 600 Ccm. of air and 720 seconds to restore it, ten times as much ether is required and only 270 seconds to produce the same effect, which can be removed in 180 seconds by 200 Ccm. of air. To the same purport are Ringer's experiments (1881). Comparing sulphuric ether with chloroform and ethidene, he states that "whilst 1 or 2 minims of chloroform or ethidene dichloride rapidly weaken the heart and arrest the ventricle, even 50 minims of anhydrous ether merely accelerate the beats and weaken them a little" (*Practitioner*, xxvii. 13).

When a compound nerve-trunk is etherized in any part of its course, it loses its sensibility at all points beyond that of the application, although it may retain its motor power, but a prolonged application destroys this also. Introduced into the rectum, especially in the form of vapor, ether produces the same phenomena as when given by the stomach or inhaled. The odor and taste of ether impregnate the flesh of animals for several days after they have inhaled it fully, and in the nervous centres is found a deficiency, and in the liver an excess, of fatty elements.

On man the primary impression of ether, even when smelled, is that of an agreeable nervous stimulant. On the skin it excites coolness if allowed to evaporate, but occasions irritation if confined. When swallowed, it creates burning heat in the throat, œsophagus, and stomach, and a rapid intoxication like that of alcohol, but more intense and of shorter duration. When inhaled, pure ether excites at first cough and dyspnœa, and then a pricking of the hands and feet and exhilaration of the spirits, with a peculiar perception of lightness, while the senses all become perverted or blunted: that of touch much less so than the sense of pain, so that severe injuries may be received without their being felt, and brief operations may at this stage be advantageously performed. The muscular system gradually becomes relaxed, while consciousness is growing more perverted or obscured. Meanwhile, the pulse and respiration are generally quickened, the skin becomes warm and moist, and the pupils are contracted, but as complete unconsciousness and anæsthesia supervene, general relaxation is more or less rapidly displayed, the pupils are dilated, the respiration is slow and deep, the pulse infrequent and feeble, the skin cool and moist, and sometimes cyanotic. This state continues only for a few moments after the vapor ceases to be inhaled; consciousness returns almost suddenly, but numbness and weakness remain for some time longer. Dr. Packard has called attention to what he calls the "first insensibility," which is shown by the patient ceasing to repeat a movement he has continued until then to make when directed. This brief insensibility, which lasts from 1 to 3 minutes, may be taken advantage of for the performance of various minor operations, and is not apt to be followed by headache, nausea, etc. It is not accompanied by marked muscular relaxation. Of occasional after-effects of anæsthesia from ether may be mentioned vomiting, congestion of the brain or lungs, various hysterical phenomena, and more rarely epileptiform or tetanoid symptoms, but these effects are exceedingly rare when the ether is pure and skilfully given. The first, vomiting, is less usual than after chloroform. The psychical effects of ether are various: sometimes a pugnacious disposition is developed, sometimes an amorous, and even a lascivious, tendency; and again, an irrepressible tendency to say things which under normal circumstances would have been kept profoundly secret, or to use indecorous and even indecent language. Ether drunkenness, like chloral intoxication, numbers a great many victims, most of whom, but for fanatical notions of temperance, would have become the prey of alcohol. It appears to be less permanently injurious than the more usual and brutal vice; for if some deaths are attributed to it, there are instances of its habitual indulgence without serious injury. In the case of a lad addicted to it the usual doses at last amounted to between 1 and 2 pints daily, without apparently impairing his mind (*Boston Med. and Surg. Jour.*, Sept. 1881, p. 262; *Med. Record*, xxiv. 459).

In appropriate cases and properly administered, we believe pure sulphuric ether to be beyond all comparison the safest of the anæsthetic agents employed in general surgery, and that *when these conditions have been observed* there is not a single authenticated example of its having destroyed life. The practical superiority of ether over chloroform is that in cases appropriate for the anæsthetic use of either agent the pulse always gives warning of danger from ether, but in death by chloroform no such signal can be relied on. In 1880 a committee of the British Medical Association presented a report upon anæsthetics, in which the following statements occur: "The danger with ether approaches from the pulmonary rather than the cardiac side, so that by establishing artificial respiration we have a means of warding off death;" and again: "The advantages which chloroform possesses over ether are more than counterbalanced by its additional dangers." In the rare cases which have proved fatal from ether-inhalation the mode of death was precisely the same as that above described in animals destroyed by it: the lungs have become obstructed or the brain congested, while the sustained pulsation of the heart showed a continued capacity of living. In nearly all such cases where an examination has been made after death it has revealed the existence of disease in the kidneys, brain, lungs, or heart, which, had it been known, would have rendered not only the use of an anæsthetic, but even the performance of a grave surgical operation, inexpedient. (Compare *Phila. Med. Times*, xi. 545, 772; *ibid.*, xii. 740; *Med. News*, xl. 295; *Med. Record*, xxiii. 261; *Bull. de thérap.*, ci. 377; *Boston Med. and Surg. Jour.*, Dec. 1883, pp. 560, 568.) Death by chloroform, on the other hand, is nearly always inexplicable by any peculiar condition of the patient, and is the direct effect of the inherent toxical qualities of the anæsthetic. These considerations have doubtless induced a great many physicians in England, Ireland, France, and Germany, as well as in this country, to substitute ether for chloroform in surgical operations.

Medical Uses.—The inhalation of the vapor of ether has in a great measure supplanted its earlier administration in a liquid form, but the latter should not be neglected. It may be given to alleviate nervous *headache* and the pain of flatulent, renal, and hepatic *colic*, spasmodic *vomiting*, including that of *pregnancy* and sea-sickness, and *asthma*, and to prevent or subdue the paroxysms of *hysteria*. Even puerperal *mania* has been held in check by ethereal enemata. It is occasionally indicated as an adjuvant to alcohol in the *typhoid state* of febrile affections, particularly when some temporary exhaustion calls for a transient but vigorous stimulation. Within the last few years ether has been administered hypodermically as a stimulant in cases of exhaustion from *hæmorrhage* in the *adynamic* state of fevers (*Bull. et Mém. de la Soc. de thérap.*, 1882, p. 127); but it is not quite clear that its administration by the mouth or the rectum would not have been as efficient. In urgent cases the ordinary hypodermic syringeful has been injected, and the operation repeated at intervals of several hours. It would appear that abscesses are very apt to follow this operation. In the treatment of *tape-worm* a full dose of ether to benumb the parasite, so as to facilitate its expulsion by means of castor oil, given directly afterward, is sometimes successful; and so are enemata of ether in destroying *ascarides* of the rectum. Ether has been used for a long time in conjunction with oil of turpentine and also with castor oil with a view of removing *biliary calculi* by dissolving them. The efficacy of the treatment, if real, may depend in part upon the local anæsthetic action of the medicine, but some authorities entitled to respect maintain the reality of its solvent operation also. Whatever view of the mode of action may be entertained, it is certain that ether very frequently removes the symptoms of biliary calculi. The difficulty of digesting cod-liver oil and other forms of fatty food in pulmonary *phthisis* has been supposed to depend upon a deficiency of pancreatic juice and the crude condition in which such food is brought into contact with that secretion. It is claimed that ether, by emulsifying the oil, and also stimulating the stomach and duodenum, and thereby increasing the flow of pancreatic juice, renders the aliment much more assimilable than it would otherwise be. It is also claimed that these views have received the confirmation of experience, and that by the use of ether after taking the food in question it is fully and easily digested, and that the objects of its administration, the increase of the patient's weight and the abatement of the pulmonary symptoms, are secured. The scientific adaptation of the medicine to the purpose in view is very complete, but, like other remedies proposed on similar grounds, and by their proposers regarded as fulfilling their object, this one does not appear to have been found successful. On the contrary, the unpleasant taste of ether, whether given separately or combined with oil, and the offensive eructations to which it gives rise, render a continued use of it difficult, if not impossible, and evidence is wanting to confirm the results at one time attributed to it.

Besides being taken internally, ether in its liquid form is applied externally to produce anæsthesia or by the cold it occasions in evaporating to cause a contraction of the tissues. With the former object it is familiarly used to relieve the pain of neuralgic *headache*, and also when applied over the superficial portions of nerves to palliate *neuralgia*. It affords prompt relief in *toothache* from carious cavities, especially when associated with camphor, and also in *earache* when applied on cotton with oil or in the form of vapor. In some cases of *deafness* due to a rheumatic condition of the auditory canal it is said to have been curative. In irritative congestion of the retina, and *photophobia* generally, a little ether allowed to evaporate from cotton-wool, so placed in the hollow of the hand as to cover the eye at the distance of an inch or two, affords decided relief. The refrigerant action of ether is best shown in some cases of *hernia* strangulated by a mere excess of blood in the tumor; it contracts the tissues, expels the blood, and permits the reduction of the bowel. The *vomiting of pregnancy*, which, as above stated, has sometimes been arrested by the inhalation of ether, is also said to have been subdued "by freezing the pneumogastric nerve under the sterno-mastoid on both sides of the neck alternately" (Lester). A similar application, "first to the epigastrium, and then for 5 minutes on both sides of the throat," is stated to have relieved obstinate *hiccup* (Regoni). It is claimed that ether spray can arrest the development of *malignant pustule* and *carbuncle* (Zimberlin), and also of *tonsillitis* (Coneato).

Ethereal inhalation is employed to produce anæsthesia, and thereby, according to its degree, to relieve pain, relax muscular tension and spasm, or produce unconsciousness. In *surgery* it permits the performance of operations which would without it be inexpedient or impracticable, both by abolishing the sense of pain and preventing the struggles of the patient, and hence it has probably diminished the mortality of grave surgical operations. It has been successfully administered for this purpose while the patient remained asleep (*Jour. Am. Med. Assoc.*, i. 244). Age is no contraindication to its use, but it should rarely be employed when there is disease of the kidneys, lungs, brain, or heart, or when the sensations of the patient are needful to guide the surgeon's hand. Operations upon the fauces and nasal passages involving the flow of blood are embarrassed, and may be rendered dangerous, by anæsthesia; it is unfavorable to success whenever the voluntary muscular action of the patient is required; it is unnecessary when the duration of an operation is short or its severity is insignificant. In general, the severer the operation the less danger of accident is there from inhaling ether; the greater number of cases with alarming symptoms have occurred where the operation was trivial, as in extracting teeth, opening abscesses, etc. In obstetrics the inhalation of ether robs the throes of *labor* of their acutest pain, and hence lessens the exhaustion of the patient; and in tedious and complicated labors, in cases of great tenderness or rigidity of the maternal organs, of unusual susceptibility to pain and great nervous irritability, in labors requiring manual or instrumental interference, and in *puerperal convulsions*, anæsthesia by ether has long been and continues to be a precious remedy. It does not involve any risk of injury either to child or mother if judiciously employed, while, by lessening the rigidity of the os uteri and perineum without impairing the strength of the expulsive efforts, it facilitates and shortens labor. It is the best palliative for *after-pains*. For all of the purposes mentioned, except those which involve operations on the interior of the uterus, it is unnecessary to produce the narcotic degree of anæsthesia. It is proper, however, to observe that during childbirth a degree of anæsthesia, by any of the agents employed, may be produced without danger, which, under other circumstances, and especially in surgical operations, might be attended with risk. This peculiar immunity of the parturient woman is probably due to the high nervous tension which her state involves.

The diseases which call for anæsthesia include all painful and spasmodic affections: *e. g. neuralgia*, *dysmenorrhœa*, *gout in the stomach*, *biliary* and *nephritic colic*, *tetanus*, *hydrophobia*, *chorea*, *hysteria*, puerperal and other reflex *convulsions*, *whooping cough*, *spasmodic croup*, *laryngismus stridulus*, *delirium tremens*, *mania*, etc. In all of these it eliminates one or the other, or both, of the symptoms which tend to exhaust the patient. In some local affections of a painful nature, such as *lumbago*, *sciatica*, and other forms of *neuralgia*, the hypodermic use of ether has been employed with advantage. The dose at first should not usually exceed 10 or 15 minims; subsequently it may be increased.

Local anæsthesia may be produced by projecting upon the skin a stream of atomized pure ether or of ether and chloroform. The former is preferable, from the rapidity of its action and the complete congelation it produces, so that a variety of surgical *opera-*

tions may be performed by its aid without inflicting pain. Among them are not only such minor ones as opening abscesses, the evulsion of nails, the excision of nævi, hæmorrhoids, and other small tumors, and the amputation of fingers, the incision of carbuncles, fistulæ, etc., but this method has also been applied to the removal of large tumors of the skin, breast, etc., to amputations, ovariotomy, Cæsarean section, etc. The latter uses indicate rather the extreme limits of its application than its practical utility. Local anæsthesia of the lumbo-sacral region by ethereal vapor has been used to mitigate the throes of *labor;* of the hypogastric region to arrest uterine hæmorrhage and promote contraction of the uterus; to facilitate the reduction of *hernia* and of *paraphimosis;* to relieve the pain of *neuralgia* by a direct action, and the spasms of *chorea* and other spasmodic affections by its application to the spine. The local use of ether as an anodyne antedates the discovery of anæsthesia by the inhalation of ether.

The hypodermic use of ether has of late (1883) been largely extended. About 1 Ccm. has been generally injected at a time, and the operation repeated as often as necessary. It causes a smarting and burning pain for a short time, but no further ill effects. This method has been found singularly efficient in cases of collapse, however arising, when the patient is unable to swallow; *e. g.* in *cholera*, *typhoid fever*, *pneumonia*, *pulmonary œdema*, *capillary bronchitis*, *infantile and puerperal convulsions*, post-partum and other *hæmorrhages*, the collapse of *opium- and chloral-poisoning*, etc. It is of interest that the ethereal injections nearly always augment the secretion of urine (Zuelzer, *Centralbl. f. d. g. Therapie*, i. 472). *Sebaceous tumors* of the scalp have been successfully treated by injecting into them with a hypodermic syringe from 5 to 10 drops of ether three or four times, at intervals of several days, until the contents of the cyst were liquefied and its walls inflamed, when the dissolved sebaceous matter and the pus were pressed out (*Bull. de thérap.*, cv. 454).

Administration.—The average dose of sulphuric ether is a fluidrachm (Gm. 4). It may be administered upon powdered sugar and rapidly swallowed with a mouthful of water. Smaller doses may be given by incorporating it with syrup or spermaceti, and diluting the mixture with water or mucilage, which should be made cold by ice if possible. It has also been administered in gelatin capsules. Ether should be administered by some one familiar with it, and who will attend to nothing else. It should not be used while the stomach contains food; no alcoholic drink of any kind should be given to the patient before the operation, nor should he be kept under the influence of the anæsthetic longer than is absolutely necessary. According to Mr. Osborn, chloroformist to St. Thomas's Hospital, London, "Valvular disease of the heart, shown by cardiac murmurs, need be no hindrance to the administration of ether, a fatty heart which is not diagnoscible by any auscultatory signs being the form of heart disease which is the most dangerous." Feebleness of pulse also is not a contraindication to the inhalation of ether; indeed, a depressed pulse frequently acquires strength and volume under its influence. It is most conveniently employed by means of a sponge saturated with ether and enclosed in a cone made of a napkin or of coarse paper, large enough to cover the nose and mouth of the patient, and open at the smaller end. Or if the napkin alone be employed, the ether may be poured freely upon its internal surface. The late Dr. Lente held that a capital precept in etherization is to produce anæsthesia as rapidly as possible by overwhelming the patient with as much of the vapor as he can possibly inhale. This method is generally preferred by American surgeons, but Mr. Osborn, above referred to, would apply to all anæsthetics the same law, that the first inhalations of the vapor should be freely diluted with air, for, according to him, large quantities suddenly placed over the patient's mouth and nostrils occasion gasping and struggling for breath. Care must be taken not to allow the contact of flame with the ethereal vapor.

ÆTHER ACETICUS, *U. S., Br., F. Cod., P. G.*—ACETIC ETHER.

Naphtha aceti.—Acetate of ethyl, E.; *Éther acétique*, *Acétate d'éthyle*, Fr.; *Essigäther*, *Essignaphtha*, G.

Formula $C_2H_5C_2H_3O_2$. Molecular weight 88.

Preparation.—Add slowly 32½ fluidounces of sulphuric acid to 32½ fluidounces of rectified spirit; cool, add 40 ounces of acetate of sodium, and distil 45 fluidounces. Digest the distillate 3 days with 6 ounces of well-dried carbonate of potassium; separate the fluid; distil all but about 4 fluidounces. Preserve in a well-closed bottle in a cool place.—*Br.*

For preparing this ether the crystallized sodium acetate is usually dehydrated by exposing it to a temperature gradually increased to about 110° C. (230° F.) until it ceases to lose weight; the water which is thus expelled is nearly 10 per cent. of the weight of the crystallized salt. The remaining operation may be performed in two ways, so that the distillation of the ether may be effected either at once or after some time. If the first is desired, the dry, coarsely-powdered salt is introduced into a retort of sufficient size, which is connected with a good condenser; the alcohol is then added through a funnel-tube inserted in the tubulure, and afterward the sulphuric acid in small quantities. If the latter is added too rapidly, the mixture will become too hot and much alcohol will distil over; should this occur, it is to be returned to the retort. The mixture may then at once be distilled from a water-bath. Or sulphovinic acid may be formed by digesting the mixed sulphuric acid and alcohol in a flask for some time, care being taken to avoid the loss of alcohol; the liquid is then poured upon the sodium acetate contained in the retort; the distillation of acetic ether will commence at once, and should be continued until a dry mass remains behind. This latter process, however, does not appear to be a very desirable one, for W. I. Clark obtained thereby a smaller amount of acetic ether and a greater residuum of secondary products.

A continuous process for its preparation has been devised by J. A. Pabst (1880): 50 Ccm. each of sulphuric acid and strong alcohol are heated in a retort to 140° C. (284° F.), and then a mixture of 1 liter each of 96 per cent. alcohol and 93 per cent. acetic acid is allowed to flow in slowly. At first some ethyl ether comes over; afterward the distillate contains, with considerable uniformity, 85 per cent. of acetic ether. The reaction takes place between 130° and 135° C. (266° and 275° F.). Clark considers this process of no practical value.

Acetic ether was first obtained by Lauraguais (1759) by distilling strong acetic acid with alcohol; the distillate in this case requires to be repeatedly returned into the retort.

The distillate contains, besides acetic ether, water, some alcohol, and acetic acid. To remove the latter, some carbonate of calcium or prepared chalk is added in slight excess and agitated with the liquid until effervescence ceases; acetate of calcium is thus formed, which dissolves in the liquid. Dry chloride of calcium, broken into small pieces and free from alkaline reaction, is now added gradually to prevent the liquid from becoming heated. It will combine with the water, forming a dense solution, which also contains the calcium acetate and nearly all the alcohol of the distillate. After repeated agitation the acetic ether is allowed to separate, when it is removed from the watery liquid and rectified from a clean retort or flask, which is placed in a water-bath kept at a temperature of about 90° C. (194° F.). Clark (1883) ascertained that calcium chloride solution dissolves fully 2 per cent. of its volume of acetic ether; he prefers the removal of water by rectifying the ether over exsiccated sodium acetate.

In the above manipulations sulphovinic acid is first formed (see page 122), 1 molecule of which reacts with 1 molecule of sodium acetate, producing acid sulphate of sodium and acetic ether, according to the equation $C_2H_5HSO_4 + NaC_2H_3O_2 = NaHSO_4 + C_2H_5C_2H_3O_2$ (acetic ether). In Pabst's process the products of the reaction between sulphovinic and acetic acid are sulphuric acid and acetic ether.

The weights of the different ingredients given in the formula of the British Pharmacopœia are very nearly the theoretical proportions. An excess of sodium acetate would cause the distillate to be contaminated with free acetic acid, while an excess of sulphuric acid and alcohol would result in the production of ethyl oxide (ether). Any other acetate in an equivalent proportion may be substituted for the sodium acetate.

In acetic ether the basylous H of acetic acid is replaced by the basylous radical C_2H_5, forming a compound having the above formula.

Properties and Tests.—Acetic ether is a colorless, limpid, volatile liquid having an agreeable, refreshing ethereal and somewhat acetous odor and taste. The pure ether has a density of .9104 at 0° C. (Kopp), and of .8981 at 15° C. (Mendelejeff; water at 4° C.); the densities given by the Pharmacopœias are: .889 to .897 (*U. S.*), .900 to .904 (*P. G.*), and .900 (*Br.*). The density is no evidence of purity, since acetic ether dissolves ether, alcohol, and chloroform in all proportions, and at 15° C. one-twenty-fourth of its volume of water. It is also soluble in water, requiring of that menstruum at 0° C., 8 volumes, and at 15° C., 9 volumes, or 10 parts by weight (Clark), about 10 parts, *Br.*, about 17 parts, *U. S.* It boils between 74° and 76° C. (165° and 168.8° F.), *P. G.*, at 74.5° C. (166° F.), *Br.*, at about 76° C., *U. S.* It is very inflammable, though less so than ether, and burns with a yellowish-white (bluish-yellow, *U. S.*) flame and the odor of acetic acid vapors. It has a neutral reaction to test-paper, but if kept in contact with the air, and particularly in the presence of water, free acetic acid is formed. Solutions of potassa, soda, and other oxides decompose it gradually or rapidly, if heated, into acetic acid and alcohol; but metallic sodium does not act upon acetic ether in the cold, except in the presence of water or alcohol (Wanklyn; Ladenburg). It dissolves a little phosphorus and sulphur, and is a good solvent for volatile and fixed oils, many resins, cantharidin, and other organic compounds.

The *purity* of acetic ether is determined by its neutral reaction, its specific gravity, its volatility without residue, and its behavior to water; when 10 Ccm. of it are agitated with an equal volume of water in a graduated tube, the ethereal layer, after its separation, should not measure less than 9 Ccm.—*U. S.*, *P. G.*

Off. Prep.—Spiritus odoratus, Tinctura ferri acetatis, *U. S.*

Physiological Action and Medical Uses.—According to Dr. H. C. Wood, in pigeons and rabbits it produces perfect unconsciousness, without as much previous struggling as when sulphuric ether is used, and has the advantage over that compound of being less inflammable. On the other hand, its volatility is less. On account of its pungency and agreeable odor and its stimulant and antispasmodic qualities it is used for several of the minor purposes of sulphuric ether, and especially to stimulate the nasal passages in cases of *syncope* and *nervous agitation*. Its vapor may also be inhaled under similar circumstances, and to allay *laryngeal and bronchial irritation* and *nervous cough*. It may be given internally for the relief of *colic* and *flatulence* in the dose of 30 minims (Gm. 2), or, more properly, diluted. Externally, it may be applied in all the cases in which sulphuric ether is appropriate.

ÆTHER FORMICICUS.—Formic Ether.

Æther formicus.—Ether formique, Fr.; *Ameisenäther*, G.

Formula $C_2H_5CHO_2$. Molecular weight 74.

Preparation.—It was first obtained by Bucholz (1782), and is conveniently prepared, according to Kopp, by mixing in a retort 8 parts of dry sodium formiate with 7 parts of alcohol of 88 per cent., and adding 11 parts of strong sulphuric acid. On the addition of the acid enough heat is usually produced to volatilize the ether. The distillate, if acid, is agitated with an equal bulk of water containing lime or magnesia in suspension, and after separation rectified from chloride of calcium.

Properties.—Formic ether is a colorless, thin, inflammable liquid of a strong, agreeable odor somewhat suggesting that of peach-kernels, and a pungent taste. Its density at 17° C. (62.8° F.) is .918; its boiling-point is 55° C. (131° F.). It dissolves in about 9 parts of water, and in all proportions in alcohol, methylic alcohol, ether, fixed and volatile oils.

Physiological Action.—Byasson made experiments with this compound upon dogs, rats, and guinea-pigs. He regarded it as readily undergoing decomposition into alcohol and alkaline formiates through the alkali of the blood. When inhaled, it lowers the temperature as much as 3½° C., induces signs of asphyxia, but not so marked as those caused by chloroform, and causes muscular relaxation and anæsthesia. The effects persist for several hours. Hypodermic injections of Gm. 1–2 in guinea-pigs and rats, and of Gm. 4–6 in dogs, produce a less degree of asphyxia, but more somnolence, lowering of temperature, and a diminution, but not a complete suppression, of sensibility. In man 6 or 8 Gm. occasion no other symptom than drowsiness. The urine contains formic acid.

ÆTHER METHYLICUS.—Methylic Ether.

Oxide of methyl, Hydrate of methylene, E.; *Ether méthylique, Oxyde de méthyl*, Fr.; *Methyläther, Holzäther, Formäther*, G.

Formula $(CH_3)_2O$. Molecular weight 46.

Preparation.—Dumas and Peligot, who discovered this ether in 1835, direct the preparing of it by distilling a mixture of 1 part of methylic alcohol and 4 parts of sulphuric acid, and purifying the gas by prolonged contact with caustic potassa, whereby carbonic and sulphurous acids are removed, and *methyl-sulphuric ether*, which has a garlic-like odor, is decomposed. Kane recommended the purification of the gas by passing it through milk of lime.

Properties.—Methylic ether is a colorless, inflammable gas, heavier than air, of an ethereal odor and aromatic taste. At −36° C. (−32.8° F.) it forms a colorless liquid which boils at −21° C. (−5.8° F.). Water dissolves 35 volumes of the gas, acquiring the odor and taste of the latter, and evolves it again at a moderate heat. It is more soluble in strong sulphuric acid, and still more freely in wood-spirit, alcohol, and ether. A solution in the latter liquid, saturated at 0° C. (32° F.), has been recommended by Dr. B. W. Richardson under the designation of *methylic-ethylic ether.* It should be kept in well-corked bottles in a cool place.

Physiological Action and Medical Uses.—Being gaseous and only feebly held in solution by alcohol, it is more readily absorbed than this liquid into the blood. Its anæsthetic operation is somewhat peculiar. A pigeon under a bell-glass filled with the vapor of methylic ether, or made to inhale it from a kind of respirator, falls into a quiet sleep without agitation or convulsion. Dr. Richardson, experimenting upon himself, observed that there was no preliminary spasm excited by it in the larynx or elsewhere—no rigidity, lividity, or other change of color. The pulse rose to 96; the anæsthesia was perfect, and was not preceded by convulsion or followed by nausea. In some further experiments (upon guinea-pigs) the anæsthesia was carried as far as possible, and the respiration ceased several minutes before the heart stopped. After death the lungs were not congested, but the pulmonary veins and both sides of the heart were filled with fluid blood, which was dark on the left side. In death by bichloride of methylene the blood in the same cavity is light red. The repletion of the heart contrasts with the emptiness of its cavities in death by chloroform. According to Richardson, it is a safe anæsthetic, yet is objectionable because it rapidly volatilizes from its solution, and its odor is more unpleasant than that of ether, chloroform, or bichloride of methylene.

ÆTHYLENI BICHLORIDUM.—BICHLORIDE OF ETHYLENE.

Æthylenum chloratum, Elaylum chloratum, Liquor Hollandicus.—Ethene chloride, Dutch liquid, E.; *Liqueur des Hollandais, Huile du gas oléfiant*, F.; *Æthylenchlorid, Elaylchlorid*, G.

Formula $C_2H_4Cl_2$ or $CH_2Cl.CH_2Cl$. Molecular weight 98.8.

Preparation.—Olefiant gas and Dutch liquid were discovered by Dieman, Troostwyk, Bondt, and Lauwernburgh (1795). The latter is produced on bringing the former in contact with chlorine gas. 1 part of strong alcohol is mixed with 3 or 4 parts of sulphuric acid and sufficient sand to form a thick mixture, which is heated, and the gas passed successively through sulphuric acid, solution of potassa, and sulphuric acid, whereby it is deprived of alcohol, ether, and sulphurous and carbonic acids. The gas thus purified is conducted into a retort containing a mixture of 2 parts of black oxide of manganese, 3 of common salt, 4 of water, and 5 of sulphuric acid. The retort is at first very moderately warmed, and afterward heated until the liquid distils. The distillate is washed with water and rectified over chloride of calcium.

Properties.—It is a colorless, thin, oily liquid, having an ethereal odor resembling that of chloroform, and a sweetish ethereal taste; it has the specific gravity 1.27 at 0° C. (32° F.) or 1.253 at 15° C. (59° F.), boils at 85° C. (185° F.), is sparingly soluble in water and freely soluble in alcohol and ether. It is inflammable, and burns with a yellowish flame having a green border, and giving off vapors containing hydrochloric acid. When agitated with water the latter does not acquire an acid reaction to litmus-paper, and when agitated with sulphuric acid the mixture is not blackened. On being mixed with alcoholic solution of potassa, water and potassium chloride are formed, and gaseous *chlorethylene*, $CH_2.CHCl$, is given off at a moderate temperature; this gas condenses at −18° C. (−.4° F.).

Allied Compounds.—By the action of chlorine upon Dutch liquid a number of chlorinated compounds may be obtained, which are isomeric with the chlorinated compounds produced under similar circumstances from *chloride of ethyl, chlorethane*, or, as it is frequently termed, *muriatic (hydrochloric) ether.*

CHLORIDE OF ETHYL, C_2H_5Cl or $CH_3.CH_2Cl$ (molecular weight 64.4), is obtained by passing dry hydrochloric acid gas into cold strong alcohol, distilling at a very moderate heat, washing the distillate with water and a weak alkaline solution, and rectifying. It is a thin, colorless, inflammable liquid, having an ethereal odor and a sweetish aromatic afterward somewhat alliaceous taste. It dissolves in about 50 parts of water, boils at 12.5° C. (53.6° F.), and at 0° C. (32° F.) has the density .9214. If chlorine, not in excess, acts upon it,

MONOCHLORINATED HYDROCHLORIC ETHER (*ethylidene chloride, ethydene chloride*), $C_2H_4Cl_2$ or $CH_3.CHCl_2$, is produced. It is isomeric with bichloride of ethylene, which it resembles in odor, but its density is only 1.198; it boils at 57.5° C. (135.5° F.), is decomposed by strong sulphuric acid, and when heated with alcoholic solution of potassa distils almost without change.

On continuing the action of chlorine, the following isomeric compounds are obtained from

	Ethyl chloride.	*Ethylene chloride.*
$C_2H_3Cl_3$.	Sp. gr. 1.372; boiling-point 75° C. (167° F.).	Sp. gr. 1.442; boiling-point 115° C. (239° F.).
$C_2H_2Cl_4$.	" 1.530; " " 127.5° C. (261.5° F.).	" 1.576; " " 147° C. (296.6° F.).
C_2HCl_5.	" 1.644; " " 158° C. (316.4° F.).	" 1.663; " " 158° C. (316.4° F.).
C_2Cl_6.	Prisms; fuse at 160° C. (320° F.), boil at 182° C. (360° F.); odor aromatic, camphoraceous.	

Physiological Action and Medical Uses.—When bichloride of ethylene was tested by Simpson, he found that although it was capable of producing anæsthesia without excitement of the pulse or subsequent headache, yet it caused so great irritation of the throat that few persons could persevere in breathing it long enough to induce the anæsthetic state. Other experimenters have reached the same conclusions, but it is generally agreed that the liquid does not tend to induce the dangerous collapse which constitutes the chief objection to chloroform. This conclusion has been fully sustained by the experiments of Dr. Reichert (*Phila. Med. Times*, xi. 492), which prove that death from this agent invariably takes place from failure of the respiration, and not from any direct action upon the heart. In regard to its administration, Dr. Reichert insists that while it does possess irritant properties, and does cause distress when first inhaled, the distress is not much, if any, worse than that caused by the inhalation of ether. As a local anæsthetic this preparation has been applied to the seat of pain in *neuralgia* and other limited painful parts, such as exist in *cancer*, etc. The dose required to produce anæsthesia is about the same as that of chloroform.

Chloride of ethyl, formerly known as muriatic or hydrochloric ether, appears to be almost identical in its primary effects with sulphuric ether, but they are more transient and are less apt to be followed by nausea. Its extreme volatility, however, renders it unmanageable in practice, and even dangerous if used near a flame. It is sometimes dissolved in an equal bulk of alcohol, and dispensed as alcoholic muriatic ether for the same purposes to which Hoffmann's anodyne is applied. It may be given in the dose of from 10 to 30 drops (Gm. 0.60–2.00) in sweetened water or in a little wine or spirit and water.

Ethydene chloride was employed by a committee of the British Medical Association in six experiments. Its odor is agreeable, it produces rapid narcosis without much previous excitement, and its use is rarely followed by nausea and vomiting. It appears to render the pulse more, and then less, frequent. In from 8 to 12 minutes complete anæsthesia and muscular relaxation are produced, the respiration going on regularly but slowly, the pulse being full and slow. There is neither pallor nor blueness of the face. Such results were also obtained by Bird (*Times and Gaz.*, Jan. 1879, p. 62) in patients operated upon for diseases of the eye. The phenomena were those occasioned by a strong stimulant of the heart's action, and the reporter's only apprehension was lest, "if it always proved such a stimulant," the reaction might be excessive. But Ringer declares, without qualification, that "ethydene dichloride affects the ventricle just like chloroform" (*Practitioner*, xxvii. 13). If this declaration refers to degree as well as to kind, it is discordant with the statements just made, and also with the latest results obtained by the committee of the British Association, among which the following are included: vomiting is occasioned by ethydene as well as by chloroform, but is more persistent after chloroform; with both the pulse falls as the respirations increase, but with chloroform the effect is both more frequent and more marked, and chloroform retards the heart-beats more, and oftener produces dicrotism; chloroform and ethydene reduce the blood-pressure in animals, but chloroform more rapidly, irregularly, and to a greater degree; in no single experiment with ethydene was there an absolute cessation of the heart's action or of respiration; as regards comparative danger to life, chloroform stands first, then ethydene, and lastly ether (*Amer. Jour. of Med. Sci.*, Apr. 1881, p. 555). The final judgment of the same committee is, that ethydene is free from the disadvantages of ether and the dangers of chloroform. The use of this anæsthetic by Macphail in minor surgical operations led him to analogous conclusions (*Edin. Med. Jour.*, xxv. 220).

Clinical experience with ethydene has quite reversed the judgment concerning it based almost exclusively upon physiological experiments. Reichert finds a record of about 3000 administrations with a list of 3 deaths, and 4 cases in which the most alarming symptoms ensued In all of these cases, except one of which no details are given, death took place by failure of the heart. He also states that ethydene was abandoned by Snow on account of its danger, and that it is probably more dangerous than chloroform, notwithstanding the views entertained of its physiological action (*Med. News*, xl. 206). As lately as 1883 a death from it occurred in England during a very slight surgical operation (*Phila. Med. Times*, xiii. 420). It is administered by pouring the liquid on a piece of lint placed in a tumbler, which is held over the mouth and nose, or by "Jun-ker's apparatus," employed for inhaling chloroform. From 1 drachm to an ounce (Gm. 4–30) has been employed in several operations.

ÆTHYL BROMIDUM.—Bromide of Ethyl.

Æther hydrobromicus.—*Hydrobromic ether*, E.; *Bromure d'éthyle, Ether hydrobromique* (*bromhydrique*), Fr.; *Bromäthyl, Bromwasserstoffäther*, G.
Formula C_2H_5Br. Molecular weight 108.8.

Preparation.—Serullas (1827), the discoverer of this ether, recommended its preparation by the action of bromine upon alcohol in the presence of phosphorus. Personne (1861) replaced the latter by amorphous phosphorus. Prof. Remington (1877) suggested the following modification of Personne's process: 33 parts by weight of absolute alcohol are introduced into a flask or retort, which is placed in ice; when thoroughly cooled, 6 parts of amorphous phosphorus are added, and afterward 26 parts of bromine dropped in, with the precaution of avoiding too great an elevation of temperature. The mixture is allowed to stand 24 hours, and then distilled; the distillate is washed with water and, if acid, with a little alkali, and finally rectified over chloride of calcium. The residue in the retort is phosphorous acid, or phosphoric acid and phosphorus; the reaction is analogous to that produced in preparing hydriodic ether. Dr. W. H. Greene (1879) found the following process to work satisfactorily: 12 parts of coarsely-powdered potassium bromide, and 11 parts of sulphuric acid diluted with its bulk of water, are heated in a flask; when hydrobromic acid begins to be disengaged, 12 parts of alcohol are allowed to flow in slowly; the distillate requires washing with water and alkaline carbonate before rectification.

Properties.—Bromide of ethyl is a colorless, very volatile liquid of a strong ethereal odor and a sweetish and warm taste. It has the density 1.419 at 15° C. (59° F.), boils at 40.7° C. (105.2° F.), burns with some difficulty with a green, non-sooty flame, is sparingly soluble in water, and dissolves in all proportions in alcohol and ether.

History.—In 1849, Nunnelly not only tested the anæsthetic virtues of this compound upon animals, but used it in various surgical operations, and claimed for it a superiority over chloroform. But the supreme authority of Simpson maintained the use of the latter, and caused the bromide to be forgotten by the medical profession in general. But in 1865, Nunnelly brought the subject before the British Medical Association, and stated that for 1 year he had performed all the operations in the Leeds Eye Infirmary with the assistance of this ether. But he failed to make any impression upon his audience. In 1876, Rabuteau made some experiments upon animals with bromide of ethyl, and in the following year it was used experimentally and clinically by Dr. Turnbull of Philadelphia, when it was taken up by Dr. Levis and others and applied to the graver operations of surgery.

Physiological Action.—*On Animals:* The earliest experiments with bromide of ethyl were made by Nunnelly. He introduced a cat into a jar containing a drachm of the liquid. The animal immediately showed signs of insensibility; the respiration grew slower and then ceased. Its lungs were found collapsed, the pulmonary veins full, the bronchial mucous membrane pale; the right side of the heart and the large veins were distended with blood; the left ventricle was contracted and empty; the vessels of the meninges were filled with blood. This experiment was repeated by Dr. Turnbull with identical effects, except that he found the kidneys very much congested. The lungs were bloodless, and the right side of the heart was "distended with ante-mortem clots." The experiments of Wolff gave essentially the same results. Dr. H. C. Wood also concluded from his experiments that "the bromide of ethyl acts as a cardiac paralysant," and that "its action is more analogous to that of chloroform than of ether, and therefore partakes of the dangerous qualities of the former"—conclusions which were fully corroborated by Reichert, who also proved that it at times acts altogether out of proportion to the dose used (*Amer. Jour. of Med. Sci.*, July, 1881, p. 54). The only dissentient from these conclusions was also a physiological experimenter, who compared the action of this bromide to that of nitrous oxide, from which it really differs *toto cœlo*. More recently, Sidney Ringer found that it "arrests the ventricle, and must, therefore, act on the muscular substance of the heart. . . . Like sulphuric ether, it accelerates its beats" (*Practitioner*, xxvii. 17).

On Man: The taste of this liquid is rather sweet and pleasant, but it is irritating to mucous surfaces. Internally, in doses of from 5 to 30 drops, well diluted, it produces only a slight drowsiness, and, inhaled, it is represented as "the most agreeable and rapid anæsthetic yet brought before the medical profession." Similar virtues were attributed to it by Dr. Levis, to whom its vogue as a surgical anæsthetic was chiefly due. According to Turnbull, its advantages are a rapid elimination by the lungs and an "increase of pulse and respiration." In 1880 he pronounced it safe when used with care, claiming that the heart and respiration are but slightly affected by it unless it is employed in excessive quantities, and that it is rapidly eliminated by the kidneys, as well as by the lungs; he dwelt upon the advantages due to its agreeable odor, its non-inflammability, its slight tendency to cause vomiting or headache, salivation, or bronchial flux, as compared with chloroform or ether, and noted the rapidity with which its effects pass off (*Trans. Amer. Med. Assoc.*, xxxi. 261). It is true that some surgeons, like Prof. Agnew, found it even more liable than chloroform to cause vomiting (*Phila. Med. Times*, x. 372). This tendency was also noted by Terillon, almost the only European physician who seems to have used the compound. Describing its anæsthetic properties, he says that "it causes relaxation rapidly, without asphyxia and without excitement, if largely administered from the first. During the anæsthetic stage, unlike chloroform, it causes suffusion of the face and neck, frequency of the pulse, and dilatation of the pupils; consciousness returns promptly. On the whole, although it seems to require a less careful supervision than chloroform, yet it certainly ought not to be used by unskilful hands" (*Bullet. de thérap.*, xcviii. 402). Terillon expressly states that he witnessed no tendency to suspension of the heart's action, and only apprehended danger from respiratory embarrassment. Some reporters have declared that its action upon the circulation is similar to that of ether, and that it causes increased frequency and strength of the pulse. One assures us that no greater toxic effects are produced upon the system than would result from the administration of ether or alcohol (*Med. Record*, xviii. 67). The frequency of the pulse under its use has also been pointed out by Reeve (*Med. News*, xlii. 317).

Deplorable experience has shown how erroneous were all such judgments. Several cases of death occurred under the administration of this agent so much lauded for its superior safety, and many other cases in which death was certainly imminent. In the fatal cases the result was usually due to syncope, but in one of them did not take place for several days, and then by exhaustion from vomiting. In the cases that did not terminate fatally the phenomena were usually those of cardiac syncope or of obstruction. In one instance pleasant intoxication, excitement, and spasm were followed by sleep, and then by a sudden cessation of the pulse (*Med. Record*, xvii. 554). In another the pulse suddenly failed, the face grew cyanotic, the respiratory movements imperceptible, the eyes upturned and fixed, the jaws locked, and the whole body stiffened (*Phila. Med. Times*, x. 430). In a third case the head was jerked back and spasms affected all the muscles, the breathing was rapid, and the pulse small (*Med. Record*, xvii. 469).

It appears probable that bromide of ethyl may be dangerous in two ways: first, as a compound, and then by its decomposition in the body. In the former of these modes of action it resembles chloroform, and destroys life by arresting the heart. The possibility of the latter operation has been suggested by Dr. Squibb (*Trans. Amer. Med. Assoc.*, xxxi. 285), who pointed out that the danger from anæsthetics is in proportion to the noxiousness of their radicals. Those which are the most readily tolerated are so in proportion to the simplicity and innocuousness of the elements of which they are composed. Bromine is an irritant poison, and bromide of ethyl is very easily decomposed, and its 73 per cent. of bromine, an active irritant, is disseminated through the system. According to Squibb, chloroform, although it contains 89 per cent. of chlorine, does not produce as toxic effects as ethyl bromide, simply because 2 atoms of chlorine are not as poisonous as 1 atom of bromine. The danger from either anæsthetic is by no means passed when consciousness returns; the chlorine in the one case and the bromine in the other remains behind, and may still induce grave and even fatal effects. In some cases the remote phenomena are distinctly those of irritant poisons. In corroboration of the last statement may be quoted Reichert's reference to Nunnelly's experiments with ethylene bibromide and ethyl iodide, in which the animals appeared perfectly well after the experiments, but after some hours perished from blood-poisoning (*Am. Jour. of Med. Sci.*, July, 1881, p. 556).

Uses.—When first introduced, this anæsthetic was cordially welcomed by many surgeons as being more agreeable and prompt than ether and less dangerous than chloroform; and one of its leading but still cautious advocates declared that his "continued experience with it in the *surgery* of a large general hospital and in private practice impressed him with the conviction that it is the best anæsthetic known to the profession" (*Phila. Med. Times*, x. 247). The disasters that followed soon after this and similar declarations seem to have discouraged its advocates and led to its disuse in general surgery. Even in *parturition*, for which it was declared peculiarly adapted, it did not find acceptance, although it continues to be used by some accoucheurs (*Med. News*, xlii. 329); but in *epilepsy*, *hysteria*, and *angina pectoris*, for which it at first was employed, it has almost ceased to be recommended as a remedy. As a local anæsthetic, applied with a hand-atomizer, it was used by Terillon in operations for opening *abscesses*, removing *vegetations*, in *fistula* and in forcible dilatation of the *anus*, flexion of *anchylosed joints*, etc.

Administration.—Bromide of ethyl may be administered in the same manner as sulphuric ether and chloroform. Those most active in promoting its use urged that unless the first portions "were crowded on the patient" it was not apt to act promptly; one also said, "I prefer always to make a rapid and decided impression with the lint and napkin held closely over the nose and mouth of the patient." After it became known that its mode of action, and therefore its dangers, are of the same kind as those of chloroform, such advice would hardly have been given. The quantity used has varied from 1 fluidrachm in short and trivial operations to 11 fluidrachms in an operation of 40 minutes' duration. The same precautions should be used as in the case of other anæsthetics relating to repletion of the stomach, the position of the patient, his breathing deeply, preventing pressure on his neck or chest. Quite as important, if not more so, is it that the surgeon should be certified by a competent physician that the patient is not affected with any organic disease tending to increase his risk. It has happened that, for want of such a precaution, patients have been allowed to take this agent or chloroform while laboring under disease of the brain or lungs or a convulsive disorder. In using it to produce a local anæsthesia the orifice of the atomizer should be large and not nearer than about 3 inches from the skin, and the spray should not be very fine. About 3 minutes are required to produce congelation.

ÆTHYL IODIDUM.—IODIDE OF ETHYL.

Æther hydriodicus, *Hydriodic ether*, E.; *Iodure d'éthyle*, *Ether hydriodique*, Fr.; *Jodäthyl*, *Jodwasserstoffäther*, G.

Formula C_2H_5I. Molecular weight 156.

Preparation.—This compound was prepared by its discoverer, Gay-Lussac (1815), by distilling a mixture of absolute alcohol and concentrated hydriodic acid, and separating the ether from the distillate by means of water. Much better results are obtained by distilling a mixture of alcohol, phosphorus, and iodine, as proposed by Serullas (1827); and the substitution of amorphous for ordinary phosphorus, first used by Personne (1861), affords still greater advantages. Reith and Beilstein (1863) obtained the best results by macerating for 24 hours a mixture of 10 parts of amorphous phosphorus, 50 parts of alcohol, specific gravity .83, and 100 parts of iodine, the latter added in small quantities: the mixture is then distilled, the distillate decolorized by a little solution of soda, and freed from water by rectification over chloride of calcium. The residue in the retort from the first distillation consists of phosphoric acid, the reaction occurring according to the following equation: $5I_2 + P_2 + 10C_2H_6O$ yields $10C_2H_5I + 2H_3PO_4 + 2H_2O$.

Properties.—Iodide of ethyl is a colorless, non-inflammable liquid having a peculiar penetrating odor. It is freely soluble in alcohol, nearly insoluble in water, does not react upon litmus, boils near 72° C. (161.6° F.), and has at 15° C. (59° F.) the specific gravity 1.93. Exposed to air and light, it liberates iodine, and is gradually colored red and brown; the presence of metallic mercury, or preferably silver, prevents the coloration, but not the decomposition. Iodine is also liberated by chlorine gas, nitric acid, and strong sulphuric acid.

Medical Action and Uses.—More than 30 years ago (1849), Nunnelly reported as a result of experiment that three out of four animals were rendered insensible by this preparation, and all of them died. He even declared that, although the animals were not made insensible, the effect of the inhalation was generally fatal. For these reasons, probably, the use of the compound was for a long time suspended, and, as it now appears, unnecessarily. Iodide of ethyl has been used by inhalation to bring the system speedily under the influence of iodine, and especially in chronic *bronchitis* and pulmonary *phthisis*. It doubtless contributes to diminish the bronchial secretions. But its more demonstrable and useful property consists in its rendering the act of breathing deeper and easier, while it exhilarates somewhat, but has no soporific or anæsthetic effect, nor does it depress any of the functions. Of the different forms of *dyspnœa* in which it gives more or less relief, spasmodic *asthma* is the one which it most relieves (Lawrence, *Med. Record*, xvii.

688; xxiii. 58). If the iodine contained in the compound has a share in its action, it is probably a subordinate one. It has been used with benefit in chronic *laryngitis.* 10 or 15 drops (Gm. 0.60–1.00) may be inhaled several times a day from a handkerchief or an appropriate respirator.

AGARICUS ALBUS.—White Agaric.

Fungus laricis, Boletus laricis.—Purging agaric, E.; *Agaric blanc, Agaric purgatif,* Fr.; *Lärchenschwamm,* G.

Polyporus officinalis, *Fries,* s. Boletus laricis, *Jacquin,* s. B. purgans, *Persoon.*

Nat. Ord.—Fungi, Polyporei.

Origin.—This fungus grows on old trunks of the European larch in Central and Southern Europe, and on Larix sibirica, *Ledebour,* in the northern section of Asia, whence it is brought into commerce. It is without a stalk, hoof-shaped or irregularly conical, 4 to 8 inches (10–20 Cm.) broad, 2 to 4 inches (5–10 Cm.) thick, and sometimes 8 to 12 inches (20–30 Cm.) high, externally grayish or yellowish; the hymenium on the lower side is in the form of small yellowish pores. It is collected in autumn and winter, and deprived of the firm outer rind.

Description.—Agaric occurs in commerce in irregular pieces of the size of a fist, and frequently much larger. It is white, light, somewhat spongy, very friable, but not readily pulverizable, has a faint odor and a sweetish afterward acrid and lastingly bitter taste.

Substitution.—We have noticed (1875) a white insipid fungus, mixed with powdered agaric to impart a bitter taste, sold in place of the medicinal drug. The substitute appeared to be a species of Agaricus, with a lamellate hymenium, the greater part of which had been removed. Another occasional substitute, according to Wiggers, is the cap of Polyporus igniarius dusted over with the powder of white agaric.

Constituents.—White agaric has been analyzed by Bucholz (1808), Bouillon-Lagrange, Trommsdorff, and Bley (1834); the boletic acid of the latter, according to Bolley and Dessaignes (1853), is identical with *fumaric acid,* and Braconnot's *fungic acid* was ascertained by them to be a mixture of citric and malic acids. Fumaric acid has also been found in several other fungi. Martius and Will (1846) separated *laricin,* $C_{14}H_{48}O_2$, in the form of a white, amorphous, bitter powder, soluble in alcohol and oil of turpentine and forming a jelly with hot water. Fleury (1870) obtained *agaric acid,* which crystallizes in needles, is freely soluble in strong alcohol, less so in ether, and is almost insoluble in water. On exhausting agaric with boiling alcohol, Masing (1870) observed the separation, on cooling, of a slowly crystallizing fusible body, which dissolves readily in alkalies but is less soluble in alcohol than agaric acid. The same author denies the presence of benzoic acid, observed by Bouillon-Lagrange; by the process of the latter he obtained an amorphous resin. The resins were further examined by Masing (1875); two are sparingly soluble in cold alcohol and crystallizable; one of these is soluble in chloroform, has a faintly bitter taste, and melts at 125° C. (257° F.); the other is sparingly soluble in chloroform, and melts at 90° C. (194° F.). The resin soluble in cold alcohol is a mixture of two resins, brownish-red, intensely bitter and readily soluble in chloroform, glacial acetic acid, benzol, and amylic alcohol. Many fungi contain mannit, others mycose; which of the two is present in agaric has not been ascertained.

Medical Action and Uses.—The ancients used agaric as a purgative in large doses and as an astringent in small doses. In the former way, and owing probably to its resin, it is said to have produced watery stools and colic, with nausea and vomiting in some cases; and in the latter it was employed to check *diarrhœa* and restrain *sweating.* It is for the last-mentioned purposes that it is now occasionally used, as well as to diminish excessive *bronchial secretion.* These three indications are often associated in pulmonary consumption, and it undoubtedly is one of the best palliatives that can be used of the symptoms mentioned. Murrell (*Practitioner,* xxix. 321) traces its use to De Haen in 1767, who learned it from an old woman. From that time it has been employed successfully to check colliquative sweating, and in pulmonary phthisis it also palliates the cough and promotes sleep, perhaps indirectly. It is said also to hasten the drying up of the *milk* in weaning. Agaric may be given in pill, in the dose of 2 or 3 grains (Gm. 0.12–0.20), and repeated hourly or less frequently, according to the urgency of the case. Wolfenden (*Times and Gaz.,* Oct. 1881, p. 442) recommends 20-grain doses of powdered agaric, but owing to its dryness, lightness, and bitterness it is taken with difficulty in this form. Murrell gave pills made of the extract, each pill of 3 grains being equivalent to

9 grains of the powder. A tincture and a fluid extract have also been found efficient. The active principle, agaricine, has been prescribed in doses of one-twelfth of a grain (Gm. 0.005). Prepared agaric is useful as an application to leech-bites and similar wounds to arrest hæmorrhage, and formed into cylinders it serves for moxas.

AGAVE.—AMERICAN ALOE.

Century-plant, E.; *Maguey*, E., Fr.; *Agave*, G.

Agave americana, *Linné*.
Nat. Ord.—Amaryllidaceæ.

Description.—The plant is indigenous to the tropical portion of America, has been introduced and naturalized in Southern Florida, and is frequently met with in cultivation in all parts of the globe, and to some extent naturalized in the warmer portions thereof. The leaves are all radical, curving backward, about 6 feet (5.4 M.) long, thick and fleshy, lanceolate in shape, and at the apex and margins armed with sharp spines. The plant flowers in its native localities usually in about 10 years, but attains a considerable age before flowering in temperate climates, hence the name "century-plant;" the rapidly-growing flowering scape reaches a height of 30 to 40 feet (9–12 M.).

Agave mexicana, *Lamarck*, and A. vivipara, *Linné*, are closely-allied Mexican species.

Uses.—A translucent gum is obtained from it, known as *gum-maguey*, which is partly soluble in water, the solution containing malate of calcium, besides a substance resembling arabin. The fibres of the leaves, known as *pita*, are strong and valuable for cordage. The juice of the plant, *aguamiel*, or honey-water, is saccharine, and is either evaporated to the consistence of honey, or more frequently fermented to yield a vinous acidulous beverage, which in Mexico is called *pulqué*, and by distillation a kind of brandy known as *mezcal* or *aguardiente de maguey*. The roots are regarded as possessing alterative properties. (For papers on the uses of Agave the reader is referred to *Amer. Journ. Pharm.*, 1875, p. 78, and 1876, p. 301.)

Agave virginica, *Linné*, of the Southern United States, produces a scape about 4 or 5 feet (1.2–1.5 M.) high. Its roots are very bitter.

Medical Action and Uses.—The fresh juice of this plant is acidulous or acrid, and is said to be laxative and diuretic. A nearly-allied species furnishes a juice from which, as above stated, the Mexican alcoholic drink *pulqué* is prepared; and in the Southern States of this country a tincture is made from the roots of A. Virginica, and used for the relief of *colic* and as an antidote to the *rattlesnake's bite*. This plant is known as the *rattlesnake's master*.

AGRIMONIA.—AGRIMONY.

Herba agrimoniæ.—*Aigremoine*, *Eupatoire des Grecs*, Fr.; *Odermennig*, *Leberklette*, G.

Agrimonia Eupatoria, *Linné*.
Nat. Ord.—Rosaceæ, Roseæ.

Description.—An herbaceous perennial, about 2 feet (60 Cm.) high, indigenous to Europe and North America, and growing along roadsides and the border of woods. The root is fibrous, several-headed, and brown; the stem almost simple; the leaves about 5 inches (13 Cm.) long below, pinnate, with 4 to 8 pairs of elliptic-oblong, coarsely-toothed leaflets, intermixed with several pairs of minute ones; the stipules semi-cordate, clasping, and coarsely serrate. The yellow flowers are rather small, in slender spicate racemes, and have a persistent top-shaped calyx, which is covered with hooked bristles. The plant is collected while flowering from June to September and deprived of the coarse stems. It has a very faint aromatic odor and a bitterish, mildly astringent taste, which is stronger in the root.

The closely-allied Agr. parviflora, *Aiton*, indigenous to the United States, is distinguished by smaller flowers and by crowded lanceolate leaflets, of which there are 11 to 19 pairs, intermixed with smaller ones.

Constituents.—H. K. Bowman (1869) determined agrimony to contain 4.75 per cent. of tannin; the other constituents are unknown.

Medical Action and Uses.—Common agrimony is astringent and stimulant, and is chiefly employed in popular medicine in gargles for *sore throat*, as a wash for *ulcers* in man and beast, and internally for the cure of *intermittent fever*, *chronic fluxes* of the bowels, bladder, vagina, etc., and for passive *hæmorrhages*. It is said to be used instead of Chinese tea by the peasantry of the north of France. It may be given in an infusion made with from 1 to 4 drachms (Gm. 4–16) in a pint of water. Externally, it may be employed in fomentations, poultices, injections, or gargles, and in the latter form with the addition of honey, vinegar, borax, or chlorate of potassium. According to Nicholson, it is an efficient *tæniacide* when given pounded to a pulp and followed several hours afterward by a dose of jalap, and also an active diuretic and *antiscorbutic* (*Times and Gaz.*, Sept. 1879, p. 367).

AILANTHUS.—Tree of Heaven.

Chinese sumach, E.; *Götterbaum*, G.

Nat. Ord.—Simarubaceæ.

Description.—Three species are medicinally employed, of which two are natives of India, and one, indigenous to China, is much cultivated in the United States and Europe as an ornamental tree. The latter is Ailanthus glandulosa, *Desfontaines*. It is of rapid growth, producing a straight trunk, which is covered with a nearly smooth, brown-gray, internally yellowish, fibrous bark. The leaves are 3 or 4 feet (.9–1.2 M.) long, oddly pinnate, with about 15 pairs of leaflets, which are shortly petiolate, oblong or ovate-lanceolate, with a few teeth near the base. The greenish polygamous flowers are in terminal panicles, and exhale an odor which is disagreeable to many persons. The pistillate flowers produce 3 to 5 linear-oblong, one-seeded samaras. This tree is known in France as *vernis des japon*, which name is also used for Rhus Vernix, *Linné*.

The leaves are the favorite food of the silk-worm, Bombyx cynthia; the barks of the trunk and of the root have been employed medicinally; both have a persistently bitter taste.

Ail. excelsa, *Roxburgh*, is a similar tree, with larger and broader leaflets. The bark, which is used as a tonic and febrifuge in India, is of a reddish or orange color internally, and has a very bitter taste.

Ail. malabarica, *De Candolle*, has obliquely oblong and entire leaflets and obtusely winged fruits. When incised the bark yields a gum-resin which has an aromatic odor and is used as incense in India and medicinally in dysentery.

Constituents.—An analysis by Alonzo Lilly (1861) of the bark of the first species determined the presence of tannin and a trace of volatile oil, besides the widely-distributed vegetable principles; the bitter principle was not isolated. The bark of the second species was analyzed by Marayan Daji (1870), who found the bitter taste to be due to the calcium salt of *ailanthic acid*, which like the lead salt is yellow and soluble in water. The acid is uncrystallizable, freely soluble in water, insoluble in other solvents, of a waxy consistence and reddish-brown color.

Medical Action and Uses.—The infusion, decoction, and tincture of the bark are stated (Daji) to be useful in *anorexia*, *dyspepsia*, and atonic conditions generally of the digestive organs, such as those for which gentian, quassia, etc. are prescribed. The acid is said to provoke the secretion of bile when it is deficient. An infusion of the leaves has been employed in *dysentery*. Ailanthus has been used in the treatment of *tænia* in dogs, and also in man, under the form of a powder of the bark or leaves, and also as a watery or an alcoholic extract of the bark, a resin, and an oleo-resin. It has caused the expulsion of the parasite when given in substance in the dose of 8 grains (Gm. 0.50) or 4 grains (Gm. 0.25) of the watery extract, or 3 grains (Gm. 0.20) of the oleo-resin. The resin alone is nearly inert. The extract occasions slight colic and moderate purging, and does not exhaust or depress like pomegranate or kousso.

ALBUMEN OVI, *Br.*—Egg Albumen.

White of egg, E.; *Blanc d'œuf*, Fr.; *Eiweiss*, G.

The liquid white of the egg of Gallus Bankiva, var. domesticus, *Temminck*. (See Vitellus.)

Medical Uses.—It forms insoluble and inert compounds with corrosive sublimate and sulphate of copper, and is therefore a convenient and efficient antidote in *poisoning* by these substances. Agitated with powdered alum, it coagulates, and thus forms a convenient and very grateful poultice for local *erythemas*, *burns*, *contusions*, *excoriations*, *bites* and *stings* of insects, etc.; and confined in a thin bag, it is a popular and useful application for acute inflammations of the *conjunctiva*. Diluted with water or added to milk, it forms a valuable article of food in the *diarrhœal* complaints of children and adults. It is an appropriate article of food in albuminuria.

ALCOHOL, *U. S.*—ALCOHOL.

Spiritus, P. G.; *Spiritus rectificatus*, Br.; *Spiritus vini rectificatissimus, Alcohol vini.—Rectified spirit*, E.; *Alcool*, Fr.; *Weingeist, Alkohol*, G.

Spirit of the specific gravity 0.820 *U. S.*, 0.838 *Br.*, 0.830 to 0.834 *P. G.* Containing per cent., by weight, of absolute alcohol 91 *U. S.*, 84 *Br.*, 87.2 to 85.6 *P. G.* Containing per cent., by measure, of absolute alcohol 94 *U. S.*, 88.7 *Br.*, 91.2 to 90 *P. G.*

Diluted alcohol has the specific gravity 0.928 *U. S.*, 0.920 *Br.*, 0.892 to 0.896 *P. G.* Contains per cent., by weight, of absolute alcohol 45.5 *U. S.*, 49.2 *Br.*, 61.5 to 59.8 *P. G.* Contains per cent., by volume, of absolute alcohol 53.2 *U. S.*, 57 *Br.*, 69.1 to 67.5 *P. G.*

Formula of absolute alcohol, C_2H_5HO. Molecular weight 46.

Origin.—Alcohol may be obtained synthetically by first preparing acetylene, C_2H_2, by direct union of its elements, converting this into ethene, C_2H_2, and by combination with the elements of water forming alcohol. It has been detected by Dr. Gutzeit (1875) in the juice of a number of plants; Béchamp (1880) proved its presence in the urine and in the muscles of animals, and in putrid meat; and Muentz (1882) showed it to be contained in minute quantities in air, river-water, and cultivated soil. It is extensively prepared by the fermentation of saccharine liquids.

Fermentation.—Although the knowledge of various fermented alcoholic liquids dates back to remote antiquity, alcohol does not appear to have been separated from the spirituous beverages until about the eighth century of the present era, and soon afterward its strength was increased by repeated distillation. Under the name of *fermentation* various processes of decomposition are embraced, apparently depending upon the mere presence of a certain substance or compound, called the *ferment*, which does not enter into chemical composition with the fermenting substance or its products, and is capable of producing a large, if not unlimited, quantity of the latter. The several varieties of fermentation are distinguished from each other by the products obtained. Accordingly, we speak of *saccharine* fermentation when starch is converted into dextrin and sugar by diastase; of *lactic* fermentation when milk-sugar is transformed into lactic acid by casein; of *butyric* fermentation when milk-sugar and lactic acid yield butyric acid in the presence of the same compound; of *mucic* fermentation when cane-sugar is changed into mucus and mannit by protein compounds; of *alcoholic* or *vinous* fermentation when grape-sugar, or fruit-sugar, is split into alcohol and carbonic acid under the influence of yeast; and of *acetic* fermentation when alcohol is oxidized to acetic acid, for which process some investigators consider the appearance of Mycoderma aceti as a ferment necessary. The decomposition of the numerous class of organic compounds known as glucosides by the action of emulsin, myrosin, and similar protein compounds, and the action of ptyalin upon starch, of pancreatin upon fat, and of pepsin upon albumen, etc., are other instances of fermentation induced and completed by the substances named, which are the ferments.

The exact manner in which these ferments act has not yet been determined, and with respect even to the vinous fermentation is still a subject of controversy, notwithstanding the numerous experiments performed with the view of solving the problem. When, in 1810, Gay-Lussac demonstrated that sugar solutions would ferment only in the presence of atmospheric air, the process was regarded as depending upon the action of oxygen. Although the presence of organisms in yeast was afterward demonstrated (see FERMENTUM), their connection with the process itself was not ascertained. Liebig (1839) perfected and enlarged the theory which was advanced by Stahl during the preceding century, and regarded fermentation as a metamorphosis induced by nitrogenized substances in a state of decomposition or putrefaction. Chiefly through Pasteur's investigations, which have been continued since 1858, it is now generally conceded that under ordinary circumstances the ferment of alcoholic fermentation is of vegetable origin, and consists of the so-called yeast-cells or yeast-plant, Saccharomyces (Torula, *Turpin*) cerevisiæ, *Meyen*, the sporules of which are widely diffused in the air, and are thus easily supplied to all liquids capable of vinous fermentation; hence, if these spores are destroyed by boiling the liquid, and if their further supply is arrested by admitting only air which has been filtered or passed through sulphuric acid, vinous fermentation does not take place. Alcohol and the other compounds formed during fermentation are not merely regarded as decomposition-products of sugar, but they result from the growth and multiplication of the yeast-plant, the existence of which depends upon the presence of sugar and protein, and by whose cells the new compounds are generated.

The formation of alcohol from sugar is expressed by the equation $C_6H_{12}O_6$ (grape-sugar) $= 2CO_2 + 2C_2H_6O$ (alcohol); but the process does not appear to be so simple, since small quantities of succinic acid (about 0.6 per cent.), glycerin (3 per cent.), and cellulose (1 per cent.) are always formed, according to Pasteur. Amylic and other homologous alcohols are likewise produced in vinous fermentation.

Berthelot observed that mannit, glycerin, milk-sugar, and other carbohydrates yield alcohol very slowly when in contact with water, chalk, and casein.

Preparation.—Cane-sugar is not directly fermentable until after it has been inverted, either by the action of a ferment or of a diluted acid. (See SACCHARUM.) Nearly all the ordinary alcohol is obtained from starchy substances, such as corn, rye, potatoes, etc., which require to be *mashed*, during which process, by the gluten contained in grain or by the diastase of the malt added with this object in view, the starch is converted into *maltose* (see AMYLUM), and finally completely changed into dextrose, or grape-sugar, when it becomes fermentable. This being accomplished, fermentation will speedily set in on the addition of yeast if the temperature is kept at 22° C. (71.6° F.) or within the limits of 18° and 28° C. (64.4° and 82.4° F.). At a lower temperature fermentation proceeds slowly, and at a higher temperature mucilage and lactic acid are apt to be formed. If too large a quantity of sugar is present, the fermentation will be arrested after some time, in consequence of the destruction of the vitality of the yeast-plant by the alcohol formed. A very favorable proportion is 1 part of sugar to 4 of water. It is obvious that grape-sugar or fruit-sugar, from whatever source obtained, may be used in the manufacture of alcohol.

On subjecting the fermented liquid to distillation a weak spirit is obtained, which requires rectification and contains small quantities of homologous alcohols or ethers, varying with the source from which the spirit has been obtained. *Potato spirit* contains amylic alcohol; *whiskey*, obtained from grain, contains, besides amylic alcohol, some œnanthic and other ethers; *brandy*, the distillate of wine, owes its odor to œnanthic and perhaps propylic and allied ethers; *rum*, from fermented molasses, to butyric ether; and *arrack*, from fermented rice, to an unknown compound. The odor of *gin* is imparted by distilling spirit with juniper-berries; that of the so-called *kirsch*, or *kirschwasser*, by the seeds of cherries or plums added before fermentation: in this case it is due to hydrocyanic acid and oil of bitter almonds.

The *purification* of spirit is effected by percolating it through recently burned and granulated charcoal, by which the fusel oil is retained; this process is called *leaching*, and is most effectually accomplished if the spirit has been previously diluted. Distillation with various chemicals, with the view of destroying the fusel oil, has been suggested, and small quantities of manganates and permanganates have been used with success (manganate of sodium for Atwood's alcohol). A small quantity of nitrate of silver (not more than from 2 to 5 Gm. for 1000 liters of crude spirit) has been recommended for the same purpose; the silver may obviously be recovered without difficulty. Usually, however, the purification and concentration of the spirit are effected in one operation by distilling it and passing the vapors through a series of condensers kept at different temperatures, or through an upright column, in the lower part of which the fusel oil and water are condensed at a temperature at which the alcohol is not liquefied, but this is recovered subsequently in an ordinary condenser. The apparatus is constructed so as to permit an uninterrupted distillation until the water finally has accumulated in the still.

Naudin (1882) has devised a process by means of which the odorous compounds, particularly the aldehyds, are changed into alcohols through nascent hydrogen, generated by electrolysis.

The last traces of foreign odor are difficult to remove by re-rectification, but are said to be completely separated by pure sodium acetate, on distilling the alcohol over about 2 per cent. or less of this salt which has been previously deprived of water by fusion.

ALCOHOL ETHYLICUM, *Br.*—Ethylic alcohol, Absolute alcohol.

The spirit, as obtained by the different processes of distillation, contains water, the first distillate being stronger, the later portions weaker, in alcohol; the strongest spirit obtainable from an ordinary still with a single condenser has the specific gravity 0.825; with a system of condensers alcohol of the density 0.815 to 0.817 is obtainable. The last portions of water can be removed only by treating the alcohol with a substance having great affinity for water, for which purpose chloride of calcium and other deliquescent salts, anhydrous sulphate of copper, burned lime, etc., have been proposed. If chloride of calcium is used, the distillation must be slow and repeated two or three times. Lime is better adapted for the purpose if broken into pieces and digested with the alcohol for a day or two, or boiled with it for an hour, previous to distillation. The distillate, the first part of which is weaker than the subsequent portions, contains lime which has been mechanically carried over, and will be left in the retort if the alcohol is again rectified with the addition of a little tartaric acid. (For some practical observations on the rectification of alcohol by means of lime the reader is referred to the *Amer. Journ. of Pharmacy*, 1872, p. 111, and 1874, p. 184.)

ALCOHOL DILUTUM, *U. S.;* Spiritus tenuior, *Br.;* Spiritus dilutus, s. Spiritus vini rectificatus, *P. G.*—Diluted Alcohol, Proof spirit, *E.;* Alcool dilué, *Fr.;* Verdünnter Spiritus, *G.*

Alcohol 50 parts (11 fluidounces); Distilled Water 50 parts (9 fluidounces), to make 100 parts (nearly 19½ fluidounces). Diluted alcohol of this strength may be prepared from alcohol of any higher percentage by the following rule, in which all terms denote weight: Divide the alcoholic percentage of the alcohol to be diluted by 45.5, and subtract 1 from the quotient. This gives the number of parts of water to be added to 1 part of the alcohol.—*U. S.*

Take of rectified Spirit 5 pints; Distilled Water 3 pints. Mix.—*Br.* Alcohol 7 parts; Distilled Water 3 parts.—*P. G.*

Properties.—Spirit containing 50 per cent. *by volume* of absolute alcohol and water, and having the specific gravity 0.936 at 15.55° C. (60° F.), has been adopted as the standard *proof spirit* of the United States custom-house and internal revenue service. The terms *second proof* (52½ per cent. alcohol, spec. grav. 0.931), *third proof* (55½ per cent., spec. grav. 0.925), and *fourth proof* (58 per cent., spec. grav. 0.920), are at present less frequently used than formerly. The British proof spirit has the specific gravity 0.920 (.9198), and contains 49.24 per cent. *by weight* of absolute alcohol. Spirits stronger than this standard are lighter, and are said to be *over proof;* they are 20 over proof if 100 measures require to be diluted with water to 120 measures to become reduced to proof strength. 100 measures of rectified spirit, sp. gr. .838, when mixed with 60 measures of water yield 156 measures of proof spirit; rectified spirit is therefore said to be 56 per cent. over proof. A spirit which is weaker than the standard is heavier, and is said to be *under proof;* it is 20 under proof if 100 measures require the addition of alcohol sp. gr. .825 (the strongest obtainable by simple distillation) to make 120 measures of proof spirit.

When alcohol is mixed with water an elevation of the temperature is observed, and the mixture assumes for a short time an opalescent appearance from the dissolved air, which is expelled in numerous minute bubbles, after which it becomes perfectly transparent; when it has cooled to the ordinary temperature the volume will be found diminished. This contraction is greatest on mixing 55 measures of absolute alcohol with 45 measures of water, which will yield 96.23 measures of weaker alcohol, showing a loss of volume equal to 3.77 per cent.

The strength of alcoholic liquids is conveniently determined by their specific gravities. A modification of the hydrometer, called the *alcoholometer*, has been constructed by which the percentage strength by volume or by weight may be directly ascertained. As the density increases appreciably with a diminution of temperature, and decreases in about the same ratio with an elevation of temperature, alcoholometers are constructed with reference to a standard temperature, which is either 15° C. or 60° F.; every degree of variation indicates a difference of .36 for the former and .25 for the latter scale, which must be added if the alcohol tested was below, or subtracted if it was above, the standard temperature.

In the United States and Germany the scale of Tralles, and in France that of Gay-Lussac, are in use. Both instruments are practically identical; they sink in distilled water to 0 and in absolute alcohol to 100, each intervening division indicating a volumetric percentum of absolute alcohol. Richter's alcoholometer is essentially that of Tralles combined with a scale indicating also the percentage by weight of absolute alcohol. The alcoholometer employed in the British revenue system is that of Sykes; its stem is divided into 10 parts, but by means of nine accurately adjusted weights which may be attached to the lower part of the instrument the scale is practically very considerably extended; the indications thus obtained are by means of tables converted into the percentage strength over proof or under proof.

In the following table we give the percentage of alcohol by volume and weight for each division of Tralles's scale, together with the specific gravity; also the density indicated by Gay-Lussac's alcoholometer at the corresponding degree. It will be observed that the absolute alcohol of this scale really contains 99.9 per cent. of absolute alcohol—a difference which is too insignificant for all practical purposes; but it should be remembered that the specific gravity for Tralles's scale is given for 15.55° C. (60° F.), compared with water at 3.9° C. (39° F.), while that of Gay-Lussac's scale applies to 15° C. (59° F.) for both alcohol and water:

Per cent. by—		Sp. gravity.		Per cent. by—		Sp. gravity.		Per cent. by—		Sp. gravity.		Per cent. by—		Sp. gravity.	
Weight.	Volume.	Gay-Lussac, 15° C.	Tralles, 60° F.	Weight.	Volume.	Gay-Lussac. 15° C.	Tralles, 60° F.	Weight.	Volume.	Gay-Lussac, 15° C.	Tralles, 60° F.	Weight.	Volume.	Gay-Lussac, 15° C.	Tralles, 60° F.
.80	1	9985	9976	21.30	26	9700	9689	43.47	51	9329	9315	69.05	76	8753	8739
1.60	2	9970	9961	22.14	27	9690	9679	44.42	52	9309	9295	70.18	77	8729	8712
2.40	3	9956	9947	22.99	28	9679	9668	45.36	53	9289	9275	71.31	78	8699	8685
3.20	4	9942	9933	23.84	29	9668	9657	46.32	54	9269	9254	72.45	79	8672	8658
4.00	5	9929	9919	24.69	30	9657	9646	47.29	55	9248	9234	73.59	80	8645	8631
4.81	6	9916	9906	25.55	31	9645	9634	48.26	56	9227	9213	74.74	81	8617	8603
5.62	7	9903	9893	26.41	32	9633	9622	49.23	57	9206	9192	75.91	82	8589	8575
6.43	8	9891	9881	27.27	33	9621	9609	50.21	58	9185	9170	77.09	83	8560	8547
7.24	9	9878	9869	28.13	34	9608	9596	51.20	59	9163	9148	78.29	84	8531	8518
8.04	10	9867	9857	28.99	35	9594	9583	52.20	60	9143	9126	79.50	85	8502	8488
8.87	11	9855	9845	29.86	36	9581	9570	53.20	61	9119	9104	80.71	86	8472	8458
9.69	12	9844	9834	30.74	37	9567	9559	54.21	62	9096	9082	81.94	87	8442	8428
10.51	13	9833	9823	31.62	38	9553	9541	55.21	63	9073	9059	83.19	88	8411	8397
11.33	14	9822	9812	32.50	39	9538	9526	56.22	64	9050	9036	84.46	89	8379	8365
12.15	15	9812	9802	33.39	40	9523	9510	57.20	65	9027	9013	85.75	90	8346	8332
12.98	16	9802	9791	34.28	41	9507	9494	58.27	66	9004	8989	87.00	91	8312	8299
13.80	17	9792	9781	35.18	42	9491	9478	59.32	67	8980	8965	88.37	92	8278	8265
14.63	18	9782	9771	36.08	43	9474	9461	60.38	68	8956	8941	89.71	93	8242	8230
15.46	19	9773	9761	36.99	44	9457	9444	61.42	69	8932	8917	91.07	94	8206	8194
16.28	20	9763	9751	37.90	45	9440	9427	62.50	70	8907	8892	92.46	95	8168	8157
17.11	21	9753	9741	38.82	46	9422	9409	63.58	71	8882	8867	93.89	96	8128	8118
17.95	22	9742	9731	39.74	47	9404	9391	64.66	72	8857	8842	95.34	97	8086	8077
18.78	23	9732	9720	40.66	48	9386	9373	65.74	73	8831	8817	96.84	98	8042	8034
19.62	24	9721	9710	41.59	49	9367	9354	66.83	74	8805	8791	98.39	99	7986	7988
20.41	25	9711	9700	42.52	50	9348	9335	67.93	75	8779	8765	100.00	100	7947	7938

The following table, by Fownes, gives the percentage of absolute alcohol by weight for alcohol of different specific gravities, temperature 15.55° C. (60° F.); upon it is based the table of Hehner, which is published in the U. S. Pharmacopœia 1880, p. 407:

Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.	Per cent. by weight.	Specific gravity.
1	9981	26	9638	51	9160	76	8581
2	9965	27	9623	52	9135	77	8557
3	9947	28	9609	53	9113	78	8533
4	9930	29	9503	54	9090	79	8508
5	9914	30	9578	55	9069	80	8483
6	9898	31	9560	56	9047	81	8459
7	9884	32	9544	57	9025	82	8434
8	9869	33	9528	58	9001	83	8408
9	9855	34	9511	59	8979	84	8382
10	9841	35	9490	60	8956	85	8357
11	9828	36	9470	61	8932	86	8331
12	9815	37	9452	62	8908	87	8305
13	9802	38	9434	63	8886	88	8279
14	9789	39	9416	64	8863	89	8254
15	9778	40	9396	65	8840	90	8228
16	9766	41	9376	66	8816	91	8199
17	9753	42	9356	67	8793	92	8172
18	9741	43	9335	68	8769	93	8145
19	9728	44	9314	69	8745	94	8118
20	9716	45	9292	70	8721	95	8089
21	9704	46	9270	71	8696	96	8061
22	9691	47	9249	72	8672	97	8031
23	9678	48	9228	73	8649	98	8001
24	9665	49	9206	74	8625	99	7969
25	9652	50	9184	75	8603	100	7938

A very useful table for the reduction of alcohol (*U. S. P.*) has been published by Dr. A. B. Lyons in 1882. It gives the *measures* of officinal alcohol and water required for obtaining 100 measures of the mixture at 15.55° C. (60° F.) and the specific gravity of this mixture at the same temperature; incidentally, the table gives also the amount of condensation. We omit the percentage-strength, which is readily ascertained from the preceding tables:

Sp. gravity of mixture.	For 100 measures use Alcohol, *U. S. P.*	Water.	Sp. gravity of mixture.	For 100 measures use Alcohol, *U. S. P.*	Water.	Sp. gravity of mixture.	For 100 measures use Alcohol, *U. S. P.*	Water.
.9986	1.	99.04	.9623	35.	67.51	.9052	68.	34.72
.9972	2.	98.08	.9610	36.	66.56	.9030	69.	33.68
.9958	3.	97.12	.9597	37.	65.61	.9009	70.	32.65
.9945	4.	96.17	.9585	38.	64.67	.8986	71.	31.60
.9933	5.	95.23	.9572	39.	63.72	.8963	72.	30.55
.9920	6.	94.28	.9559	40.	62.77	.8941	73.	29.51
.9908	7.	93.34	.9545	41.	61.81	.8818	74.	28.46
.9897	8.	92.41	.9531	42.	60.84	.8895	75.	27.40
.9884	9.	91.46	.9516	43.	59.87	.8871	76.	26.34
.9874	10.	90.54	.9501	44.	58.90	.8847	77.	25.28
.9863	11.	89.61	.9486	45.	57.93	.8822	78.	24.21
.9852	12.	88.67	.9470	46.	56.95	.8799	79.	23.18
.9842	13.	87.75	.9454	47.	55.97	.8774	80.	22.09
.9832	14.	86.82	.9438	48.	54.99	.8749	81.	21.02
.9821	15.	85.90	.9421	49.	54.00	.8724	82.	19.95
.9811	16.	84.98	.9404	50.	53.01	.8699	83.	18.88
.9802	17.	84.05	.9387	51.	52.02	.8673	84.	17.79
.9793	18.	83.16	.9369	52.	51.02	.8648	85.	16.73
.9784	19.	82.25	.9351	53.	50.02	.8622	86.	15.65
.9775	20.	81.34	.9333	54.	49.02	.8597	87.	14.58
.9766	21.	80.43	.9315	55.	48.02	.8570	88.	13.49
.9756	22.	79.51	.9296	56.	47.01	.8542	89.	12.39
.9746	23.	78.59	.9277	57.	46.00	.8513	90.	11.28
.9736	24.	77.67	.9258	58.	44.99	.8486	91.	10.19
.9726	25.	76.74	.9239	59.	43.97	.8455	92.	9.05
.9717	26.	75.83	.9219	60.	42.95	.8429	93.	7.97
.9707	27.	74.91	.9199	61.	41.93	.8400	94.	6.83
.9697	28.	73.99	.9179	62.	40.91	.8368	95.	5.72
.9687	29.	73.07	.9158	63.	39.88	.8338	96.	4.60
.9677	30.	72.15	.9138	64.	38.86	.8306	97.	3.46
.9666	31.	71.22	.9117	65.	37.83	.8274	98.	2.32
.9656	32.	70.30	.9095	66.	36.79	.8240	99.	1.16
.9645	33.	69.37	.9073	67.	35.75	.8206	100.	0.00
.9634	34.	68.44						

1. Absolute Alcohol.—This is a colorless, limpid liquid, which does not congeal, but acquires an oily consistence when cooled to —90° C. (—130° F.). It has a refreshing odor and a very pungent taste, a burning impression being produced upon the palate by the union with water, for which it has great avidity. Its specific gravity at 15.55° C. (60° F.) is 0.7938, and it boils at 78.3° C. (174° F.) (Mendelejeff). It has a neutral reaction to test-paper, and does not cause anhydrous sulphate of copper to assume a blue color when left in contact with it (absence of water). It dissolves iodine, bromine, a little phosphorus and sulphur, the alkalies and alkaline earths, the chlorides, iodides, and nitrates of many metals, many organic acids, and nearly all alkaloids, resins, volatile oils, camphor, and fixed oils. With water and ether it unites in all proportions without becoming turbid. It is entirely volatilized by heat, is readily inflammable, and burns with a non-luminous blue flame and without smoke, yielding carbonic acid gas and water. Commercial absolute alcohol generally contains a minute quantity of water, to detect which Debrunner (1879) proposed crystallized permanganate of potassium, which he found to be totally insoluble in anhydrous alcohol, but to impart a red tinge to it in the presence of .05 per cent. of water. Ethylic alcohol, *Br.*, should have the spec. grav. .797 to .800.

2. Alcohol of the present Pharmacopœia is the *Stronger alcohol* of the Pharmacopœia of 1870. It has all the properties of absolute alcohol except the specific gravity, which is .820 at 15.6° C. (60° F.) and .812 at 25° C. (77° F.), and it contains 9 per cent. by weight of water, the presence of which is shown by the tests mentioned above. Castor oil is freely soluble in it, but most of the other fixed oils dissolve only to a limited extent. It boils at 78.2° C. (172.4° F.).

Alcohol *Br.* has the density .838, and dissolves a smaller quantity of castor oil, oil of turpentine, various resins, and other compounds than the preceding.

For use in the arts and for various laboratory purposes *methylated spirit* is not subject to taxation in Great Britain. It is a mixture of 90 per cent. of alcohol and 10 per cent. of wood-spirit or methylic alcohol, which addition renders it unfit for internal administration.

3. Diluted alcohol of the different Pharmacopœias varies in density between .892

(*P. G.*), .920 (*Br.*), and .928 (*U. S.*). Its solvent powers for iodine, most of the alkaloids, the volatile oils, resins, and fixed oils are inferior to those of alcohol. Its freedom from impurities is ascertained in the same manner as for a stronger spirit; its boiling-point is 82° C. (179.6° F.).

The French Codex gives for every preparation the volumetric strength of the alcohol to be employed.

Composition.—Alcohol has the empirical formula C_2H_6O, and is the hydrate of the univalent radical *ethyl*, C_2H_5; its rational formula is therefore C_2H_5HO. It is the most common, and may be regarded as the type, of a homologous series of alcohols which are distinguished by prefixing the name of the radical contained in them; hence, *ethylic* or *ethyl alcohol* for the alcohol under consideration. Under the influence of oxidizing agents the alcohols first part with 2 atoms of hydrogen, being converted into *aldehyds*, and by combining afterward with 1 atom of oxygen are converted into a monobasic acid—in this case *acetic acid*. The ethers derived from these alcohols contain 1 molecule of the radical in place of the single atom of hydrogen in the above formula; the following will explain this relation:

Ethyl.	Ethyl oxide (ether).	Ethyl hydrate (alcohol).	Aldehyd.	Acid (acetic).
C_2H_5	$(C_2H_5)_2O$	C_2H_5HO	C_2H_4O	$C_2H_4O_2$.

Tests.—The purity of the different officinal alcohols is determined by their odor, specific gravity, miscibility with water, complete volatility, neutral reaction, and their behavior to nitrate of silver. If a portion of at least 50 Ccm. be evaporated to dryness in a glass vessel, no residue or color should appear. If mixed with its own volume of water and one-fifth its volume of glycerin, a piece of blotting-paper, on being wet with the mixture, after the vapor of alcohol has wholly disappeared should give no irritating or foreign odor (fusel oil). And if a portion be evaporated to one-fifth its volume, the residue should not turn reddish upon the addition of an equal volume of sulphuric acid (amyl alcohol). When treated in a test-tube with an equal volume of solution of potassa there should not be an immediate darkening of the liquid (methyl alcohol, aldehyd, and oak tannin). If a portion of about 150 Ccm. be digested for an hour with 20 Gm. of carbonate of lead and filtered, the filtrate then distilled from a water-bath, and the first 20 Ccm. of the distillate treated with 1 Ccm. of test solution of permanganate of potassium, the color should not disappear within 1 or 2 minutes (absence of methyl alcohol). If 20 Ccm. are shaken in a glass-stoppered vial, previously well rinsed with the same alcohol, with 2 Ccm. of test solution of nitrate of silver, the mixture should not be rendered more than faintly opalescent during 1 day's exposure to direct sunlight (absence of more than traces of foreign organic matters, fusel oil, etc.).—*U. S.*

Potassium permanganate is also readily decolorized by aldehyd and many other organic compounds. Fusel oil is readily detected by adding 10 drops of potassa solution to 50 Gm. of the alcohol, evaporating in a water-bath to about 5 Gm., and acidulating with sulphuric acid, when the odor of fusel oil will be plainly observed. Marquardt (1882) proposed to dilute the alcohol to about .980, agitate with pure chloroform, and evaporate the chloroformic solution spontaneously, when the residue, treated with oxidizing agents, will give the odor of valerianic acid; by combining this with baryta the fusel oil may be determined quantitatively.

Pharmaceutical Uses and Preparation.—Alcohol is employed on account of its solvent properties in the manufacture of alkaloids and other proximate principles, of resins, numerous extracts, some plasters and chemicals, and is a permanent ingredient of all tinctures, spirits, most fluid extracts, some mixtures, liniments, solutions, a few infusions, syrups, wines, etc.

Physiological Action.—Alcohol applied to the roots or the stems of plants destroys their life. It is poisonous to every animal, producing local or general anæsthesia according to the mode of its employment. Applied to the trunk of a nerve, it paralyzes all of its branches, and to the brain, it impairs sensation and voluntary motion. Injected into the veins in a concentrated state, it coagulates the blood, and diluted it causes intoxication. The latter effect is seen in all animals that have taken alcohol into the stomach, and, according to the dose, it produces excitement, stupor, or death. Leven found that while excessive doses of alcohol given to dogs arrested digestion and inflamed the stomach, moderate portions of it exerted a "powerful digestive action" (*Times and Gaz.*, Feb. 1880, p. 245). After death the stomach is more or less injected, the vessels of the brain are congested, and those of the portal system have been found to contain alcohol. The gastric and the intestinal mucous membranes are injected and softened, and so is the tissue of the liver, which organ is also enlarged. The lungs, heart, and kidneys are loaded with dark blood. When animals are kept for a long time intoxicated they present the same characteristics as human drunkards. The chief difference is, that after a short experience their instinct impels them to refuse the poison which the intelligence of man does not prevent his craving although it destroy him.

In man the local action of alcohol produces cold if the liquid can evaporate, but irritation if it cannot escape. Applied to a raw surface, it excites a severe smarting pain and coagulates the blood. Taken internally in small quantities appropriately diluted, it excites a sense of warmth in the stomach, and, if the person is very susceptible, an almost instantaneous glow throughout the body, flushing of the skin, with increased frequency and force of the heart and pulse, a livelier flow of ideas, which are, according to the temperament of the individual, gay or gloomy, and disposes to actions which in like manner may be playful or malevolent. In larger and intoxicating doses alcohol occasions such symptoms for a short time, but speedily induces a state of impaired perception and motor power, which is followed by one of total insensibility and unconsciousness, in which the phenomena are those of congestion of the brain and usually of the whole capillary vascular system, although the latter sometimes gives way to coldness and pallor. In this condition death has frequently occurred after an excessive draught of distilled liquor. Some of these phenomena appear to be due to a paralysis of the capillaries which favors the venous congestion of the brain, lungs, and other organs, and some to the direct poisonous action of the alcohol on the nerve-centres. After death the blood in some cases has furnished alcohol or some of its derivatives, aldehyd particularly, by distillation (*Boston Med. and Surg. Jour.*, Sept. 1880, p. 223). In two cases, occurring the one in Germany and the other in this country, the victims were about five years old: the one swallowed half a tumblerful of brandy, the other of whiskey; both had convulsions with opisthotonos, and one died in 12 and the other in 18 hours. The insensibility to pain of drunken persons is well known. We recall the case of a man who was brought into the hospital during an exciting political election in a state of intense alcoholic excitement. He had a fracture of the arm about the upper third, and yet he whirled this limb violently around his head, hurrahing for his favorite candidate, without the slightest expression of pain. He made an excellent recovery. Habitual excesses, according to the form and quantity of the alcohol consumed, tend to increase fat and diminish muscular tissue, and to render the capillary blood-vessels everywhere turgid, giving to the skin, especially of the face, a puffy and purplish look. The digestion becomes impaired, the nervous system unsteady, the gait loses its elasticity, the hands grow tremulous, the senses dull, and the mind torpid; the sleep is broken, dreamy, and unrefreshing. After unusual excesses delirium tremens is apt to occur, and habitual drunkenness, sooner or later, in many cases induces a state of chronic imbecility, with partial paralysis. Fatty heart, cirrhosed liver, and granular kidneys are frequently associated lesions, producing fatal dropsy, especially if distilled liquors have been employed, while gout is a more usual result of intemperance in wine.

Experiments and observations made to determine the mode of action of alcohol in the economy have too generally referred to excessive doses rather than to such as are employed in dietetics and in medicine. Hence a dispute has arisen whether alcohol raises or depresses the animal temperature, when it is of daily experience that moderate doses augment the heat and excessive doses diminish it. In febrile disease it is quite possible that the dose which in health would have been excessive, and even destructive of life, may, by limiting heat-production, tend to preserve the tissues upon which life depends. If, as is altogether probable, this effect is due to a power in alcohol of stimulating the exhausted nervous system, and thereby exciting the distended capillary blood-vessels to contract, it is evident that less blood will reach the tissues, that less heat will be developed, and less waste of tissue result. This diminished waste is represented by the smaller amount of carbonic acid exhaled from the lungs and of urea secreted by the kidneys. The special effect of alcohol in a given case depends upon its dose and upon the time during which it has been operating. The primary effect may be stimulating, and be indicated by an increased activity of cerebration; it corresponds to the turgescence and throbbing noted by Dr. M. P. Jacobi in her experiments in a case of exposed brain; but the secondary effect is the very opposite of this, and is accompanied by passive venous congestion. It is probable that alcohol reduces febrile temperature partly by lessening the oxidizing power of the red corpuscles. The use of alcohol in every age and by every nation in the world demonstrates that it satisfies a natural instinct, that it literally refreshes the system exhausted by physical or mental labor, and that it not only quickens the appetite for food and aids in its digestion, but that it spares the digestive organs by limiting the amount of solid food which would otherwise be required. But in accomplishing this salutary end it does not act as a mere condiment. It is also food—in this sense at least, that it offers itself in the blood as a substitute for the tissues which would otherwise be destroyed. "Alcohol," says Moleschott, "is the savings bank of the tissues. He who eats little and drinks alcohol in moderation retains as much in his blood and tissues as he who eats more and drinks no alcohol." It is certain that of any amount of alcohol ingested not in excess of what the system requires only a minute fraction can be recovered from any of the secretions; the remainder undergoes metamorphosis and is eliminated in a new form. The notion that alcohol is unassimilable, and is chiefly eliminated through the lungs, rested upon the familiar fact that all alcoholic beverages contain ethereal elements which are so eliminated, and thus infect the breath. But it results from the careful observations and experiments of Anstie, Binz, and others that alcohol is not exhaled by the lungs or skin or excreted with the urine unless the body be supersaturated with it. In that case it may be found in the blood, in exhaled serum, etc. According to some experimenters, a portion of alcohol in the blood is transformed into acetic acid, which forms acetates that are subsequently decomposed into water and carbonic acid. The doctrine that alcohol is food is probably true, not only indirectly by preventing tissue-waste, but in the more literal sense of its favoring the formation of fatty products, especially by increasing the amount of adipose tissue, and in a morbid sense by tending to produce fatty liver and kidney, gall-stones, and atheroma. All of these conclusions have been so amply confirmed by a continuous succession of observers and experimenters as to leave no doubt of their correctness.

Medical Uses.—In the form of wine or distilled spirits alcohol is the universal and familiar remedy for *debility* of every kind, whether it be due to exhaustion produced by *shock*, *fatigue*, or *prolonged sickness*, or shown by *syncope* arising from a nervously feeble or an exhausted heart, to wasting chronic disease, or to the tissue-destruction of acute febrile affections. In *typhus fever* and the *typhoid state* of numerous diseases, including *pyæmia*, the usefulness and appropriateness of the medicine are demonstrated, not only by its diminishing the frequency and increasing the strength of the pulse, and by the decline of the symptoms which denote capillary stasis, but also by the very large quantities of it which may be taken without producing intoxicating effects. This tolerance may be added to the facts already stated to confirm the doctrine that alcohol is consumed in the body and subserves the purposes of food. The special conditions which call for the use of alcohol, and without which, or some of which, it is apt to be injurious rather than useful, are the following: constitutional *debility*, and especially that which is due to advanced life; a compressible, slow, or irregular *pulse*, with a feeble impulse and first sound of the *heart;* a tendency to *syncope;* a sluggish capillary circulation and a *dry tongue;* wandering *delirium*, *stupor*, *tremor*, or *subsultus*, and involuntary dejections. In the fevers above mentioned there are both loss of power and nervous disorder (adynamia and ataxia); in some other diseases there is adynamia alone, or, as it is more specifically termed, asthenia—diseases in which the spinal nervous system appears exhausted, and debility and even paralysis of the muscles, both voluntary and involuntary, may occur. These accidents happen in the fevers already mentioned, and also, but less frequently, in the *eruptive fevers*, in *relapsing fever*, and in *diphtheria*, in all of which the first threatening of their approach should be met with alcoholic and other stimulants. It should always, in acute febrile disease, be administered in divided doses and its effect upon the symptoms noted. If it moderates such as have been enumerated, it may be regarded as useful, and may be continued in doses varied by its effects. The essential point in its administration is that it shall never be allowed to produce intoxication, even by abnormally exciting, and still less by stupefying. It is absolutely contraindicated in febrile diseases with scanty and albuminous urine of low specific gravity.

The same rule should govern the use of alcohol in *pulmonary consumption.* If it improves digestion, increases the weight and strength, reduces the fever, and lessens the cough, expectoration, and sweating, it may be regarded as exerting its most favorable influence. But, unfortunately, these salutary effects cannot be confidently anticipated; too often it increases fever, diminishes appetite, and impairs digestion. Two conditions appear to be essential to its utility: first, that the phthisis shall be primary and chronic, and not the consequence of a previous pleurisy or lobar pneumonia; and secondly, that the patient shall use muscular exercise in the open air proportioned to his strength. Under these circumstances it is the best adjuvant of cod-liver oil, which, indeed, so far as alcohol is a nutrient, it resembles in its mode of action. In *delirium tremens* alcohol in the form of malt liquor, wine, or distilled liquor is a direct antidote to this peculiar effect of intemperance. As the morning dram steadies the tremulous hand and tottering gait of the sot, so alcohol reduces to co-ordination the distracted ideas, perceptions, and movements of the victim of delirium tremens, and the more certainly, speedily, and with a smaller dose in proportion as it is aided in its operation by physical fatigue produced by walking. It must not be forgotten that this delirium is usually the result of an abrupt cessation of the habit of drinking, either by the stomach giving out or by some suddenly depressing influence, such as a surgical injury. In poisoning by venomous *serpents* and by *narcotics* alcohol is often used to sustain life until the elimination of the poison has been accomplished. In some cases of the former kind very large doses of alcohol have been tolerated—whether owing to the poison itself or the patient's excitement may be questioned. The full effects of this liquid have proved sufficient for the cure of *traumatic tetanus;* its slightly stimulant action, on the other hand, has been resorted to for preventing *epileptiform* attacks, and by the same mechanism doubtless it prevents, and even arrests, reflex *convulsions*, such as occur during *dentition*, the *vomiting of pregnancy*, and the paroxysms of *neuralgia*, when thus administered in small doses.

As an external application alcohol, either in its natural or its distilled form, has always been used as a dressing for *wounds*. The ancient use of oil and wine for this purpose is well known. In the seventeenth and eighteenth centuries alcohol was applied as a dressing to incised and other clean wounds, and also to those attacked with gangrene. Recent observations attest its excellence in arresting hæmorrhage, coagulating the albumen of exuded plasma, preventing the putrefaction of discharges, and promoting cicatrization. In 1870, Dr. Blair, a Scottish physician, published an account of the use of strong whiskey as a popular dressing for wounds among his countrymen, and of his having then recently seen it employed in the Parisian hospitals (*Glasgow Med. Jour.*, ii. 204). From 1872, Perrin employed alcoholic dressings, and proclaimed their superiority in compound and comminuted fractures, especially when complicated with contusion of the soft parts, also in wounds of whatever kind which tended to putrefaction, and held them to be more efficient, as well as more convenient, than carbolic-acid dressings. He found that alcohol protected such injuries from gangrene, excessive suppuration, and usually from erysipelas, while they rapidly acquired a healthy aspect and the traumatic fever accompanying them was slight. He gave the preference to alcohol over all other applications as a dressing for surgical wounds, including amputations (*Bull. de thérap.*, xcvi. 308). In 1874, and again in 1880 and 1882, the whiskey dressing was highly recommended by Snesserott (*Phila. Med. Times*, ii. 774; xi. 138; xii. 872); and in 1882, Gosselin used diluted alcohol to promote the cure of abscesses. Having been opened by a small incision, they were evacuated as far as possible, and washed out with alcohol, and also dressed with it. The purulent discharge rapidly became serous, the abscess contracted, and healed more rapidly than by any other method (*Times and Gaz.*, March, 1882, p. 311). In dressing wounds, after removing foreign substances and clotted blood, the part is bathed with the alcoholic liquid and covered with compresses saturated with the same and protected by some impermeable covering. It should be kept moist with the liquor for several days, during which it should, if possible, remain undisturbed. Afterward the dressing may be changed daily or less frequently, according to circumstances. It is an efficient dressing for atonic *ulcers* and *gangrenous* lesions, tends to prevent and heal fissure of the *nipples* and excoriation of the *feet* by walking, and is the best of all applications to recent *bruises* and *sprains* and superficial inflammations, and as a vehicle for other agents fitted for this purpose and for stimulating *paralyzed limbs.* Alcohol has been used to remove *polypi* of the nostrils and of the middle and external ear. It does so by abstracting the water of which they largely consist and coagulating their albumen. In the case of the ear the auditory canal should be filled with the liquid two or three times a day, allowing it to remain in place from 5 to 15 minutes. It has been injected into angiomatous and other soft tumors to cure them by hardening them (*Virch. Arch.*, lxxxv. 172). The anæsthetic power of alcohol has long been known, as exhibited by the greater or less insensibility of intoxicated persons who meet with accident, and of women who unconsciously give birth to children while drunk. It was even employed to diminish the shock of *surgical operations* and to facilitate the reduction of *dislocations*. It was formerly the custom before operations to administer a draught of alcohol and laudanum; and even since the introduction of anæsthetics it has often been found that their depressing effects are in this manner prevented, while their soporific action is more decided and occurs more promptly (Mason, *Jour. of Inebriety*, Oct. 1882).

In the treatment of alcoholic poisoning the stomach should first be emptied by means of a mustard emetic, administered by the stomach-pump if necessary. Cold water may be dashed against the breast and spine and applied to the head, while various mechanical expedients are employed to keep the patient awake. In some cases, even of dead-drunkenness, a few drops of water of ammonia instilled into the throat or held under the patient's nostrils will suffice to dissipate the stupor.

ALCOHOL AMYLICUM, *Br.*—AMYLIC ALCOHOL.

Fusel oil, Amyl alcohol, Pentyl alcohol, E.; *Alcool amylique, Huile de grain,* Fr.; *Amylalkohol, Fuselöl,* G.

Formula $C_5H_{11}HO$. Molecular weight 88.

A peculiar alcohol obtained from fermented grain or potatoes by continuing the process of distillation after the ordinary spirit has ceased to come over.

Preparation.—During the alcoholic fermentation of grain and potatoes some amylic alcohol is produced, the great bulk of which passes over with the last portions of the first distillation, which are milky, and contain besides amylic some ethylic alcohol and water, and variable quantities of propyl alcohol, isobutyl alcohol, and other compounds, differing with the source of the fusel oil. The portion remaining in solution with the distilled spirit is obtained in purifying the latter, either by the process of distillation or leaching. (See ALCOHOL.) Commercial amylic alcohol contains variable quantities (between 20 and 30 per cent.) of ordinary (ethylic) alcohol, of which it cannot readily be completely deprived by fractional distillation and washing with water. Distillation over chloride of calcium, after previous washing with water, removes most of this alcohol, a portion of which will, however, again pass over with the distillate. An effectual and economical method has been proposed by B. Hirsch (1861), who advises crude amylic alcohol to be repeatedly agitated with concentrated aqueous solutions of table-salt until a diminution of its volume is no longer noticed; it still contains a little alcohol, from which it is freed by distilling it with three or four times its volume of water.

Properties and Tests.—It is a colorless, thin, oily liquid, having a penetrating and oppressive odor and a burning, acrid taste. It congeals at —25° C. (—13° F.), crystallizing in laminæ, and has no effect on polarized light when pure. It boils at 132° C. (269.6° F.), and evaporates without leaving any residue. Its specific gravity is 0.818. It is very sparingly soluble in water, to which it imparts its odor and taste. It unites in all proportions with alcohol, ether, glacial acetic acid, benzol, petroleum benzin, fixed and volatile oils. It dissolves iodine freely, a little phosphorus, camphor, many resins, and most alkaloids, yielding the latter again, on agitation, to water acidulated with sulphuric acid. In contact with sulphuric acid it acquires a deep-red color, and reacts violently with concentrated nitric acid. Exposed to air in contact with platinum-black, it is slowly oxidized, yielding valerianic acid. It takes fire with difficulty unless heated to about 55° C. (131° F.), when it burns with a bright flame. As met with in commerce, it contains variable quantities, sometimes 12 per cent., of *active amyl alcohol*, which has the same elementary composition, but turns polarized light to the left and boils at 127° C. (260.6° F.); its amyl sulphate of barium is much more soluble in water than the corresponding salt obtained from inactive amyl alcohol. In addition to this, five other amyl alcohols have been prepared artificially, varying in their boiling-points between 97° and 137° C. (206.6° and 278.6° F.).

The *purity* of amyl alcohol is ascertained by its specific gravity, its boiling-point, its volatility without residue, and by its not diminishing in volume when agitated with an equal bulk of solution of calcium or sodium chloride.

Composition.—Amyl alcohol is *amyl hydrate*, $C_5H_{11}HO$, and yields a series of compounds homologous with those of ethyl alcohol—namely, amyl ether, $(C_5H_{11})_2O$, amyl aldehyd or valer-aldehyd, $C_5H_{10}O$, and valerianic acid, $C_5H_{10}O_2$.

Pharmaceutical Uses.—Amyl alcohol is the source of valerianic acid and of various compound ethers (fruit-essences), and may be used as a solvent in the manufacture of alkaloids and other proximate principles.

Physiological Action and Medical Uses.—The adulteration of alcoholic drinks with *fusel oil* has been supposed to explain the rapid and peculiar intoxication they sometimes produce and the dyspeptic and nervous disorders which follow their habitual use. It is certain that the oil itself will cause, even in small doses, tension and pain in the head, and in large doses insensibility or a profound and death-like sleep. In small doses, on the other hand, it acts as a direct nervous stimulant, and has been employed for the purpose of controlling the nervous weakness and irritability to which confirmed drunkards are subject. We have known it to be habitually prescribed by skilful physicians for the relief, apparently, of some of the symptoms of chronic *phthisis*, but without apparent benefit.

ALCOHOL METHYLICUM.—METHYL ALCOHOL.

Spiritus pyroxylicus rectificatus.—Pyroligneous (Pyroxylic) spirit or alcohol; Wood-naphtha, E.; *Alcool méthylique, Alcool formique, Alcool de bois, Esprit de bois, Esprit pyroligneux*, Fr.; *Holzgeist, Methylalcohol*, G.
Formula CH_3HO. Molecular weight 32.

Preparation.—Methyl alcohol was first noticed by Boyle (1661); its difference from ordinary alcohol was observed by P. Taylor (1812), but it was not correctly characterized until investigated by Dumas and Peligot (1834). It is contained to the amount of about 1 per cent. in the aqueous portion of the distillate resulting from the destructive distillation of wood, together with acetic acid, acetone, aldehyd, allyl alcohol, empyreumatic oils, and other compounds; on the addition of chalk, acetate of calcium is produced, and the portion distilling below the boiling-point of water furnishes the crude methyl alcohol. To obtain it pure, fused calcium chloride is dissolved in it to saturation, whereby a crystallizable compound, $CaCl_2.4CH_4O$, is formed, which is not decomposed by the heat of a water-bath, but acetone, lignone, and other impurities are found in the distillate. The residue is afterward diluted with water and heated, when dilute methyl alcohol passes over, which is left in contact with burnt lime and then rectified.

Properties.—Pure wood-spirit is colorless, limpid, of a peculiar odor, resembling alcohol and acetic ether, and of a warm taste. Its density is .814 at 0° C. (32° F.), and .798 at 20° C. (68° F.); it boils at about 65° C. (149° F.); burns with a pale-blue, scarcely luminous flame; is soluble in all proportions in water, alcohol, and ether; dissolves volatile oils, fats, many resins, and particularly chloride of calcium, whereby, as well as by its boiling-point, it is readily distinguished from *acetone*. Crystallized sulphate of copper is insoluble in absolute methyl alcohol, but the anhydrous salt yields a blue-green solution, from which, on the addition of a small quantity of water, the crystalline salt is precipitated (Klepl, 1882). The derivatives corresponding with those mentioned under ETHYL ALCOHOL are methyl ether, $(CH_3)_2O$ (see page 131), methaldehyd or formaldehyd, CH_2O, and formic acid, CH_2O_2 (see page 54). It is easily oxidized by solution of permanganate of potassium in the cold, while the color of the latter is more slowly altered by ethyl alcohol. For determining the presence of one or both of these alcohols Riche and Bardy (1875) proposed a process depending upon the differently-colored solutions obtained by the limited oxidation of ethyl and methyl aniline. Berthelot (1876) proposed to mix the alcohol with twice its bulk of concentrated sulphuric acid, when methyl alcohol will yield methylic ether, and ethyl alcohol ethylene gas, which is almost insoluble in water and sulphuric acid, but is readily absorbed by bromine.

Physiological Action and Medical Uses.—The vapors of methyl alcohol, diffused in the air, give rise to headache, dizziness, nausea, and loss of appetite. It was at one time employed as a stimulant in *pulmonary consumption, chronic catarrh, dyspepsia*, and *verminous affections*, but is now entirely disused. It was given in doses of from 10 to 20 drops several times a day.

ALDEHYD.—ALDEHYD.

Acetic aldehyd, Acetaldehyd, E.; *Aldéhyde acétique (vinique)*, Fr.; *Aldehyd*, G.
Formula C_2H_4O or $CH_3.CHO$. Molecular weight 44.

Origin.—Aldehyd was noticed, but not isolated, by Scheele (1774), who supposed it to be ether. Doebereiner (1832) obtained its crystalline compound with ether, and Liebig (1835) isolated it and determined its relation to alcohol. Aldehyd is formed by the oxidation of alcohol and many of its derivatives; it is found among the products of the dry distillation of wood and sugar and on distilling various protein and other compounds with binoxide of manganese and sulphuric acid.

Preparation.—The processes mostly employed are—one devised by Liebig, the other a modification of that originally suggested by W. and R. Rogers. The former distils at a gentle heat a mixture of 2 parts each of alcohol and water and 3 parts each of sulphuric acid and binoxide of manganese. According to the latter, 3 parts of potassium bichromate in coarse powder and 12 parts of water are introduced into a glass retort, and a mixture of 4 parts of sulphuric acid and 3 parts of alcohol is slowly added, avoiding rise of temperature, after which a moderate heat is applied. In both cases the distillate consists chiefly of aldehyd, ether, and alcohol; it is rectified at a temperature not exceeding 50° C. (122° F.), and the vapors conducted into ether, which is afterward charged with gaseous ammonia, when *aldehyd-ammonia*, $C_2H_4O.NH_3$, crystallizes. The crystals are washed with ether, decomposed by dilute sulphuric acid, and the distillate rectified over chloride of calcium.

Properties.—It is a colorless, thin, neutral, and very inflammable liquid, having a peculiar ethereal rather suffocating odor, and the spec. grav. .805 at 0° C. (32° F.). It boils at about 21° C. (69.8° F.), dissolves in all proportions of water, alcohol, and ether, forms with ammonia a very soluble crystallizable compound, yields with alcoholic solution of potassa a yellow resin (*aldehyd resin*), and in contact with air is converted into acetic acid. Aldehyd separates from ammoniacal solution of nitrate of silver a metallic mirror; this reaction becomes more delicate in the presence of caustic soda, so that, according to Tollens (1882), a mirror will be obtained in 1 day with a solution of aldehyd 1 part in water 250,000 parts, and a slight turbidity, yet with a solution of one-fourth this strength.

On being treated at ordinary temperatures or in a freezing mixture with gaseous hydrochloric acid, or zinc chloride, or sulphuric acid, anhydrous aldehyd is converted into two polymeric crystalline modifications, of which *paraldehyd* melts at 10.5° C. (50.9° F.) and boils at 124° C. (255° F.), while *metaldehyd* sublimes partly unaltered, without fusing, at 115° C. (239° F.). When distilled in contact with various chemicals, ordinary aldehyd is again produced. Paraldehyd is $(C_2H_4O)_3$, and dissolves in 60 parts of cold water, but requires a larger quantity of warm water for solution.

Physiological Action.—According to Lussana and Albertoni, aldehyd possesses more powerfully anti-putrescent properties than alcohol, a watery solution containing only 3 per cent. of it preventing the putrefaction of meat and of urine. From 45 to 75 grains dissolved in water and injected into the veins of a moderate-sized dog almost instantaneously arrest respiration and induce coma. In smaller doses it intoxicates and anæsthetizes. Introduced into the stomach, it irritates that organ, and may even occasion gangrene. Being very volatile, it is readily inhaled, small quantities accelerating the respiration, but large ones arresting it, while the action of the heart continues almost at the normal rate. During the stage of asphyxia the temperature may fall even as much as 7° or 9° F. Animals forcibly resist attempts to make them inhale the vapors of aldehyd, but in about a minute sensibility and motility are abolished. If the inhalation is prolonged the pupils dilate, respiration ceases, and the only sign of remaining life is the continued pulsation of the heart. Recovery takes place rapidly without vomiting or other unpleasant symptoms. Of thirty deeply-narcotized dogs, only two died. The brain is rendered anæmic during the inhalation, as happens also in anæsthesia by chloroform and ether. Aldehyd has been tried on man, but its property of arresting respiration and its irritant action upon the lungs and stomach are likely to prevent its further employment as an anæsthetic.

PARALDEHYD has been vaunted as a hypnotic and anodyne by Cervello and Morselli (*Centralbl. f. Ther.*, i. 198; *Med. News*, xlii. 244), and in this country by Dana (*Med. Record*, xxiv. 221). In the dose of 45 grains it is said to calm restlessness and insomnia, and procure unbroken sleep of from 4 to 7 hours' duration, and to leave behind neither languor, nausea, nor digestive disorder. It also acts as a diuretic. It has been found efficient in the *insomnia* of various acute diseases, and also in acute *mania* and the excited paroxysms of chronic insanity and dementia, but less so in cases of melancholy and hallucination and in epileptic or alcoholic *insanity*. In neuralgia it affords transient relief. It is proposed as possessing the good without the evil qualities of chloral. An objection to its use lies in its intense and unpleasant smell.

ALETRIS.—COLIC-ROOT.

Starwort, *Star-grass*, *Blazing star*, E.; *Alétris farineux*, Fr.; *Mehlige Aletris*, G.

The rhizome of Aletris farinosa, *Linné*.

Nat. Ord.—Hæmodoraceæ.

Origin.—The plant grows in grassy places and sandy woods in the United States, and flowers in July and August. It has a circular cluster of lanceolate, sessile, radical leaves, which are about 5 inches (125 Mm.) long and spread star-like upon the ground, and from the centre of them rises the nearly naked scape, about 2 feet (60 Cm.) high, and bearing a spiked raceme of whitish flowers having a mealy appearance.

Description.—The rhizome is horizontal, about 1 or 1½ inches (25–38 Mm.) long, ⅛ inch (3 Mm.) thick at the lower end, and about ⅜ inch (1 Cm.) at the upper end, flattish or concave on the upper surface, and densely tufted with the fibrous or scaly remnants of the leaves; on the lower surface convex and beset with numerous simple rootlets 2 or 3 inches (50–75 Mm.) long, the older ones being wiry and glossy-blackish or brown, the recent ones softer and whitish. The rhizome consists of four to six rather indistinct joints, is brown-gray externally, white internally, breaks with a mealy fracture, with protruding scattered wood-bundles, is inodorous, and has an amylaceous afterward persistently bitter taste.

Constituents.—The rhizome appears to be free from tannin, and to contain starch and a bitter principle which is more freely soluble in alcohol than in water.

Adulterations.—We have occasionally seen it adulterated with upright and horizontal rhizomes of other monocotyledonous plants, from which, however, it is easily distinguished.

Medical Action and Uses.—This humble plant, if we may credit the published accounts of its virtues, is at once tonic, emetic, purgative, diuretic, carminative, sialagogue, and anti-rheumatic, besides being "the most powerful of uterine stimulants." It is probably little more than a simple bitter, and as such produces various effects according to its dose and mode of administration—in substance, in warm or cold infusion, in tincture, etc. The infusion is made with 1 ounce (Gm. 32) to a pint of water, and may be given in doses of a tablespoonful. The average dose of the powder is about 10 grains (Gm. 0.60).

ALISMA.—WATER PLANTAIN.

Plantain d'eau, *Pain de grenouilles*, Fr.; *Froschlöffel*, *Wasserwegerich*, G.

Alisma Plantago, *Linné*.
Nat. Ord.—Alismaceæ.

Origin.—The plant is indigenous to Europe and North America, grows in swampy places and on the edges of ponds and rivers, and flowers from July to September. The American plant is regarded as a variety, Alisma americanum. *Gray*.

Description.—The rhizome consists of two or three united fleshy tuberous pieces, which vary in shape from oblong to subglobular, are externally of a blackish color and beset with numerous radicles, internally white and with scattered wood-bundles, and in the fresh state of a disagreeable sharp odor and taste. The leaves are on long petioles, ovate oblong or lanceolate, acute, frequently with a heart-shaped base, five- to nine-nerved, light-green, and of an acrid taste. The scape is about 2 feet (60 Cm.) high, three-edged, and bears a loose panicle of whitish perfect flowers, having six stamens and numerous pistils upon a flattish receptacle. The rhizome and leaves have been used medicinally.

Constituents.—Water plantain contains a butyraceous pungent volatile oil, of which Zuch (1818) obtained .6 per cent. Neljubin found in it also an acrid resin.

Medical Action and Uses.—A singular commentary on the virtues of this plant may be found in the statement that it was once regarded as an infallible cure for hydrophobia. Whatever powers it possesses are probably due to an acrid principle which exists in the fresh leaves and is strong enough to irritate the skin. It has been supposed to be useful in *calculous* renal affections, in *dysentery*, *diarrhœa*, *chorea*, and *epilepsy*, and as an application to recent *bruises*, *swellings*, and *sores*. The powder of the leaves may be prescribed in doses of about 60 grains (Gm. 4); the powder of the root has been used in half that quantity; and a decoction of the leaves is made with "a handful" in a pint of water, and may be given in doses of 2 ounces.

ALKANNA.—ALKANET-ROOT.

Radix alkannæ, P. G.—*Orcanette*, Fr.; *Alkannawurzel*, G.

The root of Alkanna (Anchusa, *Linné*) tinctoria, *Tausch*.
Nat. Ord.—Boraginaceæ.

Origin.—This perennial herb is a native of Western Asia and South-eastern Europe, is about a foot (30 Cm.) high, and has nearly sessile flowers with a whitish corolla-tube, purplish throat, and blue margin. It is cultivated in Southern Europe.

Description.—The root is a foot (30 Cm.) or less in length, of the thickness of a finger, several-headed, and often crowned with the remnants of white hairy leaves. The soft loose bark separates in thin layers, has a dark-purple color, like the medullary rays, and covers a harder, yellowish, irregularly twisted and spongy wood. Alkanet-root is nearly inodorous and almost tasteless.

Constituents.—The principal constituent of the bark is the red coloring matter, which has been called *anchusin*, *alkannin*, and *anchusic acid*. To obtain it the root, previously exhausted with cold water, is treated with alcohol, the tincture slightly acidulated with hydrochloric acid, concentrated, and agitated with water and ether. On evaporation of the latter the acid remains behind as a dark red-brown, brittle, resinous mass, which when carefully heated is sublimable in light floccules. It is readily soluble in alcohol, ether, fats, and most volatile oils, insoluble in water, and dissolves in alkalies with a blue color. On evaporating the tincture without previously acidulating it, or in the presence of ammonia, the acid gradually changes to *alkanet-green*, which dissolves in ether with a green color.

Uses.—Alkanet-root is mainly employed for coloring oils and pomades. The Oriental dye-stuff *alhenna*, corrupted into alkanna, is obtained from Lawsonia alba, *Lamarck*, s. L. inermis, *Linné;* in Oriental countries an infusion of the elliptic or broadly lanceolate entire leaves is used for dying the finger- and toe-nails orange-red.

Allied Plants.—The root of Onosma echioides, *Linné*, has a deep-red bark, and is sometimes used in Southern Europe in place of alkanet, but is inferior to it. The root and herb of the *ox-tongue* or *bugloss*, Anchusa officinalis, *Linné*, were formerly used in medicine; they have an insipid, mucilaginous taste. The root resembles alkanet in shape, but is externally blackish-brown, internally white.

Medical Uses.—Bugloss is said to have the same medicinal properties as borage (Borago officinalis), which are simply those of an emollient which becomes diaphoretic or diuretic according to the temperature and the quantity of the infusion in which it is administered. It is not used in this country. Alkanet-root has no medicinal virtues; its coloring matter is harmless.

ALKEKENGI.—WINTER CHERRY.

Alkékenge, *Coqueret*, Fr.; *Judenkirsche*, *Schlutte*, G.

The fruit of Physalis Alkekengi, *Linné*.

Nat. Ord.—Solanaceæ.

Origin.—It is a perennial herb, indigenous to Middle and Southern Europe, and to some extent cultivated and naturalized in this country under the name of *strawberry tomato*. It is more or less soft-hairy, has a nearly simple stem, broadly ovate and pointed leaves with a somewhat wedge-shaped base, and bell-shaped greenish-white unspotted flowers.

Description.—The fruit is spherical, of the size of a cherry, scarlet-red, shining, and remains enclosed in the inflated orange-colored permanent calyx. It is two-celled, and contains numerous white flattish ovate seeds attached to a central placenta. In the fresh state the fruit is very juicy and has a sweet and acidulous taste; it shrivels considerably on drying.

Constituents.—Dessaignes and Chautard (1852) found sugar and citric acid in the berries, and in the leaves and calyx an amorphous bitter principle, *physalin*, $C_{14}H_{16}O_5$, which is obtained as a whitish powder on agitating the cold aqueous infusion with chloroform, and is soluble in chloroform and alcohol, but sparingly so in ether, cold water, and diluted acids.

Allied Species.—PHYSALIS VISCOSA, *Linné*, a clammy, pubescent North American plant, with ovate or oblong, slightly cordate and somewhat toothed leaves, and purplish-brown flowers. The fruit is an orange-colored or reddish berry, remaining in the inflated calyx.

PHYS. PENNSYLVANICA, *Linné*. It resembles the preceding, but is not clammy, the leaves are usually entire, the corolla is veined in the centre, and the berry has a red color.

PHYS. PERUVIANA, *Linné*, PH. PUBESCENS, *Linné*, and NICANDRA PHYSALOIDES, *Gærtner*, are indigenous to South America and employed for similar purposes. The last-named species is occasionally found wild in the United States, where it is known as *apple of Peru*.

Physiological Action and Medical Uses.—The herb is used in Europe as tonic, anti-periodic, and depurative, and the fruit as febrifuge and diuretic. Like many other bitter plants, this one is sometimes successful in arresting the paroxysms of *intermittent fever*, and is used for that purpose by the peasantry. The berries eaten when ripe and fresh, and when dried and used to prepare a decoction, and also their expressed juice, are regarded as having decided diuretic virtues, and are frequently employed in *jaundice*, *gravel*, *dysury*, *retention of urine*, and *dropsy*. It is recommended to give the fresh berries to the extent of several ounces a day; of the expressed juice 2 or 3 fluidounces; and an infusion of the dried berries, made with an ounce (Gm. 32) in a pint of hot water, to the extent of 2 or more pints a day. The powder of the plant is used in doses of a drachm or more (Gm. 4). The allied species appear to resemble winter cherry in their qualities.

ALLIUM, *U. S.*—GARLIC.

Bulbus allii.—*Ail*, Fr.; *Knoblauch*, G.

The bulb of Allium (Porrum, *Reichenbach*) sativum, *Linné*. Bentley and Trimen, *Med. Plants*, 280.

Nat. Ord.—Liliaceæ.

Origin.—All the plants belonging to this genus are bulbous, resemble each other in their odor and taste, and contain similar if not identical volatile oils. The officinal species is indigenous to Central Asia, and perhaps also to the basin of the Mediterranean, but is cultivated for culinary purposes in other sections of Europe and North America. By cultivation and hybridization several varieties have been formed, one of which, of frequent occurrence here, was proved by R. P. Thomas (1860) to be a hybrid of A. sativum and A. Porrum, *Linné*, which is distinguished by its larger bulb, higher stem, and the absence of proliferous bulbs from the flowering heads.

Description.—Garlic is a sub-globular compound bulb, surrounded by a few dry membranaceous scales, which cover the remnant of the upright stem and the 5 to 8 small bulbs or cloves arranged in a circle around its base. These bulblets are oblong in outline, compressed from both sides, wedge-shaped toward the stem, and rounded upon the back, They consist of a few thick fleshy scales and a short fleshy axis. Garlic has a peculiar pungent and disagreeable odor and an acrid, burning taste. It is used in the fresh state only.

Constituents.—Besides the cellular tissue, garlic contains between 50 and 60 per cent. of water, 35 per cent. of mucilage, some albumen, sugar, starch, and about ¼ per cent. of volatile oil, to which its odor and taste are due. In its crude state *oil of garlic* is of a dark brown-yellow color, heavier than water, of a very repulsive taste, and consists of oxide and sulphides of allyl. The rectified oil consists mainly of the sulphide, $(C_3H_5)_2S$, is colorless, lighter than water, and may be obtained artificially by treating an alcoholic solution of potassium sulphide with allyl iodide. It dissolves easily in alcohol and ether, and sparingly in water; with nitrate of silver, mercuric chloride, and other metallic salts it forms crystalline compounds. Garlic, macerated in water or vinegar, yields its virtues to these liquids.

Preservation.—Garlic is best preserved in a dry place at a moderate temperature, in which it slowly parts with its water. A. P. Sharp proposed (1864) to put the fresh and cleaned bulblets into a jar and add a small quantity of alcohol—about 2 ounces to a quart jar. The vitality of the bulbs is destroyed, and they retain their properties in the closed vessel for a long period, but change in color, acquiring a brownish somewhat diaphanous appearance.

Off. Prep.—Syrupus allii, *U. S.*

Allied Species.—The following species of Allium are more or less cultivated for culinary purposes; their bulbs and leaves possess a garlic-like but mostly milder odor, which is dependent upon similar volatile oils. Medicinally, they appear to have the same properties, though in a milder degree:

Allium Cepa, *Linné*: Onion, *E.*: Oignon, *Fr.*: Zwiebel, *G.*
Al. Porrum, *Linné*: Leek, *E.*: Porreau, *Fr.*: Lauch, *G.*
Al. Ascalonicum, *Linné*: Shallott, *E.*: Echallotte, *Fr.*: Schallotte, *G.*
Al. Schœnoprasum, *Linné*: Chives, *E.*: Civette, *Fr.*: Schnittlauch, *G.*

Physiological Action and Medical Uses.—Garlic, as well as leek and onion, is a stimulant to the part to which it is directly applied and to the whole system. Its odorous element may be perceived on the breath and its taste in the mouth when the bruised bulb has been applied to the skin. When eaten raw its odor exhales from many parts of the body, and, given to nursing women, it taints their *milk*, so that their infants refuse the breast. It reddens the skin, and may even vesicate it. Internally, it stimulates the digestive organs, and is everywhere used, but principally in southern countries, as a condiment for various kinds of food. Excessive quantities of it produce nausea, vomiting, colic, and diarrhœa. The odor of garlic is popularly employed to revive persons from a *swoon* or from *hysterical* insensibility. It is a vermifuge not to be neglected in the treatment of *lumbricoid worms* when given by the mouth, and for destroying *ascarides* when administered by the rectum. Many cases of *dropsy*, particularly of anasarca produced by cold, have been cured by a diet of bread and raw onions. This regimen will sometimes produce copious diuresis. Onions boiled in milk have been used successfully for a like purpose. Bruised cloves of garlic and poultices of boiled onion are admirable remedies for chronic *bronchitis* in children. They should be applied over the whole front of the chest. Internally, garlic is a very useful agent in the same affection. It is also a domestic remedy for *whooping cough*. Onion poultices are particularly applicable to *abscesses;* the core of a roasted onion relieves *earache* when introduced into the auditory canal. Onion and garlic cataplasms applied to the perineum relieve *strangury*. The *dose* of bruised or chopped garlic or of the expressed juice is about 30 grains (Gm. 2).

ALNUS.—ALDER-BARK.

Black Alder, E.; *Écorce d'aune*, *Aune noir*, Fr.; *Erlenrinde*, *Schwarzerle*, *Eller*, G.

The bark of Alnus glutinosa, *Gærtner*, s. Betula Alnus, *Linné*, and of Alnus serrulata, *Aiton*.

Nat. Ord.—Betulaceæ.

Origin.—The first species is a tree about 30 feet (9 M.) high, indigenous to Europe and Northern Asia; the second is a native of the United States, and attains a height of about 10 feet (3 M.). Both grow in moist localities.

Description.—The bark is in quills or curved pieces about $\frac{1}{20}$ inch (1.2 Mm.) thick, smooth on both sides, of a brownish ash-gray color externally, the young bark with reddish-brown dots, brownish-orange on the inner surface, inodorous, and of an astringent somewhat bitter taste. It is brittle, and breaks with an uneven, not splintery, fracture. The bark of the American species, which is called *black alder*, resembles the preceding, but is of a blackish-gray externally; has small suberous warts, which become somewhat confluent transversely, and is marked with a few coarse longitudinal striæ upon the orange-brown inner surface.

Constituents.—Alder-bark contains tannin, that of the black alder about 4 per cent. and the aments of the same species 1.5 per cent. (Bowman, 1869). These results were obtained by precipitation with gelatin. According to Stenhouse (1843), the tannin of the European alder-bark is precipitated by gelatin, but not by tartar emetic; ferric acetate yields a purplish-blue, and ferrous chloride a dark olive-green, precipitate.

Medical Action and Uses.—The American species of alder is said to be "astringent and diuretic," which may be doubted, since astringents are seldom diuretics. Its astringency resides in the leaves, as well as in the bark, with both of which a decoction is prepared for the treatment of *diarrhœa* and *hæmaturia;* and the former, when bruised, are applied to *contusions*, *sprains*, and *ulcers*. The inner bark is said to be emetic. The European species possesses almost identical virtues. Its decoction is employed for the purposes above mentioned, and as a gargle in *sore throat*, as a mouth-wash in *ulceration* of the gums, etc., as an injection in *leucorrhœa*, etc.; and the bruised leaves are sometimes applied to the mammæ to lessen the secretion of *milk* or dissipate *indurations* during lactation. Internally, the bark has been used in *intermittent fever*. The *dose* of the powdered bark is 10 grains (Gm. 0.60) several times a day. The decoction or infusion may be made with half an ounce (Gm. 16) to a pint of water.

ALOE, *U. S.*, *Br.*, *P. G.*—ALOES.

Aloès, Fr.; *Aloe*, G.

The inspissated juice of the leaves of different species of Aloe. Bentley and Trimen, *Med. Plants*, 282, 283, 284.

Nat. Ord.—Liliaceæ.

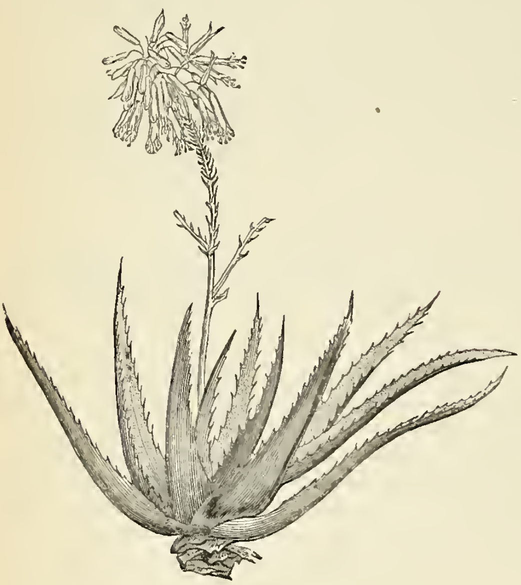
Officinal Varieties.—1. ALOE BARBADENSIS, *Br.*, *U. S.* 1870.—Barbadoes aloes, Hepatic aloes, *E.;* Aloès hépatique des Barbades, *Fr.;* Barbadoes Aloe, *G.*—From Aloe vulgaris, *Lamarck*.

2. ALOE CAPENSIS, *U. S.* 1870; Aloe, *P. G.*, Aloe lucida.—Cape aloes, *E.;* Aloès du Cap, Aloès lucide, *Fr.;* Capaloe, *G.*—From Aloe ferox, *Lamarck*, A. spicata, *Thunberg*, A. Lingua, *Linné*, s. Gasteria Lingua, *Willdenow*, and of other species of Aloe.

3. ALOE SOCOTRINA, *Br.*, *U. S.* 1870, Aloe, *U. S.* 1880, Aloe succotrina.—Socotrine aloes, *E.;* Aloès succotrin, A. socotrin, *Fr.;* Socotora Aloe, Socotrinische Aloe, *G.*

Origin.—In aspect these plants resemble the so-called century-plant, or American aloe, Agave americana, *Linné*. Of the above-named species, Aloe vulgaris has yellow flowers, and is indigenous to India and North-eastern Africa, and has been naturalized along the shores of the Mediterranean and in the West Indian Islands; A. indica, *Royle*, A. littoralis, *Kœnig*, and several other forms described as distinct species, are now regarded as mere varieties of this. A. socotrina, with orange-red flowers, belongs to the east coast of Africa, near the southern shore of the Red Sea, and to the neighboring islands of the Indian Ocean. A. purpurascens, *Haworth*, A. rubescens, *De Candolle*, and A. officinalis, *Forskal*, which are indigenous to tropical or Southern Africa, have been referred to this species as varieties. A. spicata, with yellowish and orange-colored flowers, and A. ferox, with reddish or yellowish flowers, are indigenous to the southern part of Africa, together with A. africana, *Miller*, A. linguæformis, *Linné*, A. arborescens, *Miller*, and other species, which are used in preparing some of the commercial aloes. The aloes-plant of the island of Socotra, according to Balfour (1882), is Aloe Perryi, *Baker*, a species quite distinct from A. socotrina; it is used for preparing aloes which, however, does not appear to reach our commerce. Aloe abyssinica, *Lamarck*, is probably the source of Jafferabad aloes, met with in commerce in Bombay.

Fig. 11.



Aloe vulgaris, *Lamarck*.

Preparation.—The large fleshy leaves of these plants contain in their central part an insipid, thick, mucilaginous juice, and a bitter yellowish juice in distinct, elongated, thin-walled ducts situated near the surface. To obtain this bitter juice the leaves are cut off near their base, and then placed in suitable vessels, into which their cut ends project. The vessel used in Barbadoes and other West Indian islands is an inclined trough from which the juice flows into other vessels, where it is preserved until it can be evaporated. In the Cape Colony a shallow ditch is dug into the ground and covered with a goat-skin, which, when nearly filled, is emptied at once into an iron kettle, and without much attention boiled down to the proper consistence. Greater care is bestowed upon the evaporation of the juice in Barbadoes and Curaçao, the impurities being removed during the evaporation, and when of sufficient consistence the juice is poured into boxes or gourds, where it solidifies on cooling. Socotrine aloes seems to be mostly derived from Zanzibar and other places farther north on the east coast of Africa. It enters commerce by way of Bombay. Nothing is known of the method pursued in its manufacture, except that the juice appears to be inspissated by spontaneous evaporation. The importation of all kinds of aloes into the United States varies between 96,500 pounds in 1876 and 230,624 pounds in 1882.

ALOE PURIFICATA, *U. S.*—Purified aloes, *E.;* Aloès depuré, *Fr.;* Gereinigte Aloe, *G.*

Aloes 100 parts (17 ounces av.); Alcohol 15 parts (3 fluidounces). Heat the aloes, by means of a water-bath, until it is completely melted. Then add the alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the liquid becomes brittle on cooling. Lastly, break the product, when cold, into pieces of convenient size, and keep it in well-stopped bottles.—*U. S.*

The process remains the same as heretofore; its object is the removal of fragments of leaves, wood, stones, pieces of skin, and other extraneous matter, which are always found in larger or smaller proportion in Socotrine as well as in Cape aloes. If the heat is regulated by means of a water-bath, there is no danger of impairing the virtues of aloes by overheating. The melted aloes is rendered sufficiently fluid, by the addition of the alcohol, to pass without difficulty through the sieve, if this has been previously warmed. The impurities remain upon the sieve, and the strained liquid may be at once evaporated. If the operation has been carefully performed, purified aloes will be dull-brown or reddish-brown, brittle, of the peculiar aromatic odor of Socotrine aloes, and will yield a bright brownish-yellow powder.

Description.—1. BARBADOES ALOES. It is usually imported in gourds, and has a deep-brown or orange-brown color, which in thin pieces has a decidedly yellow or reddish-yellow tinge; it is opaque in mass, translucent in thin splinters, and breaks with a smooth scarcely conchoidal, waxy fracture. When breathed upon it has a strong saffron-like odor, which is, however, distinct from that of Socotrine aloes. Ether dissolves about 10 per cent. of Barbadoes aloes.

Similar in appearance, but rather darker and more glossy, are *Curaçao* and *Bonaire aloes;* their fracture is more conchoidal and their odor less agreeable.

2. CAPE ALOES. This is readily distinguished from the other kinds by its dark, blackish-brown color (which is frequently of an olive tint), its glossy appearance, and its large conchoidal fracture. It is transparent on the edge, with a red-brown color, and has a saffron-like but disagreeable sourish odor. It affords a light yellowish-brown or greenish-brown powder, and yields to ether from 1.5 to 6.5 per cent. of soluble matter. It is imported in cases, and varies more or less in the shade of color and in the brilliancy of its fracture.

3. SOCOTRINE OR ZANZIBAR ALOES. This is put up in skins, and of late years also in kegs and tin-lined boxes. It is sometimes met with in the liquid state, and separates then into two distinct layers, of which the upper one is transparent, while the lower consists of a brown-yellow crystalline mass. Even when quite hard externally the interior of the packages is often found in a soft or semi-fluid state. When carefully dried it has a conchoidal, dull fracture, and is of a yellowish orange-brown color, destitute of the greenish hue of Cape aloes. On exposure the color darkens considerably upon the surface. The powder is of a bright brownish-yellow. When breathed upon it emits an aromatic saffron-like odor, more pleasant than that of the other varieties. From 4 to 5.5 per cent. of Socotrine aloes is soluble in ether.

4. OTHER VARIETIES OF ALOES. Under the name of *hepatic aloes* a variety of Socotrine aloes was formerly known in Europe, which came into commerce from the East Indies. The name was afterward applied to any opaque liver-colored variety. In the United States this name has been used to designate Barbadoes aloes. *Natal aloes* is an opaque variety of a brownish-gray or light brownish-yellow color, differing very considerably in appearance from the preceding varieties. It is prepared from an undetermined species in the interior of Natal, the juice being concentrated by careful boiling. *Jafferabad aloes* is of a black pitch-like color and lustre, a glassy somewhat porous fracture, and, in powder, of a pale-brown hue; its odor and taste are less agreeable than those of Socotrine aloes. An inferior kind, known in European commerce as *Moka aloes*, comes from the interior of Arabia; it is opaque, almost black, of irregular fracture and disagreeable odor, and yields a pale reddish-brown powder. By the name of *Caballine* or *horse aloes* European writers used to designate the inferior, impure, and fetid kinds of different origin.

The difference in the sensible properties of the different varieties of aloes must in part be referred to the species from which they are derived, and to the climate and soil in which the plants grow; and it must depend to a considerable extent upon the care bestowed upon obtaining the bitter juice free from the insipid mucilaginous contents of the cells of the interior parenchyma, upon the manner in which concentration is effected, and upon its freedom from accidental impurities. These latter are perhaps never absent, but are sometimes present in considerable proportion, although not readily observable on the examination of the aloes; hence the U. S. Pharmacopœia orders the purification of Socotrine aloes. The opaqueness of some sorts of aloes is due to the crystallization of one of the principles. The glossy and transparent kinds do not contain such a crystallized principle, but are nearly homogeneous. The odor of aloes is best observed when a sample is breathed upon; it resembles strongly saffron, associated with another odor, which is distinct for each kind. The taste of aloes is disagreeably bitter and very persistent.

Aloes dissolves almost completely in alcohol and in boiling water, the latter solution separating, on cooling, about 40 to 60 per cent. of the so-called *resin of aloes*, which is taken up by alkalies and reprecipitated by acids. Chloroform in contact with aloes remains uncolored even when heated to boiling; pure ether acquires only a slight yellowish color.

Constituents.—None of the older analyses have thrown any light upon the composition of aloes beyond establishing the degree of solubility of different samples in several solvents and the behavior of these solutions with different reagents. T. and H. Smith of Edinburgh succeeded (1851) in isolating from Barbadoes aloes a crystalline principle, which was then named *aloin*, but is now called *barbaloin*, to distinguish it from the crystalline principles of other varieties. Socotrine aloes, containing a large number of crystals, was noticed by Pereira in 1852, and the crystalline principle was isolated by Groves (1856), but then regarded as being identical with barbaloin, until their difference was shown by Histed (1871). Groves's process consists in dissolving 1 part of aloes in 10 parts of boiling water, decanting after cooling from the sediment, and acidulating slightly with hydrochloric acid. Tilden (1870) prefers acidulating the water with sulphuric, sulphurous, or hydrochloric acid before dissolving the aloes, and allowing to rest overnight; the clear liquid is then rapidly evaporated to about 2 parts, and set aside in a cool place to crystallize; the crystals are purified by recrystallization from very dilute alcohol. Nataloin was obtained by Flückiger (1871) by triturating Natal aloes with an equal weight of alcohol at a temperature not exceeding 48° C. (118° F.), when the amorphous portion will be dissolved; the residuary crystalline mass, after washing with cold alcohol, is recrystallized from hot methylic or ethylic alcohol. Socaloin, being soluble in cold spirit almost as freely as the amorphous constituents, cannot be obtained in the same manner; but Histed succeeded in preparing it with little loss by mixing powdered Socotrine aloes with a little alcohol (sp. gr. .960), expressing strongly between calico, and crystallizing the press-cake from warm weak alcohol. The same process yields also the aloin of Jafferabad aloes (Shenstone, 1882). Aloin, *Br.*, is barbaloin or socaloin.

Barbaloin, $C_{17}H_{20}O_7$, occurs in small yellow prismatic needles, which are insoluble in ether, and dissolve sparingly in cold but freely in warm water and alcohol. Bromine-water produces in its solution a yellow precipitate of *bromaloin*, which crystallizes in needles. Heated with nitric acid, barbaloin yields chrysammic, aloetic, picric, and oxalic acids. Barbaloin, added to a drop of nitric acid, produces a crimson color, which rapidly fades. According to Hanausek (1881), the aloin from Curaçao aloes has the same behavior to reagents, but its composition is $C_{15}H_{17}O_7$.

Nataloin, $C_{16}H_{18}O_7$, crystallizes best from methylic alcohol in thin pale-yellow rectangular scales, which dissolve at 15.5° C. (60° F.) in 35 parts of methylic alcohol, 50 of acetic ether, 230 of absolute alcohol, and 1236 of ether. It is sparingly soluble in hot and cold water and in about 60 parts of alcohol. Nitric acid does not convert it into chrysammic acid, but yields oxalic and picric acids. Nataloin, added to a drop of nitric acid, produces a crimson color, which is more permanent than the similar color produced with barbaloin. If nataloin is added to a drop of sulphuric acid and the vapor of fuming nitric acid is passed over the surface, the orange-colored liquid will assume a fine green color, quickly changing to red and blue (Histed, *Transac. Br. Pharm. Conf. 1871*, p. 580).

Socaloin or *Zanaloin*, $C_{15}H_{16}O_7$, crystallizes in small yellow needles, which dissolve in 30 parts of alcohol, 90 of water, 380 of ether, 9 of acetic ether, and freely in methylic alcohol. Cold nitric acid has little effect upon socaloin, but upon heating imparts to it an orange-red color, and oxidizes it to the same acids which are obtained with barbaloin. Precisely the same effect was observed by Shenstone with the aloin from Jafferabad aloes; hence these three aloins form a well-defined group quite distinct from nataloin.

Aloetic acid, $C_7H_2(NO_2)_2O$, is an orange-red powder. *Chrysammic acid*, $C_{14}H_4(NO_2)_4(OH)_2O$, forms bright golden-yellow laminæ, yields crystallizable salts having a metallic lustre, and by nascent hydrogen and other deoxidizing agents is converted into *hydrochrysamide*, which is sublimable, and crystallizes in indigo-colored needles.

The above formulas for the three aloins are those of Sommaruga and Egger (1874), and if correct would prove these principles to be homologous. Stenhouse's formula for crystallized barbaloin is $C_{34}H_{36}O_{14}.H_2O$; Tilden's formula for nataloin = $C_{25}H_{28}O_{11}$; Flückiger's formula for socaloin = $C_{31}H_{38}O_{15} + 5H_2O$. Tilden (1875) considers barbaloin and socaloin, although differing in chemical and some physical properties, to have the composition $C_{16}H_{18}O_7$, but to unite with different proportions of water of crystallization. These results were confirmed by E. Schmidt (1876). On pouring a solution of aloin into an excess of bromine-water, a precipitate of *bromaloin*, $C_{16}H_{15}Br_3O_7$, is obtained, which crystallizes from alcohol in beautiful yellow needles. Nataloin does not yield a similar bromine compound.

Kosmann did not succeed (1863) in obtaining a crystallizable body from Cape aloes; he assigned to the yellow amorphous portion, soluble in water and alcohol, the formula $C_{31}H_{22}O_{20}$, and stated that the insoluble portion had nearly the same composition, and that both were glucosides.

Tilden and Rammell examined (1872) the so-called resin from Barbadoes and Socotrine aloes, and observed that by continued boiling a portion of it can be rendered permanently soluble in water. This and the insoluble portion are nearly alike in composition, and appear to differ from barbaloin merely by the elements of water, and, for the insoluble resin also, by containing less hydrogen. This view is somewhat supported by the change into an amorphous substance when aloin is boiled for a long time with water, or more rapidly in the presence of a little alkali, while small quantities of acid prevent this change. The amorphous *aloetin*, *aloeresin*, and *aloebitter* of older investigators must have been aloin similarly modified.

By continued boiling of Socotrine aloes with alkali, Czumpelick (1861) obtained, among other compounds, crystals of an acid which Hlasiwetz (1865) procured by boiling aloes with dilute sulphuric acid, and named *paracumaric acid;* on fusing this with potassa, *para-oxybenzoic acid* is formed. The latter is also yielded by the same process from aloes, together with oxalic acid, volatile fatty acids, and orcin, and, according to Weselsky (1872), *alorcinic acid.* The latter is soluble in alcohol and ether, sublimable, and acquires a transient purplish-violet color with chlorinated soda.

On distilling aloes with zinc-dust, Graebe and Liebermann (1868) obtained *anthracene*, $C_{14}H_{10}$, and E. Schmidt also *methylanthracene.* On distilling aloes with lime, Robiquet (1846) separated a colorless or yellowish oil, *aloïsol*, of an odor resembling that of amyl alcohol and oil of bitter almond. Rembold (1866) ascertained this aloïsol to be a variable mixture of acetone, xylenol, and other compounds. When incinerated, aloes yields from 1 to 4 per cent. of ash.

Pharmaceutical Uses.—For internal use *purified* aloes only should be dispensed. The following preparations have been admitted into the pharmacopœias: Aloë purificata, *U. S.;* Enema aloes, *Br.;* Extract. aloes aquosum (Barbadensis and Socotrinæ), Extr. colocynthidis comp., *U. S.*, *Br.;* Pilulæ aloes, Pil. aloes et asafœtidæ, Pil. aloes et ferri, *U. S.*, *Br.;* Pil. aloes et mastiches, *U. S.;* Pil. aloes et myrrhæ, *U. S.*, *Br.;* Pil. cambogiæ comp., Pil. colocynthidis comp., Pil. colocynthidis et hyoscyami, *Br.;* Pil. rhei comp., Tinct. aloes, *U. S.*, *Br.;* Tinct. aloes et myrrhæ, *U. S.;* Tinct. benzoini comp., Vinum aloes, *U. S.*, *Br.*

PULVIS ALOES ET CANELLÆ, *Hiera Picra.*—Rub together and mix thoroughly Socotrine Aloes 4 ounces, Canella 1 ounce.—*U. S.* 1870.

Physiological Action.—Aloes acts upon quadrupeds as a purgative. Given to dogs in the dose of 60 grains, it caused the liver to secrete a greater quantity of biliary matter in a given time, although it rendered the bile more watery. It was long ago known to have a purgative effect when applied in solution to the unbroken skin, and more recently when endermically used. Hypodermic injections of a solution of aloin have caused purgation. Infants are purged by the milk of nurses using aloes. In doses of 1 or 2 grains it stimulates the appetite and improves the digestion; in doses of from 3 to 6 grains it occasions, after a delay of from 12 to 24 hours, a fecal and usually formed stool; in larger doses it excites more or less tormina, and tenesmus attends the evacuations. They have a peculiar smell, which has been ascribed to bile. At the same time slight feverishness is apt to occur, and, according to some, a sense of tension in the liver. According to Rutherford, it powerfully stimulates the liver, increasing the secretion of biliary matter, but rendering the bile more watery. It is doubtless this fact, connected with the slight purgative action of the drug, that has in all ages caused it to be used in the dyspeptic derangements named below. Habitual use of aloes does not sensibly diminish its activity. It is presumed to act decidedly upon the lower bowels, since it causes an increase of the hæmorrhoidal flux when it exists, and tends to bring on or augment the menstrual flow. Genital irritation is sometimes manifested. The general belief that aloes tends to produce hæmorrhoids is contradicted by the results of experience; these bodies probably arise from the constipation which aloes is given to relieve. The evident stimulation of the pelvic organs by aloes has led to its use as an abortifacient, but there is no case on record which conclusively proves it to be so. It is held by some that *aloin* is two or three times as active as good aloes. Its cathartic action is said to be uniform, rather more speedy than that of crude aloes, and unattended by griping. 1½ grains will, it is said, in a strong adult usually cause two or three copious evacuations; 2½ grains have been followed by powerful catharsis, producing five or six evacuations (Harley). But, on the other hand, D. Beaumetz hesitates to ascribe any purgative action to aloin, and holds it to be very slight when it exists at all.

Medical Uses.—The salutary action of aloes upon the stomach and liver, and its slow and moderate operation as a purgative, have led to its use in habitual *constipation:*

and it enters into numberless compounds devised for the relief of this condition, especially as it presents itself in persons of sedentary habits, on the approach of old age, as an effect of repeated pregnancy, etc. It is said to be contraindicated by a plethoric, bilious, or hæmorrhagic constitution, when the liver is congested, during pregnancy, and when hæmorrhoids exist; but these statements are not justified by experience. As regards *hæmorrhoids*, those attended with a mucous discharge are most apt to be benefited by aloes. *Ascarides* of the rectum may often be destroyed by enemas of aloes, of which the best consists of aloes dissolved in an infusion of quassia. *Jaundice* from "hepatic torpor" or congestion may be successfully treated with purgative doses of aloes combined with blue pill. The condition so called, however, usually depends on constipation. In simple *amenorrhœa* of the torpid sort aloetic purgatives are very efficient, especially in the form of tincture, or of the pill of aloes and myrrh, or of the powder of aloes and canella. Aloes and iron are equally valuable in cases of *menorrhagia* arising from debility, and enemas of aloes and soap have been found serviceable in curing atonic *uterine catarrh*. Aloetic laxatives will sometimes arrest *gleet*. Powdered aloes, which is used in veterinary surgery, has been found of great service in treating lacerated *wounds* (Millett). The other local applications of aloes are described in connection with the tinctures into which that substance enters.

Administration.—Aloes in pilular form is best administered alone, or simply associated with soap or with an alkaline carbonate to promote its solution. As a laxative it may be given in the dose of from 3 to 10 grains (Gm. 0.20–0.60). Custom has, however, sanctioned its use in combination with mastic for this purpose. The tincture and the wine of aloes are occasionally used as purgatives. Its combinations with myrrh, with asafœtida, and with canella are especially adapted to the treatment of derangements of the catamenia, and those with benzoin are used as internal and also as local stimulants. Aloin may be substituted for aloes in the various pills containing the latter. As a prescription for the relief of habitual constipation due to sluggishness of the bowels or torpor of the liver the following formula has been recommended: ℞. Aloes gr. ¼; Ferri sulph. exsic. gr. iss; Quiniæ sulph. gr. j; Capsici gr. ¼; Ext. nucis vomic. gr. ss; Ext. gentianæ q. s. ut ft. pil. To be taken two or three times a day, after meals.

ALSTONIA.—DITA-BARK.

Écorce de dita, Fr.; *Ditarinde*, G.

The bark of Alstonia (Echites, *Linné*) scholaris, *R. Brown*. Bentley and Trimen, *Med. Plants*, 173.

Nat. Ord.—Apocynaceæ.

Origin.—Dita-bark comes from a stately forest tree indigenous to the East Indies, Eastern Australia, the Philippines, and other neighboring islands. The wood is soft and white, and the greenish-white flowers have, in the night, a strongly aromatic odor.

Description.—The bark is in thick curved pieces, usually about 2 or 4 inches (5 to 10 Cm.) long, ½ an inch (12 Mm.) broad, and ⅛ to ⅓ inch (3 to 8 Mm.) thick. It is externally of a leather color, has a scaly appearance from its longitudinal and transverse fissures, and is not unfrequently marked with small black spots. Internally it is light yellowish-brown, the inner surface brown-gray and longitudinally striate. The bark breaks with a short, or rather horny, somewhat porous fracture, showing in the outer layer groups of yellow stone-cells, and in the inner layer narrow wavy medullary rays, and yields a yellowish-gray powder, which is inodorous and has a slightly bitter not unpleasant taste.

Constituents.—G. Gruppe of Manilla obtained from dita-bark about 2 to 5 per cent. of *ditaine*, which was uncrystallizable, very hygroscopic, and bitter. Jobst and Hesse (1875) obtained from the aqueous solution of the alcoholic extract by acetate of lead a precipitate containing a crystalline and an oily acid, by subacetate of lead a precipitate containing resin-like bodies, and by phosphotungstic acid a precipitate containing the alkaloid *ditamine*, $C_{16}H_{19}NO_2$, which is a white bitter powder soluble in ether, alcohol, chloroform, and benzol, and by sulphuric acid is colored red, on warming violet-red; by nitric acid yellow, on warming dark-green to violet. Only .02 per cent. of the alkaloid was obtained, which yields very bitter salts. The bark yields to petroleum benzin several fatty and resinous substances, named *echicaoutchin*, *echiretin*, *echicerin*, *echitin*, and *echitein*, and the three last of which are crystallizable. Harnack (1877) isolated a crystalline alkaloid, *ditaine*, which Hesse (1881) named *echitamine*, $C_{22}H_{28}N_2O_4$. It forms glossy prisms containing $4H_2O$, is a strong base, is almost insoluble in benzol and benzin, and dissolves readily in water, alcohol, and, if freshly precipitated, also in ether and chloroform. Its hydrochlorate is sparingly soluble in cold water and nearly insoluble in hydrochloric acid and in alkali chlorides. Sulphuric acid imparts a deep purplish-red color, changing to green. Hesse obtained also a third alkaloid, *echitenine*, $C_{20}H_{27}NO_4$, which is amorphous, brown, easily soluble in alcohol, less so in water, and is colored reddish-violet by sulphuric acid, and purple, afterward green and yellow, by nitric acid.

The closely-allied *poelé-bark* of Java, which comes from Alstonia spectabilis, *R. Brown*, yielded to Hesse 0.8 per cent. of echitamine, or fully six times the quantity contained in dita-bark; it contains also the other alkaloids in larger proportion than the latter; and in addition thereto *alstonamine*, which resembles ditamine in behavior, but is crystallizable; it was isolated by A. Scharlée in 1862, and then named *alstonine*, but this name is now used for one of the alkaloids of Australian alstonia-bark.

Allied Drug.—Alstonia-bark, from Alstonia constricta, *F. Mueller*, a native of Australia, differs greatly in appearance from dita-bark in being 1¼ to 2 inches (3 to 5 Cm.) thick, deeply furrowed, externally brown-gray, or after abrasion ochrey-yellow, and ridged upon the inner surface; the bast-layer is about ¼ inch (6 Mm.) broad, yellow, tough and fibrous, and is covered by the thick, spongy, and friable corky layer, which is composed of alternating bands of lighter and darker ochre color, these bands being present also in the much thinner bark from young wood, with a relatively thin periderm; the powder is grayish-yellow, odor slight, taste persistently bitter.

The bark was described and its origin determined by Charles Mohr (1879). Palm (1863) found in it a neutral bitter principle, *alstonin;* Hesse (1865) two alkaloids, *chlorogenine* and *porphyrine;* Mueller and Rummel described an alkaloid, *alstonine;* and Oberlin and Schlagdenhauffen (1879) a second uncrystallizable alkaloid, *alstonicine.* The alkaloids characterized by Hesse in 1881 are: *alstonine* (chlorogenine), $C_{21}H_{20}N_2O_4$, a brownish-yellow amorphous powder, readily soluble in alcohol, and, when freshly precipitated, also in chloroform and water, sparingly soluble in ether; its salts are insoluble in dilute acids; *porphyrine*, $C_{21}H_{25}N_3O_2$, a white amorphous powder, soluble in petroleum naphtha, freely soluble in ether, alcohol, and chloroform, the acid solutions of a blue fluorescence: sulphuric or nitric acid dissolves it with a purple color, that with nitric acid changing to yellowish- and brownish-green; *alstonidine* crystallizes from its solutions in chloroform, ether, alcohol, acetone, and hot petroleum naphtha; is not colored by sulphuric or nitric acid, but its solutions show blue fluorescence. One or more other alkaloids are present in minute quantity.

Alstonia-bark gives 9 to 10 per cent. of ash, and on successive treatment yields to ether about 1, to alcohol 28, and to water 1.4 per cent. of soluble matter.

Allied Species.—In the East Indies the root of Echites malabarica, *Lamarck*, is used as a febrifuge, and the leaves as an application to carbuncles; the leaves of Ech. caryophyllata, *Roxburgh*, in arthritic fevers; and the bark of Ech. pubescens, *Buchanan*, and Ech. antidysenterica, *Roxburgh*, like the Brazilian Ech. Cururu, *Martius*, Ech. insignis, *Sprengel*, and Ech. longiflora, *Desfontaines*, in diarrhœa and dysentery. Ech. syphilitica, *Linné filius*, of Surinam, is used there in syphilitic complaints.

Under the name of *conessi-bark* the bark of one or two of the above species has sometimes been used; but true conessi-bark is referred to Wrightia (Holarrhena) antidysenterica, *R. Brown*. It contains an alkaloid which was discovered by Haines (1858), but obtained pure by Stenhouse (1864), and has been named *conessine*, *wrightine*, and *kurchicine;* it is white, amorphous, bitter, and readily soluble in alcohol, ether, and dilute acids.

Medical Uses.—Dita-bark and also its alkaloid are said to have been used successfully in *intermittent fever* in the East Indies, where also curare is employed for the same purpose. Harnack's ditaine closely resembles curare in its physiological action, but is said to act much less energetically. According to Cathcart, "the bitter bark of Alstonia constricta, sometimes called native quinine, is in common use by the shepherds in the interior of Southern Australia as a domestic remedy for malarial fevers" (*Am. Jour. Pharm.*, Aug. 1879, p. 405).

ALTHÆA, *U. S.*—Marshmallow-Root.

Radix althææ, P. G.—*Racine de guimauve*, Fr.; *Altheewurzel*, *Eibischwurzel*, G.

The root of Althæa officinalis, *Linné*. Woodville, *Med. Bot.*, 198; Bentley and Trimen, *Med. Plants*, 35.

Nat. Ord.—Malvaceæ.

Origin.—This perennial herb is indigenous to the temperate portion of Northern and Western Asia and to the greater part of Europe, and has been naturalized in the salt-marshes along the coast of New England and New York. For medicinal purposes the root of the cultivated plant is generally employed; and in Europe the leaves, and occasionally the flowers, are likewise used.

Description.—The root is fit for use when 2 or 3 years old; of older roots only the fleshy branches are used, the woody main root being rejected. It is collected early in the spring or in autumn, and deprived of the radicles and of its brown-yellow cork and outer bark by peeling. It forms nearly cylindrical somewhat tapering, pieces about 3 to 8 inches (7 to 20 Cm.) long, and about ½ an inch (12 Mm.) in diameter. It is of a white color externally and internally, breaks with a short and granular fracture, which is fibrous only in the cortical portion from the long slender bast-fibres, visible also upon the surface of the commercial article and imparting to it a somewhat hairy appearance. The surface shows longitudinal folds, and is marked with the brownish circular scars of the radicles. The transverse section is of a yellowish-white color, exhibits the internal bark, in diameter about one-tenth of the root, and separated by the brown cambium-line from the meditullium, in which ligneous bundles are not discernible with the naked eye. The medullary rays are quite narrow; the bast-fibres are united to small groups, and these arranged somewhat in concentric circles; the wood-bundles consist of a few wood-cells and 3 or 4 ducts marked with circular or elongated dots; the thin-walled parenchyma contains starch with scattered cells containing crystalline clusters of calcium oxalate, and larger cells filled with mucilage. Marshmallow-root has a faint, peculiar aromatic odor and a sweetish mucilaginous taste.

Young and peeled *belladonna-roots* bear some resemblance to marshmallow, but are readily distinguished by the absence of the hair-like bast-fibres upon the surface and by the yellowish wood-bundles which are plainly visible.

The leaves (*Folia althææ, P. G.*) are petiolate, 2 or 3 inches (5 to 8 Cm.) long, roundish-ovate or subcordate, irregularly crenately toothed, and often three- or five-lobed, of a grayish-green color, and both sides velvety-downy with stellate hairs; their taste is mucilaginous.

The medium-sized *flowers* have a nine-leaved downy involucre, 5 sepals and petals, the latter rose-colored and retuse above; stamens numerous, united in a column and with the short claws of the petals; taste mucilaginous.

Constituents.—A. Buchner obtained (1832) from marshmallow-root 37.5 per cent. starch, 35.6 mucilage, 11 pectin, 8 asparagin and sugar, 1.25 fixed oil, 1.8 glutinous matter, 7 cellulose, and 8 phosphate of calcium. Cold water will take up the mucilage, sugar, and asparagin, while the decoction will, in addition thereto, contain starch.

Asparagin, $C_4H_8N_2O_3.H_2O$, was discovered (1805) by Vauquelin and Robiquet in asparagus, and by Bacon (1826) in marshmallow-root. L. A. Buchner obtained it (1862) in a convenient manner by dialyzing the mucilaginous infusion in water and concentrating this solution to the crystallizing point. It forms colorless, inodorous, and nearly tasteless crystals, which are insoluble in strong alcohol and ether. It unites with both acids and alkalies, and when boiled with them is converted into *aspartic* or *amido-succinic acid*, $C_4H_7NO_4$, and ammonia; hence asparagin is *amido-succinamide*. Nitrous acid converts it into malic acid, $C_4H_6O_4$, water, and nitrogen.

Allied Species.—Nearly all the plants of the natural order Malvaceæ possess mucilaginous properties, and many are employed in their native countries in regular or domestic practice. The following appear to deserve a passing notice:

ALTHÆA TAURINENSIS, *De Candolle*, of Southern Europe, has a rather woody root, which is used like marshmallow-root.

ALTHÆA (ALCEA, *Linné*) ROSEA, Cavanilles, Hollyhock, *E.*: Rose-trémière, Passe-rose, *Fr.*: Stockrose, Stockmalve, *G.*, is indigenous to the Levant, frequently cultivated in gardens. The flowers, *Flores malvæ arboreæ*, are nearly sessile, 3 or 4 inches (7 to 10 Cm.) in diameter, have a tomentose calyx, a six-cleft involucre, and 5 broad or retuse petals, which are connected at the base with the column of the united stamens. The purple-colored flowers are generally preferred.

MALVA SYLVESTRIS, *Linné*, High mallow, *E.*: Mauve sauvage, Grande mauve, *Fr.*: Käsepappel, Waldmalve, *G.* It is a native of Europe, somewhat naturalized in North America, has an erect or decumbent stem, about 2½ feet (.75 M.) high, roundish-reniform and sharply five- or seven-lobed and crenately-toothed leaves, and purplish, dark-veined flowers, which resemble the preceding, but are only 1 inch (25 Mm.) wide, and have a pubescent three-leaved involucre. The dried flowers, *Flores malvæ (vulgaris)*, P. G., are bluish, and turn green with ammonia and red with acids.

MALVA VULGARIS, *Fries*, s. M. neglecta, *Wallroth*, resembles the preceding, but the stem is procumbent, the leaves are smaller and obtusely lobed, and the petals rose-colored or whitish. The leaves of this and the preceding species constitute the *Folia (herba) malvæ*, P. G.; *Mallow-leaves*, E.; *Feuilles de mauve*, Fr.; *Malvenblätter*, G.

MALVA ROTUNDIFOLIA, *Linné*, Common mallow, *E.*: Petite mauve, *Fr.*: Käsekraut, *G.*, is indigenous to Europe, extensively naturalized in America; has a procumbent stem, round heart-shaped somewhat lobed and crenate leaves, whitish flowers with slightly retuse rather short petals, and numerous wrinkled one-seeded carpels circularly arranged.

Hibiscus (Abelmoschus, *Guillemin et Perrottet*) esculentus, *Linné*, Okra or Gombo. Bentley and Trimen, *Med. Plants*, 36. It is indigenous to tropical Africa, and cultivated in most tropical and subtropical countries. The heart-shaped about five-lobed toothed leaves and the unripe capsules are used. The latter are about 2½ and sometimes 10 inches (6–25 Cm.) long, pentagonal, narrow cylindrical, tapering above, hairy, often curved, and contain many roundish reniform seeds.

Abelmoschus moschatus, *Moench*, s. Hibiscus Abelmoschus, *Linné*, indigenous to India and Egypt, naturalized in tropical America, yields *Semen abelmoschi, s. Grana moschata—Musk-seed*, E.; *Ambrette, Graine de musc*, Fr.; *Moschuskoerner, Bisamkoerner*, G. These seeds are flattish reniform, about ⅛ inch (3 Mm.) long, grayish-brown, concentrically striate, blackish at the hilum, internally whitish and oily, and have a thin endosperm and curved embryo. The strong musk-like odor resides in the testa, and becomes more apparent on rubbing or warming. The seeds are used in perfumery as a substitute for musk.

Abutilon avicennæ, *Gærtner*, s. Sida Abutilon, *Linné*, indigenous to India and China, naturalized in Europe and America, is known here as *velvet leaf*, and has roundish heart-shaped, pointed, irregularly toothed, pale-green, velvety leaves and yellow flowers.

Pharmaceutical Uses.—Powdered marshmallow-root, being very absorbent, is advantageously used to impart to soft pill-masses the proper consistence.

Off. Prep.—Syrupus Althææ, *U. S.*

Species emollientes, *P. G.* A mixture of equal parts of bruised marshmallow-leaves, mallow-leaves, melilot, German chamomile-flowers, and flaxseed.

Species ad gargarisma, *P. G.* 1872. A mixture of equal parts of cut marshmallow-leaves, mallow-flowers, and elder-flowers.

Species pectorales, *P. G.*; Pectoral tea, *E.*; Espèces pectorales, *Fr.*; Brustthee, *G.* A mixture of thinly-cut marshmallow-root 8 parts, peeled liquorice-root 3 parts, orris-root 1 part, colt's-foot leaves 4 parts, mullein-flowers and anise each 2 parts.—*P. G.* Equal parts of the flowers of mallow, marshmallow, mouse-ear, colt's-foot, red poppy, violet, and mullein.—*F. P.* Although composed of seven flowers, it is known in France as *quatres-fleurs*.

Species pectorales cum fructibus, *P. G.* 1872. A mixture of pectoral tea 16 parts, cut St. John's bread 6 parts, pearl barley 4 parts, and cut figs 3 parts.

Medical Action and Uses.—Marshmallow is an emollient protective, and is somewhat nutritious. It is employed in Europe as a *demulcent* in all inflammatory and irritable conditions of the mucous membrane of the respiratory, digestive, and urinary organs, and poultices formed of the bruised or powdered root are applied to local *inflammations of the skin*. The decoction has been used as an injection to allay irritation of the *vagina* and of the *rectum*. It is prepared by adding the sliced root to hot water, to the production of a mucilage of the required thickness. The root is made use of in France, as orris-root is elsewhere, for teething children to bite upon. The so-called marshmallow paste contains no marshmallow. All the other plants above enumerated may be used, like marshmallow, as demulcents.

ALUMEN, *U. S., P. G.*—Alum.

Aluminii et Potassii Sulphas, U. S. 1870; *Sulphas aluminico-potassicus.—Potassa Alum, Sulphate of aluminium and potassium*, E.; *Alun, Sulfate d'alumine et de potasse*, Fr.; *Alaun, Kalialaun*, G.

Formula $K_2Al_2(SO_4)_4 24H_2O$. Molecular weight 948.

Alumen, Br.; *Aluminii et ammonii sulphas, Sulphas aluminico-ammonicus.—Alum, Ammonia alum*, E.; *Alun ammoniacal*, Fr.; *Ammoniakalaun*, G.

Formula $(NH_4)_2Al_2(SO_4)_4 24H_2O$. Molecular weight 906.

Origin.—Alums are compound sulphates, readily crystallizing in cubes and octahedrons of the regular system, and containing 24 molecules of water of crystallization, and 2 atoms each of a univalent and trivalent basylous radical. The most important trivalent radicals which are capable of forming alums are aluminium, chromium, and iron, and the univalent radicals potassium, sodium, and ammonium. Ordinarily, the name *alum* is indiscriminately used for the aluminio-ammonium and for the aluminio-potassium alum, both kinds being recognized as such by the British Pharmacopœia, while the United States, French, and German Pharmacopœias recognize the latter only.

Salts possessing a styptic taste (among them alum) were known and employed in ancient times. In the Lipari Islands it appears to have been found as the product of disintegration of alum-stone and alum-slate, and in the sixth century B. C. it was employed by the Phœnicians in dyeing. But the ancient Greek name, *stypteria*, and the Latin, *alumen*, were given alike to various minerals and different products, and afterward the latter were insufficiently distinguished for many centuries. The earthy constituent of alum was by Marggraf (1754) first shown to be distinct from lime. Agricola and Libavius in the sixteenth century had recognized the necessity of using putrid urine (ammonia compounds) for the production of alum. Marggraf had observed that alumina and sulphuric acid would not produce alum until after the addition of potash; but the existence of alkali in alum was first proven by Lavoisier (1777), and by Chaptal and Vauquelin (1797), the latter showing that either potash or ammonia may be present. Soda alum was first prepared by Macintosh at the beginning of the present century. The exact composition of alum was further determined by Vauquelin, Thénard, Berzelius, and others.

The minerals most largely used in the manufacture of alum are *alum-stone*, or *alunite*, and *alum-slate*. The former contains aluminium and potassium sulphates and aluminium hydrate; the latter consists mainly (about two-thirds) of clay or aluminium silicate, the remainder being pyrites (sulphide of iron) and bituminous matter, together with small quantities of lime, manganese, etc.

Preparation.—When calcined clay containing but little iron (pipe-clay) is treated with sulphuric acid until a pasty mass is obtained, this, on exposure to the air, will be gradually converted into sulphate of aluminium, which needs merely to be mixed, while in solution, with ammonium or potassium sulphate to obtain crystals of alum. Previous to calcination the clay is often mixed with 12 to 15 per cent. of charcoal or coke, after which the combination with the sulphuric acid is more readily effected. This is one of the processes employed in the United States, where alum is also made from cryolite by heating it with strong sulphuric acid, washing with a little cold water, dissolving the aluminium sulphate in hot water, and adding potassium or ammonium sulphate.

To prepare alum from alum-stone, this is calcined and then made into heaps, which are kept moist; after several months it has become disintegrated and converted into alum, which is extracted by water and crystallized.

Alum-slate or shale is broken up and made into heaps, which are exposed to the air for several months or years; or, if the mineral be very hard, it is first subjected to a process of slow roasting by stratifying it with wood or coal, setting fire to the heaps, and covering it more or less in order to prevent too great a rise of temperature. During the exposure the sulphur of the pyrites is oxidized to sulphuric acid, aluminium and iron sulphates being formed, which are obtained in solution by lixiviating the heaps with water. This solution is concentrated, and while hot mixed with potassium chloride, which, reacting with the ferric sulphate, yields potassium sulphate and ferric chloride, the latter remaining in solution in the mother-liquor, from which the alum separates on cooling as a crystalline powder. If the lixivium of the alum-heaps does not contain sufficient ferric sulphate, the chloride of potassium is partly replaced by the sulphate. It is obvious that by this process potassa alum is obtained, or ammonia alum if the corresponding ammonium compound is substituted for the potassium salt. The alum is purified by one or two recrystallizations, the last one being performed in large vats which can be taken apart.

The potassium chloride necessary in this process is obtained as soap-boiler's waste and as the refuse of saltpetre-refineries. The ammonium sulphate is cheaply obtained from the liquor of gas-works.

Alum is extensively manufactured in the United States, but its consumption in the arts is so great that over 8,500,000 pounds of the different commercial kinds were imported in 1878, the importation having been reduced since 1880 to less than 2,500,000 pounds.

Properties.—The two officinal alums are similar in every respect, except that the ammonia alum gives the odor of ammonia on the addition of an excess of hydrate or carbonate of potassium, and, when heated to full redness, leaves finally alumina. Potassa alum, at a white heat, leaves a mixture of alumina and sulphate of potassium; but if mixed with one-third its weight of sugar or similar organic matter, the mixture carbonized and afterward heated to redness in a flask, contact with air being avoided, a powder known as *Homberg's pyrophorus* is obtained, which consists of an intimate mixture of alumina, charcoal, and potassium sulphide, and which ignites spontaneously on exposure to the air.

Alum crystallizes in colorless, inodorous, transparent regular octahedrons, which are usually combined with the cube. Its specific gravity is 1.724—of ammonia alum, only 1.631. It has an acidulous sweetish and astringent taste, and a strongly acid reaction to test-paper. Its aqueous solution dissolves iron, zinc, and other metals which are soluble in diluted sulphuric acid, with the evolution of hydrogen. It is insoluble in alcohol or ether, effloresces slightly on exposure to the air, losing at 40° C. (104° F.) 2.7 per cent., and at 47° C. (116.6° F.) 9.6 per cent. of water; when heated to about 92° C. (197.6° F.) it fuses in its water of crystallization (45.57 per cent.), and after this has evaporated at a higher heat solidifies again. (See ALUMEN EXSICCATUM.) Ammonia alum loses all its water of crystallization (47.6 per cent.) at above 205° C. (401° F.), but potassa alum persistently retains a little water when heated to 280° C. (536° F.). At a full red heat both are decomposed, but to effect the complete decomposition of potassa alum a white heat is required, when sulphuric and sulphurous anhydride and oxygen are given off. According to Poggiale (1843), 100 parts of water dissolve at—

	0°	10°	20°	30°	40°	50°	80°	100° C.	
Ammonia alum,	5.22	9.16	13.66	19.29	27.27	36.51	103.08	421.9	parts.
Potassa alum,	3.9	9.52	15.13	22.01	30.92	44.11	134.47	357.48	“

The determinations made by Mulder (1864) closely agree with those of Poggiale for ammonia alum, but differ considerably for potassa alum. 1 part of the latter, according to Redtenbacher (1865), dissolves at 17° C. (62.6° F.) in 7.41 parts, and according to Poggiale, at 20° C. (68° F.) in 6.61 parts, and at 10° C. (50° F.) in 10.5 parts of water; this last figure is given by both the United States and German Pharmacopœias as the solubility of alum at 15° C. (59° F.), while Mulder's results at the same temperature are 10.9 parts.

Tests.—The alkalies and alkaline carbonates precipitate white gelatinous hydrate of aluminium, which is insoluble in ammonia and the carbonated alkalies, but dissolves in an excess of caustic soda and potassa. Commercial alum always contains a little iron, from which it cannot be completely freed by recrystallization. It is owing to its presence that solutions of alum become blue on the addition of ferrocyanide of potassium, and yield a grayish precipitate with sulphydrate of ammonium. The limit of this impurity is thus ascertained: “A solution of 1 Gm. of alum in 30 Ccm. of water should not assume more than a bluish coloration on the addition of a drop of test solution of ferrocyanide of potassium.”—*U. S.* The German Pharmacopœia, which requires alum to be free from iron, very properly directs the testing to be done at ordinary temperature, and limits the time for the non-appearance of a bluish color to 10 minutes; the reagent is gradually, and on heating rapidly, decomposed by alum solution, with the production of a green and blue color. The solution of alum in caustic potassa or soda should not give off the odor of ammonia (absence of more than traces of ammonia alum), nor should it yield a precipitate with sulphuretted hydrogen or sulphide of ammonium (absence of zinc and other metals).

Pharmaceutical Uses.—For the preparation of Alumen exsiccatum, Aluminii hydras, and other aluminium compounds.

Physiological Action.—Primarily, alum constringes all organic fibres, and hence tends to diminish blood-supply and secretion in living parts; but, secondarily, it increases both as a result of its continued use. This operation it is of the utmost importance to remember in its therapeutical applications. It is said to exert a destructive action upon the enamel of the teeth. Alum is absorbed from the stomach, and is found in the urine, liver, and spleen (Orfila); but its local action is that of an irritant, whereby it readily excites vomiting when freely administered. Its operation is not violent, however, and it does not occasion nausea. In other words, it is a mechanical emetic.

Medical Uses.—Alum is of advantage in several *hæmorrhages*, and particularly in those of a passive type. Thus, in gastric and intestinal hæmorrhage its efficacy will depend upon whether the blood is rapidly or slowly extravasated; in pulmonary hæmorrhage, which is generally active, its efficiency is not very great; while in *menorrhagia* and *hæmaturia* it is appropriately and beneficially employed. In various *fluxes* its astringent operation is advantageous. In *gastric* and *intestinal catarrh* it represses the secretion of mucus, and the vomiting or diarrhœa that results therefrom. The *diarrhœa* of *typhoid fever* is better treated by alum than by any other astringent, except, perhaps, acetate of lead. In chronic *dysentery* it is a valuable remedy for occasional use, and even in the acute form of the disease alum enemata have been found efficient. In other fluxes it may lessen the discharge, as in *diabetes*, but its utility is not very great. In *diabetes insipidus* or *polyuria* it would probably be more useful. Formerly, it had much repute in chronic *bronchial fluxes*, and it is still found advantageous in diminishing excessive secretion from the air-passages. and not merely in chronic but also in acute bronchitis, and especially in that form which occurs as an element of *whooping cough* and is attended with a profuse expectoration of ropy mucus. Strangely enough from a rational point of view, some forms of *constipation* are favorably affected by alum, as that in which the condition depends upon atony of the bowels maintained by habitual distension of them by flatus. It is still more singular that in *lead colic*, a disease in which the intestine is spasmodically contracted, alum has been proved efficient in overcoming the constipation. For this purpose it should be given in doses of from 1 to 3 drachms (Gm. 4–12) daily, dissolved in a large quantity of water slightly acidulated with sulphuric acid. As an emetic, alum may be employed whenever mechanical emetics are indicated, and particularly in *pseudo-membranous laryngitis*, or true *croup*, a disease in which such emetics are peculiarly indicated, but in which nauseants are exceedingly mischievous. In *narcotic poisoning* similar evacuants are indicated, and none is better than alum, especially in children. It probably operates not only as an emetic, but by its astringent action on the gastric mucous membrane it checks the absorption of the poison. Alum is one of the many remedies that occasionally cure *intermittent fever*, even after the failure of quinia. It is still used in India, where burnt alum is preferred, and given in doses of 8 grains (Gm. 0.50) 3 hours before the expected paroxysm.

The topical uses of alum are numerous. It is extensively employed to arrest *hæmorrhage*. As a local hæmostatic it is used to check bleeding from the nostrils, gums, anus, vagina, bladder, and rectum, from leech-bites and from the sockets of extracted teeth, etc. In all such cases it may be applied in powder, or in a strong solution upon sponge or lint. The solution should be used warm, and allowed to cool where it is applied. Lotions of alum-water are useful in repressing local and general *sweats*, and particularly the fetid secretions of the feet, armpits, etc.; the solution should not be strong, and should be applied warm; it is improved by the addition of salicylic acid. In *ophthalmia* a solution of 4 or 5 grains (Gm. 0.25) to the ounce of water may be instilled into the eye, but a much better method is to apply a poultice made by stirring finely-powdered alum and white of egg together, and enclosing the coagulated albumen in a cambric bag. This application is a most excellent one for recent *ecchymoses*. *Aphonia* from laryngeal atony is diminished by gargles of a drachm of alum in 2 or 3 ounces (Gm. 4 in Gm. 100) of barley-water; and the same remedy is of constant use for the relief of *sore throat*, especially of that form of *tonsillitis* in which the soft parts are tumid. In the graver forms of *angina*, and especially in *diphtheria* and *gangrenous pharyngitis*, gargles, insufflations, and atomized solutions of alum have been much employed; they probably tend to promote the separation of the exudation, if not to check its formation. As far as the local treatment of the diseases in question goes, alum is useful, although less so than other agents; but they, and especially diphtheria, are not local affections, and cannot be cured by such treatment merely. Alum washes are useful in all the forms of *stomatitis*, but especially in the ulcerative form. In subacute, in mild acute, and in chronic *laryngitis* gargles containing alum are of decided advantage, but the medicine is still more useful when it is applied to the interior of the larynx in an atomized solution. Finely-powdered alum or burnt alum is one of the best applications for *ingrown teeth*, as when a posterior molar tooth of the lower jaw becomes partially covered by the gum, subjecting it to contusion and irritation and producing a very painful sore. The overhanging flesh should be first cut away with a gum-lancet. In the analogous affection, *ingrown toe-nail*, the same application is of great use if ulceration with granulation has already taken place; but it is essential that scraped lint should be introduced between the nail and the sore, and that the movement of the parts should be restricted by a narrow roller of adhesive plaster. The stimulant and astringent action of alum makes it a useful application in *chilblains*. In all cases of morbid and exuberant action of mucous membranes, besides those above noticed, alum renders important services. For indolent *ulcers*, whether arising from *burns* or otherwise, and for all profuse mucous and purulent discharges from mucous membranes, when the inflammatory element is not active and the parts are relaxed, it is one of the best remedies. Its efficacy is shown conspicuously in cases of *relaxation* of the *gums*, *uvula*, *pharynx*, *vagina*, and *anus*. In vaginal *leucorrhœa* alum injections are better than any others, and washes of the same in leucorrhœa of the vulva. In the former of these two affections a tampon of cotton coated with finely-powdered alum may be applied by means of a speculum, or a cylinder of cotton cloth saturated with a solution of alum, of which the strength should vary with the grade of inflammation present. Injections of a solution of alum may be used in the treatment of *gonorrhœa* and *gleet* in the male, a weak solution being generally the most efficient. Some physicians, however, give a preference to a saturated solution. A mixture of alum, mucilage, and sulphuric ether has been applied to carious cavities for the relief of *toothache*.

Administration.—Alum may be administered internally in doses of from 5 to 40 grains (Gm. 0.30–2.60), mixed with powdered sugar or with syrup. A few grains of some aromatic prevent its nauseating effects. The emetic dose is from 1 to 2 drachms (Gm. 4–8), given in syrup; when retching commences vomiting may be promoted by warm water. *Alum whey* is made by boiling 2 drachms (Gm. 8) of powdered alum in a pint of milk, and straining; the *curd* left behind is applicable to the purposes already mentioned, and may be prepared with white of egg instead of milk. Alum *gargles* are made with from half an ounce to an ounce (Gm. 15–30) of alum in a pint of water, which may be sweetened with honey. For *collyria* a solution of 2 or 3 grains (Gm. 0.10–0.20) of alum in an ounce of water is usually sufficient; for *hæmostatic* uses a hot saturated solution is preferable.

"*Acetate of alumina*" has been proposed for antiseptic purposes as a substitute for carbolic acid (*Times and Gaz.*, May, 1880, p. 506).

ALUMEN EXSICCATUM, *U. S., Br.*—DRIED ALUM.

Alumen ustum, P. G.—*Burnt alum*, E.; *Alun calciné*, *A. desséché*, *A. brulé*, Fr.; *Gebrannter Alaun*, G.

Formula $K_2Al_2(SO_4)_4$. Molecular weight 516.

Preparation.—Alum, in small pieces, 183 parts; to make 100 parts. Expose the alum for several days to a temperature of about 80° C. (176° F.), until it has thoroughly effloresced. Then place it in a porcelain capsule and gradually heat it to a temperature of 200° C. (392° F.), being careful not to allow the heat to rise above 205° C. (400° F.). Continue heating at the before-mentioned temperature until the mass shall have become white and porous, and weighs 100 parts. When cold, reduce it to a fine powder and preserve it in well-closed vessels.—*U. S.*

Heat 4 ounces of potassium alum in a porcelain dish or other suitable vessel till it liquefies; then raise and continue the heat, not allowing it to exceed 400° F., till aqueous vapor ceases to be disengaged and the salt has lost 45 or 46 per cent. of its weight. Reduce the residue to powder, and preserve it in a well-stoppered bottle.—*Br.*

The first process is identical with that of the German Pharmacopœia, except that the latter permits the heating of alum only to 160° C. (320° F.); but since potassa alum is not decomposed short of a red heat, the limiting of the temperature, as directed, is not necessary: the final product of the U. S. Pharmacopœia retains about .5 per cent., that of the German Pharmacopœia (5.5 parts from 10 parts of alum) about 1.5 per cent., of water. Ammonia alum parts with 45 per cent. of its water at 190° C. (374° F.), and with all its water at 205° C. (401° F.); if carefully dried, so as to retain about .6 per cent. of water, the salt will not be decomposed.

Properties.—After exsiccation, dried alum forms a light porous mass which is easily rubbed into a white granular powder. It is very slowly (but completely) soluble in cold water, but dissolves in a short time in 1.5 times its weight of boiling water, these tests being sufficient to prove its faultless preparation. Owing to its slow solubility its taste is at first slight, but soon becomes more styptic than that of crystallized alum. *Impurities* may be detected in the same manner as in alum.

Medical Uses.—Dried alum is a powerful astringent and stimulant, and when applied to tissues in process of growth may become escharotic. Hence, as was more particularly pointed out in the preceding article, it is used to repress *fungous granulations* and stimulate indolent and sanious *ulcers*, as well as mucous membranes tending to hypertrophy, with morbid secretion. Powdered dried alum is peculiarly fitted for insufflation.

ALUMINII HYDRAS.—HYDRATE OF ALUMINIUM.

Alumina hydrata, P. G. 1872; *Argilla pura s. hydrata.*—*Aluminium hydroxide*, *Hydrated alumina*, E.; *Hydrate d'alumine*, Fr.; *Thonerdehydrat*, G.

Formula $Al_2(HO)_6$. Molecular weight 156.

Origin.—Aluminium hydrate is occasionally found native, forming the rare crystalline minerals *gibbsite*, $Al_2(HO)_6$, of North America, and *diaspore*, $Al_2(OH)_2O_2$, of Eastern Europe. For use in medicine it is prepared by precipitating the solution of an aluminium salt with an alkali or alkaline carbonate. Alumina is more frequently found in the ashes of cryptogamous plants than in those of phænogams.

Preparation.—Alum 11 parts; Carbonate of Sodium 10 parts; Distilled Water a sufficient quantity. Dissolve each salt in 150 parts of distilled water; filter the solutions and heat them to boiling. Then, having poured the hot solution of carbonate of sodium into a capacious vessel, gradually pour in the hot solution of alum with constant stirring, and add about 100 parts of boiling distilled water. Let the precipitate subside, decant the clear liquid, and pour upon the precipitate 200 parts of hot distilled water. Again decant, transfer the precipitate to a strainer, and wash it with hot distilled water until the washings give but a faint cloudiness with test solution of chloride of barium. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.). and reduce it to a uniform powder.—*U. S.*

On mixing solutions of sodium carbonate and alum a decomposition takes place, resulting in the formation of sodium sulphate and potassium sulphate, which remain in solution; aluminium hydrate, which is precipitated; and carbonic acid gas, which escapes; $3Na_2CO_3 + Al_2K_2(SO_4)_4 + 3H_2O$ yield $3Na_2SO_4 + K_2SO_4 + Al_2(HO)_6 + 3CO_2$. If ammonia alum be used, ammonium sulphate remains in solution in place of potassium sulphate; the sodium carbonate may be replaced by an equivalent quantity of potassium or ammonium carbonate. On adding the alkaline carbonate to the alum solution the precipitated aluminium hydrate persistently retains sulphuric acid and alkali; but on slowly adding the alum solution to the alkaline carbonate, so that the latter remains continually in excess, only a minute amount of basic sulphate will enter into the precipitate, and will be almost completely decomposed by digesting the latter with the alkaline liquid. In order to obtain it absolutely free from sulphate, Berzelius found it necessary to redissolve the washed aluminium hydrate in hydrochloric acid, and to precipitate this solution with an excess of ammonia. The quantity of sodium carbonate ordered by the pharmacopœia is less than .5 per cent. in excess of the theoretical quantity of the pure salt, and, in the presence of a small amount of impurity, may prove inadequate for the complete decomposition of the alum; it is therefore advisable to use a partly effloresced carbonate, so that the mixed liquids after digestion may have a distinct alkaline reaction. For the decomposition of ammonia alum an equal weight of crystallized sodium carbonate is required. For the washing of the precipitate hot (not boiling) water is directed—a precaution necessary to avoid decomposition of the hydrate. Sainte-Gille (1855) determined that by prolonged contact with boiling water the hydrate, $Al_2(HO)_2O_2$, is formed, which is insoluble in dilute acids. Drying the aluminium hydrate at a low temperature leaves it in a smooth condition and prevents it from getting gritty. Most of the details of the above process were elaborated by Prof. Lloyd (1879). The yield is 1.8 parts.

Nearly pure aluminium hydrate is prepared from cryolite. The sodium aluminate obtained in the manufacture of sodium carbonate (see SODII CARBONAS) is treated with milk of lime, resulting in the production of sodium hydrate and a precipitate of calcium aluminate (see SODA); on dissolving a portion of the latter in hydrochloric acid, chlorides of aluminium and calcium are formed, and this solution, on being digested with another portion of the precipitate, yields more calcium chloride, which remains in solution, and aluminium hydrate; $Al_2Cl_6 + Al_2(O_2Ca)_3 + 6H_2O$ yield $3CaCl_2 + 2Al_2(HO)_6$.

Properties.—Aluminium hydrate is "a white, light, amorphous powder, permanent in dry air, odorless and tasteless, and insoluble in water or alcohol; soluble, without residue, in (dilute) hydrochloric or sulphuric acid, and also in solution of potassa or of soda. When heated to redness it loses 34.6 per cent. of water of hydration."—*U. S.* A portion of the water is given off already at a temperature a little above 100° C. (212° F.), but for expelling the last 10 or 12 per cent. of it a full red heat is required, when *aluminium oxide*, Al_2O_3, is obtained. Its solution in a mineral acid is not precipitated or colored by hydrosulphuric acid, and shows toward alkalies and alkaline carbonates the behavior described under ALUMEN. When added to a turbid or colored liquid, the impurities suspended and the coloring matter contained therein are precipitated; freshly-precipitated aluminium hydrate (*alumine engelée*, Fr.) is best adapted for this purpose; hence its use for the clarification of vegetable juices and the preparation of *lakes*, which consist of aluminium hydrate united with and tinged by pigments.

Tests.—Aluminium hydrate is liable to be contaminated with alkaline carbonate or sulphate and a trace of iron derived from the alum; zinc and other metals can only be present through great carelessness. The allowable limits of these impurities are thus ascertained: "A solution of 1 Gm. of hydrate of aluminium in 30 Ccm. of diluted hydrochloric acid should not be colored blue by a drop of test solution of ferrocyanide of potassium (iron), and should not give more than a faint cloudiness with test solution of chloride of barium (limit of sulphate). When dissolved in solution of potassa or of soda it should yield no precipitate with test solution of sulphide of ammonium (zinc or lead). When finely-powdered hydrate of aluminium is boiled with 20 parts of water and filtered, the filtrate should not leave more than a slight residue on evaporation (limit of salts of alkalies)."—*U. S.* The presence of calcium compound is determined by dissolving the aluminium hydrate in diluted hydrochloric acid, precipitating the solution with an excess of ammonia, adding to the filtrate ammonium carbonate, and boiling, when carbonate of calcium and of other alkaline earths will be precipitated.

Allied Compounds.—Corundum, *E.*, Corindon, *Fr.*, Korund, *G.*, is a mineral consisting of Al_2O_3. It varies in color, forms rhombohedric crystals, is nearly as hard as diamond, and has the specific gravity 3.9. Transparent varieties of it are the gems *ruby* (rubis, *Fr.*, Rubin, *G.*), which is colored red by chromium; the *sapphire* (saphir, *Fr.*, *G.*), which is blue, or if yellow is known as *Oriental topaz*, if green as *Oriental emerald*, and if violet-colored as *Oriental amethyst.* A coarse variety of corundum is known as—

Lapis smiridis, s. smyris; Emery, *E.;* Emeril, Corindon granuleux ferrifère, *Fr.;* Smirgel, Schmirgel, *G.* Its English and French names are derived from Cape Emeri on the island of Naxos, where the mineral has been mined from ancient times. It is also found in other parts of Europe and in the United States. Owing to its hardness, it is largely employed for cutting and polishing glass, metals, and other hard substances, and is prepared for this purpose by crushing under stampers, sifting, and, for delicate operations, by elutriation. Its color varies between gray, bluish, and brown.

The metal *aluminium* was first obtained by Woehler (1827) by fusing aluminium chloride together with potassium. St. Claire-Deville (1854) was enabled to prepare it in larger quantities by heating a mixture of 100 parts of aluminium sodium chloride, 35 parts of sodium, and 40 parts of cryolite. Pure aluminium resembles tin in appearance; its specific gravity varies between 2.50 and 2.79. It is very ductile, melts at about 700° C. (1292° F.), is not volatile, and is not tarnished on exposure, even at an elevated temperature; but in the form of powder or thin foil it burns to alumina when heated in oxygen, and slowly evolves hydrogen with boiling water.

Action and Uses.—*Hydrate of aluminium* appears to resemble the oxide of bismuth and also magnesia in its action and uses. Like the former, it is absorbent and protective, and, like the latter, antacid. It is suitable for the treatment of *dyspepsia* and of *diarrhœa* when they depend upon an excess of acid in the digestive canal. In Germany it is used in infantile disorders of the stomach and bowels. It may be given in doses of from 3 to 6 grains (Gm. 0.20–0.40). It may be applied externally as a substitute for oxide of zinc, oxide of bismuth, and similar protectives in cases of *intertrigo, superficial burns*, etc.

ALUMINII SULPHAS, *U. S.*—Sulphate of Aluminium.

Aluminium sulfuricum, P. G.—*Sulfate d'alumine*, Fr.; *Aluminiumsulfat*, *Schwefelsaure Thonerde*, G.

Formula (crystallized) $Al_2(SO_4)_3 18H_2O$. Molecular weight 666.

Preparation.—Aluminium sulphate is occasionally found as an efflorescence near volcanoes and upon alum-slate. For medicinal use it should be prepared from aluminium hydrate, which need not be previously dried, by dissolving it in the requisite quantity of dilute sulphuric acid. 6 parts of strong sulphuric acid, diluted with 35 to 40 parts of water, will be sufficient for combining with the aluminium hydrate obtained by the process described under Aluminii Hydras from 19 parts of ammonia alum or 20 parts of potassa alum; the gelatinous hydrate will dissolve quite readily. The solution is filtered, and evaporated until a pellicle begins to form, when the vessel should be removed to a water-bath and the evaporation continued until a dry salt remains. Several soluble and insoluble basic aluminium sulphates being known to exist, an excess of aluminium hydrate should be avoided. Quite as objectionable, or still more so, is an excess of sulphuric acid; the total absence of uncombined acid is readily ascertained by testing the clear solution with sodium hyposulphite, when it should not become turbid by the separation of sulphur, and should not evolve sulphurous acid gas.

For use in the arts sulphate of aluminium is prepared by heating ammonia alum to a dull-red heat, when the ammonium sulphate is decomposed and expelled, leaving anhydrous aluminium sulphate; or it is made from shale and other aluminous silicates, and is known to dyers as *concentrated alum* or *cake-alum.*

Properties.—Sulphate of aluminium may, with some difficulty, be obtained in thin pearly lamellar crystals, but usually forms a white crystalline mass or granular powder. It melts readily in its water of crystallization, and loses it completely when heated to between 150° and 200° C. (302° and 392° F.), leaving 51.4 per cent. of a light porous mass, consisting of the anhydrous salt, $Al_2(SO_4)_3$. When heated to bright redness, oxygen and sulphuric acid are given off, and alumina is finally left. The salt is quite freely soluble in water, the solution having an acid reaction to test-paper: according to Poggiale (1843), 100 parts of water dissolve—

At	0°	10°	20°	30°	40°	50°	60°	80°	100° C.
in	86.85	95.8	107.35	127.6	167.6	201.4	262.6	467.3	1132 parts.

Anhydrous aluminium sulphate is less freely soluble in water. The dilute aqueous solution of the crystallized salt is precipitated by alcohol in pearly flakes, having the composition $Al_2(SO_4)_3 10H_2O$, which, according to Hauer (1854), attract water on exposure to a damp atmosphere and are converted into the officinal salt. This has an acid, styptic, and, at the same time, sweetish taste. Its aqueous solution shows the presence of sulphuric acid by barium chloride; it is precipitated by caustic potassa or soda, the precipitate being soluble in an excess; and this alkaline solution is not affected by sulphuretted hydrogen (absence of zinc, manganese).

Tests.—The salt generally contains a small quantity of sodium or other alkaline sulphate, and often a trace of iron, derived from the alum. The allowable limits of these impurities are thus determined: "A solution of 1 Gm. of the salt in 30 Ccm. of water should not give more than a faint blue coloration with a drop of test solution of ferrocyanide of potassium (limit of iron). If 1 Gm. of the salt be dissolved in 50 Ccm. of water, a slight excess of water of ammonia added, the liquid heated until all odor of ammonia has disappeared, and then filtered, the precipitate well washed with water, and the filtrate and washings evaporated to dryness and gently ignited, the residue should not weigh more than 0.05 Gm. (absence of more than 5 per cent. of sulphates of alkalies)."—*U. S.* The sulphates of sodium and potassium are readily detected by this test, but not ammonium sulphate, which is likely to be present if ammonia had been used in the preparation of aluminium hydrate; more than minute traces of this impurity are detected by adding to a warm strong solution of the salt, contained in a long test-tube, an excess of potassa or soda solution, when the ammonia may be recognized by its odor, its reaction upon moistened red litmus-paper, and by the white vapors produced on the approach of a glass rod previously dipped into hydrochloric or acetic acid.

Other Preparations of Aluminium.—Aluminii Acetas. Acetate of aluminium, *E.:* Acétate d'alumine, *Fr.;* Aluminium acetat, *G.*, $Al_2 6C_2H_3O_2(+Aq)$.—Prepared by dissolving aluminium hydrate in cold acetic acid, or by decomposing aluminium sulphate with lead acetate, and evaporating at a low temperature, it is obtained as a gum-like mass having an acid reaction and a styptic taste. The solution, heated in presence of other salts, is decomposed, with the separation of basic aluminium acetate.

An impure solution of the salt, containing also sulphate of potassium or ammonium, obtained by mixing the aqueous solutions of 6 parts of sugar of lead and 5 parts of alum, and filtering from the precipitated lead sulphate, is extensively employed in dyeing as a mordant and is serviceable as a disinfectant.

Liquor Aluminii Acetatis (*Acetici*, P. G.). Solution of acetate of aluminium, *E.:* Soluté d'acétate d'alumine, *Fr.;* Aluminiumacetat-Lösung, *G.*—Dissolve aluminium sulphate 300 parts in water 800 parts; add acetic acid (sp. gr. 1.041) 360 parts; triturate calcium carbonate 130 parts with water 200 parts, and add this mixture slowly and with continued stirring to the first solution; set the whole aside for 24 hours without applying heat, and stir occasionally; then strain, press the precipitate without washing it, and filter the liquid. It is a clear colorless liquid, having the spec. grav. 1.044 to 1.046, a faint odor of acetic acid, an acid reaction, and a sweetish astringent taste. On adding to it one-fiftieth of its weight of potassium sulphate and heating it in a water-bath, it coagulates, but after cooling becomes clear again in a short time. The solution is not colored by hydrosulphuric acid, and on being mixed with twice its volume of sulphuric acid becomes opalescent, but does not produce a precipitate. 20 Gm. of the solution mixed with 20 Gm. of water and a few drops of solution of phenolphtalein should require not less than 9.2 to 9.8 Ccm. of normal potassa solution for producing a red color. On precipitating 10 Gm. of the solution with ammonia, .24 to .25 Gm. of alumina should be obtained, proving 7.5 to 8 per cent. of basic aluminium acetate.—*P. G.*

The formula of this compound is $Al_2(HO)_2(C_2H_3O_2)_4$; its molecular weight 324. The above process is more simple, and yields more uniform results, than the one devised by Hager (1871), in which aluminium sulphate was decomposed by basic lead acetate.

Aluminii Nitras. Nitrate of aluminium, *E.:* Azotate d'alumine, *Fr.:* Salpetersaure Thonerde, *G.*—Formula $Al_2(NO_3)_6.18H_2O$. Molecular weight 750. The gelatinous aluminium hydrate obtained from 33 parts of potassa alum or from 31.5 parts of ammonia alum, when dissolved in 20 parts of officinal nitric acid, yields a solution containing 26 parts of this salt; diluted with water to 260 parts, the solution contains 10 per cent. of the salt, which is with difficulty obtained in deliquescent crystals, soluble also in alcohol.

Chloride of Aluminium, in an impure state, has been used to some extent. A solution sufficiently pure for disinfecting purposes is obtained by mixing the solutions of 2 parts of alum and 1 part of anhydrous calcium chloride and filtering from the precipitated calcium sulphate.

The pure salt, Al_2Cl_6, is best prepared by dissolving aluminium hydrate in hydrochloric acid and evaporating carefully, when crystals containing $12H_2O$ are obtained, which are readily soluble in water and alcohol and are decomposed by heat. In the anhydrous state, however, aluminium chloride is volatile.

Ultramarine, *E.*, *Fr.;* Outremer, *Fr.;* Ultramarin, *G.*, is a pigment which was formerly obtained from *lapis-lazuli* or *lazulite*, a mineral found chiefly in Asia, and composed of sulphur compounds and silicates of aluminium and sodium. The preparation of artificial ultramarine was first made known by C. Gmelin in 1828, and about the same time discovered by Guimet. Shortly afterward it was manufactured on a large scale, and its consumption, which was 3,500,000 kilos in 1862 and 8,500,000 kilos in 1872 (R. Hoffmann), was estimated by R. Wagner in 1880 to be 30,000,000 kilos. It is prepared by heating in crucibles a mixture of clay, sodium sulphate, and charcoal nearly to a white heat for several hours. A white compound is first formed, called *white* ultramarine; this passes into *green* ultramarine, which is employed in the arts to a certain extent, but mostly converted into *blue* ultramarine, usually by roasting it in the presence of sulphur. By increasing the amount of silica in the first operation the product acquires a more purplish tint, and by treating these products at an elevated temperature with acids *violet* and *red* ultramarines are prepared. All these compounds are decomposed by acetic acid, which does not affect lazulite. Mineral acids decompose them, separating gelatinous silicic acid, sulphur, and hydrosulphuric acid; red ultramarine evolves sulphurous acid gas on being treated with acids. The exact composition is still unknown. Ultramarine blue is largely used for whiting—that is, neutralizing—the yellow tint of sugar, starch, paper, etc.

Medical Uses.—On account of the acid taste of this preparation it is seldom used alone internally, but is either combined with zinc or is saturated with gelatinous hydrate of aluminium and mixed with the soluble constituents of benzoin. As a topical application a solution of 1 part of the sulphate in about 20 parts of water has been used to promote the healing of ulcers and to correct the fetor of discharges, especially in certain cases of *leucorrhœa* and chronic *dysentery*, and to cure *ulcers* of the cervix uteri. The addition of benzoin to the solution for these purposes also has been recommended. In a concentrated state sulphate of aluminium is a powerful astringent, and in some degree a caustic also. It has been used for destroying exuberant growths, and even *cancerous* tumors. Its free acid corrodes textile fabrics and metals. To mitigate this effect the excess of acid has been neutralized by zinc, and a sulphate of aluminium and zinc formed, which in a pure state acts as a caustic, and either in this condition or mitigated with glycerin may be used to repress fungous granulations, to destroy imperfectly organized tissues and certain hypertrophies, such as *cancers*, vascular *nævi*, and *polypoid* growths, and to stimulate tissues *chronically inflamed*, as those of the nostrils, throat, vagina, rectum, urethra, etc. This double salt has been used for injecting dead bodies, which it preserves unchanged for a long time.

Acetate of aluminium resembles alum in its general astringent action, contracting the tissues and restraining secretion. When 30 or 40 drops of a solution of 1 part of the salt to 8 of water are taken internally a sense of warmth is excited in the stomach, and if the doses are reiterated some fulness of the head and confusion of the senses result. Added to putrescible mixtures, it restrains or prevents putrefaction. It has been used for the same purposes as the sulphate of aluminium, and particularly to deodorize fetid secretions of sweat, pus, mucus, etc. As a lotion or injection 1 part of a 10 per cent. solution mixed with 100 or 200 parts of water may be employed.

The *chloride* is said to be closely analogous to the acetate of aluminium in its action, and may be used for the same purposes. Under the name of *chloralum* a preparation which contains only from 10 to 15 per cent. of chloride of aluminium, besides arsenic and copper as impurities, and which is also said to be a compound of the sulphate and chloride, has been much used of late years as a disinfectant and deodorizer, and as a hæmostatic when applied on cloth or cotton impregnated with it. The cheapness of chloride of aluminium and its freedom from odor fit it well for use in hospitals and private houses.

Nitrate of aluminium has been used in a solution containing 15 or more grains to an ounce (Gm. 1 in Gm. 30) of water as a lotion for the relief of *pruritus vulvæ*.

AMBRA GRISEA.—Ambergris.

Ambra cinerea.—Ambre, Ambre gris, Fr.; *Amber, Graue Ambra*, G.

Origin.—Ambergris is regarded as a morbid product of the sperm whale, Physeter macrocephalus, *Linné*, and is found in its intestines as well as floating on the sea. One whale has been known to yield 750 pounds of this product (*Amer. Jour. Pharm.*, 1859, p. 183).

Description.—It comes in irregular pieces, varying considerably in size, is opaque, of a gray or gray-brown color, with lighter and darker-colored streaks and spots, lighter than water, friable in the cold, but softening when held in the hand. It is of a waxy appearance, fusible in hot water, mixing with melted fats, and soluble in volatile oils, ether, and hot alcohol. It has a peculiar fragrance, is nearly tasteless, and on ignition leaves but little ash.

Composition.—Ambergris consists mainly (about 85 per cent.) of a fatty substance resembling cholesterin, which Pelletier and Caventou have named *ambreïn.* It crystallizes from hot alcohol in white, shining, tasteless, and inodorous needles, which fuse near 35° C. (95° F.). The remaining constituents, according to John (1818), are some balsamic matter, chloride of sodium, benzoic acid (?), and coloring matter.

Adulterations.—Adulterated and fictitious ambergris can be readily recognized by different physical properties.

Pharmaceutical Uses.—*Tinctura ambræ* of the French Codex is prepared by macerating 10 parts of ambergris, which, according to Stanislas Martin, should be finely powdered by trituration with washed sand, in 100 parts of 80 per cent. alcohol. It is often used for fixing very volatile delicate perfumes.

Medical Action and Uses.—Ambergris, like other strongly odoriferous animal products, has been believed to possess a stimulant action upon the nervous and circulatory systems, with a special direction to the generative organs. It was used in *low fevers* and in spasmodic disorders, especially of the *hysterical* sort, and often associated with musk, castor, and valerian. It was prescribed in substance in the dose of from 5 to 20 grains (Gm. 0.30–1.30), or more frequently in ethereal solution. It is seldom if ever employed at the present day as a medicine, but it enters into various perfumes.

AMBROSIA.—RAGWEED.

Ambrosie, Fr.; *Traubenkraut*, G.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This genus comprises coarse-looking rough or hairy weeds, with mostly opposite leaves, and with inconspicuous, yellowish, staminate flower-heads arranged in elongated racemes or spikes, at the base of which one to three staminate flowers are situated in the axils of the leaves. The following two, growing in waste places in North America, have been used:

AMBR. TRIFIDA, *Linné*, attains a height of 8 feet (2.4 M.) or more, and has entire oval or usually deeply-trilobed leaves with the lobes oval lanceolate and serrate.

AMBR. ARTEMISIÆFOLIA, *Linné*, also known as *bitterweed*, *hogweed*, *Roman wormwood*, is about 3 feet (.9 M.) high: its leaves are thinner, smoother, and of a lighter green than the preceding, and twice pinnatifid, with the divisions lanceolate. It grows southward to Brazil.

Both species have a slight and rather fetid odor and a bitter and slightly astringent taste. Ambr. maritima, *Linné*, of Southern Europe, which resembles the last, but is grayish-pubescent, has an agreeable odor and an aromatic bitter taste.

The constituents of these plants have not been investigated.

Medical Uses.—The two species of Ambrosia, like other bitter herbs, have been employed in the cure of *intermittent* fever. Its astringency has caused it to be used to moderate *discharges* of blood and mucus and to palliate mercurial *salivation*; the stimulant qualities attributed to it are supposed to be shown in the *typhoid state* of febrile affections. An infusion of the tops may be made with 3 or 4 drachms to a pint of water (Gm. 10–15 in Gm. 500).

AMMONIACUM, *U. S., Br., P. G.*—AMMONIAC.

Gummi-resina ammoniacum.—*Ammoniacum*, E.; *Ammoniaque*, *Gomme-resine ammoniaque*, Fr.; *Ammoniakgummi*, G.

A gum-resinous exudation from Dorema Ammoniacum, *Don.* Bentley and Trimen, *Med. Plants*, 129, 130.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant, which is of a striking appearance, grows to the height of 6 or 7 feet (2 M.); its leaves are all radical; the hollow stem bears a few long leaf-sheaths, and divides toward the apex into about sixteen ascending branches, upon which the small globular short-stalked umbels are borne, the inflorescence forming a paniculate raceme. The root is rich in milk-juice, which rapidly diminishes in quantity when, in about the fifth year, the stem is produced, after which the plant perishes. The gum-resin exudes from the stem and flowering branches from punctures produced by insects; an inferior kind exudes near the base of the stem among the remnants of the leaf-sheaths, and in the soil considerable quantities of hardened milk-juice are often found which has exuded from fissures in the root produced during the hot season.

This species of Dorema prefers a silicious soil, and occurs abundantly in the deserts and barren regions of Persia and Tartary, usually accompanied by Ferula Scorodosma, the Persian asafetida-plant, but growing farther north and north-east than the latter, extending to the southern shore of the Sea of Aral and nearly to the south-eastern extremity of the Caspian Sea, while its southern limits are near Bahziran in Southern Khorassan (Borszczow, 1860).

It is not impossible that Dorema Aucheri, *Boissier*, a West-Persian plant, but less frequent than the former, may yield some of the commercial ammoniac; but D. robustum, *Loftus*, which is united with the species mentioned by Boissier, affords a gum-resin distinct from ammoniac (*Pharmacographia*).

Description.—The best quality of ammoniac exists in dry tears from $\frac{1}{16}$ to $\frac{1}{2}$ inch (1.5–12 Mm.) in diameter, which are globular or irregularly roundish in shape, often more or less flattened, externally of a pale brownish-yellow and internally milk-white. Their fracture is somewhat conchoidal and of a waxy lustre. The tears sometimes coalesce and form irregular masses, which when broken show the outlines of the individual grains, without any intervening darker-colored mass.

Cake-ammoniac is an inferior quality, and consists of the tears imbedded in the brown gum-resinous mass obtained from the base of the stem; and a kind is occasionally seen in which the tears are not larger than a pin's head and few in number, the greatest bulk consisting of a plastic brown or greenish-brown mass mixed with vegetable fragments and earthy matter.

Ammoniac softens by the heat of the hand and when triturated in a mortar. It has a peculiar odor, which becomes stronger after heating, and a bitter, acrid, and nauseous aromatic taste. Chlorinated lime imparts to it an orange and potassa a yellowish color. On being triturated with water it readily yields a white emulsion, which, on the addition of caustic soda, acquires a yellow, and finally a brown, color. In contact with hydrochloric acid, ammoniac is not changed in color even when heated to 60° C. (140° F.). Warm concentrated sulphuric acid dissolves ammoniac with a blood-red color, and the solution shows no fluorescence on dilution with water and on the addition of alkali (Schlickum). For medicinal purposes the tears only should be used.

African ammoniac, obtained from Ferula tingitana, *Linné*, is not found in our market; it has a faint but more agreeable odor, somewhat like that of benzoin, and an acrid but not bitter taste. Moss (1873) found in it 68 per cent. of resin, 9 per cent. of soluble gum, 19 per cent. of insoluble matter, and 4 per cent. of moisture and volatile principles. Umbelliferon was obtained from it by Hirschsohn (1875). Goldschmiedt (1878), by fusing with potassa, prepared resorcin and an acid, $C_{10}H_{10}O_6$, the aqueous solution of which strikes a beautiful red color with ferric chloride; officinal ammoniacum does not yield such a compound.

Composition.—According to the analyses of Bucholz, Hagen, and Braconnot, ammoniac contains from 1.8 to 4 per cent. of volatile oil, 70 to 72 per cent. of resin, 18 to 22 per cent. of gum, $1\frac{1}{2}$ to 4 per cent. of bassorin or gluten, and about 6 per cent. of moisture. The volatile oil, of which usually only between $\frac{1}{2}$ and 2 per cent. is obtained, is free from sulphur (Moss, 1873), and its solution in alcohol acquires a reddish hue with ferric chloride (*Pharmacographia*). According to Przeciszewki (1861) the gum is nearly identical with gum-arabic, and the resin is a mixture of an acid and an indifferent resin, of which the one insoluble in ether dissolves readily in volatile and fixed oils.

Fused with caustic potassa, Hlasiwetz and Barth obtained (1864) resorcin and oxalic and a volatile fatty acid. On the dry distillation of ammoniac Sommer failed to obtain umbelliferon.

Pharmaceutical Uses and Preparations.—Ammoniac may be powdered after exposure to cold, or, after having been dried over lime, in the same manner as asafetida, the powder should be preserved over lime. It forms an ingredient in Emplast. ammoniaci, *U. S.;* Empl. ammoniaci cum hydrargyro, *U. S.*, *Br.;* Empl. galbani, *Br.;* Mistura ammoniaci, *U. S.*, *Br.;* Pil. scillæ comp , Pil. ipecacuanhæ cum scilla, *Br.*

Physiological Action.—Ammoniac has always been regarded as a stimulant of the circulation and nutrition. Large doses of it have been said to produce an eruption on the skin, besides vomiting, colic, and diarrhœa. In a plaster it occasions a papular eruption. The above effects have been questioned, but are too well established clinically to be set aside by any experiments upon healthy subjects. It is probable that they depend chiefly upon the volatile oil and partly upon the resin of ammoniac.

Medical Uses.—The most important internal use of ammoniac is in the treatment of chronic pulmonary catarrh, or *bronchitis*, in which the secretion is excessive and expectoration difficult and there is an absence of fever. The condition of the bronchia in such cases includes passive congestion, excessive secretion, and feeble action of the circular muscles; all stimulants tend to remove this condition, and those especially which are excreted through the lungs, including the whole resinous class. The alleged benefits of ammoniac in *asthma* are probably most demonstrable in asthma associated with pituitous and other analogous forms of bronchitis. It tends to remove the exciting cause of the nervous paroxysm, but probably has a minor influence upon the spasmodic element itself. There is a certain acrimony about ammoniac which perhaps explains the fact that its continued use is apt to render the bronchial and laryngeal mucous membrane dry and irritable, and therefore the medicine, if long continued, may increase coughing after having lessened it. It is said to be very useful in *hysterical asthma*, but with the qualification that it should be associated with asafetida. This gives the credit of the cure to the asafetida, which is alone entitled to it. In bronchial affections ammoniac may be administered in the form of the officinal mixture or in that of the compound pills of squill. It has sometimes been employed in chronic catarrh of the *urinary passages*. Externally, ammoniac is used as a rubefacient in plasters for the relief of chronic *rheumatism*, especially of the muscular form, for promoting the cure of bronchial *catarrh*, chronic *pleurisy*, and various other affections requiring a superficial and sustained irritation of the skin. In some of these cases the plaster of ammoniac with mercury is preferable on account of the specific action of the metal, which is very apt to display itself. The *dose* of ammoniac is from 10 to 30 grains (Gm. 0.60–2.00).

AMMONII BENZOAS, *U. S., Br.*—BENZOATE OF AMMONIUM.

Benzoas ammonicus, F. Cod.; *Ammoniæ benzoas*, *Ammonium benzoicum.*—*Benzoate d'ammoniaque*, Fr.; *Ammoniumbenzoat*, *Benzoësaures Ammonium*, G.

Formula $NH_4C_7H_5O_2$. Molecular weight 139.

Preparation.—Take of Benzoic Acid 2 ounces; Solution of Ammonia 3 fluidounces or a sufficiency; Distilled Water 4 fluidounces. Dissolve the benzoic acid in 3 fluidounces of the solution of ammonia, previously mixed with the water; evaporate at a gentle heat, keeping ammonia in slight excess, and set aside that crystals may form.—*Br.*

The formula of the U. S. P. 1870 was identical with the foregoing. During the evaporation of the solution considerable ammonia is given off, and an acid ammonium benzoate would be left. To obtain the neutral salt it is necessary to add sufficient ammonia until an alkaline reaction is obtained, when the liquid is set aside to crystallize, and to avoid heat while drying the crystals.

Properties.—Benzoate of ammonium crystallizes in colorless or white thin four-sided laminæ, having a slight odor of officinal benzoic acid, and a saline somewhat bitter taste, with a slight acrid after-taste; it is readily soluble in alcohol and water, requiring 5 parts of water or 28 parts of alcohol at 15° C. (59° F) and 1.2 parts of boiling water or 7.6 parts of boiling alcohol (*U. S. P.*). On being heated it fuses, gives off vapors of benzoic acid and ammonia, and finally evaporates without leaving any residue. Its neutral solution gives, with ferric salts, a bulky light brownish-yellow (yellowish, *Br.*, flesh-colored, *U. S.*) precipitate, evolves ammonia when heated with potassa, and, if it be not too dilute, deposits benzoic acid when acidulated with hydrochloric acid. The acid salt is less soluble, requiring about 60 parts of water and 12 parts of alcohol.

The *purity* of the salt is ascertained by its not yielding any carbonaceous mass when heated or leaving a non-volatile residue when ignited. Its diluted solution, acidulated with nitric acid, should not be precipitated by chloride of barium or nitrate of silver (absence of sulphate and chloride).

Medical Action and Uses.—The action of benzoate of ammonium in the system appears to be much the same as that of benzoic acid alone, and the salt possesses over the acid only the advantage of greater solubility. Its chief uses are treated of in the article on BENZOIC ACID. In addition it may be stated that this preparation has been used in chronic *gout* and *gravel*. *Dose*, from 5 to 20 grains (Gm. 0.30–1.30), which may be given best in a mixture.

AMMONII BROMIDUM, *U. S., Br.*—Bromide of Ammonium.

Ammonium bromatum, P. G.—*Bromure d'ammonium*, Fr.; *Bromammonium*, *Ammonium bromid*, G.

Formula NH_4Br or AmBr. Molecular weight 97.8.

Preparation.—Bromide of ammonium may be prepared by neutralizing hydrobromic acid with ammonia or ammonium carbonate, and evaporating the solution. It may also be obtained by first preparing ferrous bromide from 4 parts of bromine, 2 parts of iron, and 16 parts of water, and precipitating the greenish solution with a slight excess (about 9 parts) of ammonia-water, when bulky ferrous hydrate is deposited. Or the above solution of ferrous bromide is mixed first with 1 part of bromine, and afterward with ammonia in excess (about 11 parts), when a dense ferroso-ferric hydrate is precipitated, which may be readily washed with water; the filtrate is evaporated and allowed to crystallize or the salt is granulated.

But, according to Charles Rice (1873), ammonium bromide prepared by the processes just mentioned is prone to decomposition, bromine being gradually liberated. This change does not occur if the salt is prepared as follows: The solutions of 4 troyounces of bromide of potassium in 6 fluidounces of boiling water, and of 3 troyounces of ammonium sulphate in 4½ fluidounces of boiling water, are mixed while boiling hot, and when cool 1½ fluidounces of alcohol are added. After 24 hours the clear liquid is decanted from the crystalline deposit of potassium sulphate, the latter washed with a little 18 per cent. alcohol, and the filtrate evaporated as before. Prepared in this manner, the salt contains minute quantities of ammonium and potassium sulphate, the presence of which is avoided by sublimation. For this purpose an intimate mixture of well-dried potassium iodide (20 parts) and exsiccated ammonium sulphate (11 parts) is introduced into a retort with a wide and rather short neck, and heated in a sand-bath.

When bromine and ammonia are brought into direct contact in the presence of water, bromide of ammonium is formed and nitrogen escapes; $3Br_2 + 8NH_3 = 6NH_4Br + N_2$. According to Dr. Pile (1874), the violence of the reaction is best controlled by keeping the two liquids at first separate from each other by a layer of distilled water; he manipulates as follows: 1 pound of bromine is introduced into a 5-gallon stone jar, under a layer of half a gallon of water; stronger water of ammonia is then added in quantities of 2 or 3 ounces at a time, so that it will float upon the surface of the water. The jar is covered with a glass plate, and after the reaction has subsided more ammonia is added. Should the reaction become too violent, it must be moderated by placing the jar in cold water. When the color of bromine has entirely disappeared and the ammonia is finally in slight excess, the solution is evaporated. If the salt is desired in crystals, the solution is concentrated and set aside without stirring it.

Properties.—It is either in white granular, cubical, or in larger colorless prismatic crystals, which have a neutral reaction to test-paper and a pungent saline taste. On exposure to air the salt gradually becomes damp and acquires a yellow color and acid reaction. When heated it sublimes without melting. It is soluble in 1.5 parts of water and in 150 parts of alcohol at 15° C. (59° F.), in .7 part of boiling water, and in 15 parts of boiling alcohol (*U. S.*). Ether dissolves a minute quantity of the salt. Chlorine-water, carefully added so as to avoid an excess, liberates from the aqueous solution of the salt bromine, which dissolves in disulphide of carbon or in chloroform with a yellow, reddish-yellow, or yellowish-brown color, which is free from violet tint (iodine).

Tests.—It may be regarded as pure if, on being heated upon platinum-foil, a non-volatile residue is not left behind. A small portion of the salt placed upon a porcelain tile should not at once acquire a yellow color on the addition of a few drops of diluted sulphuric acid (absence of bromate). Its solution should not be precipitated by chloride of barium (absence of sulphate and phosphate). The solution, mixed with a little mucilage of starch, should not show a blue color (which would indicate iodine) if a drop of chlorine or bromine-water be added on top. If 10 grains of the salt are dissolved in water, and the solution is well mixed with a solution of 17 grains of nitrate of silver, a curdy yellowish precipitate will appear, and the clear liquid should be merely rendered cloudy on the further addition of nitrate of silver. A white precipitate would indicate the presence of ammonium chloride, which requires a larger quantity of silver nitrate for complete precipitation than the bromide; and if no cloudiness is produced, iodide of ammonium may probably be present, which, from its greater molecular weight, is completely precipitated by less nitrate of silver. The precipitate of 10 grains of ammonium bromide by sufficient silver nitrate, after washing with water acidulated with nitric acid and drying, will weigh 19.17 grains (1.917 Gm. from 1 Gm. AmBr.). The presence of chloride of ammonium would increase the weight of the silver precipitate. The allowable limits of the impurities are thus determined: "On adding to 1 Gm. of the salt dissolved in 20 Ccm. of water 5 or 6 drops of test solution of chloride of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 Ccm., and 10 Ccm. of this solution treated with a few drops of test solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 31.4 Ccm. (31.1 Ccm., *P. G.*) of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than 3 [2, *P. G.*] per cent. of chloride)."—*U. S.* A solution of .5 Gm. of the salt in 5 Ccm. of water, mixed with 1 drop of solution of ferric chloride and agitated with chloroform, should not impart a violet color to the latter (iodide).—*P. G.*

Physiological Action.—"Bromide of ammonium in *almost* every respect has the same action as bromide of potassium." In animals it induces capillary anæmia and venous congestion of the brain, thereby producing drowsiness and anæsthesia, but at the same time a liability to clonic (passing into tonic) convulsion. It does not appear to restrain the movements of the heart. According to Chéron and Fouques, this salt moderates reflex action and stimulates the periphery of the nervous system. This salt has a more acrid taste and is more irritating than potassium bromide. It obtunds the sensibility of the mouth and pharynx, as well as general reflex sensibility. It produces a papular eruption upon the skin, and its prolonged use brings on a sort of hebetude or intellectual dulness. Its unpleasant taste and irritating qualities render it less convenient for administration than bromide of potassium.

Medical Uses.—Bromide of ammonium, in conjunction with potassium bromide, has been used extensively in the treatment of *epilepsy;* but while it is held by some authorities that this association diminishes the bad, while it increases the good, effects of the combination, other observers have failed to recognize in it any advantage, while they object to the unpalatable taste of the bromide of ammonium—a grave defect in a medicine which must be continuously used for a long time in the treatment of disease. The weight of authority, however, appears to be in favor of the opinion that 10 grains of bromide of potassium with 3 or 5 grains of bromide of ammonium produce a greater sedative influence than 12 or 15 grains of either of them administered separately. This salt has been successfully employed in some cases of *delirium tremens.* It has also been recommended as possessing remarkable virtues in *whooping cough* during the spasmodic stage of the disease, and the success of bromide of potassium in the same affection supports the recommendation. It has been particularly eulogized by Kormann in Germany (*Med. News, etc.*, xxxix. 473) and Grinnell in this country (*ibid.*, xl. 294), but without any statement of the duration of the disease under its use. Probably a combination of the two salts would be more efficacious than either alone. In acute articular *rheumatism* this medicine has been supposed to exert a favorable influence; but since it was first proposed 8 or 10 years have elapsed without eliciting any confirmatory experience. The intolerable itching of *prurigo* is sometimes strikingly diminished by it when it is given in doses of 10 grains three times a day. It has been recommended to prevent *menorrhagia.*

Dose, for adults, from 5 to 30 grains (Gm. 0.30–2.00) three times a day; for children, from 1 to 5 grains. It is conveniently administered in a bitter infusion, and especially in hop tea.

AMMONII CARBONAS, *U. S., Br.*—CARBONATE OF AMMONIUM.

Ammoniæ sesquicarbonas; Ammonium carbonicum, P. G.; *Carbonas ammonicus, Sal volatile siccum, Alkali volatile.*—*Volatile salt*, E.; *Carbonate d'ammoniaque, Alkali volatil concret, Sel volatil d'Angleterre*, Fr.; *Ammoniumcarbonat, Kohlensaures Ammonium, Flüchtiges Laugensalz, Reines Hirschhornsalz*, G.

Formula $NH_4HCO_3.(NH_4)NH_2CO_2 = N_3H_{11}C_2O_5$. Molecular weight 157.

Origin.—Ammonium carbonate was first prepared by Raymund Lull, in the thirteenth century, by the distillation of putrid urine, which contains the normal carbonate, $(NH_4)_2CO_3$, formed from urea, CON_2H_4 and $2H_2O$, water. It was subsequently obtained by the dry distillation of horn, bones, blood, and other animal matters, and for a long time purified by resubliming this crude product in the presence of animal charcoal. In the fifteenth century Basilius Valentinus observed its production from sal ammoniac and potassium carbonate, in place of which afterward chalk was employed. At present it is largely manufactured by modifications of this process.

Preparation.—A mixture of powdered sal ammoniac with twice its weight of chalk, or of 4 parts each of ammonium sulphate and chalk with 1 part of charcoal, is gradually heated to dull redness in an iron or earthen retort, the vapors being passed through an iron pipe into a leaden chamber, where they condense. The chalk is used in excess to prevent sublimation of undecomposed chloride of ammonium, which would otherwise be apt to contaminate the product. It is then purified by resublimation from iron vessels. The reaction results in the formation of chloride (or sulphate) of calcium and neutral carbonate of ammonium, which on condensation is converted into a salt of the above composition, water and ammonia being given off; $4NH_4Cl + 2CaCO_3$ yield $2CaCl_2 + N_3H_{11}C_2O_5 + NH_3 + H_2O$. The ammonia is utilized either by passing the uncondensed vapors into water or through a cylinder filled with coke which is impregnated with dilute sulphuric acid, resulting in the formation of ammonium sulphate. Barium carbonate may be employed in place of chalk, and is advantageously used with ammonium chloride, when barium chloride is obtained at the same time. The ammonium salts used being almost exclusively those obtained from coal-gas liquor, the first sublimate contains tarry products, from which it is freed by resublimation. Nearly 600,000 pounds were annually imported into this country previous to 1878; since that time, between 300,000 and 500,000 pounds.

Properties.—Carbonate of ammonium is found in commerce in white crystalline translucent masses, having a strong ammoniacal odor, an alkaline reaction, and a pungent saline and caustic taste. Exposed to the air, it parts with ammonia and carbonic acid gas, becomes opaque, and falls into a white powder of acid carbonate of ammonium, NH_4HCO_3; this salt is likewise obtained by washing the powdered officinal carbonate with a little cold water, which dissolves chiefly ammonium carbamate. Such a solution begins to evolve gas when heated to 47° C. (116.6° F.), and in larger quantity at 55° C. (131° F.). Divers (1870) found the officinal salt to be soluble in 1.5 parts of water at 65° C. (149° F.), and in 4 parts of water at 15° C. (59° F.), and the latter solution to give off carbonic acid gas when heated to 75° C. (167° F.); at 85° C. (185° F.) also ammonia, which may be partly condensed as acid carbonate; at 100° C. (212° F.) the whole of the ammonia salt is volatilized. Dilute solutions require to be heated to a higher temperature before gas is given off. Alcohol dissolves ammonium carbamate, and on being heated yields a sublimate of this salt.

Composition.—Of the formulas given above, the last one is purely empirical, while the first represents the salt as a compound of 1 molecule of acid ammonium carbonate with 1 of ammonium carbonate, from which a molecule of water has been separated. The last mentioned compound is regarded as the ammonium salt of carbamic acid (which is unknown in the isolated state), and hence is called *ammonium carbamate*, the formula of which is $NH_4NH_2CO_2$. In its pure state this forms tabular crystals, is deliquescent, volatilizes completely at 59° C. (138.2° F.), with decomposition into ammonia and carbonic acid gas, and in aqueous solution is soon converted into normal ammonium carbonate; the solution of the officinal salt, therefore, contains a mixture of neutral and acid ammonium carbonate.

The salt formerly in the market, which was prepared from animal matters, closely resembled the officinal salt, but had the composition $N_4H_{16}C_3O_8 = 2NH_4HCO_3.NH_4NH_2CO_2$; according to Divers, it was a mixture of the above salt with acid ammonium carbonate.

Tests.—Carbonate of ammonium should be completely volatilized without charring when heated upon platinum-foil (absence of organic matters and non-volatile salts). It should dissolve in diluted acids without residue, and this solution should be free from empyreumatic odor. "If 1 Gm. of the salt be supersaturated with diluted sulphuric acid, then diluted to 20 Ccm. with distilled water, and treated with a few drops of test solution of permanganate of potassium, the color should not be perceptibly changed by standing for 5 minutes at the ordinary temperature (absence of empyreumatic substances)."—*U. S.* "1 Gm. of the salt, on being supersaturated with nitric acid and evaporated to dryness by means of a water-bath, should leave a colorless (white) residue, which at a higher heat volatilizes completely."—*P. G.* Empyreumatic products impart a yellow or brown color to the residue. Hyposulphite of ammonium, which may be present from the decomposition of the sulphate during sublimation, is detected by the brown color produced on adding to the aqueous solution of the salt first an excess of solution of silver nitrate and afterward of nitric acid. After dissolving the salt in a slight excess of diluted nitric acid it should not be precipitated by chloride of barium (sulphate), nitrate of silver (chloride), or sulphuretted hydrogen (metals). Traces of iron may frequently be detected in this solution by ferrocyanide or sulphocyanide of potassium. The presence of ammonium bicarbonate is indicated by the change of the translucent mass into an opaque pulverulent condition. Occasionally the bicarbonate has been observed (see *American Journal of Pharmacy*, 1874, p. 540) in translucent solid masses mixed with the officinal article. In this condition it has but a faint odor of ammonia, and dissolves slowly in water at the ordinary temperature, giving off carbonic acid gas.

59 grains of carbonate of ammonium dissolved in 1 ounce of distilled water will be neutralized by 1000 grain-measures (*Br.*) or 2.95 Gm. of the salt by 50 Ccm. of the volumetric solution of oxalic acid (*U. S.*).

Pharmaceutical Uses and Preparations.—Carbonate of ammonium reacts with the salts of nearly all inorganic and organic bases, with the exception of sodium and potassium, and is therefore incompatible with such salts. Prescribed with syrup of squill or similar preparations, the annoyance caused by the evolution of carbonic acid gas is best overcome by triturating in a mortar the carbonate with a little of the syrup, adding the latter gradually, if admissible, alternately with water or a tincture. The generation of carbonic acid gas in many reactions renders it necessary to triturate the ingredients of pill masses containing carbonate of ammonium with some strong alcohol until the reaction has been completed, when the excipient may be added. The salt is used in making Ferri et ammonii tartras, *U. S.;* Liquor ammon. acetat., Spir. ammon. arom., *U. S.*, *Br.*

AMMONII BICARBONAS, NH_4HCO_3, is obtained by treating the powdered officinal carbonate of ammonium with about twice its weight of water, when carbamate will be dissolved, or by keeping the former for two weeks under a bell-glass over sulphuric acid and slaked lime, when the carbamate will evaporate, being decomposed into carbonic acid gas, CO_2, and ammonia, NH_3. Bicarbonate of ammonium is a white powder, when perfectly dry free from ammoniacal odor, of a cooling saline taste, insoluble in alcohol, but soluble in 8 parts of water at 15° C. (59° F.); the solution, heated to 36° C. (96.8° F.), begins to give off carbonic acid gas. From a concentrated solution clear rhombic prisms of the salt may be obtained. Vogler (1878) ascertained that the salt is not permanent in the air, but is slowly volatilized, with the production of an ammoniacal odor.

LIQUOR AMMONII CARBONICI and LIQUOR AMMONII CARBONICI PYRO-OLEOSI, P. G., 1872, are solutions of 1 part of carbonate or of pyro-oleous carbonate of ammonia in 5 parts of distilled water.

AMMONII CARBONAS PYRO-OLEOSUS, s. *Ammonium carbonicum pyro-oleosum*, P. G., 1872, *Sal volatile cornu cervi.*—32 parts of carbonate of ammonium are thoroughly incorporated with 1 part of ethereal animal oil.

Physiological Action.—*On Animals:* In poisonous doses carbonate of ammonium, when given to dogs by the stomach, produces retching and vomiting, followed first by general convulsions, and then by tetanoid rigidity and death, after which the stomach is found actively congested and inflamed and its epithelium softened. The blood in the veins is either liquid or but slightly coagulated. When the salt is introduced into the connective tissue similar symptoms and lesions are produced, including the inflammatory alterations of the gastric mucous membrane. It does not render the urine alkaline. 15, and even 25, grains of it have been injected into the veins of dogs without notable result, except a transient spasm of the abdominal muscles. It is remarkable that the salt does not appear to undergo decomposition, nor does it cause any free ammonia to be exhaled with the breath or from the blood. This fact is the more remarkable since carbonate of ammonium mixed with blood no longer living becomes decomposed. The tetanoid spasms above referred to are very marked when the agent acts through the blood, and there is a momentary suspension of the inspiratory act, which is followed by rapid breathing. Section of the vagi, after the rapid breathing has commenced, does not occasion the labored action which is observed in animals not poisoned after this operation. When the section is performed before the administration of the salt the primary arrest of respiration is prevented, but not the subsequent hurried breathing. These phenomena are ascribed (Lange) to the production by the ammonia of an abnormally excited action of the respiratory centre in the medulla oblongata, which under normal conditions is but transiently or not at all stimulated by inspiratory impulses conducted through the par vagum to the brain.

On Man: The direct effect of carbonate of ammonium when taken in doses of from 5 to 10 grains is to cause some increase of the fulness and force of the pulse and a sense of tightness about the head, sometimes with throbbing. It is also said to increase the temperature of the body during health, and excite the secretions of the skin, kidneys, and bronchia. It readily enters the blood, increasing its alkaline reaction, and escapes by the breath and sweat, and still more by the urine. In doses of from 10 to 20 grains, it excites vomiting. In still larger doses it occasions symptoms of inflammation in the throat, gullet, and stomach, tetanoid convulsions, and death. In a case which proved fatal intense inflammatory lesions were found in the organs last mentioned, and also congestion of the lungs, with œdema. Long-continued use of the salt deranges the stomach, causes diarrhœa, emaciation, and a dissolution of the blood, with symptoms resembling those of scurvy. The last-mentioned effect it displays in common with the other alkaline salts, especially those of sodium.

Medical Uses.—This medicine has been used in *typhus fever* and in the *typhoid state* of various febrile affections; that is to say, in which nervous disorder is associated with a tendency to dissolution of the blood. Thus it has been found beneficial in the fever just named, in low forms of *typhoid fever*, *typhoid scarlatina*, *measles*, *erysipelas*, *pneumonia*, etc. There is no reason to suppose that it is, in any sense, a specific for those affections. Like other stimulants, it urges the organs to perform their functions until the poison which is the cause of their debility is eliminated and the tissue-repair advanced, and probably it also quickens their performance of this work. In appropriate doses it has the advantage over alcohol that it leaves no depression behind it, and over turpentine that it is not apt to occasion any local derangements. Like other stimulants, its virtues depend upon the quantity of it administered. In excessive doses it is perturbative and irritant, and if long continued, even in doses which the stomach will tolerate, it impairs nutrition in the manner stated above. Its efficacy in the treatment of bites of *venomous serpents* and *insects* and in *alcoholic intoxication* is, in a great degree, due to its stimulant action; but the extraordinary rapidity with which, when applied locally, it arrests the pain and inflammation of insect-bites, and when taken internally suspends even a high degree of drunkenness, seems to show that it exerts also a more direct antidotal power. In various forms of *bronchitis*, both primary and secondary, it may be employed, the cases in which it is most useful being those which have passed the acute stage, and which tend to become chronic, with dilatation of the bronchia or with consolidation of the vesicular tissue, constituting the so-called broncho-pneumonia. When this form of disease arises, as it often does, as a consequence of measles, ammoniacal medicines ought never to be neglected. The *dyspepsia* of drunkards is said to be favorably modified by this medicine, probably by its combined antacid and stimulant properties, which counteract the acidity and dissolve the tenacious mucus that coats the stomach. The antacid property of the salt has led to its use in cases of excessive secretion of *uric acid;* and in *diabetes* it sometimes diminishes the quantity, as well as the saccharine condition, of the urine. Like other volatile ammoniacal preparations, it is useful in alleviating *headache*, whether dependent upon acidity of the stomach or upon exhaustion of the nervous system. Its stimulant quality renders it useful in *faintness*, *syncope*, *nervous spasms*, etc.; and when mixed with sal ammoniac and scented with an aromatic oil it forms the usual smelling-salts employed to relieve the symptoms just referred to, and also to dissipate congestion of the nostrils in commencing *coryza*. Externally, it is sometimes applied to promote the resolution of *glandular swellings*. It has also been administered internally for the same purpose.

Administration.—Carbonate of ammonium is generally given in a watery solution, and its acrimony is blunted by the use of mucilage, sugar, or liquorice. As a stimulant expectorant its dose is 2 or 3 grains (Gm. 0.10–0.15) or more, repeated every 2 or 3 hours. In low fevers 5 or 10 grains (Gm. 0.30–0.60) should be given every hour or two, until five or six doses are taken. An emetic effect is produced by 30 grains (Gm. 2).

AMMONII CHLORIDUM, *U. S., Br.*—CHLORIDE OF AMMONIUM.

Ammonium chloratum, P. G.; *Ammonium muriaticum s. hydrochloratum depuratum*, *Chloruretum ammonicum*, *Sal ammoniacum*, *Ammoniæ hydrochloras s. murias.*—*Purified chloride of ammonium*, *Muriate of ammonia*, *Sal ammoniac*, E.; *Chlorure d'ammonium*, *Sel ammoniac*, *Chlorhydrate d'ammoniaque*, Fr.; *Salmiak*, *Chlorammonium*, *Ammonium chlorid*, *Reiner Salmiak*, G.

Formula NH_4Cl or AmCl. Molecular weight 53.4.

Origin.—The sal ammoniacum of ancient writers was perhaps in all cases rock-salt. In the eighth century Geber prepared sal ammoniac from urine. Subsequently it was manufactured in Egypt from camel's dung and urine, and exported to Europe, where its manufacture was begun in Venice in the seventeenth century, in Great Britain in 1756, and soon after in Germany and France. At present it is obtained from the products of the dry distillation of bones and other animal matters, and of coal. It is frequently met with in the neighborhood of volcanoes, and is a constituent of several mineral springs, such as Hall, Homburg, Wiesbaden, and others.

Preparation.—The so-called coal-gas liquor is a watery liquid condensed in the preparation and purification of illuminating gas from coal, and contains principally carbonate of ammonium, besides some sulphide, cyanide, and empyreumatic products. This is either neutralized by hydrochloric acid or decomposed by chloride of calcium, in both of which cases a solution of ammonium chloride is obtained, which is evaporated and the dry salt afterward sublimed. In order to avoid the expense attending the evaporation of such dilute solutions the gas-liquor is now frequently treated with lime and the generated ammonia gas conducted into a more concentrated acid. If the gas-liquor is neutralized by sulphuric acid, the resulting solution will yield more or less brown-colored crystals of ammonium sulphate, which are mixed with sodium chloride (table-salt), and the mixture is sublimed from iron pots, the vapors being condensed upon the inside of leaden or iron domes. On the application of heat a mutual decomposition of the ammonium sulphate and sodium chloride occurs, resulting in the formation of ammonium chloride, which sublimes, and sodium sulphate, which remains behind; $(NH_4)_2SO_4 + 2NaCl$ yields $2NH_4Cl + Na_2SO_4$. From the corrosive action of the vapors upon iron the product is always contaminated with chloride of iron.

Instead of using sulphuric acid, the gas-liquor may be digested with powdered gypsum (sulphate of calcium), when ammonium sulphate and insoluble calcium carbonate are produced, the latter retaining a considerable amount of the tarry products. Any liquid containing ammonia or carbonate of ammonium, like the aqueous liquor obtained on the destructive distillation of bones or other animal matter, may be employed in the same manner as coal-gas liquor. The annual importation of sal ammoniac has increased from less than 800,000 pounds previous to 1879 to nearly 1,500,000 pounds in 1882.

When the crude article is refined by carefully resubliming it, ammonium chloride may be obtained sufficiently pure for medicinal use. Commercial sal ammoniac contains, usually, variable quantities of ferrous and ferric chloride, and should be purified by dissolving 2 parts of it in 3 parts of hot water, adding a small quantity of chlorine-water to convert the ferrous into ferric chloride, and afterward ammonia-water in slight excess, then filtering the hot solution from the precipitated ferric hydrate. If the sal ammoniac has been otherwise pure, the filtrate may be evaporated to dryness and the salt granulated by stirring it continually. If, however, it contains other saline impurities besides the iron, it is best to allow the filtrate to cool, stirring it occasionally, and to collect the crystalline powder upon a muslin strainer. The impurities will remain in the mother-liquor.

Properties.—SAL AMMONIAC is imported in casks, and consists of colorless or whitish translucent masses which are of a fibrous crystalline structure, very tough and difficult to powder. It is free from odor and has a cooling and strongly saline taste. Its specific gravity is 1.53, and it is soluble in about 3 parts of cold and in little more than its own weight of boiling water. During the solution of the salt in water a considerable reduction of temperature is observed. When the solution is heated with potassa or lime gaseous ammonia is given off, and when treated with nitrate of silver a curdy white precipitate soluble in ammonia is produced. It is less freely soluble in spirituous liquids, requiring 14 parts of boiling alcohol for solution. The salt is permanent in the air, but its solution on being boiled evolves a little ammonia and acquires an acid reaction. Ammonium chloride evaporates completely without melting at an elevated temperature, and on cooling is condensed again unchanged. Metals which are dissolved by hydrochloric acid are likewise attacked by the hot solution or the vapor of this salt; hence commercial sal ammoniac contains iron, derived from the vessels in which it has been prepared, and its solution turns blue on the addition of ferrocyanide of potassium.

PURIFIED CHLORIDE OF AMMONIUM forms a snow-white granular crystalline powder, the hot solution of which has a faint acid reaction, and does not acquire a bluish-black color by tannin or a blue coloration on the addition of ferrocyanide of potassium. The solubility of pure chloride of ammonium in water has been ascertained by Alluard (1864) for the following temperatures, and a barometric pressure of 718 Mm., at which 100 parts of water will hold in solution,

28.40	32.84	37.28	41.72	46.16	50.60	55.04	59.48	63.92	68.36	72.80	77.24 parts of NH_4Cl
at 0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110° C.

Gerardin gives (1865) the following figures, indicating the solubility of chloride of ammonium in 100 parts of alcohol, specific gravity 0.939: At 4° C., 11.2; at 8°, 12.6; at 27°, 19.4; at 38°, 23.6; and at 56° C., 30.1 parts of NH_4Cl.

Tests.—The salt should be completely volatilized from platinum-foil (non-volatile salts), and should yield a clear solution with 4 parts of water (barium sulphate, lead salts). The solution, in 20 parts of water, should not be affected by sulphydric acid (lead, copper, etc.), diluted sulphuric acid (barium, lead), barium chloride (sulphate), nor, after acidulating with hydrochloric acid, by ferric chloride; a red color produced with the last test would indicate the presence of sulphocyanate, observed by Warington. The U. S. Pharmacopœia requires also absolute freedom from iron, in that the aqueous solution should not be affected by sulphide of ammonium, and a 1 per cent. solution not be rendered blue by potassium ferrocyanide; the readiness with which iron is attacked by the salt and its solution renders this very difficult, and the German Pharmacopœia for this reason permits the presence of a trace of iron, which in a 5 per cent. solution may give a dark-green color, but not a black precipitate, with sulphide of ammonium. Empyreumatic impurities may be detected by moistening 1 Gm. of the salt with nitric acid and drying at the heat of a water-bath, when it should not acquire a brown tint.

Pharmaceutical Uses.—Chloride of ammonium is used for generating ammonia in preparing Aqua ammonia.

AMMONII ET FERRI CHLORIDUM, *s. Ammonium chloratum ferratum*, P. G., *s. Ferrum ammoniatum;* Ammonio-chloride of iron, ammoniated iron, *E.;* Sel ammoniac martial, *Fr.;* Eisensalmiak, *G.*—32 parts of chloride of ammonium are mixed with 9 parts of solution of ferric chloride (*P. G.*), and evaporated with constant stirring to dryness. It is an orange-colored, somewhat deliquescent powder, having a strongly saline and ferruginous taste, and containing 7.25 per cent. of ferric chloride, Fe_2Cl_6, equal to 12.1 per cent. of crystallized ferric chloride or to 2.5 per cent. of metallic iron. It should yield a clear solution with water, and, being decomposed in the sunlight, should be kept in a dark place.

Physiological Action.—*On Animals:* The general result of experiments in which chloride of ammonium was administered internally by the stomach or by the veins to different animals is that it acts as a depressant of the nervous system, generally inducing tetanic spasms. In some experiments the salt, when injected into the veins, produced temporary paralysis, and not spasm. On the mucous membrane of the alimentary canal it appears to increase the secretion of mucus, while it renders the blood less coagulable, without, however, impairing the constitution of its corpuscles.

On Man: The direct effects of doses of from 5 to 20 grains of this salt, repeated at intervals of several hours, are a sense of oppression, warmth, and uneasiness in the stomach, some fulness of the head, and an increased tendency to urinate. If it is used for many days together in full doses it disturbs the digestion, coats the tongue, and impairs the appetite; it may even occasion gastric pain, vomiting, and diarrhœa. Its prolonged use is said to cause emaciation. The idea which has appeared chiefly to direct its use in medicine is, that it tends to render all the secretions freer and more abundant, while it at the same time lessens the plasticity of the blood; in other words, that its operation is in some respects analogous to that attributed to mercury. Its efficacy in certain cases of neuralgia would appear to point to another mode of operation—those cases, namely, which are apparently pure neuroses, and not painful conditions of the nerves due to pressure upon them by the neurilemma or by the periosteum of bony canals. The action upon the blood referred to above has frequently been illustrated clinically. In one case there were bloody blebs upon the skin and in the mouth, besides hæmaturia and bloody stools (Isham, *Med. News*, xl. 454); in another there was profuse hæmorrhage from the nose, eyes, fauces, and bowels (Lucas, *Med. News*, xl. 587); and in a third instance inhalations of the fumes of the salt seem to have occasioned hæmorrhage from the pharynx (Fuller, *Med. Record*, xix. 474).

Medical Uses.—Chloride of ammonium is sometimes used with a view of promoting the cutaneous efflorescence in *eruptive fevers;* but it is of more value in the cure of obstinate *intermittent fevers*, doubtless through its influence upon the function of nutrition. This value is, however, very uncertain and restricted. In *bronchitis* that has passed its inflammatory stage few medicines are more efficient than this; and in all the chronic forms of the affection occurring in persons of a feeble and relaxed habit of body it is a most valuable remedy when given alone or associated with stimulant expectorants. *Whooping cough* is benefited by its use when the sputa are tenacious and excessive. Its wholesome stimulation is manifested in cases of *chronic pharyngitis* accompanied with a flaccid state of the mucous membrane and a glairy secretion. A similar secretion from other mucous membranes, constituting *gleet*, *leucorrhœa*, etc., is often modified favorably by it. The alterative action of the medicine—*i. e.* its slow but steady modification of the nutrition of tissues—is exhibited by its beneficial action in *amenorrhœa* and *dysmenorrhœa* when the former depends upon torpor of the uterine system, and the latter upon chronic engorgement of the uterus, with or without catarrh. This action is doubtless exerted by it in those cases of cure which it brings about in the various general disorders that arise from sympathy with the uterine system at the *menopause*. It is also in this manner that it appears to be useful in certain cases of fibrous *tumors of the uterus*. To a similar mode of action may be referred its utility in chronic *glandular enlargements*, as in those of the *thyroid body* (*goitre*), the *prostate*, the *liver*, etc. In regard to its utility in *goitre* there can be little doubt. Among many illustrations may be mentioned six cases in which the disease began at puberty, and which were cured after about 3 months of treatment (Stevens, *Med. Record*, xvii. 429). In the case of the liver its administration has been alleged to diminish the tendency to *hepatic abscess*, but such an assertion must be difficult to substantiate. According to the first and the only physician who has attributed this virtue to the medicine, and whose field of observation was in the East Indies, it should be prescribed in the dose of 20 grains (Gm. 1.30) as soon as pain in the hepatic region gives warning of the danger of suppuration.

The forms of *neuralgia* in which chloride of ammonium is beneficial are not easily defined. According to certain statements, it is equally useful in rheumatic and idiopathic neuralgias, in those depending upon local congestions, and those associated with anæmia, as well as those of less easy definition which are connected with uterine, gastric, and other functional disorders. We have no doubt that it is chiefly serviceable in neuralgia depending upon cold, in which, indeed, especially in neuralgia of the fifth pair, the intercostal nerves, and the sciatic nerve, it sometimes exerts a very prompt and salutary action. In those cases of diffused neuralgic headache known as hæmicrania, and often associated with gastric acidity, this medicine is sometimes beneficial, but less so than the carbonate or the liquid preparations of ammonia. In the muscular aches which are produced by the prolonged and repeated use of the same set of muscles, and which have been styled *myalgia*, this medicine is of service if the tired organs are allowed repose. A somewhat analogous condition obtains in chronic *muscular rheumatism*, for which also this salt may be advantageously prescribed. Like other ammoniacal preparations, it has been used with alleged benefit for *snake-bites*, but associated with such other active remedies that a judgment of its share in the result is impossible. It has also been recommended in the treatment of *hæmorrhage* from the stomach, the uterus, and the lungs; but except in the case of the uterus the tendency of bleeding to cease spontaneously is so well known that the influence of a medicine in controlling it demands a clearer demonstration than is offered in this case. This salt is alleged to reduce the proportion of sugar voided in *saccharine diabetes*, but clinical observation does not favor its use in that disease (Guttmann, *Zeitschrift f. klin. Med.*, i. 610; ii. 473; Adamkiewicz, *ibid.*, ii. 195).

The stimulant action of this salt has been employed to stay the progress of *gangrene*, especially of the senile variety. It should be applied in cataplasms or in local baths, according to the situation of the disease. The same action is very usefully resorted to in the treatment of *contusions* and lacerated and contused *wounds*. In local *inflammations* the cold produced by it while dissolving may sometimes be taken advantage of. A mixture of 5 parts of it with as many of nitrate of potassium and 16 parts of water will lower the thermometer from 50° to 10° F. Such a mixture, contained in a bladder, has been used to promote the reduction of *hernial tumors* and in various cutting operations of minor surgery. Chloride of ammonium forms a useful ingredient of *errhine* powders, *gargles*, *dentifrices* for whitening the teeth, *cosmetic* preparations for removing the pimples of *acne* from the face, plasters for the treatment of enlarged *bursæ* and *joints*, and atomized solutions for the cure of *pharyngeal* and *laryngeal* affections requiring direct stimulation. Among the last are nervous *aphonia* and *chronic bronchitis*.

Administration.—The dose of chloride of ammonium varies from 5 to 30 grains (Gm. 0.30–2.00), but a larger dose than 10 grains is seldom necessary. It is best administered in solution, and its taste may be disguised by the addition of extract of liquorice or the syrup of liquorice-root. In bronchial diseases its virtues are increased by this association. In neuralgia it may be necessary to repeat hourly the dose of 5 or 10 grains (Gm. 0.30–0.60) for 3 or 4 consecutive hours. In affections of the air-passages it may be given by the stomach, and also by the inhalation of an atomized saturated solution of the salt in water. The *ammonio-chloride of iron* is credited by some German therapeutists with special virtues in scrofula, anæmia, and other states involving general debility. There is no sufficient ground for this opinion, and the taste of the preparation is so disagreeable that the use of it may well be dispensed with. Its dose is said to be from 3 to 10 grains. It may be given in a solution of extract of liquorice.

AMMONII IODIDUM, *U. S.*—IODIDE OF AMMONIUM.

Ammonium jodatum, Ioduretum ammonicum.—Iodure d'ammonium, Fr.; *Jodammonium, Ammoniam jodid*, G.

Formula NH_4I or AmI. Molecular weight 144.6.

Preparation.—This salt is most advantageously prepared by the process recommended by Jacobsen in 1863, and which, with some modifications, was adopted by the U. S. Pharmacopœia of 1870. After correcting the errors in the latter this process is as follows: Mix potassium iodide in coarse powder 2½ troyounces and ammonium sulphate in coarse powder 1 troyounce; add to the mixture 2 fluidounces of boiling water; stir well, allow to cool slowly, add 2 fluidounces of alcohol, and place the mixture in a bath of iced water, stirring occasionally; throw the mixture into a glass funnel stopped with moistened cotton, collect the clear liquid, and wash the crystalline salt with diluted alcohol; lastly, evaporate the filtrate rapidly to dryness, stirring constantly. Contact with iron or other metals is to be avoided.

1 molecule of ammonium sulphate (132 parts) and 2 molecules of potassium iodide (331.2 parts) decompose each other when mixed in solution, with the formation of iodide of ammonium and sulphate of potassium; $2KI + (NH_4)_2SO_4$ forms $2NH_4I + K_2SO_4$. The latter salt, being insoluble in alcohol, will separate from the solution as a crystalline powder on adding alcohol and cooling the mixture, after which the filtrate may be evaporated to dryness, yielding rather more than 2⅛ troyounces of the iodide. The minute quantity of sulphate of potassium contained in it does not interfere with its medical properties. If a still purer salt is desired, the product may be dissolved in alcohol, filtered from the insoluble potassium sulphate, and evaporated as before.

Other processes have been proposed, of which the following may be mentioned: Hydriodic acid is neutralized with ammonia or ammonium carbonate. Ferrous iodide is decomposed by ammonium carbonate, and the filtrate evaporated (Ch. Ellis, 1835). Potassium iodide and ammonium bitartrate are made to react upon each other in hot solutions; on cooling, potassium bitartrate crystallizes, and the evaporated filtrate, still containing a little of this salt, is treated with 70 per cent. alcohol, which dissolves only the ammonium iodide (W. H. Pile, 1862). Iodine is treated with sulphide of ammonium until the brown color has completely disappeared, when the solution is boiled, filtered from the liberated sulphur, and evaporated (Spencer, 1852).

When iodine is added to ammonia-water, iodide of ammonium is produced, but at the same time the extremely explosive compound iodide of nitrogen results. Mixtures of the two substances named should therefore be made with great caution.

"Iodide of ammonium should be preserved in small, well-stopped vials, protected from light. When deeply colored it should not be dispensed, but it may be deprived of all but traces of free iodine by washing with stronger ether and rapidly drying."—*U. S.*

Properties.—Iodide of ammonium is in white granular crystals, and on the slow evaporation of its solution, which should be kept slightly alkaline by ammonia, is obtained in colorless and inodorous cubes having the specific gravity 2.498. If the air is excluded the salt sublimes undecomposed; in contact with the atmosphere it acquires a yellowish-brown color and a slight odor of iodine. The salt is very deliquescent, and dissolves freely in water and alcohol, requiring 1 part of water and 9 parts of alcohol at 15° C. (59° F.), .5 part of boiling water, and 3.7 parts of boiling alcohol for solution (*U. S.*); the solutions have a slight acid reaction and become yellow on exposure. Iodine is liberated on the addition of nitric acid and ammonia by potassa or lime. On the addition of a little chlorine-water to the aqueous solution of the salt, iodine is set free, which will dissolve in chloroform or in disulphide of carbon with a violet color, and will impart a blue color to mucilage of starch; excess of chlorine will prevent these color-reactions through the formation of colorless compounds.

Tests.—The purity of the salt is recognized by its complete volatility, and by its solution yielding not any, or only a slight, turbidity with barium chloride (sulphate). Bromide and chloride of ammonium are recognized by precipitating the solution with silver nitrate and adding ammonia in excess, in which silver iodide is very sparingly soluble, so that the ammoniacal liquid will yield merely a slight turbidity on the addition of nitric acid. If a precipitate occurs, this is agitated with chlorine-water gradually added in the presence of chloroform, which will be colored red if bromine be present; if the chloroform is not colored, the impurity is a chloride. The limits of impurities are thus ascertained: "On adding to 1 Gm. of the salt, dissolved in 20 Ccm. of water (with a few drops of dilute hydrochloric acid), 5 or 6 drops of test solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 1 Gm. of the salt be dissolved in 10 Gm. of water of ammonia, then shaken with a solution of 1.3 Gm. of nitrate of silver in 20 Gm. of water, and the filtrate be supersaturated with 8 Gm. of nitric acid, no cloudiness should make its appearance within 10 minutes (absence of more than about 0.5 per cent. of chloride and bromide). A 1 per cent. aqueous solution should not be colored blue by test solution of ferrocyanide of potassium (absence of iron), nor, after being mixed with gelatinized starch, should it assume a deep-blue color (limit of free iodine)."—*U. S.* The solution of 10 grains of iodide of ammonium, treated with sufficient nitrate of silver, yields a precipitate of iodide of silver, which, after washing and drying, weighs 162 grains (or 1.62 Gm. from 1 Gm. AmI).

Physiological Action and Medical Uses.—This salt has the general properties of the alkaline iodides, but is more active as well as more transient in its effects. It is said that 8 grains (Gm. 0.50) (Böcker), and even 20 grains (Gm. 1.30) (Gamberini), may be taken at a dose without other effect than some warmth and irritation of the throat and stomach. It was first used in an ointment for *psoriasis*, *tinea capitis*, and other scaly affections of the skin, particularly those due to a syphilitic infection, and it was afterward administered internally for the same class of affections with success. As a topical application in ointments and poultices it reduces *enlarged glands*, and, being more irritating than iodide of potassium, is probably superior to the latter salt for this purpose, but it is inferior to the iodide of lead. A solution of 30 or 40 grains (Gm. 2.00–2.60) of the salt in a fluidounce of glycerin has been used with the same object, and also as an application to enlarged and indurated *tonsils*. It is sometimes added to volatile, camphorated, and other liniments used for the relief of *rheumatic* and other local pains. The *dose* of this iodide is from 1 to 5 grains (Gm. 0.06–0.30) and upward. It should be dissolved in water with syrup, and dispensed in bottles of blue glass to prevent its decomposition by the light. An ointment containing from 30 to 60 grains (Gm. 2–4) of the salt in an ounce of lard should be freshly prepared when required.

AMMONII NITRAS, *U. S., Br.*—NITRATE OF AMMONIUM.

Ammoniæ nitras, Br. Add.; *Ammonium nitricum*, *Nitrum flammans.*—*Nitrate of ammonia*, E.; *Azotate d'ammoniaque*, *Nitre inflammable*, *Nitre ammoniacal*, *Sel ammoniacal nitreux*, Fr.; *Salpetersaures Ammon* (*Ammonium*, *Ammoniak*), *Ammoniumnitrat*, G.

Formula NH_4NO_3 or $AmNO_3$. Molecular weight 80.

Preparation.—Ammonium nitrate exists in small quantity in the atmosphere and in rain-water, particularly after thunder-storms; likewise in the water of several springs. On dissolving iron in nitric acid the same salt is formed through the action of nascent hydrogen upon a portion of the acid; many other metals have the same effect.

For preparing ammonium nitrate, nitric acid is neutralized with ammonia or ammonium carbonate, or, in place of the latter, the pulverulent bicarbonate which accumulates in the shops may be advantageously employed; the solution is concentrated by evaporation and crystallized, or until it congeals on cooling. On the large scale it is manufactured from ammonium sulphate and potassium nitrate, the mixed solutions of which yield, first, crystals of the less freely soluble potassium sulphate, afterward crystals of ammonium nitrate, which require to be purified by recrystallization.

Properties.—Ammonium nitrate crystallizes in colorless hexagonal prisms, or on the rapid refrigeration of the concentrated solution in long, flexible, thread-like needles; after fusion it forms colorless crystalline, inodorous masses. It has the specific gravity 1.70, and possesses a sharp bitterish taste. It deliquesces in contact with moist air, and dissolves at ordinary temperatures in about half its weight, and in much less of boiling water. It dissolves in 2.20 parts of alcohol, specific gravity 0.880, at 25° C. (77° F.) (Pohl); in 1.1 parts of boiling alcohol (Wenzel); in 20 parts of alcohol at 15° C. (59° F.), and in 3 parts of boiling alcohol (*U. S. P.*). The solutions on exposure or on heating lose ammonia and acquire an acid reaction. The salt deliquesces in ammonia gas, forming a solution in liquefied ammonia, as observed by Divers (1872); at 23° C. (73.4° F.) and the pressure of the atmosphere the liquid consists of 4 parts, and at 0° C. (32° F.) of 2 parts, by weight, of the nitrate to 1 part of ammonia; but under greater pressure or at lower temperatures much more ammonia can be condensed by the nitrate. Like an aqueous solution, the liquid boils when heated, and may crystallize on cooling or become supersaturated with the salt without crystallizing; at 80° C. (176° F.) the whole of the ammonia is expelled. Ammonium nitrate softens on the application of heat, and fuses at 108° C. (226.4° F.) (Pleischl), at 152° C. (305.6° F.) (Berthelot, 1872), at 165° to 166° C. (329°–330.8° F.) (Pickering, 1878), the difference in these observations being doubtless due to the presence of moisture and other impurities. The same causes affect also the temperature at which the salt is decomposed, and which has been determined at 185° C. (365° F.) by Pickering, at 190°–200° C. (374°–392° F.) by Legrand, at 210° C. (410° F.) by Berthelot, and at near 240° C. (464° F.) by Pleischl. A portion of the salt is volatilized unaltered. When rapidly heated it is decomposed into water, nitrous acid, and nitrogen, or into nitrous and nitric oxides, nitrite of ammonium, and ammonia; but if gradually heated it is decomposed into water and nitrous oxide, or *laughing gas*, N_2O. This decomposition is effected according to the following equation: $NH_4NO_3 = N_2O + 2H_2O$. It is evident from this that in the preparation of nitrous oxide gas to be used for inhalation the heat should be carefully regulated and the gas pass through solutions of potassa (or lime-water) and ferrous sulphate, whereby all the gaseous impurities, except the nitrogen which may be present, are completely removed, even if chlorine should have been evolved in consequence of the presence of ammonium chloride in the nitrate.

The salt detonates when thrown upon red-hot charcoal or when mixed with powdered charcoal and heated to 170° C. (338° F.). When mixed with sulphuric acid, nitric acid vapors are given off, and potassa or lime evolves ammonia when heated with the aqueous solution.

Tests.—The salt should be completely volatilized without charring when heated upon platinum-foil, and its aqueous solution should not be precipitated either by silver nitrate or barium chloride (absence of chloride and sulphate).

Medical Action.—This substance is seldom used in medicine. It is generally regarded as having properties analogous to those of potassium nitrate. It is made officinal chiefly as the source from which nitrous oxide gas is derived by means of heat.

AMMONII PHOSPHAS, *U. S., Br.*—Phosphate of Ammonium.

Ammoniæ phosphas, Ammonium phosphoricum, Phosphas ammonicus.—Phosphate of ammonia, Diammonium orthophosphate, E.; *Phosphate d'ammoniaque,* Fr.; *Ammoniumphosphat, Phosphorsaures Ammon (Ammonium, Ammoniak),* G.

Formula $(NH_4)_2HPO_4$. Molecular weight 132.

Preparation.—Take of Diluted Phosphoric Acid 20 fluidounces; Strong Solution of Ammonia a sufficiency. Add the ammonia to the phosphoric acid until the solution is slightly alkaline, then evaporate the liquid, adding ammonia from time to time so as to keep it in slight excess, and when the crystals are formed on the cooling of the solution dry them quickly on filtering-paper placed on a porous tile, and preserve them in a stoppered bottle.—*Br.*

This process yields the salt by the direct union of tribasic phosphoric acid and ammonia. Since the salt has a distinct alkaline reaction and heat expels a portion of the ammonia, it becomes necessary to add ammonia-water from time to time, and particularly when the solution is set aside to crystallize, in order to preserve the alkaline reaction, otherwise this so-called neutral salt will be mixed in variable proportions with the acid phosphate, having the composition $NH_4H_2PO_4$. The officinal salt may also be obtained from bones calcined to whiteness by the process for Phosphate of Sodium (which see), if the sodium carbonate there directed is replaced by ammonium carbonate, and the resulting liquid, after suitable concentration, is rendered alkaline by the addition of some ammonia. If necessary, the salt obtained is to be purified by recrystallization from distilled water, with the addition of a little ammonia, until the crystals are free from sulphate. If the crystallizing liquid should have been rendered strongly alkaline by ammonia, the salt would consist of or contain triammonium (the so-called basic) orthophosphate of the formula $(NH_4)_3PO_4$.

Properties.—The officinal phosphate of ammonium crystallizes in transparent colorless, monoclinic prisms having the specific gravity 1.678 (Buignet, 1861). It has a cooling and sharply saline taste, effloresces superficially in a damp atmosphere through loss of ammonia, is insoluble in alcohol, but dissolves in 4 parts of water at 15° C. (59° F.) and in .5 parts of boiling water, yielding a solution which is at first slightly alkaline, but on exposure becomes neutral through loss of ammonia, and by continued boiling loses one-half of it. The solution yields a yellow precipitate with nitrate of silver, soluble in nitric acid and ammonia, and evolves ammonia when heated with potassa. The salt, when heated, fuses and is gradually decomposed into metaphosphoric acid, ammonia, and water, and at a bright red heat is finally completely volatilized.

Tests.—20 grains of the salt, dissolved in water and precipitated by ammonio-sulphate of magnesium (test mixture of magnesium, *U. S.*), yield a crystalline precipitate which, when well washed with diluted ammonia-water, dried, and ignited, weighs 16.8 grains, *Br.* (1.68 Gm. from 2 Gm. of the salt, *U. S.*). The solution should not be affected by sulphide of ammonium, or, after being acidulated with nitric acid, by hydrosulphuric acid (absence of metals), and should yield no precipitate with barium chloride (sulphate) or silver nitrate (chloride). 10 grains of the salt, gradually heated upon platinum-foil to redness, should leave a residue weighing 6.1 grains.

Physiological Action and Medical Uses.—This medicine was originally proposed as a remedy for *gout*, upon the theoretical ground that it would produce, with the uric acid in the system, more soluble salts than those of soda and lime, which form the bases of gouty concretions. By a singular perversion of logic the same condition was assumed to exist in *rheumatism*, which is a totally different disease, essentially as well as clinically. It was indeed pointed out that, even from a chemical point of view, the administration of the medicine would be apt to favor the formation of ammoniaco-magnesian calculi. However, it was alleged that during the use of the medicine uric acid rapidly disappeared from the urine, and that the pains and other local phenomena in the joints during acute gout and rheumatism subsided, just as they do in the latter disease under the use of the carbonates of the alkalies. No general concurrence in the results of observation has confirmed the special if not specific advantages ascribed to this medicine at its introduction, and which are neither greater than those of the other alkalies nor different from them. Like them, phosphate of ammonium has been found very serviceable in many cases of *diabetes* by maintaining a highly alkaline condition of the blood, and thereby diminishing the amount of sugar eliminated with the urine. The *dose* is from 10 to 20 grains (Gm. 0.60–1.30) three times a day, dissolved in water or in some mild liquid, such as barley- or rice-water.

AMMONII SULPHAS, *U. S.*—SULPHATE OF AMMONIUM.

Ammonium sulphuricum, Sulphas ammonicus, Sal ammonium secretum Glauberi.—Sulfate d'ammoniaque, Sel secret de Glauber, Fr.; *Schwefelsaures Ammon* (*Ammonium, Ammoniak*), *Ammoniumsulfat*, G.

Formula $(NH_4)_2SO_4$ or Am_2SO_4. Molecular weight 132.

Origin.—Ammonium sulphate was observed by Libavius (1595), and first prepared from oil of vitriol and volatile alkali by Glauber (1667), after which time it was much employed as a purgative. The salt is a constituent of a few minerals, and is sometimes found in the neighborhood of volcanoes.

Preparation.—Sulphate of ammonium is largely obtained from coal-gas liquor (see AMMONII CHLORIDUM) by neutralizing it with sulphuric acid or by digesting it with sulphate of calcium. A convenient process is to percolate the gas-liquor through powdered gypsum, whereby carbonate of calcium is left in the percolator and sulphate of ammonium is found in the filtrate; $CaSO_4 + (NH_4)_2CO_3$ yields $CaCO_3 + (NH_4)_2SO_4$. The solution is evaporated; the resulting crystals are gradually heated to about 240° C. (464° F.) to expel tarry compounds, and then recrystallized from water. Nearly all that is consumed in the United States is manufactured here.

Properties.—It forms colorless rhombic prisms isomorphous with sulphate of potassium, free from odor, and of a sharp saline and bitterish taste. It has the specific gravity 1.76, fuses at 140° C. (284° F.), and is decomposed at a heat exceeding 260° C. (500° F.), yielding ammonia, water, nitrogen, and a sublimate of ammonium sulphite with a little ammonium sulphate. 100 parts of water dissolve, according to Alluard (1864),

71.00	73.65	76.30	78.95	81.60	84.25	86.90	89.55	92.20	94.85	97.50 parts of Am_2SO_4
at 0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100° C.

The solution in cold water has a neutral reaction to test-paper, but on exposure or on boiling evolves a little ammonia and acquires a faint acid reaction (Debbits, 1872). It is insoluble in absolute alcohol, requires for solution about 500 parts of alcohol (spec. grav. .88), but dissolves more freely in weaker alcohol. Its solution evolves ammonia when heated with potassa or lime, and chloride of barium produces in it a white precipitate insoluble in diluted nitric acid.

Tests.—When gradually heated to redness the salt should not be blackened, and should finally leave no residue upon platinum-foil. Metals, chlorides, and other impurities are detected in the same manner as in other ammonium salts; the allowable limits are thus determined: "A 1 per cent. solution of the salt should not be blackened by test solution of sulphide of ammonium (lead and iron), nor, when acidulated with nitric acid, should it be rendered more than opalescent by test solution of nitrate of silver (limit of chloride)."—*U. S.*

Uses.—This salt is extensively used in the manufacture of ammonia-water, chloride of ammonium, and ammonia alum; also for Ferri et ammonii sulphas.

Medical Action.—This salt is not used as a medicine.

AMMONII VALERIANAS, *U. S.*—Valerianate of Ammonium.

Valerianas ammonicus.—*Valérianate d'ammoniaque*, Fr.; *Ammoniumvalerianat*, *Baldriansaures Ammonium*, G.

Formula $NH_4C_5H_9O_2$. Molecular weight 119.

Preparation.—The practical details of the process recognized by the U. S. Pharmacopœia of 1870 were published by B. J. Crew (1860), and are based upon Chevreul's observations that concentrated valerianic acid, placed in an atmosphere of ammonia, yields this salt in crystals. A convenient quantity of valerianic acid (spec. grav. .935) is placed in a tall, narrow glass vessel and saturated with dry ammonia gas, which is generated from a mixture of equal weights of ammonium chloride and slaked lime, the gas being dried by passing it through a bottle filled with pieces of burned lime. On the combination of the dry ammonia gas with the acid much heat is produced, and after neutralization has been attained the salt crystallizes readily on cooling; after several hours it is broken into pieces, drained, if necessary, in a glass funnel, dried on bibulous paper, and preserved in a well-stopped bottle. Valerianic acid, which is weaker than the above and of higher specific gravity, yields few or no crystals by this process.

Properties.—Valerianate of ammonium, thus prepared, forms colorless or white quadrangular plates having the odor of valerianic acid and possessing a sharp and sweet taste. It effloresces when placed in a dry atmosphere, and deliquesces in moist air. On the application of heat it fuses, giving off ammoniacal and acid vapors, and is finally dissipated without leaving any residue. It dissolves freely in water and alcohol, the solutions being neutral, and on evaporation acquiring an acid reaction from the loss of ammonia. Alkalies decompose it with the evolution of ammonia, and the stronger acids with the separation of oily valerianic acid, floating upon the aqueous solution. Should the salt have an acid reaction, its solution, when dispensed, should be neutralized by the careful addition of ammonia, whereby the disagreeable odor and taste of valerianic acid are masked to a considerable extent.

Tests.—Heated to redness upon platinum-foil, the salt should leave no residue (potassium, etc. salts). Its aqueous solution, after having been acidulated with nitric acid, should not be precipitated by chloride of barium (sulphate) or nitrate of silver (chloride), or, after having been rendered alkaline by ammonia, by sulphate of magnesium (phosphate). When the aqueous solution is treated with an excess of sulphuric acid, and the clear watery liquid is nearly neutralized with ammonia, a deep-red coloration should not be produced on the addition of ferric sulphate or chloride (absence of acetate).

Medical Uses.—Of the physiological action of this salt we have no knowledge; like several other medicines, including valerian itself, its influence is exhibited chiefly in certain morbid conditions due to exhaustion of the nervous system. It was first employed successfully for the relief of *neuralgia* of this description, and it continues to be used as a convenient palliative for that affection, for *nervous headache*, *nervousness*, *insomnia*, *hysterical disorders*, *palpitation of the heart*, etc. It would be a waste of time to prescribe it in cases of epilepsy, chorea, and fully-formed hysterical convulsions. *Dose*, from 2 to 10 grains (Gm. 0.10–0.60), dissolved in water, with the addition of a flavoring tincture, which also preserves the salt from decomposition.

AMPELOPSIS.—Virginia Creeper.

American ivy, E.; *Vigne vierge*, Fr.; *Wilder Wein*, *Amerikanischer Epheu*, G.

The young branches and bark of Ampelopsis (Cissus, *Persoon*, Vitis, *Mœnch*) quinquefolia, *Michaux*, s. Vitis (Cissus, *Barton*) hederacea, *Willdenow*.

Nat. Ord.—Vitaceæ.

Description.—The Virginia creeper is a woody vine, climbing extensively by adventitious roots and by tendrils; it has digitate leaves composed of five oblong lanceolate somewhat dentate leaflets, and cymose clusters of greenish flowers with five unconnected deciduous petals, and produces two-celled and two- or four-seeded acidulous blue-black berries of the size of a pea. The young branches and bark are employed, and collected in autumn. The plant is indigenous to North America, and is often cultivated here and in Europe as a covering for walls.

Constituents.—The leaves were analyzed by Wittstein (1845) and by Gorup-Besanez (1872 and 1874). Collected in June, they contain albumen, sugar, pyrocatechin, free tartaric acid, potassium bitartrate, and calcium tartrate; when collected in September no potassium bitartrate or free tartaric acid was found, and in addition to the other constituents pectin and glycolate of calcium were obtained. The berries contained the same principles except glycolic acid.

The root of Amp. Botrya, *De Candolle*, of South-eastern Africa, is reputed to possess diuretic properties.

Medical Action.—There appears to be nothing recently added to the scanty statements long ago made regarding this plant. A decoction or infusion of the bark was said to be useful in dropsy, and "to act rather by stimulating absorption than as a diuretic." The therapeusis of this statement is probably crude as its physiology.

AMYGDALA.—Almond.

Amandes, Fr.; *Mandeln*, G.

The seed of the almond tree, Amygdalus communis, *Linné*, s. Prunus Amygdalus, *Stokes*. Bentley and Trimen, *Med. Plants*, 99.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Officinal Varieties.—1. Amygdala amara, U. S., Br.; *Amygdalæ amaræ*, P. G.; *Semen Amygdali amarum.*—*Bitter Almond*, E.; *Amandes amères*, Fr.; *Bittere Mandeln*, G.

The seed of Amygdalus communis, *Linné*, var. amara, *De Candolle.*

2. Amygdala dulcis, U. S., Br.; *Amygdalæ dulces*, P. G.; *Semen amygdali dulce.*—*Sweet Almond*, E.; *Amandes douces*, Fr.; *Süsse Mandeln*, G.

The seed of Amygdalus communis, *Linné*, var. dulcis, *De Candolle.*

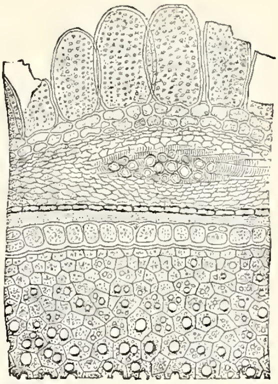
Origin.—The almond tree is probably indigenous to Western Asia, but at an early period was introduced into Northern Africa and Southern Europe, where by long cultivation numerous varieties have been produced, differing mainly in the size and shape of the fruit and in the hardness of the shell (endocarp). It has also been introduced in the warmer parts of the United States and in other countries of the warmer temperate and subtropical regions; in California, according to M. J. Murphy, about 100 trees are planted to the acre, and begin to yield fruit when three years old of an average value of $50, increasing to $2000 in the eighth year. The tree attains a height of 15 to 20 feet (5 to 6 M.), and with its bright green foliage and large rose-colored or white flowers presents a handsome appearance. The fruit is a short-stalked, ovate drupe about 1½ inches (38 Mm.) long, 1 inch (25 Mm.) broad, somewhat flattened, with a groove on one side, covered with a greenish leathery sarcocarp, which is whitish velvety hairy, splits at maturity, and falls away from the putamen; this constitutes the *commercial* almond, which, at least in California, is bleached and rendered of uniform appearance by exposure to the vapors of burning sulphur, whereby insects present are also destroyed. The putamen, deprived of its hard shell, the thick or papery endocarp, furnishes the *officinal* almond. The bitter and sweet almond trees do not differ from each other botanically, and even the fruits and seeds of the two varieties resemble each other closely.

Description.—The sweet and bitter almonds cannot be distinguished from each other except by one of their constituents and their taste. Bitter almonds are usually thinner, broader, and shorter than the larger variety of the sweet almond, which is ordered by the British Pharmacopœia, and which is known in our commerce by the name of *Jordan almonds.* They are cultivated in Spain; the best are exported from Malaga, and are a hard-shelled variety, but are frequently seen in commerce deprived of the shell. The soft-shelled sweet almonds (variety fragilis, *De Candolle*) are cultivated largely in the Balearic Isles (Majorca), and are exported from Valencia and the Mediterranean ports of France and Italy. The cheapest variety are the Barbary almonds, which are small and unsightly in appearance.

Jordan or Malaga almonds are about an inch (25 Mm.) in length and $\frac{3}{5}$ inch (15 Mm.) broad, flattened, and ovate-lanceolate in shape. The testa is of a cinnamon-brown color and scurfy upon its surface from detached cells; it adheres to the whitish tegmen, and the two integuments are easily detached from the white embryo or kernel (blanched) after the seed has been soaked in lukewarm water for a short time. The hilum is just below the pointed end and upon one edge of the almond, the raphe running along this edge to the broad end, where it forms the broad chalaza, and divides into about sixteen branches, which pass in plainly visible lines toward the pointed end. The embryo consists of two plano-convex white and oily cotyledons of the size and shape of the seed, between which, near the pointed end, the flat plumule is placed, with the short thick radicle somewhat projecting. The tissue of the embryo is made up, besides a small number of delicate fibro-vascular bundles, of thin-walled, irregularly angular parenchyma-cells filled with fixed oil and granules of different size. Almonds are inodorous, and have a sweetish bland, nutty taste, that of the bitter variety being decidedly bitter and aromatic.

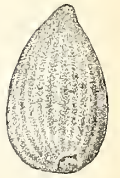
The embryo of both varieties of almonds yields, on being triturated with water, a milk-white emulsion, which is either inodorous and sweet or aromatic and bitter, according to the variety used.

Fig. 12.



Almond: section through seed-coats and portion of cotyledon. Magnified 190 diameters.

Fig. 13.



Almond.

Constituents.—Both varieties of almonds have qualitatively the same composition, except that amygdalin is found in bitter but not in sweet almonds. The fixed oil (see Oleum Amygdalæ Expressum) is present to the amount of 45 to 56 per cent., the sweet almonds yielding usually from 5 to 10 per cent. more than the bitter. About 3 per cent. of mucilaginous matter, 6 per cent. of sugar, and 24 to 30 per cent. of protein compounds, besides water and cellular tissue, are found in almonds. On keeping almonds for several days in absolute alcohol they become covered with minute crystals, which Portes (1876) recognized as asparagin. Ludwig and Scheitz (1872) found in unblanched almonds tannin, giving a green reaction with ferric salt, green resin, and a bitterish acrid yellow substance, which is possibly a glucoside; the three compounds seem to be contained only in the integuments; the last two yield with caustic soda a cherry-red color, which, with more alkali, turns dingy-green. The sugar of almonds is mostly glucose, but Pelouze obtained (1855) also cane-sugar. The two protein compounds are, according to Ritthausen (1872), modifications of vegetable casein. Both are soluble in cold water; one, the *conglutin* of Ritthausen and *amandin* of Comaille (1866), being precipitated by acetic acid, while the second compound, known as *emulsin* or *synaptase*, may afterward be precipitated by alcohol, together with some inorganic salts. Both protein compounds act as emulsionizing agents in suspending the fixed oil when the almonds are triturated with water; but it appears to be the emulsin only which is capable of decomposing the amygdalin of bitter almonds into hydrocyanic acid and benzaldehyd. (See Oleum Amygdalæ Amaræ.)

Amygdalin, $C_{20}H_{27}NO_{11}$, was discovered by Robiquet and Boutron-Charlard (1830) by exhausting bitter almonds, deprived of their fixed oil, by alcohol; they also observed that the residue would not yield oil of bitter almonds in contact with water. Liebig and Wöhler found (1837) that amygdalin, on being decomposed by emulsin, yields, besides oil of bitter almonds and hydrocyanic acid, also grape-sugar; it was the first glucoside discovered. Amygdalin is obtained from bitter almonds to the amount of from 1 to 3 per cent., and is also contained in the bark, leaves, flowers, and seeds of many trees and shrubs of the sub-orders Amygdaleæ and Pomeæ; according to Henschen (1872), also in minute quantity in sweet almonds, and, according to Ritthausen and Kreussler (1870), in the vetch. It occurs sometimes in an amorphous condition, but as obtained by alcohol from bitter almonds, peach-kernels, etc. it crystallizes with $2H_2O$, the water being expelled at 120° C. (248° F.). It is soluble in about 15 parts of water, has no odor, but a bitter taste, and is not poisonous unless decomposed by emulsin. Henschen found that this decomposition is also effected by rye-, wheat-, and pea-flour, but it is uncertain whether by the agency of emulsin or another proteid. 17 grains of anhydrous amygdalin yield 1 grain of hydrocyanic acid. On boiling amygdalin with an alkali it is decomposed into ammonia and *amygdalic acid*, $C_{20}H_{28}O_{13}$, the latter, on being boiled with dilute acids, yielding glucose and *mandelic* or *phenylglycolic acid*, $C_8H_8O_3$ or $C_6H_5.CHOH.COOH$.

Almonds yield from 3 to 5 per cent. of ash, consisting mainly of potassium, calcium, and magnesium phosphates.

Preservation.—Bitter almonds should be kept unbroken and in a dry atmosphere, to prevent the decomposition of amygdalin and of the fixed oil. Almonds the embryo of which has become discolored or acquired a rancid odor and taste, or has been partly converted into gum (bassorin), as described by Vulpius (1878), are unfit for medicinal purposes.

Pharmaceutical Uses.—Both varieties are employed for obtaining Oleum amygdalæ and in preparing Syrupus amygdalæ. Sweet almonds enter into the composition of Mistura amygdalæ, Syrupus amygdalæ, *U. S.*, and Pulv. amygdalæ comp., *Br.*

Physiological Action and Medical Uses.—Sweet almonds are used to prepare an emulsion, and also an oil, which are treated of elsewhere. With them a kind of bread is made which is a tolerable substitute for wheaten bread in the treatment of *diabetes*. Bitter almonds and their essential oil are excessively poisonous in large doses, owing to the quantity of hydrocyanic acid developed in the former by admixture with water and by the presence of the same acid in the latter. A drachm of bitter-almond pulp will kill a pigeon or a kitten. The symptoms produced in man by an overdose of this substance are great debility and depression, cyanosis, collapse, convulsions or muscular rigidity (see ACID HYDROCYANICUM), and, if the dose is fatal, insensibility occurs suddenly, with frothing at the nose and mouth, and after death the eyes remain fixed and glistening. Non-poisonous doses are apt to produce an eruption of urticaria—an effect which sometimes follows the ingestion of sweet almonds.

In preparing the almond for food in cases of *diabetes*, it is first blanched, then subjected to a strong pressure to expel a portion of the oil, treated with boiling water slightly acidulated with tartaric acid to remove the sugar, and then ground to a fine powder, which can be made into cakes and puddings with eggs and cream. These products have a pleasant taste and are said to be quite digestible.

The proper treatment in poisoning by bitter almonds consists in evacuating the stomach by means of the finger in the throat or the administration of a mechanical emetic, such as sulphate of zinc. If the patient is unable to swallow, the stomach-pump should be used. If respiration fails the galvanic battery should be resorted to without delay. Reaction may be promoted by small but repeated doses of brandy or whiskey and the application of ammonia to the nostrils.

AMYL NITRIS, *U. S.*, *Br.*—NITRITE OF AMYL.

Amylium nitrosum, P. G.; *Amylæther nitrosus.*—*Amylo-nitrous ether*, E.; *Azotite d'amyl*, *Ether amylazoteux*, Fr.; *Amylnitrit*, G.

Formula $C_5H_{11}NO_2$. Molecular weight 117.

Preparation.—Purified amylic alcohol is introduced into a capacious glass retort with about an equal bulk of nitric acid; a gradually-increasing heat is applied until the mixture approaches boiling, when the reaction will proceed spontaneously. The distillate is collected until the temperature in the retort rises above 100° C. (212° F.), the portion distilling at a higher temperature containing much nitrate of amyl and ethylamylic ether. The distillate obtained below 100° is agitated with water and an alkali (potassa, lime, or their carbonates) to remove hydrocyanic, nitric, and nitrous acids: and the oily layer, which separates, is rectified from a clean retort by a gradually-increased heat, amylic aldehyd coming over in the first portion; that distilling between 95° and 100° C. is collected separately. (See *Amer. Jour. of Pharmacy*, 1871, p. 147.) If not carefully rectified it requires to be purified by fractional distillation.

This is Balard's process (1844), with some modifications. A. B. Tanner (1871) prepares it more advantageously by mixing, in a glass retort containing some copper wire, 10 measures of pure amylic alcohol with 1 measure of sulphuric acid and 1 measure of nitric acid previously diluted with an equal bulk of water. On the application of a gentle heat the reaction will commence at about 18.3° C. (65° F.), and gradually rise to about 36.6° C. (98° F.). The contents of the retort are cooled, more nitric acid is added, and the distillation continued as before as long as any ether is obtained. This is then washed and rectified as before. The reaction between amylic alcohol and the undiluted acids is extremely violent.

Properties.—Nitrite of amyl is an ethereal liquid of a yellowish color, a neutral reaction, a peculiar not disagreeable fruit-like odor, and a pungent aromatic taste. The U. S. Pharmacopœia requires its spec. grav. to be .872 to .874, while Rieckher has determined it to be .877 and Bunge .905 at 14.5° C. (58° F.). Amyl nitrite boils constantly and without being decomposed at 96° C. (205° F.) (W. H. Greene, 1879), or, according to

Chapman (1867), between 98° and 99° C.; the vapor is orange-colored and has the density 4.03. Amyl nitrite burns with a bright fawn-colored and sooty flame. It is insoluble in water, but dissolves in all proportions in rectified spirit and other alcohols, in ethers, carbon disulphide, benzol, benzin, and other hydrocarbons. It dissolves fixed oils, fatty acids, phosphorus, and a small proportion of sulphur, caoutchouc, and gutta-percha. On exposure to air and light it acquires an acid reaction, and should therefore be preserved in small glass-stoppered vials kept in a cool and dark place—according to *P. G.* with a few crystals of potassium tartrate, whereby an undue amount of free acid will be prevented. In contact with potassa solution it is gradually decomposed, with the formation of amyl alcohol and potassium nitrite, the decomposition being accelerated by warming and in the presence of alcohol; the presence of nitrite is shown by adding to the alkaline liquid a little potassium iodide, then acetic acid to an acid reaction; an immediate separation of iodine will take place, and on the addition of gelatinized starch a deep-blue color will appear (distinction from nitrate). If it be added drop by drop to caustic potassa heated to fusion, potassium valerianate will be formed, frequently with the production of flame.

The commercial product is frequently very impure. Six samples examined by Dott (1878) yielded 85, 65, 47.5, 33.3, 11.5, and 6.7 per cent. of distillate between 90° and 100° C., and Dr. W. H. Greene (1879) found the boiling-point to rise from 70° to 180° C., and some samples to consist chiefly of amyl alcohol.

Tests.—Amyl nitrite should remain transparent or nearly so when exposed to the temperature of melting ice (absence of water).—*U. S.* On shaking 10 Ccm. of nitrite of amyl with 2 Ccm. of a mixture of 1 part of water of ammonia and 9 parts of water, the liquid should not redden blue litmus-paper (limit of free acid).—*U. S. and P. G.* On adding to amyl nitrite three times its volume of a mixture of equal parts of ammonia-water and absolute alcohol, followed by the addition of a little silver nitrate, the application of a moderate heat should cause neither a brown nor black color (absence of valeraldehyd).—*P. G.*

Allied Compounds.—AMYL NITRAS, nitrate of amyl, $C_5H_{11}NO_3$. It was discovered by W. Hofmann (1848), and is most advantageously prepared, according to Chapman and Smith (1867), by dropping through a long tube, and *with constant stirring*, 50 Ccm. of amylic alcohol into 150 Ccm. of a mixture made of 1 volume of nitric and 2 volumes of sulphuric acid, and kept cool by ice and table-salt. Without any visible reaction an oily layer of amyl nitrate separates on the surface, which is obtained pure by washing with dilute potassa solution and water, drying with calcium chloride, and rectifying. It is a colorless oily liquid of a peculiar odor and sweet and burning taste. Its density at 15° C. is .902, and it boils at 147° C. (296.6° F.). It dissolves in glacial acetic acid, benzol, and in ethylic, methylic, and amylic alcohol, but not in water.

NITROPENTANE, $C_5H_{11}NO_2$, was obtained by Von Meyer and Stüber (1872) by treating nitrite of silver with amyl iodide. The liquid is isomeric with amyl nitrite, but boils between 150° and 160° C. (302° and 320° F.), and under the influence of nascent hydrogen yields amylamine. According to Dr. Greene, traces of it are present in commercial nitrite of amyl.

Physiological Action.—*On Animals:* Experiments made with this compound (which was introduced as an anæsthetic by Dr. Richardson in 1863) show that it is readily absorbed by all the tissues, is not an anæsthetic or a local irritant, and does not produce unconsciousness until its other effects are fully developed. It prevents the changes which give to arterial and venous blood their contrasting hues, and occasions a cyanotic tint of the tongue and other vascular parts. The blood in both sets of vessels acquires a brownish color. Primarily, it quickens the respiration, but its prolonged action retards the movements of the chest. It greatly lowers the animal temperature, especially when given in a lethal dose. These phenomena are explained by the fact, which was determined experimentally, that under the influence of the vapor the blood contains two-thirds less than the normal proportion of oxygen, and the hæmoglobulin loses its power of crystallizing. This nitrite primarily dilates the capillaries and reduces arterial pressure, while the action of the heart, for this reason probably, becomes very rapid; but if the use of the nitrite is prolonged the pulse-rate is lowered. The cardiac pulsations are stronger, as well as more frequent, in proportion as the vascular resistance diminishes; and, according to Franck, the heart in each of its cycles receives and discharges as much blood as it did under normal circumstances. This agent is held, on the one hand, to increase the irritability of the spinal cord, upon the ground that animals under its influence pass into a tetanoid condition (Meyer and Friedrich), and on the other that it is a direct and paralyzing poison to the muscles (Pick).

On Man: When 5 or 6 drops of it are inhaled the heart becomes excited, the pulse rising from 70 to 160; its force, as measured by the sphygmograph, diminishes, but practically is increased, for all clinical observation proves that it directly or indirectly enables the heart to overcome embarrassment; the skin, especially of the face, turns crimson; some vertigo is experienced, and the breathing is hurried as it is after rapid walking. If the dose is large the sight may be dimmed, and in the field of vision sometimes a yellow circle appears, surrounded by a violet border. It neither increases nor lessens general sensibility. In full doses it depresses the normal temperature by from 1° to 3° F. Sanders has recorded cases in which sudden collapse followed upon its administration, and Samelsohn one in which the usual flush was succeeded by deadly pallor, the pulse becoming thread-like and slow, the skin cold and clammy, and respiration difficult and gasping, although consciousness was retained. Others are referred to by Jastrowitz. Dugau (1879) relates that after continuing to breathe the vapor for a considerable time he suffered from distressing and irregular palpitation of the heart, with pallor, debility, vertigo, and loss of appetite. During the inhalation the patient is generally conscious of giddiness, a feeling of the head being inordinately large, a diffused glow, and throbbing of the heart and large arteries. It is alleged that the action of this medicine is exceedingly capricious—that while some persons can without injury inhale 30 or 40 drops, others are sensibly affected even by a fraction of a drop.

Dr. Senter has reported the case of a lady who swallowed a dessertspoonful (fʒij) of nitrite of amyl. 25 minutes later she was vomiting, her face grayish-white, the pupils widely dilated, and the eyes glassy and rolling. The mouth was open, the breathing alternately rapid and slow, and then was almost suspended. The pulse, irregular and jerking at first, became very slow and hardly perceptible. The muscles were all relaxed; the skin, cold and sweating, exhaled an odor of amyl. The patient recovered under the use of coffee, laudanum, heat, friction, and flagellation (*Amer. Jour. of Phar.*, Mar. 1881, p. 137). In the case of a man affected with pulmonary phthisis death followed the inhalation of 7 drachms of nitrite of amyl (*Boston Med. and Surg. Jour.*, May, 1883, p. 526).

Nitropentane, according to Schadow, when respired by man in the dose of 18 drops for 5½ minutes, produces no peculiar symptoms; in dogs and cats prolonged inhalations of the vapor induced dilatation of the pupils and epileptiform convulsions.

Uses.—The power of nitrite of amyl to dilate the capillaries is said to have suggested its use in *angina pectoris*, *epilepsy*, and other spasmodic diseases. It is certain that in many cases of the former disease the inhalation of 2 or 3 drops suffices to arrest the paroxysm of pain or materially to mitigate it. The various lesions which may give rise to angina render these differences of effect intelligible. In some cases, probably those which are either purely functional or connected with the less serious organic lesions of the heart and aorta, the habit of using the medicine appears to render the attacks both less frequent and less severe. But in course of time, like other nervines, its influence declines. The mode of action of the medicine in this disease appears to be anodyne, and at the same time antispasmodic. It should be very cautiously used, and most of all when there is reason to suspect degeneration of the arteries of the brain. In pure *neuralgia*, especially of the fifth nerve, it sometimes relieves the pain promptly; and the same may be said of *neuralgic headache* and of *gastralgia*. In *spasmodic asthma* also it frequently brings prompt relief in proportion as the character of the attack is nervous. In several cases it appears to have suspended dyspnœa produced by fatty degeneration and other debilitating lesions of the heart. Persistent *hiccup* has yielded to its use. It has also been used in *whooping cough*. In 1877 ten cases of the disease were reported by D. Bayles, who claimed for the nitrite a positive value "in allaying the violence and limiting the duration of the cough" (*Trans. N. Y. State Med. Soc.*, 1877, p. 181). In persistent *hiccup* occurring without known cause nitrite of amyl has arrested the attack after the failure of cautery, atropia, and chloroform (*Med. Record*, xxii. 231). It has relieved infantile *spasm of the glottis* (Williams). In *syncope* from post-partum hæmorrhage it has restored consciousness and saved life (Köhler; Kerr), and dissipated the dizziness and *faintness* caused by anæmia or by such severe pain as *hepatic* and *renal colic* produce (Kurz). It may be believed that these effects are due to the power which the nitrite has of dilating the blood-vessels, for they are observed in other affections to which this explanation applies. One is *sea-sickness*, in which the subjective symptoms seem due to cerebral anæmia, and are promptly relieved by this medicine (Clapham, *Lancet*, June, 1879); another is the *vertigo* and *syncope* which accompany various obstructive or asystolic lesions, such as mitral insufficiency, dilatation, and softening of the heart. It may be added that this preparation has been used to distinguish anæmia from congestion of the brain—conditions which are often very much alike in their phenomena. The nitrite palliates the former, but aggravates the latter state. In *pneumonia* involving a large portion of both lungs, and therefore producing a relative debility of the heart and imper-feet supply of blood to the brain, it has been given by the stomach with marked advantage (Keating). It is said that the chill of *intermittent fever* has been abruptly arrested by the inhalation of this vapor, while the febrile stage was correspondingly shortened; and also that a like effect has been produced in the paroxysm of *dysmenorrhœa* (*Boston Med. and Surg. Jour.*, Dec. 1881, p. 597). The medicine has been used to combat the *night-sweats* of phthisis, but in the reported cases (Murrell, *Practitioner*, xxiii. 97) the dose employed was too insignificant to be efficient and the results were mainly negative. There appears to be good reason for believing that it sometimes cures *chorea*, but for this purpose it must be administered two or three times daily for several days. Several cases of traumatic *tetanus* have recovered under its use; and since, in experiments upon frogs tetanized by strychnia, death was prevented by the use of nitrite of amyl until the elimination of the poison, it is probable that the same effect might ensue, and even more promptly, in man. In the cases of tetanus successfully treated by the nitrite it was administered two or three times a day, and in doses of only 5 drops. In *trismus nascentium* it has also been found to control the spasms. The same statement is true of *puerperal eclampsia*. In one such case the use of the medicine was followed by relaxation of the uterus and profuse hæmorrhage. In *infantile convulsions* its utility has been shown, even when the child was brought to death's door by a farrago of medicines, including chloral, chloroform, and morphia; and in *hydrophobia*, although incapable of staying the advance of death, it has enabled the patient to take food and drink and lessened the horror of impending dissolution. In *hysterical convulsions* it has also arrested the paroxysm, but in no degree modified the general course of the disease or lessened the frequency of the attacks. If we may trust the published reports, its influence upon *epilepsy* is more permanent and radical; it would seem not only to prevent the development of the paroxysms when applied early, but also to render their occurrence less frequent. This is particularly true of cases in which several successive convulsions make up the paroxysm. Necessarily, it must be most useful when the fit is preceded by an aura or other warning symptom; but even in those cases in which the fits are subintrant the remedy usually produces a very sensible amelioration. It is to be noted that when it is employed during the fit, and when the face is very livid, this color is gradually replaced by a vivid flush as consciousness returns. Epilepsy cannot be cured by this medicine. It has been employed to relieve *pain* of a more or less *spasmodic nature* occurring in the œsophagus, diaphragm, stomach, bowels, bladder, urethra, uterus, vagina, etc. A case of *blepharospasm* is recorded in which the patient is said to have been cured by its inhalation in very unusual doses—viz. from fʒss to fʒj from one to three times a day for 4 successive days. A case of *strychnia-poisoning* in which the tetanic phenomena were very severe was cured by the repeated inhalation of nitrite of amyl, which effectually averted or greatly modified the fits as often as it was administered (Barnes, *British Med. Jour.*, Apr. 1, 1882). The same method has relieved *chordee*. It has arrested the paroxysm of *intermittent fever* when inhaled during the cold stage in the dose of 4 drops. In a case of *exophthalmic goitre* 2 drops were found to be an excessive dose, and "one-tenth of a drop" was directed to be taken half an hour before eating, with complete relief of all the subjective symptoms (Blake). The patient was a nervous female.

One of the most important qualities of nitrite of amyl consists in the antagonism of its primary action to *chloroform syncope*. It is certain that chloroform contracts, and that nitrite of amyl dilates, the capillaries of the brain and of the skin of the face; under the former the patient grows pale, under the latter he is flushed. In experiments upon animals, if the nitrite be used in an excessive dose, cyanosis arises in consequence of venous engorgement. Experiments have also shown that if it is given, according to the latter method, to an animal already narcotized by chloroform, it deepens instead of relieving the narcotism, while if it be administered in moderate quantities, either by inhalation or hypodermically, it revives the heart's action and removes the pallor caused by the chloroform. These effects have been happily illustrated in at least eight cases of chloroform-poisoning. In all of them the patients were rescued from imminent death. The salutary or pernicious effects of the nitrite being due to the amount of it administered, we may explain why Testa should have fallen into the error of declaring that it intensifies the dangers which chloroform creates. Besides the cases just mentioned of its remedial power in chloroform syncope, others might be cited to show that it is equally efficacious when injected hypodermically in the dose of 3 minims (*Medical Record*, xxi. 335). The nitrite has also been used with advantage in poisoning by *chloral* (*British Med. Jour.*, June, 1879). Like alcohol and other excitants of the heart and nervous system, it has been found of service in various states of *exhaustion* and *typhoid depression*.

As its action is fugitive, its administration must in such cases be frequently repeated. It has been successfully employed in several cases of *carbonic acid* poisoning and to relieve insomnia produced by the *opium habit.* Imperfect vision due to insufficient blood-supply to the retina (*amblyopia*), and which strychnia has failed or ceased to profit, has sometimes improved under this medicine; and in many cases of subjective *noises in the ear* the repeated use of it has afforded great relief when the tinnitus has not been due to a mechanical cause. Applied locally, it is anodyne, relieving the pain of *headache, toothache, earache, neuralgia, dysmenorrhœa,* etc.

Administration.—Nitrite of amyl may be given in the dose of from 3 to 5 drops (Gm. 0.15–0.30) by the mouth, dissolved in a little aromatic spirit. Like most other medicines which act directly upon the nervous system, it rapidly becomes tolerated in increased doses. Dugan relates that in experiments on himself he could at first inhale no more than 5 drops, but he gradually became able to inspire the vapor largely without occasioning symptoms which in the beginning seemed alarming. Bourneville frequently gave it in doses of 20 drops. We have found but one case recorded of its fatal use, and that was from an excessive dose, mentioned above. It has sometimes been injected hypodermically in cases of chloroform-poisoning, and without occasioning any local irritation. Usually, nitrite of amyl is administered by inhalation, about 5 drops being poured upon the palm of the hand, a piece of sponge, or a folded napkin; or else it is carried in a well-stopped bottle (especially by epileptics), to be used when the fit threatens. Tubes and (still better) "tears" of glass containing about 5 drops (Gm. 0.30) each are also employed by the same class of patients, the glass being crushed in a handkerchief and its contents inhaled. It should rarely be used when syncope is produced by profuse hæmorrhage or when there is organic disease of the heart or brain.

AMYLENUM.—AMYLENE.

Valerene, Pentene, E.; *Amylène,* Fr.; *Amylen, Valeren,* G.
Formula C_5H_{10}. Molecular weight 70.

Preparation.—It was discovered by Balard (1844) by distilling amylic alcohol with a concentrated solution of chloride of zinc. Bauer (1861) recommends the leaving in contact for several days 2 parts of amylic alcohol with 3 parts of fused chloride of zinc, and then distilling until the temperature has risen to about 135° C. (275° F.). The distillate contains some amylic alcohol, water, and amylene with its polymeres. All these impurities have a much higher boiling-point, and are removed by careful rectification in a water-bath and over chloride of calcium at a temperature not exceeding 40° C. (104° F.); it is more difficult to separate amyl hydride, which boils at nearly the same temperature.

Properties.—Amylene, thus obtained, is a thin, volatile, inflammable liquid having a disagreeable cabbage-like odor. It boils at about 35° C. (95° F.), has at 10° C. (50° F.) the specific gravity .6549, and is soluble in alcohol and ether, but insoluble in water. It is a mixture in varying proportions of two or three isomeric compounds boiling respectively at 35° and 37° C. (95° and 98.6° F.).

Amyl hydride, C_5H_{12}, which is contained among the most volatile portions of petroleum and in the light tar-oil of cannel coal, resembles the preceding, but has a more agreeable ethereal odor, recalling that of chloroform, and boils at 30° C. (86° F.).

Physiological Action.—This substance, which was introduced by Snow in 1856, was shown by him to produce unconsciousness and anæsthesia in animals very rapidly, but not in proportion to the amount inhaled, since a very large part of it was expelled without having been absorbed. It produced death suddenly by causing arrest of the heart. In the *surgical operations* in which it was used anæsthesia was observed to be complete in many instances before consciousness was lost, while under ether or chloroform unconsciousness precedes complete anæsthesia. Its action occurs more promptly than even that of either of the substances just named, but its effects pass off with like rapidity. It does not cause sickness at the stomach as readily as they do. But, whatever its advantages may have been, the occurrence of several cases of sudden death during it use caused it to be laid aside.

AMYLUM, *U. S., Br.*—STARCH.

Amylum tritici, P. G.—*Wheat starch,* E.; *Fécule (Amidon) de froment, de blé,* Fr.; *Stärke, Kraftmehl, Weizenstärke,* G.
Composition $C_6H_{10}O_5$. Molecular weight 162.

The fecula of the seed of Triticum vulgare, *Villars*, s. T. sativum, *Lamarck.* Bentley and Trimen, *Med. Pl.*, 294.

Nat. Ord.—Graminaceæ.

Origin.—Starch is found in most vegetables at some period of their growth, and exists in different plants in very different proportions. It is nearly always deposited in the cellular tissue, but is found suspended in the milk-juice of some plants. In many plants a considerable amount of starch is deposited in the root, rhizome, or tuber, or in the seed; in some cases, as in certain palms, it is largely found in the trunk previous to flowering. The mode of preparation must necessarily vary to a certain extent, but always consists in the comminution of the part of the plant by grinding or rasping, and in removing the coarse particles of tissue by sieves, and by subsidence from water, in which the starch remains suspended for some time. (For remarks on the origin and composition of wheat see FARINA TRITICI.)

Description.—From whatever source obtained, starch appears to the naked eye in the form of a fine white powder, the particles of which frequently adhere together superficially, so as to form irregular columnar masses. Under the microscope the powder is observed to consist of distinct grains of a peculiar shape and size, which vary with the plant from which the starch has been obtained. The smallest starch-granules observable with the aid of a microscope are globular in appearance, but the form of the larger granules, such as potato starch, arrow-root, etc., is quite characteristic, so that the origin of starch may by this means be detected with tolerable certainty.

Schleiden classified the starches thus:

1. Without distinct shape (non-mealy sarsaparilla, Carex arenaria).

2. Mostly single grains: *a*, roundish, and without or oftener with a small nucleus; layers indistinct (maize, rice); layers distinct and grains ovate (potato, arrow-root), conchoidal (lily) or subconical (bletia); nucleus elongated (pea, bean) or cup-shaped (orris); *b*, lenticular, layers more or less distinct (wheat, rye, barley); *c*, very flat, layers distinct (Zingiberaceæ); *d*, stick-like, and layers distinct or nucleus elongated, or shape irregular (euphorbia).

3. Compound grains: *a*, without nucleus (bryony, sarsaparilla); *b*, with nucleus, and this small (manihot), large and radiate (colchicum), or cup-shaped (anatherum), forming irregular groups (arum), or several small grains united with a large one (sago).

The granules are evidently made up of layers, apparently differing somewhat in density, and more or less concentrically arranged around a nucleus or hilum, which in many cases is not in the centre, but near the margin or one end of the granule. With respect to the relative age of the different layers, the fact that the innermost ones are softer or less dense is regarded by Schleiden, Payen, Nägeli, and others as conclusive evidence that the outer ones were first deposited, and that those near and around the hilum originated later; while Fritzsche, Berg, and others, on the contrary, find that this condition is a proof of the external growth of the granules by deposits of fresh and denser layers around the more or less gelatinous nucleus. All these layers are considered by many investigators to be of the same composition, and to differ from each other mainly in the amount of moisture retained by them. Opinions, however, in relation to the existence of an enveloping membrane differing in composition are considerably at variance with one another. Those investigators who explain the formation of the starch-granules by external additions reject its existence, and, according to Schleiden, the denser outer layer of the granule which is first deposited is uniform and of precisely the same chemical behavior as the remainder. Payen, Persoz, and Nägeli, on the other hand, find that the starch proper has been deposited within a very thin membrane which has some of the characteristics of cellulose. If starch is acted upon by being digested with saliva, pepsin, or bile, it is dissolved, according to Nägeli, with the exception of a minute residue which does not swell on being boiled with water and requires to be treated with sulphuric acid before it is colored blue by iodine, but dissolves in ammoniacal solution of cupric oxide. For this outer membrane the name *amylin* has been proposed, while the portion soluble in hot water has been named *granulose* and *amidin.* The chlorides of zinc and calcium dissolve starch completely without leaving any residue.

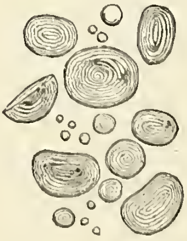
Wheat starch, when viewed under the microscope, is found to consist of nearly circular and flat or lenticular granules, the largest of which are about $\frac{1}{1000}$ inch in diameter, and are mixed with many minute granules, but with a few of an intermediate size. The hilum, if observable, is near the centre of the circle, the indistinct layers forming nearly uniformly concentric rings.

Rye starch, from Secale cereale, *Linné*, consists of small and large granules, the latter varying between oblong-ovate and lenticular in shape. The layers are concentric and rather indistinct; the hilum is near the centre, and mostly with 3 to 5 or 6 rays.

Preparation.—Wheat or other grain is soaked in warm water, to which sometimes an alkali is added, until the outer coating has become soft; it is then ground under water, and washed upon suitable sieves with pure water, with which the starch passes through and is collected by subsidence in suitable tanks, the alkaline water retaining the gluten; or the latter is removed by allowing it to undergo decomposition, when acetic, butyric, or lactic and other acids are produced. The gluten need not be destroyed, but may be obtained as a by-product; for this purpose wheat flour is made with water into a stiff dough; this is set aside for 2 hours, and then placed upon a fine wire sieve, where it is kneaded under a thin stream of water until the latter no longer becomes milky; nearly the whole of the gluten will remain upon the sieve. After sufficient washing with pure water the starch is drained in boxes, cut into cubical blocks, and dried in properly constructed drying-chambers.

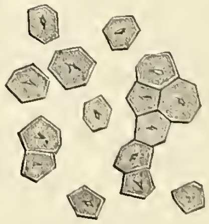
Properties.—Starch forms a white, inodorous, and tasteless powder, with a peculiar slippery feel between the fingers. Exposed to the atmosphere, it contains from 10 to 12 per cent. of moisture, which is given off at 100° C. (212° F.), and is reabsorbed on exposure. The spec. grav. of starch is about 1.5, but after complete drying is increased to 1.56. It is insoluble in ether, alcohol, and cold water; the last-mentioned liquid, however, when triturated with starch, so that some of the granules are ruptured, evidently dissolves a little, since it acquires, after filtration, a blue color on the addition of iodine. *Soluble starch* is obtained, according to Maschke, by the prolonged heating of starch to 100° C. (212° F.). When heated to between 160° and 200° C. (320° and 392° F.) it is gradually converted into *dextrin* (see below). Starch becomes soluble in cold water in the presence of the chlorides of zinc and of calcium and of other deliquescent or freely soluble salts. Its solution in hot water gelatinizes on cooling, the jelly of wheat starch being milk-white—that of potato starch, particularly when made with much water, being more translucent. On heating starch with glycerin a solution is obtained which, according to Zulkowski (1875, 1880), contains soluble starch, obtainable by diluting with water and precipitating the clear filtrate with alcohol. Potato starch is easily converted into the soluble form, but wheat starch requires a prolonged heating, and rice starch is thus changed with still greater difficulty.

FIG. 14.



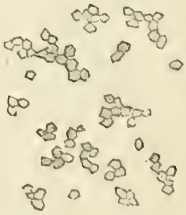
Wheat Starch.

FIG. 15.



Corn Starch.

FIG. 16.



Rice Starch.

Each magnified 250 diameters.

Mucilage of starch, when heated to about 160° C. (320° F.), or when boiled with very dilute sulphuric acid, or when digested with diastase at about 70° C. (158° F.), is converted, according to Musculus (1860), first into *maltose*, $C_{12}H_{22}O_{11}$, which is probably a compound of *dextrin*, $C_6H_{10}O_5$, and *dextrose*, $C_6H_{12}O_6$, the former passing finally likewise into glucose. Iodine imparts to starch in the presence of water, and to starch-mucilage, a blue color which disappears on the application of heat, but reappears on cooling. Bromine colors the starch brown-yellow. Fuming nitric acid transforms starch into *xyloidin*, $C_6H_9(NO_2)O_5$, which is a white, tasteless powder, insoluble in alcohol, but softening in boiling water. A filtered solution of starch in water yields with tannin a flocculent precipitate which is soluble in boiling water. When incinerated, starch should leave not over 1 per cent. of ash.

Preservation.—All starches and farinaceous substances should be kept in a dry place. When confined in a damp atmosphere they acquire a musty odor, which may be removed by repeated washing with pure water and rapid drying.

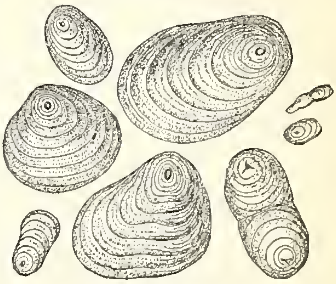
Pharmaceutical Uses.—Starch is sometimes employed as an absorbent powder for preserving pills; it is contained in the following preparations: Amylum iodatum, *U. S.;* Glyceritum (Glycerinum) amyli *U. S., Br.;* Mucilago amyli, Pulvis tragacanthæ comp., *Br.*

Other Starches.—1. Amylum Maydis.—Corn starch, *E.;* Fécule de maïs, *Fr.;* Maisstärke, *G.* From the seed of Zea Mays, *Linné.* Bentley and Trimen, *Med. Pl.*, 296. Nat. Ord. Graminaceæ.—The plant known as *maize* and *Indian corn* was found in extensive cultivation at the time of the discovery of America, and was from here introduced into Europe; it is said to have been introduced into China from Central Asia. The starch-granules are more uniform in size, but only about two-thirds as large as those of wheat starch; they are irregularly angular, rounded on the edges, and occasionally oblong muller-shaped, with a usually slit hilum and indistinct layers.

2. Amylum Oryzæ.—Rice starch, Rice flour, *E.;* Farine de riz, *Fr.;* Reisstärke, *G.* From the seed of Oryza sativa, *Linné.* Bentley and Trimen, *Med. Pl.*, 291. Nat. Ord. Graminaceæ.—The rice-plant is a native of India, has been cultivated from a very early period, and has been introduced into most tropical and subtropical countries. *Rice* of commerce consists of the seeds deprived of the persistent paleæ and of the integuments; it is oblong or subcylindrical in shape, about ⅛ inch (3 Mm.) or more in length, translucent, and furrowed on one side. Rice starch consists of polygonal granules less than one-fifth the diameter of wheat starch, and smaller than all other commercial starches, but mostly united to larger grains.

3. Amylum Solani.—Potato starch, *E.;* Fécule de pommes de terre, *Fr.;* Kartoffelstärke, *G.* From the tubers of Solanum tuberosum, *Linné.* Nat. Ord. Solanaceæ.—The potato-plant grows wild in the mountainous districts of Peru and Chili, and several tuber-bearing species of Solanum are indigenous to the mountains of New Mexico and Arizona. The potato was brought to England from Virginia in 1586, and is at present extensively cultivated in many varieties in most countries of the temperate zones; its starch is largely manufactured and used in Europe, and is sometimes substituted for arrow-root or used for adulterating it. The granules are of two sizes, a portion being small and subspherical, another portion larger than maranta starch, of an ovate or irregular oval shape, marked with rather coarse concentric lines, and with an inconspicuous hilum at the narrow end.

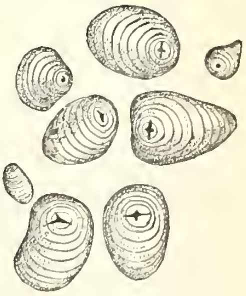
Fig. 17.



Potato Starch.

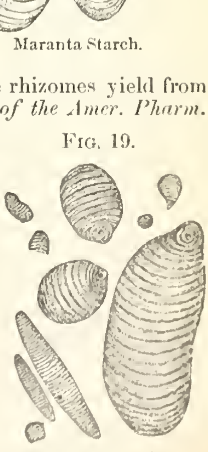
4. Amylum Marantæ, Maranta, *U. S.* 1870.—Arrow-root, *E., Fr., G.;* Salep des Indes occidentales, *Fr.;* Marantastärke, *G.* From the rhizome of Maranta arundinacea, *Linné.* Bentley and Trimen, *Med. Pl.*, 265. Nat. Ord. Marantaceæ.—The plant is indigenous to the West Indies and tropical America, and is largely cultivated in the Bermudas, in Georgia, Jamaica, St. Vincent, and in Brazil. It is a perennial herb, with a branching, fleshy, cylindrical rhizome covered with whitish scales or annulate with their scars. The slender branching stem is 5 to 6 feet high, has thickened nodes, ovate lanceolate leaves with long sheaths, and small whitish flowers, usually in pairs at the ends of the branches. M. indica, *Tussac*, is now regarded by botanists as being a smooth and narrower-leaved variety of the preceding; it is found in Bengal, Java, and the Philippines, and has been introduced into tropical Africa; the *Natal* and *East-India arrow-root* is obtained from it, but the latter sometimes consists of the starch of Curcuma leucorrhiza and C. angustifolia, *Roxburgh*, which is in flattened elliptic or elongated ovate granules marked with numerous fine lines and at the narrow end with a hilum. When about a year old the rhizomes of maranta are dug up, carefully cleaned from the scales, well mashed, and either ground in a mill or rasped until reduced to a pulp, which is suspended in water, the fibrous portion being either separated by hand or by sieves. The starch which settles from the water is repeatedly stirred with fresh portions of clean water, finally allowed to settle, and dried with a gentle heat. The rhizomes yield from 13 to 20 per cent. of fecula. (See papers by Robert Battey in *Proceedings of the Amer. Pharm. Assoc.*, 1858, p. 332, and by W. Eberhard in *Archiv d. Pharm.*, 1868, vol. clxxxiv. p. 257.) The importation of arrow-root into the United States amounted to over 1,500,000 pounds in 1876, and decreased to 69,206 pounds in 1881 and 77,192 pounds in 1882.

Fig. 18.



Maranta Starch.

Fig. 19.



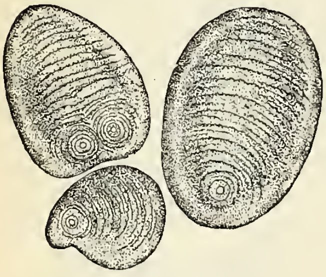
Curcuma Starch.

Arrow-root is pulverulent or in small irregular lumps, less than ¼ inch thick, white, opaque, tasteless, and inodorous. Under the microscope it is seen to consist of ovate or somewhat oval granules, the layers of which are marked by fine but distinct lines, and have usually upon the broader end a small nucleus or a transverse fissure; the granules are nearly uniform in size.

Tests.—According to the German Pharmacopœia of 1872, 1 part of arrow-root gives with 96 parts of boiling water a moderately thin, pellucid mucilage; and when it is agitated for 10 minutes with a mixture of 2 parts of hydrochloric acid and 1 part of water, nearly the whole of the starch should separate unchanged and without the formation of a mucilage or the production of an herbaceous odor. Schaer (1875) showed that some samples of maranta starch yield in a short time a turbid jelly which gradually becomes limpid, while in most cases it separates unchanged, but is partly dissolved within 24 hours. This difference is probably due to climatic influences. The starches of manihot and curcuma have a similar behavior; wheat starch yields no jelly, but after several hours a strongly opalescent solution. Potato starch, however, is readily transformed into a thick, almost clear jelly, forming a complete solution in a few hours, and having a strong herbaceous or bean-like odor.

5. Amylum Cannæ, Canna, *U. S.* 1870.—Canna starch, Tous-les-mois, Toulema, *E.;* Amidon de canne, Fécule de Tolomane, *Fr.;* Cannastärke, *G.* From the rhizome of (probably) Canna edulis, *Ker.* Bentley and Trimen, *Med. Pl.*, 266. Nat. Ord. Marantaceæ, Canneæ.—This showy plant is indigenous to Peru and Brazil, and is cultivated in St. Kitts and other West Indian islands. Canna starch is a white powder having a satiny lustre; its granules are the largest among the commercial starches, flattish, usually oblong or ovate, but variable in outline, with the inconspicuous nucleus or hilum mostly near the narrowed end, and with numerous concentric rings. Canna starch contains about one-sixth of its weight of hygroscopic water, and yields with 20 parts of boiling water a jelly which is considerably more tenacious, but less clear and transparent, than that of arrow-root.

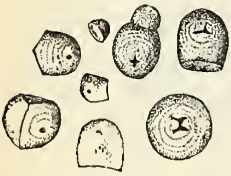
Fig. 20.



Canna Starch.

6. Amylum Manihot.—Brazilian arrow-root, Tapioca meal, *E.;* Cassava, *E.*, *Fr.*, *G.* From the root of Manihot utilissima, *Pohl*, s. Janipha (Jatropha, *Linné*), Manihot, *Kunth.* Bentley and Trimen, *Med. Pl.*, 235. Nat. Ord. Euphorbiaceæ.—The plant, also known as *mandioc* and *manioc*, is probably indigenous to Brazil, where it has been cultivated from a remote period. It has been introduced into other parts of tropical America, into Florida, Africa, and the East Indies. Its fleshy, tuberous roots attain a length of 40 inches (1 M.), and contain a milky juice which is poisonous from the presence of hydrocyanic acid. E. Francis (1882) found cassava-root to yield on an average .0275 per cent., and the sweet cassava .0168 per cent., HCy. The sweet cassava is Manihot palmata, *J. Mueller*, s. M. Aipi, *Pohl*, s. Jatropha dulcis, *Gmelin.* This and another species, Manihot carthaginensis, *J. Mueller*, s. Jatropha Janipha, *Linné*, are used like the preceding. On grating the roots, expressing the poisonous juice, drying the residue and grinding it, *cassava meal* is obtained, which, when baked in thin cakes, furnishes *cassava bread.* From the expressed juice, and by washing the meal with water, on standing the *starch* is deposited. On drying this starch while still moist on heated plates *tapioca* is obtained.

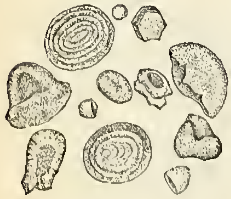
Fig. 21.



Cassava Starch.

Cassava starch forms a white powder, which under the microscope is seen to consist of muller-shaped granules; these, viewed from one end, have the appearance of spherical grains. The nucleus is small, circular, or often elongated, sometimes radiate, and the different layers are indistinctly marked. The grains were originally united in groups of two to four, but in the commercial article are mostly separate. Their size is usually less than half that of potato starch. Tapioca (*U. S.* 1870) is in irregular opaque or somewhat translucent pieces, which consist of the same starch-granules partly distended, ruptured, and agglutinated. It is inodorous, has an insipid taste, and agrees in chemical behavior and composition with other starches.

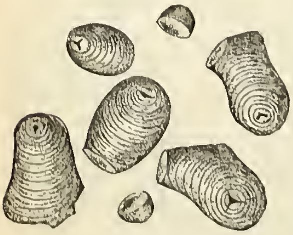
Fig. 22.



Altered Starch-granules from Tapioca.

7. Sago, *U. S.* 1870.—Sago, *E.*, *G.:* Sagou, *Fr.* From the pith of Metroxylon Sagu, *Rottboell* (s. M. Sago, *Koenig*, M. læve, *Martius*, Sagus lævis, *Blume*), Metr. Rumphii, *Martius* (s. Sagus Rumphii, *Willdenow*, S. genuina, *Blume*), Sagus farinifera, *Lamarck*, Arenga saccharifera, *Labillardière* (s. Saguerus Rumphii, *Roxburgh*), and of other palms. Bentley and Trimen, *Med. Pl.*, 278. Nat. Ord. Palmæ.—The sago-palms inhabit the East Indian and Polynesian islands, and are extensively cultivated. They are mostly trees of medium height, but with a thick stem, containing a large amount of parenchyma-tissue, the cells of which are filled with starch. When of sufficient size the tree is cut down, split lengthwise, and the pith removed, powdered, and washed with water to remove woody tissue and other impurities. The dry starch is known as *sago meal.* This is granulated by passing the sufficiently damp meal through a sieve, the globular pieces dropping into a shallow pot suspended over a fire, where they are dried with constant stirring. While flowering the Arenga furnishes a juice rich in sugar.

Fig. 23.



Sago Starch.

Sago is occasionally seen in the form of whitish glistening powder or irregular grains, varying somewhat in tint, and being distinguished as *white* and *brown sago.* More frequently it is seen as *pearl sago*, in the form of globular grains, pearl-like in appearance, with a smooth surface, and occasionally two or three grains adhering together. From the heat employed in its preparation it is somewhat diaphanous, and when examined under the microscope some of the starch-granules are seen to be distended and partly ruptured. Sago starch consists of irregularly ovate, oval, or elliptical grains, often with a roughish surface; the hilum is located near one end, and is naturally small and circular, but in sago is often slit in one or more directions from the effect of heat. The end opposite the hilum is always more or less truncate or flat and muller-shaped. *Factitious sago*, which is made in Europe of potato starch, is best recognized by means of the microscope.

The granules of *Tahiti arrow-root*, which is obtained from Tacca pinnatifida and oceanica, *Forster*, and which is now rarely seen in commerce, are of about the same size as those of cassava starch, but are flattened and angular.

Derivative of Starch.—DEXTRINUM, *Dextrin*, $C_6H_{10}O_5$. Heat in a steam-bath, with frequent stirring, a mixture of 150 parts of starch, 750 parts of distilled water, and 4 parts of oxalic acid, until starch can no longer be detected by solution of iodine; then neutralize the acid with pure calcium carbonate, and after 2 days filter, evaporate, and dry at a gentle heat.—*P. G.*, 1872. On a large scale dextrin is prepared by heating starch in a cylinder or flat vessel to a temperature between 225° and 260° C. (437° and 500° F.); the yellowish product thus obtained is known in commerce as *British gum.* White dextrin, resembling starch in appearance, is manufactured by Heuzé's process: 1000 parts of starch are mixed with diluted nitric acid, made from 2 parts of nitric acid sp. gr. 1.4 and 150 parts of water; the mixture is formed into cakes; these are dried in the air, then slowly heated to about 80° C. (176° F.) until the acid has been expelled, and powdered; on exposing the powder for from 60 to 90 minutes to a temperature between 100° and 110° C. (212° and 230° F.) the conversion into dextrin will be completed. It may be purified and freed from sugar, according to Hager (1870), by dissolving 10 parts of it in 18 parts of distilled water by agitation, straining if necessary, and mixing the solution with about 2 volumes of alcohol; the doughy precipitate is redissolved in a little distilled water and the solution dried upon glass. Dextrin is granular or a whitish or pale-yellowish amorphous gummy mass, readily soluble in water, but insoluble in alcohol and ether; its solution is dextrogyre and does not reduce an alkaline solution of copper.

Medical Action and Uses.—Starch is applied in dilute decoction as a demulcent to protect irritated surfaces upon the skin and in the digestive canal. As a powder it is extensively employed to shield the skin from the action of the air, to diminish the friction of contiguous surfaces, and to promote the healing of excoriations. Thus it may be used to allay the itching and burning of the skin in *erythema*, *urticaria*, *erysipelas*, and *small-pox.* In the form of a thick mucilage it has been employed to prevent pitting in the last-named disease. Bandages saturated with starch-mucilage made with hot water are used in dressing *fractures* and other injuries and diseases of the bones in which absolute rest of the injured part is required; or the mucilage is smeared on the outer surface of the bandage as it is applied to the affected part. This dressing dries slowly, and should be kept at perfect rest for nearly 24 hours. Starch-mucilage is constantly employed as a lenitive injection in inflammations of the *rectum* and the *bladder* and as a vehicle for applying narcotic and other substances to those parts. Mixed with water, starch is the best antidote to the caustic action of *iodine* upon the stomach, as it forms with this substance a bland compound. It also forms the surest test of the presence of iodine in the urine and other secretions by striking with it a characteristic blue color. Starchy food is to be avoided in fermentative *dyspepsia*, in consequence of its liability to undergo fermentation.

The fecula of *canna* has the nutritious and demulcent qualities of starch in general. As the purest natural form of starch, *arrow-root* is nutritious and demulcent, and does not, like potato starch, irritate the bowels. Hence it is extensively used in *febrile affections*, especially in those involving the stomach and bowels, and is also a favorite food for infants at weaning-time. It is prepared by mixing a tablespoonful of arrow-root with sufficient cold water to reduce it to a paste, and then gradually adding a pint of boiling water or milk, or a due proportion of each, stirring the mixture the while. It may then be sweetened. Cream is sometimes mixed with the watery mucilage when the stomach or bowels are irritable. In exhausting diseases a little wine may be added, with cinnamon or nutmeg. *Sago* is demulcent and nutritious, and forms an excellent food for the sick when the digestive organs are feeble or fever contraindicates the use of stimulant diet. It is more generally acceptable to the palate than arrow-root or tapioca, and is more digestible than rice. The demulcent and nutritive properties of *tapioca*, as well as the poisonous properties of the juice of the plant that yields it, were known in the seventeenth century. The qualities of the juice are due to the prussic acid it contains. The symptoms it produces are identical with those of prussic acid, as spasmodic constriction of the throat, convulsions, coma, and death with dilated pupils. Tapioca is chiefly used for making puddings and as a simple mucilaginous food for the sick and for infants.

A palatable form of it is prepared as follows: Take a tablespoonful of tapioca; macerate it in a pint of warm water for an hour, and then boil it for 10 minutes, stirring all the time. Sugar, lemon-juice, or some fruit-syrup, nutmeg, wine, etc., may be added for flavoring and to neutralize the pasty and mawkish taste of the starch.

AMYLUM IODATUM, *U. S.*—Iodized Starch.

Amyli iodidum, Ioduretum amyli.—Iodide of Starch, E.; *Iodure d'amidon*, Fr.; *Jodstärke*, G.

Preparation.—Starch 95 parts; Iodine 5 parts; Distilled Water a sufficient quantity to make 100 parts. Triturate the iodine with a little distilled water; add the starch gradually, and continue triturating until the compound assumes a uniform blue color, approaching black. Dry it at a temperature not exceeding 40° C. (104° F.) and rub it to a fine powder. Iodized starch should be preserved in glass-stoppered vials.—*U. S.*

That starch produces a blue or violet-blue color with iodine was observed by Colin and Gaultier de Claubry in 1814, and that the color of starches of different origin and age may vary to some extent was subsequently shown by Nägeli and others. Liebig regarded iodized starch as a mere mixture of starch with finely-divided iodine, and this view is now generally adopted. Payen and Fritzsche, however, believed it to be a definite compound, $(C_6H_{10}O_5)_{10}I$, and Boudonneau gives it the formula $(C_6H_{10}O_5)_5I$, equal to 13 per cent. of iodine, the latter being dissolved by alcohol, but not by potassium iodide, benzin, sulphide of carbon, or other solvents. According to the process adopted the amount of iodine varies, and, though generally about 7.5 per cent., may be as low as 3.2 per cent. (Sonstadt) or, as obtained by Lassaigne, as high as 41.75 per cent. The officinal iodized starch contains 5 per cent. of iodine. Fritzsche obtained his supposed definite compound by adding tincture of iodine to a filtered solution of starch in concentrated hydrochloric acid. Boudonneau (1878) dissolved the starch first in caustic soda, and precipitated the slightly acidulated solution with tincture of iodine. According to Quesneville (1868), it may be obtained both in a soluble and an insoluble state as follows: 1050 parts of starch and 100 parts of iodine, both in fine powder, are well mixed, and then triturated with a mixture of 400 parts of water and 100 of alcohol, the liquid to be added gradually; the whole is left in contact for 15 or 20 days, and afterward carefully dried. Thus prepared, it is a dark blackish-blue powder, has no odor of iodine, and contains 10 per cent. of this element. To obtain it soluble it is heated in a porcelain or enamelled dish over a slow fire and with continued agitation until a pungent odor commences to be given off. It may be still further purified by making a concentrated solution in warm water, precipitating the clear liquid by alcohol, drying, and powdering the precipitate.

Properties.—Iodized starch is a dark-blue powder having the odor of iodine in a mild degree. Exposed to the sunlight, it is decolorized; when heated with water to 65° C. (149° F.) it becomes colorless, and blue again on cooling; but when heated to boiling, iodine is given off, and may be completely expelled by continuing the heat for a sufficient length of time.

The production of iodized starch is one of the most delicate tests for the recognition of starch as well as of iodine, the limits of the reaction being influenced by the temperature. Fresenius (1857) ascertained that 1 part of iodine may thus be detected at 0° C. (32° F.) in 660,000 parts of water, at 13° C. (55.4° F.) in 330,000 parts, at 20° C. (68° F.) in 264,000 parts, and at 30° C. (86° F.) in 132,000 parts of water. For detecting minute quantities of starch or iodine the test should obviously be applied at as low a temperature as possible.

Action and Uses.—This preparation was proposed as a means of introducing a large amount of iodine into the system without irritating the stomach. Buchanan, who proposed it, gave as much as an ounce of it three times a day without any unpleasant symptoms. In 1879, Bellini recommended it as an antidote for *poisons* generally, stating that it formed insoluble compounds with many of them, and that in cases of poisoning by salts of lead or mercury it aids in their elimination (*Boston M. and S. Jour.*, Aug. 1879, p. 267). McCall Anderson used it with advantage in *lupus erythematodes*, giving a heaped-up teaspoonful several times a day.

ANACARDIUM.—Cashew-nut.

Acajou à pommes, Fr.; *Caschunuss*, G.

The fruit of Anacardium occidentale, *Linné*, s. Cassuvium pomiferum, *Lamarck*.

Nat. Ord.—Terebinthaceæ.

Origin.—This is the fruit of a small tree with coriaceous, shining, oval, entire, and very obtuse leaves, and loose racemes of small whitish or purplish flowers. After fructification the pedicels of the pistillate flowers become large, fleshy, pear-shaped, and edible, having an acidulous taste, and bear upon their summits the nut-like fruit. The plant is indigenous to tropical America, and has been naturalized in some portions of Africa and the East Indies.

Description.—The fruit is about an inch (25 Mm.) long, somewhat less broad, and about one-third of an inch (8 Mm.) thick. It is kidney-shaped, convex on the back, with a scar on one of the rounded ends, of a gray-brown color, and inodorous. The shell is hard and brittle, and contains in the mesocarp a very acrid oily liquid which in contact with air turns black. The single white seed has the shape of the fruit and a mild oily taste.

Constituents.—The cotyledons contain some bland fixed oil. Vieira de Mattos (1831) found in the pericarp tannin, gallic acid, soft acrid resin, etc. The brown oil was found by A. Basiner (1881) to be soluble in potassa, with a red color, darkening on exposure, and its alcoholic solution to yield a red precipitate with basic lead acetate. Staedeler (1847, 1848) separated the vesicating principle, *cardol*, $C_{21}H_{30}O_2$, as a yellowish or reddish oil, evolving, when heated, a faint aromatic odor, and readily soluble in alcohol and ether. It is obtained from the ethereal extract, which is washed with water to remove tannin, dissolved in alcohol, and digested, and afterward boiled with hydrate of lead to remove *anacardic acid* and ammonia salt. The remaining color is removed by a little basic lead acetate. Cardol may be separated from mixtures by extraction with glacial acetic acid and subsequent agitation of the latter with benzol (Basiner). Anacardic acid, when pure, is white and crystalline, has an aromatic afterward burning taste, but is not vesicating. Cazeneuve and Latour (1875) found *catechin* in the wood of the cashew tree.

The *Oriental cashew-nut*, known as Anacardium orientale, is the fruit of Semecarpus Anacardium, *Linné filius*, s. Anacardium latifolium, *Lamarck*, a tall tree of India. The nut is about an inch (25 Mm.) long, nearly heart-shaped, flattish, obtuse, smooth, glossy, and black. The pericarp and cotyledons have the same properties and probably the same constituents as the preceding; but Basiner (1881) ascertained that the brown oil of the mesocarp dissolves in potassa with a green color, and its alcoholic solution turns black with basic lead acetate.

Medical Action and Uses.—Although the kernel, when roasted, and even when raw, is edible, the juice furnished by the rind of the cashew-nut is acrid and almost caustic, and has been used for destroying *corns*, *warts*, and *vegetations* and as an epispastic. But the latter application of it is very objectionable, not only because it is slow in its operation, but because the juice is apt to be carried by the patient's fingers to the genitals and other parts and give rise to a very painful and persistent eczematous eruption. The liquid contained in the blisters has a similar property. A like effect is produced by the fumes arising from the nuts while roasting. The remedies are such as are employed in poisoning by toxicodendron. A weak solution of tincture of iodine may also be applied with advantage. A case in which this topical remedy was successfully used was caused by using heat to reduce a liquid extract of the drug to a solid consistence (*Am. Jour. Pharm.*, June, 1881, p. 281). It is stated (Buchheim) that the oil has a very faint and hardly acrid taste, and that 3 or 4 drops of it may be swallowed without marked effects. This contrast with its action upon the skin is attributed to its total insolubility in the watery fluids of the digestive canal, while upon the dry skin nothing interferes with its irritant action. It has, however, been used as a *vermifuge*. According to Basiner, the subcutaneous injection of small doses of cardol produces on cold-blooded animals paresis, increasing to paralysis, of the extremities, stupor, paralysis of respiration, and tetanic spasms. In warm-blooded animals large doses are not lethal, but stupor, paralysis of the extremities, and diarrhœa occur, and after death congestion of the intestinal lining is found. Cardol seems to be excreted chiefly with the urine, but partially also with the feces. Applied on a small piece of lint to the skin of the breast, it raised a watery blister in 14 hours. The brown-black oil of the Oriental cashew-nut occasioned within 12 hours a black blister, and on the following day eczematous vesicles appeared in the neighborhood, and afterward extended to the arm, hands, face, abdomen, and penis, the poison no doubt being carried thither by the fingers. On the sixth day scales began to form on the breast and forehead; micturition was painful, the urine red-brown; the stools bloody and very painful. More than 2 weeks elapsed before the sores were healed (Basiner, *Am. Jour. Pharm.*, Mar. 1882, p. 131).

ANDIRA.—CABBAGE TREE BARK.

Ecorce de geoffrée, Fr.; *Kohlbaumrinde*, *Wurmrinde*, G.

The bark of Andira (Geoffroya, *Swartz*) inermis, *Kunth*, and of Andira (Geoffroya, *Lamarck*) retusa, *Kunth*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Both species are medium-sized trees, with impari-pinnate leaves, terminal racemes of red flowers, and roundish hard one-seeded pods. The first-named species is a native of Jamaica and other West Indian islands, the second is found in Surinam and Cayenne.

Description.—*Jamaica* cabbage tree bark occurs in long pieces about one-eighth of an inch (3 Mm.) thick, gray or whitish, and fissured externally, upon the inner surface brownish and striate, internally brown or brownish, radially striate, and with yellowish bast-fibres in tangential rows, which cause the laminated fibrous appearance of the bark when broken transversely. It yields a grayish powder, and has a feeble but disagreeable odor and a mucilaginous bitter taste.

Surinam cabbage tree bark resembles the preceding, but is internally dark red-brown, has a checkered and glossy appearance on transverse section, yields a cinnamon-colored powder, is nearly inodorous, and has a bitterish acrid taste.

Constituents.—Hüttenschmid (1824) discovered in each of the cabbage tree barks an alkaloid, which he named *jamaicine* and *surinamine*, the former of which was proved by Gastell (1866) to be identical with berberine. The latter is described as being in fine white needles, scarcely soluble in cold water, alcohol, and ether, but readily soluble in boiling water. The other constituents are those commonly occurring in plants; the bark from Surinam contains also notable quantities of tannin.

Allied Species.—AND. ANTHELMINTICA, *Bentham*, s. Geof. vermifuga, *St. Hilaire*, is a tall forest tree of Brazil. The seeds, known there as *angelim amargosa*, are of the size of a nutmeg, oblong, somewhat horny, yellowish, usually in transverse or longitudinal sections, whitish internally, inodorous, and almost tasteless. They are regarded as anthelmintic. According to Peckolt (1858), the wood contains *andirin*, a brown-yellow coloring principle, soluble in water and fixed and volatile oils, but insoluble in alcohol and ether. The drastic and anthelmintic principle is an acrid resin soluble in ether and alcohol. (See also ARAROBA.)

Medical Action and Uses.—In medium doses andira is said to occasion nausea, vomiting, diarrhœa, fever, and delirium, especially when given in cold infusion. Sometimes it augments the urinary secretion. It was used in the West Indies as a remedy for *lumbricoid worms*. The dose is stated to be from 5 to 10 grains (Gm. 0.30–0.60) for children, and from 10 to 30 grains (Gm. 0.60–2.00) for adults. An infusion or decoction was made with an ounce of the bark in 8 fluidounces of water (Gm. 30 in Gm. 250), and was given in tablespoonful doses.

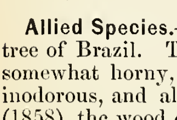
ANETHI FRUCTUS, *Br.*—DILL-FRUIT.

Aneth, *Fenouil puant*, Fr.; *Dill*, G.

The fruit of Anethum (Peucedanum, *Hiern*) graveolens, *Linné*. Bentley and Trimen, *Med. Pl.*, 132.

Nat. Ord.—Umbelliferæ, Orthospermæ.

FIG. 24.



Anethum: fruit, 3 diameters; transverse section, 5 diameters.

Origin.—The plant is indigenous to Southern Europe and Asia Minor, and is cultivated in other parts of Europe and in this country. It is an annual, with finely-divided glaucous leaves, growing to the height of about 2 feet (60 Cm.) and bearing yellow flowers.

Description.—The fruit is oval, about one-eighth to one-fifth of an inch (3 to 5 Mm.) long, dorsally compressed, of a brown color, and separates when ripe into two mericarps, which are flat upon their face and somewhat convex upon the back. The three dorsal ribs are filiform and rather sharply keeled, while the two lateral ones are extended into a light-colored broad membranous margin. The fruit cultivated in India is narrower, more convex on the back, and is less winged than the European fruit. Of the six dark-colored vittæ, two are found on the commissure, the remaining four in the furrows of the back. The odor and taste of dill are aromatic.

Constituents and Uses.—The fruit contains a fixed and 3 to 4 per cent. of an oxygenated volatile oil (see OLEUM ANETHI), to which its medicinal properties are due. It is used for preparing dill-water.

Medical Action and Uses.—Dill is not much used in this country. It has the properties of the aromatic stimulants generally, and is employed to relieve *flatulent colic* and *hiccup* occasioned by gastric indigestion and flatulence. Dill-water, the usual form of exhibiting it, may be given in doses of a fluidrachm (Gm. 4) or more. The essential oil may likewise be used in the dose of from 2 to 5 minims (Gm. 0.10–0.30) with sugar or incorporated with magnesia.

ANGELICA.—Angelica-Root.

Racine d'angélique, Fr.; *Engelwurzel*, G.

The root of (1) Archangelica officinalis, *Hoffmann*; s. Angelica Archangelica, *Linné*, s. Ang. officinalis, *Moench*, and of (2) Arch. (Angelica, *Linné*) atropurpurea, *Hoffmann*, s. Ang. triquinata, *Michaux*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—These plants attain a height of 6 feet (1.8 M.). The former is indigenous to Northern Europe, and the latter to North America, from Pennsylvania northward. The European angelica-root is solely obtained from plants cultivated in Germany, which differ in some respects from the wild species named, of which they are regarded by some botanists as a variety merely, and by others as a distinct species, Archan. (Angelica, *Miller*) sativa, *Fries*.

Description.—European or garden angelica-root consists of a short, thick root-stock, which is closely annulated above, and below abruptly divided into a large number of nearly simple branches, which are about ¼ inch (6 Mm.) thick and 6 inches (15 Cm.) long, longitudinally wrinkled, of a grayish-brown color externally, yellowish inside, with a spongy, radiated meditullium and numerous shining resin-cells in the thick bark. It has a strong aromatic odor and a sweetish, pungently aromatic, and bitter taste, and breaks with a smooth somewhat waxy fracture.

American angelica-root is similar, but smaller, has a longer main root, few branches, a lighter color, fewer resin-dots in the bark, and is less strongly aromatic. The very similar but rather smaller root of Archan. (Angelica, *Michaux*) hirsuta, *Torrey and Gray*, which grows southward to Florida, is not unfrequently collected with it.

The root of the European Ang. sylvestris, *Linné*, is light gray-yellow, internally white, and more woody.

All the above roots are readily attacked by insects.

Constituents.—Garden angelica contains about ½ per cent. of yellowish volatile oil, a white waxy matter crystallizing from hot alcohol in wart-like masses; *angelicin*, which is a somewhat acrid acid resin, soluble in alkalies and crystallizing from alcohol in colorless needles; volatile angelic acid; an amorphous bitter principle; some tannin, pectin, and other common principles (Buchner, 1842). The volatile oil was examined by F. Beilstein and E. Wiegand (1882), who, by fractional distillation and rectification over sodium, obtained three terpenes, of which one distilled at 158° C. (316.4° F.), the second near 175° C. (347° F.), and the third near 250° C. (482° F.). The first one is present in largest quantity; the second yields a crystallizable hydrochloride having the properties of the so-called artificial camphor, and melting at 127° C. (260.6° F.). Naudin (1883) showed that by distillation *in vacuo* a hydrocarbon of a peppery odor and the boiling-point 166° C. is obtained, and that at 160° C. (320° F.) it becomes thick and polymerized; the volatile oil of the fruit, examined in 1881, boils at 175° C. (347° F.), but becomes thick already at 100° C. (212° F.); these hydrocarbons have been named *terebangelene*. The composition of the American roots is probably similar.

Angelic acid, $C_5H_8O_2$, crystallizes in colorless prisms, melts at 45° C. (113° F.), boils at 190° C. (374° F.), has a peculiar aromatic odor and a strongly acid taste, and when melted with potassa yields propionic and acetic acids.

Medical Action and Uses.—Angelica is a tonic, stimulant, and diaphoretic, and in large doses and in warm infusion may act as an emetic or a diaphoretic. It was formerly employed in the treatment of *typhoid* conditions to meet the same indications for which serpentaria and valerian are now generally administered. It appears to have been beneficial in *chronic bronchitis* under conditions similar to those in which senega is recommended. It has also been used in chronic *rheumatism* and *gout* and in *intermittent fever*. Angelica-root may be given in powder in doses of from 10 to 30 grains (Gm. 0.60–2.00), or an infusion made with an ounce (Gm. 32) of the root to a pint of water or white wine may be used in the dose of 1 or 2 teaspoonfuls. Externally, it is sometimes applied as a decoction to foment painful parts.

ANGUSTURA.—Angustura-Bark.

Cuspariæ cortex, Br.; *Cortex angusturæ.—Angusture*, Fr.; *Angustura-Rinde*, G.

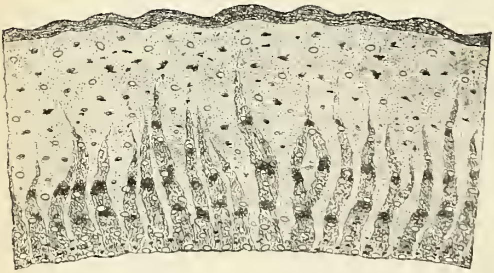
The bark of Galipea Cusparia, *St. Hilaire*, s. Gal. officinalis, *Hancock*, s. Gal. febrifuga, *Baillon*, s. Cusparia febrifuga, *Humboldt*, s. Bonplandia trifoliata, *Willdenow*. Bentley and Trimen, *Med. Plants*, 43.

Nat. Ord.—Rutaceæ, Cusparieæ.

Origin.—The tree attains a height of 20 feet (6 M.), and is found abundantly in the mountains near the Orinoko River.

Description.—The bark is met with in commerce in flat or curved pieces, usually between 1 and 3 inches (about 5 Cm.) in length, rarely longer, about 1 to 1½ inches (25–38 Mm.) wide, and $\frac{1}{16}$ to ⅛ inch (1.5–3 Mm.) thick. Its color is reddish-brown, the inner surface smooth and lighter than the outer surface, which is uneven, and, if carefully preserved, covered with an ochrey-gray, scurfy, and friable cork. It breaks readily with a smooth, somewhat granular fracture, which is of a reddish-brown color, resinous in appearance, and displays to the naked eye numerous white, glistening striæ of crystals of calcium oxalate. The latter are more plainly visible with a lens, whereby also the radiating medullary rays and bast-wedges are revealed. The odor of the bark is aromatic, not agreeable; its taste is aromatic and bitter.

Fig. 25.



Angustura-bark: transverse section, magnified 10 diameters.

Substitutions.—The so-called false angustura-bark obtained from Strychnos Nux vomica, *Linné*, was found in Europe, early in the present century, mixed with the former, to which it bears no resemblance. The trunk-bark is of an irregular shape, rather thick and hard, externally gray, with bright rust-colored patches of cork, and white warts; the inner surface brown; the fracture smooth and destitute of white striæ; the branch-bark is more or less quilled, externally gray, with whitish warts. It has a bitter taste, and contains strychnine and brucine.

Another substitution appears to be frequently met with in France, and has also been noticed in this country (*Amer. Jour. Pharm.*, 1874, pp. 50, 414). This bark, now sometimes called *Brazilian angustura*, comes from Brazil, from Esenbeckia (Evodia, *St. Hilaire*) febrifuga, *Martius*, and consists of dark-brown inner layers, covered with patches of a soft, brownish-gray cork, which is of a pale-orange rust-brown within; it breaks with a short fibrous fracture, is without the white striæ, and has a purely bitter not aromatic taste. Copalchi, guaiacum, and other more or less bitter barks have likewise been observed as adulterations.

Constituents.—The latest analysis of angustura-bark is by Oberlin and Schlagdenhauffen (1878), who found 9.2 per cent. moisture, .27 fat, wax, and stearic acid, soluble in benzin, .47 fat soluble in alcohol and yellow bitter matter, 3.86 resin, .19 volatile oil, 7.8 ash. The bitter matter contained an alkaloid, *angosturine*, $C_{10}H_{40}NO_{14}$, which melts at 85° C. (185° F.), is crystallizable, and is turned red by pure sulphuric acid and green by the same acid containing nitric acid or other oxidizing agent. The volatile oil, according to Herzog (1858), has the composition $C_{13}H_{24}O$, and boils at 266° C. (511° F.). *Cusparin* was obtained by Saladin (1833) by spontaneously evaporating the tincture prepared with strong alcohol. It crystallizes in the cold in needles and tetrahedrons, fuses at a moderate heat, is inflammable, insoluble in ether and volatile oils, soluble in 100 parts of boiling water, but readily soluble in alcohol; it is neutral in behavior and has a bitter taste. Herzog was unable to obtain it. Tannin is not present, but the infusion yields a red-brown precipitate with ferric chloride and several other metallic salts.

The Brazilian angustura-bark contains the alkaloid *evodine* or *esenbeckine*, $C_6H_{18}NO_6$, which is colored yellowish-green by sulphuric acid (Oberlin and Schlagdenhauffen).

Off. Prep.—Infusum cuspariæ, *Br.*

Medical Action and Uses.—Angustura has a tonic operation without astringency, and a slightly stimulating action. It was at one time supposed to be a valuable antiperiodic, but experience has proved it to have no more claim to this virtue than the simple bitters. It is probably of more use in the *typhoid state* of fevers and inflammations, and especially in that of tropical *dysentery*, in which its highest reputation has been gained. In ordinary cases of atonic *dyspepsia*, and especially in those in which flatulence predominates, it has been found of service. But it has no special superiority over numerous other tonic and aromatic stimulants which can be more readily procured. The dose of angustura in powder is from 10 to 30 grains (Gm. 0.60–2.00). An infusion may be made by percolation, containing half a troyounce of the bark in a pint of water. *Dose*, 1 or 2 fluidounces (Gm. 32–64).

ANILINA.—ANILINE.

Amidobenzol, *Phenylamine*, E.; *Aniline*, Fr.; *Anilin*, G.
Formula C_6H_7N or $C_6H_5H_2N$. Molecular weight 93.

Origin.—Aniline was discovered by Unverdorben (1826) among the products of the dry distillation of indigo, and was found by Runge (1833) in the heavy oil of coal-tar. Zinin (1842) introduced the method of preparing it from nitrobenzol by the action of sulphuretted hydrogen in the presence of alcohol and ammonia, and A. W. Hofmann (1845) by nascent hydrogen from the action of dilute sulphuric acid upon zinc. The name *aniline* (from *anil*, the Portuguese name for indigo) was proposed by Fritzsche (1841). Unverdorben had called it *crystalline*, and Runge *kyanol* on account of the deep violet-blue color which it gives with chlorinated lime. The identity of these bodies was proven by Erdmann and Hofmann. Aniline has also been named *benzidam* and *phenamid*.

Preparation.—Aniline is prepared from nitrobenzol by the reducing action of nascent hydrogen, by digesting with a mixture of iron filings and acetic acid, as suggested by Béchamp, in which case the deoxidizing action of ferrous acetate, $Fe(C_2H_3O_2)_2$, first produced, materially assists the change. Nitrobenzol is thereby converted into aniline and water; $C_6H_5(NO_2) + 3H_2$ yields $C_6H_7N + 2H_2O$. The acetic acid has been replaced, by Brimmeyr, by hydrochloric acid. When, after several days, the reaction is completed, milk of lime is added and the aniline is distilled off, the receiver being changed toward the close of the distillation; the temperature then rises, and a red oil, *azobenzid*, $C_{12}H_{10}O_2$, passes over, which congeals to a crystalline mass. The separation of aniline from the heavy oil of coal-tar is effected by a complicated process depending upon its solubility in hydrochloric acid, the insolubility of this compound in ether, the liberation of the bases by an alkali, and their separation from each other by fractional distillation.

Properties.—Aniline is a colorless, limpid, oily, inflammable liquid of a peculiar wine-like odor and burning aromatic taste. It has the spec. grav. 1.0245 at 15° C. (59° F.), congeals at a low temperature, melts at 8° C. (17.6° F.), boils at 184.5° C. (364.1° F.), acquires in contact with air a yellow and brown color, is sparingly soluble in cold water and in all proportions of wood-spirit, alcohol, ether, aldehyd, acetone, and fixed and volatile oils. It dissolves phosphorus, camphor, several resins, and by the aid of heat much sulphur; coagulates albumen; precipitates the salts of iron, zinc, and aluminium; and unites with acids to form salts, which are mostly crystallizable, readily soluble in water, inodorous and colorless, but acquire a red color in contact with the air; alkalies decompose them, with the separation of aniline. Commercial pure aniline usually contains about 1 per cent. of toluidine; other grades contain more of this base.

Toluidine or *amidotoluol*, C_7H_9N or $C_7H_7H_2N$, exists in three modifications, of which two are present in the product of the above process. *Paratoluidine* forms colorless tabular crystals, melts at 45° C. (113° F.), and boils at 198° C. (288.4° F.). *Orthotoluidine* or *pseudotoluidine* is a colorless liquid of the same density as water at 15° C. (59° F.), boiling at 199.5° C. (390.2° F.), and not solidifying at −20° C. (−4° F.).

Toluidine gives a reddish color with chlorinated lime, but aniline is characterized by the production of a violet color with the same reagent—a reaction which has led to its application in the production of *coal-tar dyes*, the more important of which are the following:

ANILINE-PURPLE, or *mauve*, is obtained by acting upon aniline with sulphuric acid and potassium bichromate or other oxidizing agents, whereby the alkaloid *mauveïne*, $C_{26}H_{24}N_4$, is produced.

SAFRANINE, $C_{21}H_{20}O_4$, is a red compound obtained from aniline containing toluidine, by treatment with nitrous and arsenic acid.

ANILINE-RED, or *magenta*, is formed by heating a mixture of aniline and toluidine with corrosive sublimate or arsenic acid, and is a salt of *rosaniline*, $C_{20}H_{19}N_3$, or of *pararosaniline*, $C_{19}H_{17}O_3$, the alkaloids being colorless. *Roseine*, *fuchsine*, and *azaleine* are the acetate, hydrochloride, and nitrate of the same base. If obtained by the action of arsenic acid the dyes usually contain arsenic. To obtain the dyes free from arsenic the oxidation is now often effected by nitrobenzol or nitrotoluol.

Aniline-yellow, or *chrysaniline*, $C_{20}H_{17}N_3$, is a yellow secondary product of the preceding process; its hydrochloride has a scarlet color, and its nitrate is ruby-red and very sparingly soluble in water.

Aniline-blue is a salt of *triphenyl-rosaniline*, $C_{20}H_{16}(C_6H_5)_3N_3$, obtained by boiling a salt of rosaniline with aniline, and by treatment with iodide of methyl, ethyl, and similar compounds a large variety of blue, violet, and green (*iodine-green*, *methyl-green*, etc.) dyes are obtained.

Aniline-black, or *jetoline*, a salt of $C_{12}H_{10}N_2$, is very dark-green, and is obtained by the slow oxidation of aniline. *Nigrosine*, $C_{30}H_{29}O_3HCl$, is a similar compound of a dark-blue tint.

The aniline colors are largely employed in dyeing, and are used in the preparation of *colored inks*, which consist of aqueous solutions of the dyes, to which a small quantity of gum-arabic may be added. *Ink for stamping* is made by dissolving 5 parts of the dye in 75 parts of hot water, and adding 1 part of syrup and 2 parts of glycerin. On exposure to light all aniline dyes fade more or less rapidly.

Most of the aniline dyes used in the United States are imported from Europe, the importation having increased from 210,500 pounds in 1877 to 1,103,864 pounds in 1882.

Physiological Action and Medical Uses.—A substance of so little apparent value as a medicine does not here require an extended consideration. It is well, however, to be acquainted with its physiological effects, since many cases of poisoning have occurred from its use. In experiments upon animals it does not appear to act as a powerful local irritant, although in large doses it excites vomiting. Its special action seems to be upon the spinal marrow, for it causes staggering and more or less loss of muscular power and of sensibility in the hinder limbs of quadrupeds, with tonic and clonic spasms affecting all the muscles or only some particular muscles or portions of them. The heart-pulse and the respiration are quickened, and death occurs during convulsion or afterward in resolution. In some experiments death by coma took place. The lethal dose for rabbits is from 15 to 20 grains, and for dogs about 80 grains. Aniline is recognized in the blood and in the urine by its characteristic smell. After death the lungs are found congested and the heart is distended with blood, which there and everywhere else is dark and uncoagulated. The poison is discoverable in the blood and the principal solid organs.

Workmen exposed to the vapors evolved in the manufacture of aniline acquire a cyanotic hue of the face, lips, and mouth, and suffer from giddiness, headache, chilliness, weakness of the lower limbs, and sometimes epileptiform convulsions. They are subject also to bronchial irritation, nausea, constipation, diarrhœa, and cutaneous eruptions. In one case a lad of sixteen employed in scrubbing out an aniline-vat was seized with giddiness and insensibility; the skin was cold, the pulse slow and thready, the breathing laborious. The cyanotic color of his skin and mouth gave him the appearance of a person in the last stage of cholera. The graver symptoms were promptly dissipated, but the blueness had not disappeared on the following day. In the case of a man who swallowed a mouthful of a concentrated solution of "magenta red" the cyanotic symptoms mentioned were present in a high degree; the pulse was thready and frequent (120–140); the inspirations shallow, 30 in a minute; muscular tremor and twitching pervaded the body; the head ached and there was some drowsiness, but the mind was otherwise clear; the patient was restless, and his breathing oppressed as if by a weight. Vomiting was provoked by an emetic, and on the third day he had entirely recovered. The skin continued bluish for more than 48 hours. In a later case no less than 4 ounces were swallowed of a mixture of aniline and toluidine. Nearly 2 hours later the patient felt dull and sluggish and had headache. After vomiting produced by warm water he fell into coma, with the characteristic color of the skin, trismus, and general coldness. Clonic convulsions followed, the pupils were dilated and nearly insensible, and the urine was dark, and later became albuminous. At the end of 24 hours the face was still slightly cyanosed and the pharynx was insensible to tickling. Feltz and Ritter state that a man who drank about 3 pints of wine containing 7 grains of fuchsine soon felt his lips itch, while his ears grew red and his gums were swollen. Afterward, in the course of 12 days, he drank daily about a quart of wine colored with fuchsine. On the last day he suffered from colic and diarrhœa. Dogs that had been given by the mouth or by venous injection large doses of this preparation had albuminuria, and their kidneys were granular (*Boston Med. and Surg. Jour.*, Sept. 1876, p. 378). Recovery took place in 5 or 6 days (Merklen, *Med. Press and Circular*, 1880, p. 498). Stockings, cravats, gloves, etc. dyed with aniline have occasioned eczematous eruptions upon the skin in contact with them, and patients affected with psoriasis have been poisoned by the application of bandages wet with a solution of muriate of aniline.

Medical Action and Uses.—Aniline has been used in *chorea.* Six inveterate cases are reported to have been speedily cured by this agent in doses of 1 or 2 grains three times a day (Turnbull); while in another group of five cases, in which aniline was given persistently until the doses reached 6 or 7 grains (Gm. 0.40–0.50) three times a day, not the slightest impression was made upon the symptoms (Fraser, etc.). It has also been administered in *epilepsy* without apparent advantage. In 1876, Bergeron and Clouet claimed that the use of fuchsine to color wines was innocuous, and that employed as a medicine it caused the disappearance of albumen from the urine while increasing the proportion of phosphates in this secretion (*Gaz. hebdomadaire*, June 23, 1876). Divet observed that it removed albuminuria without regard to its cause (*Bull. de thérap.*, xcviii. 89). Bouchut found it an efficient remedy for scarlatinous dropsy, and not productive of injury (*Practitioner*, xxiii. 203). Similar results were obtained by Sawyer in England (*Practitioner*, xxvi. 41) and De Renzi in Genoa (*Virchow's Archiv*, lxxx. 510). It seems, however, that it has only been conspicuously useful in tubular nephritis, and Dieulafoy denies that it diminishes renal dropsy or its attendant thoracic and pulmonary symptoms (*Bull. de thérap.*, xcvii. 478). It appears, therefore, that neither the conditions nor the nature of its influence are at present understood. The daily portion of fuchsine has varied between 1½ and 3 grains (Gm. 0.10–0.20), given in divided doses, and it is said that it may be prescribed to the extent of from 3 to 5 grains without causing nausea.

ANISUM, *U. S.*—ANISE.

Anisi fructus, Br.; *Fructus Anisi*, P. G.; *Fructus (Semen) Anisi vulgaris.—Aniseed*, E.; *Anis*, *Anis vert*, Fr.; *Anis*, G.

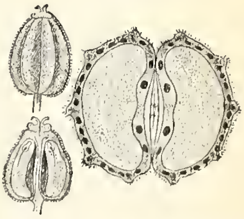
The fruit of Pimpinella Anisum, *Linné*, s. Anisum vulgare, *Moench.* Bentley and Trimen, *Med. Plants*, 122.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant is an annual which is indigenous to the eastern portion of the basin of the Mediterranean, and extensively cultivated in Southern and Central Europe, and occasionally in this country. It grows to about 1 foot (30 Cm.) in height, has the radical leaves roundish-cordate, lobed, and serrate, the stem leaves pinnate with lanceolate lobes, and the upper ones trifid or undivided and linear. The flowers are small and white, in numerous small and long-stalked umbels.

Description.—The fruit is about $\frac{1}{6}$ to $\frac{1}{5}$ inch (4–5 Mm.) long, ovate, tapering above toward the thick stylopode, somewhat compressed at the sides, of a grayish or greenish-gray color, and covered with short appressed hairs. The two mericarps are usually united. Each has five light-brownish filiform ridges, and from 12 to 20 oil-tubes situated on the flat commissure and in the furrows. The fruit has an agreeable aromatic odor and a sweet spicy taste. The importation of anise and star-anise in 1877 was 93,485 pounds, and 367,186 pounds in 1881.

FIG. 26.



Anisum: Fruit and longitudinal section, magnified 3 diameters; transverse section, magnified 8 diameters.

Impurities.—Anise of commerce is not unfrequently mixed with earthy matters resembling the fruit in color. This adulteration is readily detected and the amount thereof determined, according to Hager, by agitating a known weight of anise for a short time with a saturated solution of table-salt; the anise will rise to the surface of the liquid, and after rapidly washing with water and drying is again weighed; earthy matter and sand will subside. Accidental admixtures of *conium-fruit* have been repeatedly reported. This is easily distinguished from anise by the mericarps, when ripe, being separate, smooth, grooved upon the face, with the ribs prominent and crenate, and by being destitute of oil-cells.

Constituents.—The fruit contains, according to Brandes and Reimann, 3 per cent. of volatile oil, 3.38 per cent. of fixed oil, some gum, sugar, resin, malates, phosphates, and other salts. The volatile oil represents the medical properties of the fruit. (See OLEUM ANISI.)

Pharmaceutical Uses.—Anise is used for preparing Oleum anisi and Aqua anisi.

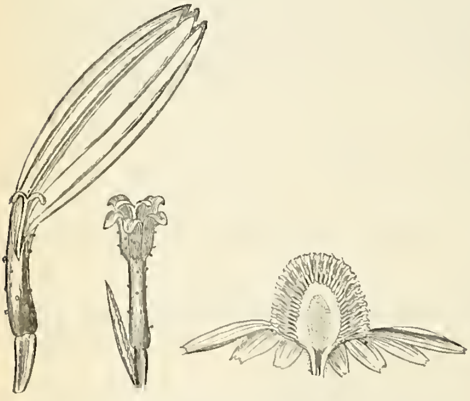
Off. Prep.—Tinct. Rhei dulcis, U. S.

Medical Action and Uses.—Although it imparts a peculiar taste to the milk of nurses, it probably does not augment the secretion (Dolan). Anise is an aromatic stimulant and carminative; its oil and infusion are habitually employed to relieve *flatulent colic*, and the seeds enter into the composition of many culinary products as a condiment which tends to render them less indigestible. It has been imagined to have some special influence upon the *bronchial tubes*, modifying their secretions and promoting expectoration. But all volatile oils and resins are exhaled by the bronchia, and all have more or less repute as stimulant expectorants. In *infantile catarrh*, when the acute stage has passed, infusion of anise may be given with advantage. It may be made with 2 or 3 drachms (Gm. 8–12) of the bruised seeds in half a pint of boiling water, and given in teaspoonful doses to infants at the breast. The dose of bruised anise is from 10 to 20 grains (Gm. 0.60–1.20).

ANTHEMIS, *U. S.*—ANTHEMIS.

Anthemidis flores, Br.; *Flores Chamomillæ romanæ.—Chamomile-flowers, Roman or English chamomile*, E.; *Camomille romaine*, Fr.; *Römische Kamille*, G.

Fig. 27.



Anthemis nobilis, *Linné*.

Ray- and disk-floret, mag. 4 diam. Section through single flower-head, nat. size.

The flower-heads of Anthemis (Chamomilla, *Godr.*) nobilis, *Linné*, collected from cultivated plants. Bentley and Trimen, *Med. Plants*, 154.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—A low perennial plant indigenous to Southern and Western Europe as far north as England, and cultivated in Germany, Great Britain, France, and Belgium. The small oblique rhizome produces numerous prostrate or ascending and radiating stems, with alternate sessile grayish-green leaves, which are hairy and twice or thrice pinnately divided into acute linear segments. The flower-heads terminate the branches, and appear from June to September. Anthemis-flowers have been dismissed from the German Pharmacopœia.

Description.—The flower-heads of the wild plant, which have a single row of white ligulate ray-florets and numerous yellow tubular disk-florets, are not met with in commerce. In the cultivated plant the tubular florets are more or less changed into white ligulate florets, and therefore the heads have either a smaller yellow centre or are entirely white. The heads are about ¾ inch (2 Cm.) broad, and consist of an involucre composed of numerous imbricated oblong ovate scales with a scarious margin, of a solid convex finally conical receptacle with narrow concave chaff, and of numerous white strap-shaped and three-toothed florets, which are pistillate. The yellow disk-florets, if present, are tubular, five-toothed, and hermaphrodite, with the two branches of the style projecting. The tapering achene is destitute of a pappus. Since the oil-glands are found mainly on the tubular portion of the florets, the so-called *single chamomile*, with one or a few rows of ray-florets, appears to be better adapted for medicinal use, and has a stronger and more agreeable odor.

Adulterations.—The flower-heads of several Compositæ, like Anthemis arvensis, *Linné*, Maruta Cotula, *De Candolle*, Matricaria Chamomilla, *Linné*, Pyrethrum Parthenium, *Linné*, and Achillea Ptarmica, *Linné*, have been named as occasional adulterations, but they are much smaller than Roman chamomile. The first-named three species, not being cultivated, have the heads always with a single row of ray-florets, while the last two are frequently double in cultivation. Of these, the feverfew (Pyrethrum) has a flat or merely convex and nearly naked receptacle, and the Achillea flowers have shorter and rounded rays, are inodorous, and of an acrid taste.

Constituents.—According to J. P. Wyss (1833), chamomile-flowers contain volatile oil (see OLEUM ANTHEMIDIS), traces of tannin, 5.25 per cent. resin, 1.50 per cent. wax, albumen, gum, bitter principle, fixed oil, chlorophyll, extractive, and salts. From the investigations of Camboulises (1871) it seems probable that the bitter taste is due to anthemic acid (see MATRICARIA); fat, grape-sugar, and 6 per cent. of ash were found in the flowers. The bitter principle is soluble in water and alcohol.

Pharmaceutical Uses.—For preparing Oleum anthemidis, Extract. anthemidis, and Infusum anthemidis, *Br.*

OLEUM ANTHEMIDIS INFUSUM, Oleol of chamomile, *E.;* Huile de camomille, *Fr.;* Gekochtes Römisch-Kamillenöl, *G.*—Digest for 2 hours chamomile-flowers 10 parts in olive oil 100 parts; express and filter.—*F. Cod.*

Physiological Action.—Chamomile is stimulant and tonic. The former property is due to its essential oil, the latter to its bitter principle. In substance or strong infusion it occasions a sense of warmth in the stomach; it expels flatus, improves digestion, does not constipate, and, like other aromatic stimulants, is reputed to possess emmenagogue virtues. In large doses it occasions nausea, vomiting, diarrhœa, pain, and fulness of the head, and sometimes a degree of somnolent intoxication. In medicinal doses the infusion is tonic if cold, but emetic if warm.

Medical Uses.—Chamomile is commonly used as a mild stimulant tonic to improve the *digestion* during convalescence from acute diseases and in many states of general debility. It is particularly indicated when the gastric digestion is laborious and accompanied with flatulence, and also when the latter stage of the process is attended with colic. It is an excellent preventive remedy for periodical sick headache, and its warm infusion is a salutary emetic during the attack. It is reputed also to be *emmenagogue*, to cure *neuralgia*, and to diminish chronic *suppuration*. Evidently, it exerts these powers indirectly and only by its power of improving the nutrition of the whole system. In the same way, probably, it sometimes cures *intermittent fever*. Many bitter tonics have a similar operation, but cinchona alone exhibits a direct curative control over periodical fevers. These remarks apply only to their use as tonics; chamomile and its associate bitters often cure mild intermittents when administered in the form of a hot infusion immediately before the paroxysm. This is a physiological mode of cure, and may be practised with the aid of whatever will equally well excite copious diaphoresis. In forms of malarial fever distinguished by *biliary derangement* warm chamomile tea is often used to produce both vomiting and diaphoresis, and thereby not only to moderate the general severity of the paroxysm, but also to lessen hepatic congestion and the evils which ensue thereon. As an emetic, chamomile is peculiarly appropriate whenever it is desired to empty the stomach without depressing the system, and hence in those numerous cases of crapulous *indigestion* occurring in coarse feeders and in drunkards. It often will put an end to an attack of *delirium tremens* in the forming stage. Subsequently, nothing excels a cold infusion of chamomile in repairing the exhausted condition of the digestive organs.

Externally, fomentations made with chamomile-flowers saturated with hot water or with hot vinegar and water form a most soothing application for *local pains*, whether neuralgic or congestive, in intestinal and uterine *colic*, *toothache*, *earache*, *abscess*, *sprains*, etc. It is believed by high authorities that the odor of chamomile is destructive of the *itch-insect*, the *gnat*, etc. Oil of chamomile has been applied to painful *rheumatic* parts and to the abdomen in *flatulent colic*.

Chamomile is never prescribed in substance except as a masticatory, and in this manner it is often useful in slight dyspeptic disorders. The extract (*Br. Ph.*) is a good simple bitter tonic in the dose of from 3 to 10 grains (Gm. 0.20–0.60). A fluid extract is prepared, a fluidrachm of which represents 30 grains of chamomile. The oil is sometimes prescribed internally in doses of 5 or 6 drops upon sugar, in ether, in Hoffmann's anodyne, or in pills made with crumb of bread. An infusion is made with half a troyounce of chamomile to a pint of boiling water. When cold it is used as a tonic in doses of 1 or 2 fluidounces (Gm. 30–60). When warm it acts as an emetic if freely drunken.

ANTIARIS.—UPAS ANTIAR.

Upas antiar, Fr., G.

A gum-resinous exudation of Antiaris toxicaria, *Leschenault.*

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The upas tree is one of the largest trees of the forests of Java and of some of the neighboring islands. When wounded it yields a milk-white or yellowish exudation, which on exposure turns brownish, and constitutes the principal ingredient of the Upas antiar, or Javanese arrow-poison.

Description.—Upas antiar is reddish-brown, of a waxy consistence, and has an extremely bitter and at the same time acrid taste. Triturated with water, it yields an emulsion. It is partly soluble in alcohol and ether.

Constituents.—It contains gum, sugar, albumen, wax, resin, and *antiarin*, the poisonous principle discovered by Pelletier and Caventou (1824). The latter is obtained by exhausting the alcoholic extract with boiling water. Mulder obtained from the dry juice 3.5 per cent. of antiarin, the composition of which is $C_{14}H_{20}O_5$. It crystallizes from water in silvery scales containing 11.86 per cent. ($2H_2O$) of water, and is soluble in 70 parts of alcohol, very slightly in ether, more freely in dilute acids and alkalies. The resin is readily soluble in ether, sparingly in cold alcohol, and is not poisonous.

Physiological Action.—Under the name "upas," which in the Malay language signifies poison, or, specifically, arrow-poison, several quite different products are included. Upas Tieuté contains strychnia, and the symptoms it occasions are more or less distinctly tetanic, but Upas antiaris and its active principle, antiarin, produce very different effects. However introduced into the system, it impairs or suspends voluntary movements without causing convulsions. It is a paralyzing poison to the heart as well as the voluntary muscles, and appears to act directly upon these organs and upon the great nervous trunks, but not upon the brain or spinal marrow. A specimen of arrow-poison has been found to contain both a convulsing and a paralyzing agent, which could be separated and made to display their respective effects.

We are unacquainted with any instances of the therapeutical use of this product, but the remarkable analogy of its operation with that of physostigma would seem to indicate its application to similar conditions.

ANTIMONII ET POTASSII TARTRAS, *U. S.*—TARTRATE OF ANTIMONY AND POTASSIUM.

Antimonium tartaratum, *Antimonii potassio-tartras*, *Antimonium tartarisatum*, Br.; *Tartarus stibiatus*, *Tartarus emeticus*, *Stibio-kali tartaricum*, P. G.—*Tartarated antimony*, *Tartar emetic*, E.; *Tartrate de potasse et d'antimoine*, *Emétique*, *Tartre stibié*, Fr.; *Brechweinstein*, G.

Formula $2(KSbOC_4H_4O_6).H_2O$. Molecular weight 664.

Origin.—A process for the preparation of tartar emetic from cream of tartar and crocus of antimony was first published in 1631 by Adrian van Mynsicht. Glauber (1648) used flowers of antimony or antimonial glass. At present the salt is generally prepared with oxychloride or with pure oxide of antimony. Both the British and German Pharmacopœias recognize two synonyms besides the officinal title.

Preparation.—Take of Oxide of Antimony 5 ounces; Acid Tartrate of Potash in fine powder 6 ounces; Distilled Water 2 pints. Mix the oxide of antimony and acid tartrate of potash with sufficient water to form a paste and set aside for 24 hours. Then add the remainder of the water and boil for a quarter of an hour, stirring frequently. Filter and set aside the clear filtrate to crystallize. Pour off the mother-liquor, evaporate to one-third, and set aside, that more crystals may form. Dry the crystals on filtering-paper at the temperature of the air.—*Br.*

The process formerly recognized by the U. S. Pharmacopœia consisted in boiling for 1 hour 18 fluidounces of water containing a mixture of 2 troyounces of oxide of antimony and 2½ troyounces of acid tartrate of potassium, water being added from time to time to supply the loss by evaporation. This long-continued application of heat is apt to produce a change whereby the liquid becomes colored and a portion of the salt is converted into an uncrystallizable compound; the mother-liquor from the first crystallization yields, on further evaporation, crystals which are colored and require to be recrystallized. By the British process heat is avoided, except for a much shorter time, the combination being effected at the ordinary temperature; or digestion at a gentle heat may be resorted to with little danger of inducing the changes alluded to. The compounds are made to react upon each other in the presence of a little water, a slight excess of antimonious oxide being used; and the subsequent boiling with a larger quantity of water mainly aims at bringing the tartar emetic already formed into solution, so that it may be freed by filtration from the excess of oxide used, and obtained in crystals. It is of importance that the antimonious oxide should be free from oxychloride, otherwise the mother-liquor will become acid, and more or less of the salt will be lost by refusing to crystallize. The acid potassium tartrate should be free from calcium tartrate, which would contaminate the crystals of tartar emetic, necessitating their recrystallization, and thus occasioning loss.

Other processes have been recommended, and are perhaps followed by some manufacturers; they agree in this, that an impure oxide of antimony, which may be obtained in various ways, is used. While the trouble of its purification is thus avoided, a subsequent loss cannot be prevented, as explained above. Operating on a large scale, such a course is probably the cheapest, but for the pharmacist the use of pure materials is by far more advantageous, since with proper and careful manipulation the entire solution may be made to crystallize.

Properties.—Tartrate of antimony and potassium produces colorless transparent crystals, which have the form of a rhombic octahedron, become white and opaque on exposure to the air, and have a sweetish afterward disagreeable strongly metallic taste. In commerce it is usually seen in the form of a white finely-granular powder. Heated to 108° C. (226.4° F.), the salt loses its water of crystallization; at 200° C. (392° F.) it parts with more water, and is converted into metatartrate; at a higher heat it decomposes, becomes brown and black, giving off empyreumatic products having the odor of burning sugar, and finally leaves a black or gray residue having an alkaline reaction. According to Brandes, 1 part of the salt

Dissolves in	19.0,	12.6,	8.2,	7.1,	5.5,	4.8,	3.2,	3.0,	2.8	parts of water
at	8.7°,	21°,	31°,	37.5°,	50°,	62.5°,	75°,	87.5°,	100° C.	

The aqueous solution is precipitated on the addition of alcohol in the form of a crystalline powder; in this manner a pure powder of tartar emetic is readily and most advantageously obtained for pharmaceutical purposes. The solution yields with hydrochloric and other mineral acids a white precipitate of an oxy-salt of antimony, which is soluble in hydrochloric acid, and does not occur if tartaric acid has been previously added to the solution. The aqueous solution, even if largely diluted, at once becomes turbid on the addition of a little potassium carbonate. Hydrosulphuric acid causes an orange-red precipitate, which, when obtained from 20 grains of the salt after washing and drying at 100° C. (212° F.), weighs 9.91 grains. A solution of tartar emetic which is not too dilute produces a flocculent precipitate on the addition of infusion of galls; an excess of the latter redissolves the precipitate. The salts of most metals and earths, being precipitated by normal tartrates, are incompatible with tartar emetic; also the alkalies, tannin, and tinctures containing tannin.

Tests.—Chlorides and sulphates, if present, are detected in the solution, previously acidulated with acetic acid, by nitrate of silver and chloride of barium, calcium by ammonium oxalate, and copper, iron, and other metals by ferrocyanide of potassium. "A 1 per cent. solution of the salt should not be clouded by the addition of a few drops of the reagents named."—*U. S.* Arsenic may be detected by carefully heating about 20 or 30 grains of the salt until a black residue remains; on gradually increasing the temperature to redness a garlic-like odor will be evolved. More delicate tests are the following: "If 1 Gm. of the salt and some pieces of aluminium wire be added to strong solution of soda (sp. gr. about 1.260) contained in a long test-tube, a gas is given off which should not impart any color to filter-paper wet with test solution of nitrate of silver and held over the mouth of the test-tube (absence of more than traces of arsenic)."—*U. S.* "If .5 Gm. of the salt be dissolved in 10 Gm. of hydrochloric acid without heat, and 2 drops of freshly-saturated solution of sulphuretted hydrogen added, neither a yellow color nor a yellow precipitate should be produced within 4 hours."—*P. G.* The impurity which is likely to be met with in consequence of faulty preparation is cream of tartar, the presence of which cannot be detected by its behavior to test-paper, since the solution of tartar emetic has an acid reaction; but a permanent precipitate will not appear with potassium carbonate until after this impurity has been neutralized. By dissolving 24 grains of the salt in a fluidounce of warm water and cooling the solution to 10° C. (50° F.) it should remain clear. A crystalline deposit will occur if more than 8 per cent. of cream of tartar is present. A more delicate test, which, however, does not indicate the nature of the impurity, consists in preparing the sulphide of antimony from a given weight of the salt, as stated above.

Pharmaceutical Uses and Preparations.—Tartar emetic is a convenient test for distinguishing different kinds of tannin, some of which yield no precipitate with it. It is an ingredient in Syrupus scillæ comp., *U. S.*; Unguentum antimonii tartarati, *Br.*; and Vinum antimonii (antimoniale, *Br.*), *U. S.*

Emplastrum Antimonii, *U. S.* 1870; Emplastrum stibiatum s. antimoniale.—Antimonial plaster, *E.*; Emplâtre (Poix) émétisée, Emplâtre antimonial, *Fr.*; Brechweinstein-Pflaster, *G.*—Take of Tartrate of Antimony and Potassium in fine powder a troyounce; Burgundy Pitch 4 troyounces. Melt the pitch by means of a water-bath and strain; then add the powder, and stir them well together until the mixture thickens on cooling. The finely-powdered tartar emetic should not be added until the fused mass almost begins to thicken; the addition of 2 or 4 drachms of wax would improve the adhesive qualities of the plaster.

Physiological Action.—*On Animals:* The following conclusions in regard to the action of tartar emetic were reached by Dr. Richardson in 1856, and they remain substantially correct at the present time: "1. Tartar emetic excites the same symptoms in dogs as in man. 2. All the permeable tissues absorb it, and its effects are specifically the same by whatever channel, including the blood, it may enter the system. 3. After absorption it may be detected in the blood, the serum, the urine, and all the organs. 4. It excites marked local effects in any membrane by which it is eliminated, and hence, however introduced into the system, it causes redness of the lining membrane of the stomach and the symptoms which attend its direct application to that organ. 5. In large doses it produces vomiting and purging and rapid collapse, but small doses long continued may cause death by exhaustion. 6. The immediate cause of death from this agent is, in all cases, failure of the heart's action. 7. The post-mortem lesions produced by it are general congestion, fluidity of the blood, intense vascularity of the greater curvature of the stomach, and in some cases of the rectum and other parts of the intestinal tube, but without ulceration, and a pale-yellow, glairy, mucous secretion. 8. In rapid poisoning by tartar emetic the fatal effect seems due to a direct chemical change in the blood, and an indirect effect therefore upon the heart; while in slow poisoning there is added an interference with the assimilative powers, the result of the lesions excited in the stomach or other parts of the alimentary canal." In this summary there is an apparent incongruity between the statement that death is due to failure of the heart's action and also to a chemical change in the blood. Doubtless both modes concur, but the first is shown by experiment to be a primary effect of the poison, the heart being weakened and its contractions retarded, the respiration and the temperature declining in a like proportion, while paralysis of sensation and motion supervenes. This mode of action accounts for the venous engorgement of the heart, lungs, and abdominal organs found after death. The injection of the gastro-intestinal mucous membrane is due not so much to the primary irritant action of the poison as to the fact, already implied, that it is in great part eliminated by this channel, however it may have been introduced into the body. According to Hoch (*Inaugural Essay*, Univ. Penna., 1880), antimony is eliminated chiefly by the kidneys. It may be found in the urine 5 minutes after ingestion, and continue to be present for 97 hours. In regard to the mechanism of the action of tartar emetic, Soloweitschyk drew from his experiments the following conclusions: In frogs, after slightly stimulating the co-ordinating centres of the medulla oblongata, it paralyzes the spinal reflex functions and the excito-motor nervous apparatus of the heart, but does not lessen the excitability of the motor nerves and voluntary muscles. In mammals it continuously reduces the blood-pressure by dilating the blood-vessels and perhaps by directly depressing the heart, disturbs the functions of the central nervous system, and occasions vomiting and purging by causing a moderate congestion of the blood-vessels of the mucous membrane. In this operation antimony exhibits a complete analogy to the action of arsenic and platinum (*Archiv. f. experiment. Pathol. u. Pharm.*, xii. 438).

On Man: When tartar emetic in strong solution or in an ointment is applied to the skin it produces a pustular eruption almost identical in appearance with that of small-pox, forming scabs and leaving indelible scars. If the skin is very delicate it may ulcerate or slough. The pustulation is less apt to occur in persons of a naturally tough integument and also during high febrile action. Occasionally the constitutional operation of the medicine has been developed by its endermic employment. A solution of tartar emetic has been injected into the veins for the purpose of dislodging foreign bodies from the stomach by vomiting. This effect has also followed its administration by enema.

Taken internally, even in such doses as the $\frac{1}{100}$th of a grain frequently repeated, it occasions malaise and nausea, with colic and looseness of the bowels, loss of appetite, a pasty state of the mouth, debility and depression, and sometimes a pustular eruption on the skin. When the dose is large enough to excite vomiting it produces a sense of sinking, nausea, copious salivation, violent and prolonged retching, and often liquid stools, coldness of the hands and feet, and a cool perspiration. The matters vomited usually contain bile before the end of the operation. If the salt is given with but little fluid, the evacuations may be confined to vomiting: if the liquid is abundant, there may be copious purging without emesis. The more depressing the operation of the medicine, as indicated by the preceding symptoms, the more frequent and feeble does the pulse become. In the case of a boy whose brain-membranes were exposed, Dr. Mary Putnam Jacobi observed that in 2½ hours after the administration of a quarter of a grain of tartar emetic, which did not occasion vomiting, the intra-cranial blood-pressure was diminished and the walls of the arteries relaxed. This peculiarity was not noticed under the action of sedative doses of quinine, and was confined to the nauseating dose of tartar emetic. Tartar emetic is eliminated chiefly by the kidneys (Morton).

In poisoning by this substance the symptoms mentioned are greatly intensified. The patient is attacked with pain in the stomach, followed by incessant retching, præcordial cramps and burning heat, distension of the epigastrium, severe colic, watery and frequent stools, dryness of the throat, difficult deglutition, and salivation. The muscles are sometimes rigid, but generally relaxed; the skin pale, cool, and clammy; the pulse feeble and at first infrequent, but subsequently rapid and thready; respiration is slow. The dose required to produce such symptoms cannot be precisely stated. It may be but the fraction of a grain which occasions them with a fatal result. In other instances several drachms of the salt have been taken without fatal consequences. Its continued use generally establishes a tolerance of its operation, as was formerly shown by its employment in the treatment of pneumonia—a method which is now forgotten except as a monument of rashness and folly. The use of this method illustrated the local action of the salt by the inflammation and ulcers which it sometimes produced in the mouth, fauces, œsophagus, and stomach. It is to be noted that after fatal acute poisoning by tartar emetic gastric lesions are not always found—a fact which further illustrates the previous proposition, that it causes death by its action upon the heart and lungs through the nervous system, and not merely by its local operation on the stomach.

Medical Uses.—The idea that fever must be combated by means of agents which directly tend to lessen the frequency and lower the force of the pulse, and which was formerly carried out by venesection and purgation, and more recently by veratrum viride, aconite, and digitalis, was at one period sought to be realized by means of tartar emetic. The palpable mischief wrought by the last-named agent when so employed reached its extreme development when Rasori, an Italian theorist, demonstrated that it was possible to administer 24 grains in as many hours of this salt to a pneumonic patient, and as much as 2 ounces in the course of an attack of *pneumonia*, without occasioning such a mortality as might reasonably have been expected. Indeed, many of the most distinguished clinical observers have recorded their eulogies of this treatment, and if it were to be compared with those alone which approach it in their perturbative effects, it might still maintain the claims which once were made in its behalf. But since it has been demonstrated that the most successful by far of all methods of treating pneumonia is simply to place the patient in the most favorable conditions for the exertion of his natural powers of cure, a discussion of the relative values of different active medications has greatly declined in interest as well as utility. Even in 1882 some indications existed of a desire to return to this obsolete method, which seemed to have been finally condemned and abandoned by the physicians of all countries. But we trust that the number of those who are acquainted with its martyrology will prove sufficient to check this dangerous tendency. The proposed revival did not, indeed, contemplate the use of the original sedative doses, but only the administration of divided doses until vomiting and purging had occurred three or four times. That such a method may be useful in exceptionally robust persons and in the early stages of the disease may be admitted, but its dangers, as well as its needlessness, in all other cases we cannot for a moment doubt.

A confusion produced by ignorance of the essential differences between pseudo-membranous *laryngitis* and spasmodic laryngitis led to the use of tartar emetic in the former disease, although clinical observation and analogy are strong against it, for it tends to produce a sudden and extreme prostration, and thereby to lessen the chances of the removal of the false membrane by coughing. On the other hand, the spasmodic affection, which involves also a superficial inflammatory element, is beneficially treated by nauseants and emetics which relieve at once the congestion and the spasm of the larynx and terminate the attack. It is not generally necessary to excite vomiting with this object; nauseant doses of the medicine are usually sufficient. This statement is indirectly illustrated by the usually prompt effect of opiates and revulsives in the same affection. Among inflammatory diseases *acute bronchitis* is most decidedly modified by nauseant doses of this medicine, and even by smaller ones than produce any sensible effect besides an increase of the bronchial secretion and a greater facility of expectoration. Acute articular *rheumatism* was at one time treated by sedative doses of tartar emetic, but the evidence in its favor, which was originally small, is less than nothing at the present day. It has been said that nauseating and depressing doses of it will sometimes cut short various local inflammations in their forming stage, such as *tonsillitis*, *mammary abscess*, *hernia humoralis*, acute *ophthalmia*, *mumps*, etc. There is very little doubt of the fact, but the uncertainty of action of the medicine and its distressing operation have, for the present at least, rendered its use in these affections quite exceptional. It has been employed in *dropsy* produced by cold (renal dropsy); to arrest mercurial *salivation*; in acute *meningitis*; in *epilepsy*, *chorea*, *mania*, *convulsions*, *mania-à-potu*, etc.; but in none of these diseases does the good it effects outweigh the inconveniences arising from its depressing and exhausting operation. Its power of overcoming *rigidity of the os uteri* during labor has been attested by the highest authorities, but owing to the superior advantages of anæsthetics it is now seldom resorted to. The same remark applies to its use for producing relaxation in *strangulated hernia* and *dislocations*. Locally, it has been applied to excite inflammation and thereby destroy *nævi*, and also to produce the constriction and closure of *varicose veins*. The plaster and the ointment of tartar emetic, which are no longer officinal, were used to pustulate the skin. But the severity of their action and the scars they frequently left behind them have led to their disuse.

Tartar emetic should seldom be administered to the very young or very old or to those who from any cause are feeble. If it produces *poisoning* by being swallowed, the stomach should be emptied as soon as possible by large draughts of tepid water containing or followed by vegetable astringents, such as green tea, galls, tannic acid, etc. Its sedative effects may be moderated by strong coffee, by wine, alcohol, ether, or opium.

The average emetic *dose* of tartar emetic is 1 grain (Gm. 0.06), or 3 grains (Gm. 0.20) may be dissolved in a fluidounce of water, of which one-half may be administered; if this have no effect, half of the remainder may be given in 15 minutes, and in 15 minutes more the rest. Warm water should be freely administered. As a nauseant sudorific the dose is from a quarter to half a grain (Gm. 0.01–0.03) every hour or more. As a diaphoretic and expectorant from one-twelfth to one-sixth of a grain (Gm. 0.005–0.01) may be given at intervals of from 1 to 3 hours. Pustulation may be produced by means of tartar emetic ointment, by a strong watery solution applied on a compress, or by inoculation of a paste made with the salt and by means of a fine lancet, or by the antimonial plaster (*U. S. P.* 1870). The last is a painful and unmanageable preparation.

ANTIMONII OXIDUM, *U. S., Br.*—Oxide of Antimony.

Stibium oxydatum, *Oxydum antimonicum s. stibicum.*—*Antimonious oxide*, E.; *Oxyde d'antimoine*, Fr.; *Antimonoxyd*, G.

Formula Sb_2O_3. Molecular weight 288.

Origin.—Oxide of antimony in an impure form was known to the alchemists of the Middle Ages. The term *flores antimonii* was at first chiefly applied to the product obtained by the burning of the black sulphide, but subsequently to the purer white powder resulting from the burning of metallic antimony in the air. The mineral *valentinite* or *white antimony* consists of this oxide; *antimony ochre* or *cervantite* is antimonious-antimonic oxide.

Preparation.—Take of Solution of Chloride of Antimony 16 fluidounces; Carbonate of Soda 6 ounces; Water 2 gallons; Distilled Water a sufficiency. Pour the antimonial solution into the water, mix thoroughly, let the precipitate settle, remove the supernatant liquid by a siphon, add 1 gallon of distilled water, agitate well, let the precipitate subside, again withdraw the fluid, and repeat the process of affusion of distilled water, agitation, and subsidence. Add now the carbonate of soda, previously dissolved in 2 pints of distilled water, leave them in contact for half an hour, stirring frequently, collect the deposit on a calico filter, and wash with boiling distilled water until the washings cease to give a precipitate with a solution of nitrate of silver acidulated by nitric acid. Lastly, dry the product at a heat not exceeding 100° C. (212° F.).—*Br.*

The process of the U. S. Pharmacopœia (1870) was essentially the same as the above, except that directions were also given for preparing a solution of antimonious chloride by digesting black sulphide of antimony 4 parts with hydrochloric acid 18 parts. By this treatment $Sb_2S_3 + 6HCl$ yields $2SbCl_3$, which remains dissolved in an excess of the acid, and $3H_2S$, which escapes; the solution contains also ferrous chloride, resulting from the iron usually contained in the black antimony. The subsequent step of adding nitric acid was an unnecessary complication; it will oxidize any sulphuretted hydrogen that may have remained in solution to sulphuric acid, and convert the ferrous into ferric chloride; but the former can be expelled more expeditiously and with less cost by boiling the solution, and the ferrous chloride will not be precipitated on the addition of water, which will also retain in solution the chlorides of the other metals occasionally present. On adding the solution to water, antimonious oxychloride, or *powder of Algaroth*, is precipitated and obtained of the composition $2SbCl_3.5Sb_2O_3$. By washing this with water the chlorine is gradually but not completely removed as hydrochloric acid, a more basic oxychloride remaining. The conversion into the oxide is most readily effected by an alkali or alkaline carbonate, for which purpose ammonia may be used or sodium carbonate, as directed above. In the one case ammonium chloride, in the other case sodium chloride and carbonic acid gas, are formed, antimonious oxide remaining behind in both instances; $2SbCl_3.5Sb_2O_3 + 3Na_2CO_3$ yields $6Sb_2O_3 + 6NaCl + 3CO_2$. The resulting antimonious oxide must be dried at a not too elevated temperature, to avoid the formation of higher oxides of antimony. A contamination with arsenious acid, resulting from the sulphide of arsenic frequently present in the black antimony, need not be apprehended; the greater part of it will be expelled during the first part of the operation as chloride of arsenic, and what little may be left in the liquid will remain in solution on precipitating with water. The large quantity of noxious gases given off renders it necessary to operate under a hood or to dispose of the gases by consuming them in a furnace.

On heating metallic antimony in a loosely-covered crucible the metal burns at a red heat when in contact with air to antimonious oxide, and this sublimes in glossy, transparent, or white needles, intermixed with octahedrons; this product was formerly distinguished as *flores antimonii* (*flowers of antimony*).

Properties.—Antimonious oxide is a dense white or grayish-white powder, which is very sparingly soluble in water, insoluble in alcohol, ether, and nitric acid, but dissolves readily in hydrochloric or tartaric acid. It is without odor and taste, and when heated in closed vessels turns yellow, and on cooling becomes white again; melts at a dull red heat to a yellowish liquid, which on cooling congeals white and crystalline, and at a full red heat sublimes in crystals, as stated above; slow sublimation gives mainly octahedrons, while rhombic prisms are obtained by rapid heating. But when the oxide is slowly heated in contact with air it is converted into grayish, infusible, and non-volatile tetroxide, or *antimonious-antimonic oxide*, Sb_2O_4 or $Sb_2O_3.Sb_2O_5$; and on being rapidly heated in the air to dull redness antimonious oxide melts, and on cooling solidifies into a pearl-colored crystalline mass. When heated with soda upon charcoal by means of the blowpipe very brittle metallic globules are obtained. Its solution in hydrochloric acid dropped into water yields a white precipitate, and this is at once changed to orange-red by sulphuretted hydrogen.

Tests.—Oxide of antimony should dissolve completely when boiled with an excess of acid potassium tartrate (earthy impurities, etc.), and its solution in tartaric acid should not be precipitated by nitrate of silver (chlorides), chloride of barium (sulphates), or ferrocyanide of potassium (metals).

Pharmaceutical Uses.—Oxide of antimony is employed in preparing tartar emetic, and is a constituent of Pulv. antimonialis, *U S.*, *Br.*

OTHER OXIDES OF ANTIMONY, more or less pure or combined with sulphide of antimony, were formerly employed in medicine, and are occasionally, though very rarely, called for. When black sulphide of antimony is gradually heated to redness in contact with the air, it is partly oxidized to antimonious antimoniate, $Sb_2O_3.Sb_2O_5$, and constitutes then an ash-gray powder known as *cinis antimonii* (*antimony ash*). When this is fused with a little black antimony a transparent garnet-red mass known as *vitrum antimonii* (*antimonial glass*) is obtained. When a mixture of equal parts of black antimony and potassium nitrate is deflagrated by igniting it in small quantities, it yields *hepar antimonii* (*liver of antimony*), and when this is exhausted with water to remove sulphate and sulphantimoniate of potassium *crocus of antimony* is left behind, which is mainly a mixture of oxide and sulphuret of antimony. *Antimonium diaphoreticum* (*diaphoretic antimony*) is prepared like liver of antimony, except that more (2 parts of) potassium nitrate is used, so that the preparation contains, besides oxide of antimony, antimoniate, sulphate, nitrate, and nitrite of potassium in varying proportions. By washing this with water the residue consists mainly of *antimoniate of potassium*, which is recognized by the French Codex. The other preparations described were formerly employed in medicine.

Medical Action.—The oxide of antimony is rarely used in medicine. It is stated to possess the general properties of antimonial preparations, with a less tendency to excite nausea and vomiting, owing to its inferior solubility. Its *dose* is from 2 to 4 grains (Gm. 0.10–0.20).

ANTIMONII SULPHIDUM, *U. S.*—SULPHIDE OF ANTIMONY.

Antimonii sulphuretum, U. S. 1870 ; *Antimonium nigrum*, Br. 1867 ; *Stibium sulfuratum nigrum*, P. G. ; *Antimonium crudum*, *Sulfuretum stibicum.*—*Black (crude) antimony*, *Sulphuret or Trisulphide of Antimony*, *Antimonious sulphide*, E. ; *Sulfure d'antimoine*, *Antimoine cru*, *A. sulfuré*, Fr. ; *Schwefelspiessglanz*, *Spiessglanz*, *Schwefelantimon*, G.
Formula Sb_2S_3. Molecular weight 336.

Origin.—It is found native as *stibnite*, gray antimony ore, or black antimony, and associated with galena, iron pyrites, quartz, and heavy spar, in various parts of Europe, Borneo, New Brunswick, Nevada, and in Sevier co., Ark. It was known to the ancients as "stimmi," and was early employed as an external remedy in cutaneous diseases and for darkening the eyebrows and eyelashes. From the infusible ores with which it is associated it is freed by fusion in pots arranged in such a manner that the fused sulphide runs off into earthen vessels, where it cools. It is afterward powdered.

Properties.—Thus purified, it is known in commerce as crude antimony, and contains variable small quantities of iron, and often traces of arsenic, lead, and copper, all in the state of sulphides. From the shape of the pots in which it has cooled it usually is in the form of blunt cones, which are of a blackish color externally, and when broken steel-gray, of a metallic lustre and a radiated crystalline texture, friable, soft, and leaving a black mark upon harder bodies. Its specific gravity varies between 4.6 and 4.7, it being but little lighter than black oxide of manganese, from which it is readily distinguished by the ready fusibility of splinters of antimony sulphide when held in the flame of a candle. It is inodorous and tasteless, and insoluble in simple solvents. It is frequently seen as a heavy black or grayish-black and somewhat shining powder. This, "when boiled with 10 parts of hydrochloric acid, dissolves without leaving more than a slight residue, hydrosulphuric acid being evolved. The solution when added to water gives a white precipitate which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration the filtrate gives an orange-red precipitate with hydrosulphuric acid."—*U. S.*

Purification.—ANTIMONII SULPHIDUM PURIFICATUM, *U. S.;* Antimonium nigrum purificatum, *Br.*—Sulfure d'antimoine depuré, *Fr.*; Gereinigtes Schwefelantimon, *G.*—Sulphide of Antimony 10 parts; Water of Ammonia 5 parts ; Water a sufficient quantity. Reduce the sulphide of antimony to a very fine powder. Separate the coarser particles by elutriation, and, when the finely-divided sulphide has been deposited, pour off the water, add the water of ammonia, and macerate for 5 days, agitating the mixture frequently. Then let the powder settle, pour off the water of ammonia, and wash the residue by repeated affusion and decantation of water. Finally, dry the product by the aid of heat.—*U. S.* The *Br. P.* process is identical with this.

Similar processes have been long in use with the object of freeing antimonious sulphide from arsenic; but it has long since been proven that antimonious sulphide is likewise dissolved to a large extent; and Garot has shown that the ammoniacal liquid, when evaporated, leaves a red residue which contains very little arsenic. Arsenious sulphide is, however, freely soluble in *ammonium carbonate*, which dissolves but little antimonious sulphide. The process devised by Hager is as follows: Mix in a high vessel 1000 parts of levigated antimony sulphide with 100 parts of ammonia-water, sp. gr. .960, and sufficient warm water to permit the mixture being readily stirred; digest for a day at between 30° and 40° C. (86° and 104° F.), add 50 parts of officinal ammonium carbonate, again digest with frequent agitation for 48 hours, then dilute with water, and wash thoroughly. It forms a dark-gray or grayish-black lustreless powder having the properties mentioned above.

Tests.—Commercial sulphide of antimony is sometimes adulterated with coal-dust, or mixtures of powdered coal and chalk are sold in place of it. The latter effervesce briskly with dilute hydrochloric acid, forming a solution containing calcium chloride. On heating 1 part of the sulphide with 10 or 12 parts of hydrochloric acid but very little residue should be left, and a solution should be obtained in which, after the sulphuretted hydrogen has been expelled, stannous chloride should indicate only traces of arsenic (see Bettendorff's test, p. 27). After diluting the acid solution with five or six times its bulk of water, and filtering from the precipitated oxychloride of antimony, the filtrate should give no precipitate or only a slight one by dilute sulphuric acid (lead), should yield with ferrocyanide of potassium merely a slight blue precipitate (iron), and, when mixed with an excess of ammonia and filtered, should furnish a colorless or only a faintly blue filtrate (copper). "If 2 Gm. of the salt be mixed and cautiously ignited in a porcelain crucible with 8 Gm. of pure nitrate of sodium, and the fused mass boiled with 25 Gm. of water, there will remain a residue which should be white or nearly so, and not yellowish nor brownish (absence of other metallic sulphides). On boiling the filtrate with an excess of nitric acid until no more nitrous vapors are evolved, then dissolving in it 0.1 Gm. of nitrate of silver, filtering again if necessary, and cautiously pouring a few drops of water of ammonia on top, not more than a white cloud, but no red nor reddish precipitate, should appear at the line of contact of the two liquids (absence of more than traces of arsenic)."—*U. S.*

Pharmaceutical Uses.—Sulphuret of antimony, being the commonest and cheapest antimony ore, is employed for preparing the metal and as the source of all compounds of antimony, of which the following are officinal: Antimonii et potassii tartras, *U. S.* (Antimonium tartaratum, *Br.*); Antimonii oxidum, *U. S.*, *Br.;* Antimonium sulphuratum, *U. S.*, *Br.;* Liq. antimonii chloridi, *Br.*

Medical Uses.—Sulphide of antimony is rarely employed in medicine. It was formerly prescribed along with drastic cathartics in the *dose* of from 5 to 15 grains (Gm. 0.30–1.00).

ANTIMONIUM SULPHURATUM, *U. S., Br.*—SULPHURATED ANTIMONY.

Antimonii oxysulphuretum (Lond.); *Antimonii sulphuretum aureum* (Edinb.); *Antimonii sulphuretum præcipitatum* (Dubl.), Br.—*Sulfure d'antimoine précipité*, Fr.; *Gefälltes Schwefelantimon*, G.

Chiefly antimonious sulphide (Sb_2S_3; 336), with a very small amount of antimonious oxide.—*U. S.*

Origin.—Both antimonial kermes and golden sulphur appear to have been first obtained by Basilius Valentinus in the fifteenth century. The latter was called *sulphur auratum* by Quercetanus (1603). The former was prepared by Glauber by dissolving black antimony in potash and cooling, and was lauded by Simon (1719) under the name of *alkermes minerale*. Numerous processes for obtaining these preparations have been published, nearly all of them resulting in mixtures of one or both sulphides of antimony with more or less antimonious oxide. The U. S. and Br. Pharmacopœias now recognize a nearly pure Sb_2S_3, which, from the synonyms given by the Br. Phar. of 1867, may also be dispensed as golden sulphur. The German Pharmacopœia recognizes only pure Sb_2S_5.

Preparation.—Purified Sulphide of Antimony in very fine powder 1 part (6 troy-ounces); Solution of Soda 12 parts (4½ pints); Distilled Water, Diluted Sulphuric Acid, each a sufficient quantity. Mix the sulphide of antimony with the solution of soda and 30 parts (12 pints) of distilled water, and boil the mixture over a gentle fire for 2 hours, constantly stirring, and occasionally adding distilled water, so as to preserve the same measure. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, diluted sulphuric acid so long as it produces a precipitate. Wash the precipitate with hot distilled water until the washings are at most but very slightly clouded by test solution of chloride of barium; then dry the precipitate and rub it to a fine powder.—*U. S.*

This process is identical with that of the Pharmacopœia of 1870, except that solution of soda is now ordered in place of solution of potassa. The British Pharmacopœia follows a similar process, but employs a weaker soda solution and a larger amount of sulphide of antimony, the proportion being 4½ Imperial pints of the former to 10 ounces of the latter, mixed with 10 ounces of sublimed sulphur.

Amorphous sulphide of antimony dissolves readily in cold alkaline liquids, but for effecting the solution of the crystalline sulphide the application of heat is required. The solution contains both sulphantimonite and antimonite of the alkali, the formation of which is seen from the following equation: $4Sb_2S_3 + 8NaHO = 3Na_2Sb_2S_4 + 2NaSbO_2 + 4H_2O$. On adding sulphuric acid both the compounds named are decomposed and antimonious sulphide is precipitated, without the evolution of sulphuretted hydrogen: $3Na_2Sb_2S_4 + 2NaSbO_2 + 4H_2SO_4$ yields $4Na_2SO_4 + 4Sb_2S_3 + 4H_2O$. The precipitate, however, is likely to retain a portion of undecomposed antimonite, which, if remaining in the hot acidulated liquid, is gradually decomposed; to ensure this decomposition, Liebig suggested to pour the hot alkaline solution into an excess of diluted sulphuric acid and to boil the moist precipitate with a fresh portion of such acid.

1 part of sodium hydrate is theoretically able to form sodium antimonite and sulphantimonite with 4.2 parts of Sb_2S_3. In practice, however, a much smaller amount of the sulphide should be used, the pharmacopœias ordering 1.66 (*U. S.*) and 2.55 (*Br.*) parts.

Using larger proportions would result in the formation of sodium sulphantimoniate and antimoniate, and finally of antimonic sulphide, Sb_2S_5. The reaction is likewise influenced by the concentration of the alkaline liquid and by its exposure to air. The adopted processes should therefore be strictly followed in order to obtain as nearly as possible uniform results.

Properties and Tests.—Sulphurated antimony is a reddish-brown (orange-red, *Br.*) powder, insoluble in water and other simple solvents. When heated with twelve times its weight of officinal hydrochloric acid it is nearly all dissolved, with evolution of hydrosulphuric acid gas. The residue, after having been washed and dried, burns with the characters of sulphur and leaves a scanty ash. The solution in hydrochloric acid, when added to water, deposits a white powder. The liquid filtered from this powder yields an orange-red precipitate with hydrosulphuric acid. Water in which the preparation has been boiled should not yield a white precipitate with chloride of barium or with oxalate of ammonium. The last two tests indicate the absence of sulphates and of calcium compounds. The U. S. Pharmacopœia permits a slight opalescence with test solution of chloride of barium. The precipitate, which falls when a solution of 60 grains of sulphurated antimony in sufficient hydrochloric acid is dropped into water, should, after washing and drying, weigh not less than 51 grains, or 85 per cent. (*U. S.*). Boiled in water with acid tartrate of potassium, the resulting solution is precipitated orange-red with sulphuretted hydrogen, thus showing the presence of antimonious oxide. Oxidized with nitric acid, 60 grains give a white residue of 40 grains (*Br.*).

Off. Prep.—Pil. antimonii comp., *U. S.* (Pil. hydrarg. subchloridi comp., *Br.*).

Allied Compounds.—1. Antimonii oxysulphuretum. *U. S.* 1870.—Stibium sulfuratum rubeum, *P. G.* 1872; Sulphur stibiatum rubeum, Kermes minerale, Alkermes aurificum minerale.—Oxysulphuret of antimony, Kermes mineral, *E.;* Sulfure d'antimoine hydraté, Kermès minéral, Poudre des chartreux, *Fr.;* Mineralkermes, *G.*

Composition, a mixture of Sb_2S_3 and Sb_2O_3.

This was prepared by boiling for 1 hour 1 part of black antimony with 250 parts of water containing 23 parts of sodium carbonate, filtering and cooling; after 24 hours the precipitate was collected, washed with cold water previously boiled, and dried. The process was proposed by Cluzel, and received the prize of the Paris Pharmaceutical Society in 1806. The reaction is similar to that described above, except that carbonic acid gas is given off. On cooling, a mixture of Sb_2S_3 and Sb_2O_3 is deposited, varying with the relative proportion of the sulphide and carbonate, and with the concentration of the liquid. The solution decanted from the precipitate, on being boiled with a fresh portion of antimonious sulphide, yields again a precipitate of similar appearance, but containing a much larger amount of oxide. Sonnenberg obtained by four successive boilings kermes containing 8, 33, 43, and 67 per cent. of antimonious oxide.

Oxysulphuret of antimony is a purplish-brown, tasteless powder, soft and velvety to the touch, wholly and readily soluble in hot hydrochloric acid, with evolution of hydrosulphuric acid gas, and partly soluble in a hot solution of potassa, leaving a residue soluble in tartaric acid. On examination with the microscope it is found to be a mixture of amorphous globules of the sulphide with minute transparent prisms of oxide of antimony, which latter is dissolved by solution of tartaric acid.

2. Antimonii pentasulphidum.—Antimonii sulphuretum aureum s. præcipitatum, Stibium sulfuratum aurantiacum, *P. G.;* Sulphur stibiatum aurantiacum, Sulphur auratum antimonii.—Antimonic sulphide, Golden sulphuret of antimony, Golden sulphur, *E.;* Soufre doré d'antimoine, *Fr.;* Goldschwefel, Sulfaurat. *G.*

This was originally prepared by precipitating an aqueous solution of liver of antimony (see Antimonii Oxidum) with an acid, and contained, besides Sb_2S_5, also variable amounts of Sb_2S_3 and Sb_2O_3. Instead of such mixtures the German and other pharmacopœias now recognize the pure antimonial sulphide, which is prepared as follows:

A solution of 70 parts of crystallized carbonate of sodium in 250 parts of water is boiled, and mixed with milk of lime containing 26 parts of lime and 80 parts of water. 36 parts of levigated sulphuret of antimony and 7 parts of sublimed sulphur are added, and the whole boiled until the gray color has disappeared, when the liquid is filtered and crystallized. 24 parts of these crystals, which, from the discoverer Schlippe (1821), are known as *Schlippe's salt*, and have the composition $Na_3SbS_4 + 9H_2O$, are dissolved in 700 parts of water, and added to a mixture of 9 parts of sulphuric acid and 200 parts of water. The precipitate, having the composition Sb_2S_5, is washed and dried.

It is an orange-colored, inodorous, and tasteless powder, which on being slowly heated in a test-tube gives a sublimate of sulphur, leaving a residue of black antimonious sulphide; at a red heat it is completely volatilized.

"It should be soluble in 200 parts of ammonia-water at a moderate heat, leaving merely a trace of residue; it should readily dissolve in sulphide of ammonium, and when this solution is acidulated with hydrochloric acid a precipitate is obtained which, after washing with water and while moist, on being agitated with a 5 per cent. solution of ammonium carbonate, and at once filtered, yields a filtrate which is not rendered yellow on acidulating with hydrochloric acid and the addition of sulphuretted hydrogen."—*P. G.* This test, proving the absence of arsenic, is also available for the other sulphides of antimony.

Medical Action.—Sulphurated antimony has essentially the same medicinal properties as the oxysulphuret, and may be prescribed in the same doses. It is very rarely employed.

Kermes mineral does not differ essentially from other antimonials in its action, but is generally described as being "alterative, diaphoretic, and emetic," although of very uncertain operation. Its dose as an alterative may be stated to be 1 or 2 grains (Gm. 0.05–0.10) twice a day, and as an emetic from 5 to 20 grains (Gm. 0.30–1.20).

APOCYNUM, *U. S.*—APOCYNUM.

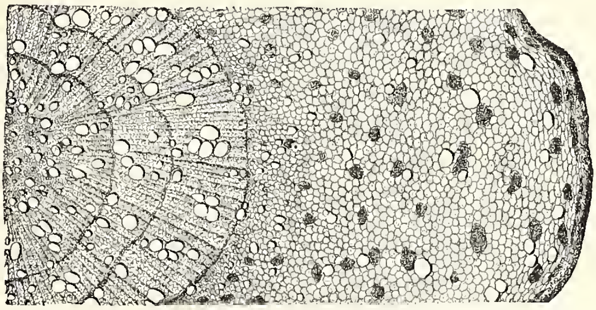
Canadian Hemp, E.; *Chanvre du Canada*, Fr.; *Canadische Hanfwurzel*, G.

The root of Apocynum cannabinum, *Linné.*

Nat. Ord.—Apocynaceæ.

Origin.—This perennial herb grows in fields and grassy places and on the border of woods throughout a large portion of the United States. The smooth often purplish stem is about 40 inches (1 M.) high, has rather erect branches, opposite oblong or linear-oblong acute and mucronate leaves, and many-flowered cymes, the corolla being greenish-white or reddish, having five erect lobes and a tube of the length of the calyx; the fruit consists of a pair of slender follicles containing numerous narrow silky tufted seeds. All parts of the plant, which flowers in July and August, contain a white adhesive milk-juice. Its popular name of *Indian hemp* refers to the strong fibres of the stem-bark, which somewhat resemble the bast-fibres of hemp.

FIG. 28.



Apocynum cannabinum: transverse section; magnified 25 diameters.

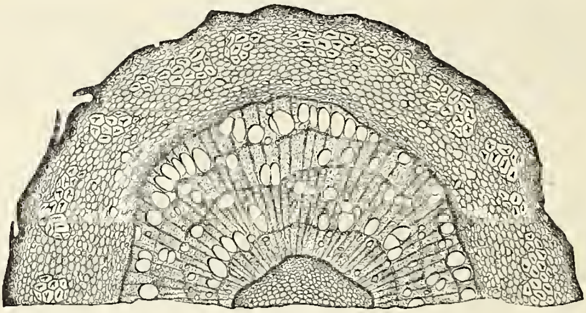
Description.—The root is horizontal, several feet long, ¼ to ½ inch (6 to 12 Mm.) thick, slightly branched and beset with a very few fibres; when dry, longitudinally wrinkled, and the thinner portions somewhat annulated by deep transverse fissures. It has a brownish-gray or pale-brown color externally, and under the thin corky layer a fleshy whitish bark, which is about as thick as the woody layer, contains laticiferous vessels, and encloses a yellowish or whitish porous wood composed of several rings and radiate by finely medullary rays; in the centre is a thin pith. The root breaks with a short fracture, is inodorous, and the wood tasteless, but the bark develops gradually a very persistent bitter and rather disagreeable taste. It is usually mixed with the lower portion of the stem, which has a smoother and tougher bark and harder wood, the latter enclosing a larger pith.

Constituents.—The earlier analyses of Dr. Knapp and Dr. Griscom (1833) failed to isolate the active principle, but proved the presence of the widely-distributed proximate constituents, among which are stated to be tannin, gallic acid, gum, starch, resin, and wax. J. U. Lloyd (1879) obtained from a fluid extract of this root, on standing, crystals of cane-sugar and a precipitate of white, tasteless, waxy matter. Schmiedeberg (1883) has isolated two principles resembling digitalin in their properties. *Apocynin* is resin-like, amorphous, easily soluble in alcohol and ether, nearly insoluble in water, and becomes inert on being boiled with hydrochloric acid. *Apocynein* is a yellowish glucoside, easily soluble in water and alcohol, insoluble in chloroform, ether, and benzin, and, like apocynin, gives no characteristic reaction with sulphuric acid and bromine.

Fluid extract of apocynum may be prepared by following the directions for making Extractum gentianæ fluidum.

Allied Plant.—Apocynum androsæmifolium, *Linné*, is known as *dog'sbane*, and grows in similar localities as the preceding, but appears to be more frequent in New England and Canada. It differs from Canadian hemp chiefly by the spreading stem and branches, the relatively broader leaves, and the bell-shaped, rose-colored corolla with reflexed lobes and a tube longer than the calyx. The long rhizome and roots are from $\frac{1}{8}$ to $\frac{1}{4}$ inch (3 to 6 Mm.) thick, and have a pale brownish wrinkled transversely fissured thickish bark, which is about half the thickness of the woody layer, contains groups of stone-cells in the middle part, is of an unpleasantly bitter taste, and separates easily from the tough white finely-porous and delicately rayed wood, enclosing a rather large pith. The starch of this species is much smaller than that of the preceding. Canadian hemp-root has been frequently sold in place of dog'sbane-root. (For microscopical descriptions of both drugs see E. B. Stuart in *Proceedings Amer. Phar. Assoc.*, 1881, p. 468, and E. A. Manheimer in *Amer. Jour. Phar.*, 1881, p. 554.) Bigelow found in dog'sbane a red coloring matter soluble in water and insoluble in alcohol, a trace of volatile oil, and a caoutchouc-like body. The bitter principle was obtained as an extract-like mass.

Fig. 29.



Apocynum androsæmifolium: transverse section; magnified 25 diameters.

Medical Action and Uses.—Apocynum is a powerful emetic and cathartic, and when it produces vomiting is diaphoretic also. It also promotes expectoration, causes a tendency to drowsiness, increases the urinary secretion, and diminishes the frequency and force of the pulse. Its evacuant properties have sometimes been made available in *dropsy*, but it does not appear in what forms of dropsy, cardiac, renal, hepatic, or splenic, its efficacy has been chiefly shown. Probably it is a mere evacuant of dropsical effusions, the ultimate tendency of the dropsy depending on the nature of its organic cause. There can be little doubt of its possessing this value in common with jalap and other hydragogue cathartics. Possibly it has the advantage of exciting diaphoresis and diuresis, while it purges and vomits. It is said to destroy *intestinal worms*. An infusion and a tincture of the root have both been regarded as tonic and alterative in *dyspeptic* derangements, and as curative of mild cases of *intermittent fever*. These properties are doubtless owing to the bitter principle which it contains. The dose of the powdered root is about 5 grains (Gm. 0.30) as an antiperiodic, and 20 grains (Gm. 1.30) as an emetic. The decoction is usually made with an ounce (Gm. 32) of the root in 1½ pints of water boiled to a pint, and may be given in doses of a wine-glassful three times a day. Some physicians recommend as a diuretic in dropsy an infusion made with a drachm (Gm. 4) of the bark of the root in 8 ounces (Gm. 250) of water, of which half an ounce may be given once in 6 hours.

Dog'sbane is said to be diaphoretic and emetic, without causing much nausea, and to operate more gently and certainly than ipecacuanha; but it deteriorates by keeping. It is also reputed to be tonic, cathartic, and alterative, and to possess anti-syphilitic powers. In reality, its virtues, if it have any that entitle it to a place in the materia medica, are not well defined. The powder of the recently-dried root is emetic in the dose of 30 grains (Gm. 2). From 10 to 20 grains (Gm. 0.60–1.30) may be given as a tonic or alterative in substance, infusion, decoction, or tincture.

APOMORPHINÆ HYDROCHLORAS, *U. S., Br.*—Hydrochlorate of Apomorphine.

Apomorphinum hydrochloricum, P. G.—*Chlorhydrate d'apomorphine*, Fr.; *Apomorphin-Hydrochlorat*, G.

The hydrochlorate of an artificial alkaloid prepared from morphine.—*U. S.*

Formula $C_{17}H_{17}NO_2.HCl$. Molecular weight 303.4.

Preparation.—1 part of pure morphine and 20 parts of pure hydrochloric acid are introduced into a strong glass tube having at least fifteen times the capacity of the mixture; the open end is securely sealed, the glass tube introduced into a strong metallic tube closed by a screw-cap, and the whole immersed for 3 hours in an oil-bath heated to between 140° and 150° C. (284° and 302° F.). After cooling, the tube is opened, the liquid diluted with water, and bicarbonate of sodium added in excess. The liquid is decanted from the precipitate, and this is agitated with ether. To the ethereal solution a few drops of hydrochloric acid are added, whereby hydrochlorate of amorphine is separated; this is recrystallized from boiling water and rapidly dried over concentrated sulphuric acid. In this process chloroform may be used in the place of ether.

This process is the one devised by Matthiessen and Wright (1869). The hydrochloric acid, acting upon the morphine at the temperature stated above, merely abstracts 1 molecule of water from the molecule of morphine, and on opening the cooled tube no pressure is observed in it and no gas escapes. During the heating, however, there is considerable pressure in the sealed tube from the volatile acid, and to guard against accidents its enclosure in a strong metallic tube, as directed above, is advisable. A portion of morphine may possibly not undergo the change, and will be precipitated with the apomorphine by the bicarbonate. Morphine being insoluble in ether, it is left behind when the precipitate is treated with this solvent, which readily dissolves apomorphine. On the addition of a little hydrochloric acid hydrochlorate of apomorphine is produced, and, being insoluble in ether, separated in a crystalline condition. The recrystallization of the salt from boiling water renders it perfectly pure. Since apomorphine is soluble in aqueous liquids, the mother-liquor decanted from the precipitate contains notable quantities of the alkaloid, which may be recovered by agitation with ether or chloroform and by treating these solutions with a little hydrochloric acid. The salt as well as the alkaloid should be rapidly dried upon bibulous paper or over sulphuric acid under a bell-glass, and kept in small well-stopped bottles protected from moisture and light.

Matthiessen and Wright have obtained the same compound from codeine and hydrochloric acid, which yield at first *chlorocodid*, $C_{18}H_{20}ClNO_2$, and on continuing to heat in a sealed tube this compound is split into chloride of methyl, CH_3Cl, and apomorphine, $C_{17}H_{17}NO_2$.

Mayer (1871) noticed that hydrochlorate of morphine is more rapidly and at a lower temperature converted into apomorphine by heating it to 120° C. (248° F.) with a solution of zinc chloride of such strength that its boiling-point is at 200° C. (392° F.); the change is then effected in 90 minutes, and the apomorphine or its salt may be obtained pure by the above process, the carbonate of zinc, which is precipitated at the same time, being insoluble in ether.

In 1845, Arppe had obtained *sulphomorphid*, by heating sulphate of morphine with an excess of sulphuric acid and water to 150° C. (302° F.). This is white, nearly insoluble in water, and was proved by Matthiessen and Wright to be sulphate of apomorphine. Arppe had given it the formula $C_{17}H_{18}NSO_4$. Nadler (1873) separated from it the alkaloid and converted it into hydrochlorate.

Properties.—Hydrochlorate of apomorphine is in "minute, colorless or grayish-white, shining crystals, turning greenish on exposure to light and air, odorless, having a bitter taste and a neutral or faintly acid reaction; soluble in 6.8 parts of water and in 50 parts of alcohol at 15° C. (59° F.); slowly decomposed by boiling water or boiling alcohol; almost insoluble in ether or chloroform, and should it impart color to either of these liquids it should be rejected, or it may be purified by thoroughly agitating it with either liquid, filtering, and then rapidly drying the salt on bibulous paper in a dark place. The aqueous solution on gentle warming rapidly turns green, but retains a neutral reaction. Solution of bicarbonate of sodium, added to an aqueous solution of the salt, throws down the white, amorphous alkaloid, which soon turns green on exposure to air, and forms a bluish-green solution with alcohol, a purple one with ether or pure benzol, and a violet or blue one with chloroform. Addition of test solution of nitrate of silver to an aqueous solution of the salt produces a white precipitate insoluble in nitric acid, but instantly reduced to metallic silver by water of ammonia."—*U. S.* "It turns blood-red with nitric acid, dissolves in an excess of solution of soda, the liquid kept in an open vessel becoming in a short time purple, and finally black."—*P. G.* Its concentrated solution yields with potassium permanganate a dingy-green precipitate, soluble brown-yellow in potassa, and brick-red in nitric acid; potassium iodide yields a white gelatinous precipitate insoluble in excess, but soluble in ammonia (Anneessens, 1882).

The pure alkaloid is a white, or more generally a grayish, amorphous powder, rather freely soluble in water, ether, benzol, and chloroform. On exposure to the air while still moist it rapidly turns green, and then dissolves in chloroform with a blue color. Nadler observed that on being precipitated from its solution in sulphuric acid by ammonia it speedily acquires a reddish-brown color, and yields with chloroform a rose-colored solution. Apomorphine is colored red by nitric acid, brown by iodic acid, and rose-red or amethyst-red by ferric chloride, this last reaction being quite distinct from the blue color produced by the same reagent with morphine.

The salts of apomorphine appear to be slightly soluble in cold water, but more freely so in warm and in acidulated water. The aqueous and alcoholic solutions of the alkaloid and its salts acquire an emerald-green color on exposure to air, at the same time losing their medical properties; apomorphine should therefore not be kept in solution. In order to preserve it for a week or two, Hager recommends the addition of a drop of ether to half a drachm (2 Gm.) of the solution.

Physiological Action.—*On Animals:* The introduction of apomorphine into medicine dates from 1869, when the first experiments with it were made by Dr. Gee. He found that 2 grains of the muriate of apomorphine given hypodermically to a dog caused vomiting, and in 2 or 3 minutes the animal began to course around the room in a curiously persistent and methodical manner. 3 grains injected into a cat caused the animal to run around in the same manner, and also to turn vaulting somersaults in the air. 2 more grains induced epileptiform convulsions, and 2 additional grains caused perfect relaxation. The next morning the animal was found dead. It is generally held to produce emesis by acting upon the nervous centres governing that act, and not by a direct irritation of the stomach. Chloroform and chloral hinder, but morphia promotes, its operation. In general, an excessive dose is less apt than a moderate one to occasion vomiting; on the other hand, it produces general relaxation and insensibility, impaired reflex susceptibility, and paralysis of the hinder limbs.

On Man: Locally, apomorphine does not usually act as an irritant, for it causes no pain when applied endermically or hypodermically, and even upon the tongue does not produce a painful impression. Yet its subcutaneous injection has sometimes caused indurated swelling. Its effects upon the system are essentially alike whether it be administered by the mouth or hypodermically, but in the former case they are more slowly developed. In 20 minutes after one-fifth of a grain had been taken internally headache, dizziness, oppression, and qualmishness were complained of; the face grew pale, there was copious salivation, the pulse was infrequent, small, and feeble, and free vomiting occurred in from 10 to 20 minutes. In some cases there is said to have been drowsiness rather than the apathy of depression (Dujardin-Beaumetz). Sometimes there is retching, or, again, vomiting without effort occurs. This operation is apt to be repeated several times at intervals of a few minutes, and is followed by a quiet sleep. No marked action upon the pulse is observed except during the emetic operation, when it tends to become slower than natural, as well as feebler and smaller; but it speedily returns to the normal rate. Unlike antimony, ipecacuanha, and other nauseant emetics, it neither irritates the stomach nor causes diarrhœa, nor has it the former effect like mechanical emetics, and it operates more promptly than any of them, even more so than some mechanical emetics. By repetition it does not appear to lose its efficacy, but whatever tends to blunt sensibility impairs its action. Thus it acts but feebly upon animals under the influence of chloroform or chloral; all morbid conditions in man that induce a like condition have the same effect, as stupor, asphyxia, etc. It may produce its specific action by absorption through the sound skin; so a gentleman who sometimes had his hands wetted with solutions of this agent vomited frequently, was depressed, uncomfortable about the head, and unfit for work.

Some persons appear to be readily poisoned by apomorphine, which then produces, usually, a degree of sedation which may reach full collapse. This has happened even in robust subjects. In one nausea occurred at the end of 10 minutes; in 3 minutes more the patient grew very giddy and pale, and fell to the ground; he then broke into a cold sweat and appeared to be dying, but he vomited copiously and recovered. One-thirty-second of a grain was very unwisely injected in the case of a child affected with capillary bronchitis. Violent and repeated vomiting took place, the patient grew as pale as wax, and had a tracheal rattle, but it survived. A drunkard affected with albuminuria had injected one-sixth of a grain of muriate of apomorphine. Vomiting presently took place, and then sudden syncope; the pulse was extinct and respiration hardly perceptible; the skin was pale and livid and covered with a cold sweat; there was complete extinction of consciousness and sensibility. Under electrical stimulus the man was saved (Dujardin-

Beaumetz). Very similar effects occurred in the following case: A middle-aged woman, suffering from sore throat, received a hypodermic injection of one-sixteenth of a grain of muriate of apomorphine. Besides the symptoms last mentioned there occurred convulsive twitchings of the corners of the mouth. For some hours after the return of consciousness she was inclined to faint. In a case of quinsy one-sixth of a grain was injected subcutaneously. In 10 minutes the patient suddenly threw himself backward and flexed his arms rigidly; the pulse was very small, the skin cool, and the heart-sounds feeble. Opisthotonos followed, the man supporting himself on the neck and heels. In a few minutes the rigidity disappeared and the patient sank into a deep sleep. A man fifty-two years old, suffering from bronchitis, received a subcutaneous injection of one-fifteenth of a grain of muriate of apomorphine. He did not vomit, but in 7 minutes he became collapsed and died. The autopsy threw no light upon the immediate cause of his death (Ungar).

Pecholier, a professor of Montpellier, has published a detailed history of the poisonous effects produced in himself by the hypodermic injection of about one-sixth of a grain of this substance. He lay with his limbs extended, inert, and unconscious, his face livid, his tongue protruding, and his breathing suspended. Strange to say, however, the pulse was full and firm and the temperature natural. Another injection like the first was administered! It brought on copious vomiting, immediately followed by complete collapse, in which, besides the phenomena just mentioned, the pulse grew feeble and irregular and the limbs cold. From this state of imminent death the patient was rescued by hypodermic injections of sulphuric ether and sinapisms, after which reaction took place rapidly (*Bull. de thérap.*, cii. 353).

According to Harnack, the action of apomorphine may be described, using the conventional language of the day, in the following manner: 1. In man and in Mammalia capable of vomiting a moderate dose excites the centre of emesis, but large doses depress and even paralyze it. 2. In rabbits the respiratory centre is affected in a similar manner. 3. The centre of voluntary motion in rabbits is strongly irritated, even to convulsions, by small doses; dogs and cats are excited to active movements resembling those due to volition. 4. In rabbits, cats, and frogs the centres of sensation appear to be depressed. 5. Striated muscles in frogs have their irritability lessened by this agent, but in higher animals and in man it is uncertain whether the muscular relaxation which occurs is due to an action on the spinal marrow or on the muscular fibres. 6. The heart, in frogs, is paralyzed.

The elaborate experiments of Reichert (*Inaugural Thesis*, Univ. of Penna., 1879) led him to numerous conclusions, of which the greater number agree with these. He also remarked that the drug produced copious salivation and left no lesions behind it after causing death.

Medical Uses.—The sedative, or rather the depressing, action of apomorphine has been occasionally invoked. Thus in the case of a boy in *maniacal delirium*, with dilated and insensible pupils, one-tenth of a grain given hypodermically produced in a few minutes calmness, and then vomiting, after which he slept, and the next morning was well. In India *sunstroke* has been treated in the same way, one-sixteenth of a grain producing emesis, followed by a speedy reduction of temperature and return of consciousness (*Practitioner*, xxiv. 456). It is said to have produced relaxation of a *rigid os uteri*, and it has been given hypodermically with negative or only palliative results in *epilepsy*. In a case of attempted suicide by a man who took the estimated quantity of 6 grains of *strychnia* one-third of a grain of apomorphine was injected hypodermically within half an hour. Immediately the spasms subsided, vomiting took place, and the patient recovered (Glisan). It has also been given hypodermically in the *convulsions* of children, with the effect of arresting them (*Medical News*, 1882, p. 391). It has been administered similarly in cases of alcoholic *intoxication*, and dissipated the condition rapidly after free vomiting had taken place (*Practitioner*, xxx. 211). In a case of poisoning with *oil of bitter almond* it acted as a prompt and sufficient emetic in the dose of one-eighth of a grain hypodermically. Half a grain administered in the same manner in 3 minutes produced copious emesis in a case of poisoning with *carbolic acid*, and the patient recovered. A similar result occurred when a man had been poisoned by swallowing 1½ pints of *kerosene*. The like expedient has been used to cause the expulsion of a *foreign body* from the œsophagus. In *quinsy*, when swallowing is very difficult, this medicine may be used hypodermically to excite vomiting with the intention of breaking the abscess. It is generally thought to be contraindicated in affections of the air-passages, on account of its tendency to produce a profuse watery secretion from the bronchia; yet it has sometimes been given in emetic doses, and with advantage, in cases of *bronchorrhœa* and of *foreign bodies* in the larynx or trachea, and has been recommended in membranous *croup*. Smidowitsch used it in the latter disease and in *spasmodic croup* with alleged advantage, giving large doses, such as 1 grain in the course of a day for several successive days (*Med. Record*, xvii. 346). In minute doses it appears to be applicable to some of the conditions which antimony is used to remove, especially when, in *laryngitis* or *bronchitis*, the mucous membrane is dry and irritable. Kormann, Kushel, and others have found it serviceable in bronchitis and catarrhal pneumonia. It was given in minute doses of from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain, and, without causing vomiting or interfering with digestion, it converted the dry into moist râles, facilitated expectoration, and reduced the fever (*Med. Record*, xx. 290).

Administration.—The use of this product is very limited. Fortunately, the cases for which it is exclusively adapted are very few indeed, as the above enumeration of them demonstrates. The difficulty of preserving it forms another obstacle to its employment, although it is alleged not to lose its special mode of action when its color changes to a green or olive tint. Even this change is said to be preventible by adding glycerin or glucose to its solution, while the former renders muriate of apomorphia more soluble. By the stomach the dose for a child, when it is to be repeated, is about $\frac{1}{120}$ grain (Gm. 0.0005); for an adult, from $\frac{1}{60}$ to $\frac{1}{10}$ grain (Gm. 0.001–0.006). A single hypodermic dose for an infant is from $\frac{1}{30}$ to $\frac{1}{16}$ grain (Gm. 0.002–0.004); for a child of ten years, $\frac{1}{20}$ grain (Gm. 0.003); for an adult, $\frac{1}{10}$ grain (Gm. 0.006) subcutaneously, or $\frac{1}{5}$ grain (Gm. 0.013) by the mouth. For hypodermic injections a 1 per cent. solution is eligible.

AQUA, *U. S., Br.*—WATER.

Aqua communis, P. G.—*Eau*, Fr.; *Wasser*, G.

Natural water in the purest attainable state (*U. S.*), cleared, if necessary, by filtration (*Br.*) through alternate layers of sand and charcoal.—*P. G.* 1872.

Composition H_2O. Molecular weight 18.

Properties.—Water is often combined in nature, as in many crystalline compounds, and is very abundant in the free state. Natural water is an excellent solvent for most gases and many salts, but it is rarely found pure; B. M. Brackenridge and Dr. E. Stieren observed (1860) chemically pure water in the spring of a ravine known as "the Dark Hollow" in Allegheny county, Pa. With few exceptions *spring-water* contains carbonic acid gas in solution, and by its agency dissolves some carbonate and sulphate of calcium and carbonate of magnesium from the soil. Such water precipitates an insoluble lime-soap from solution of ordinary soap, and is called hard. This hardness may be removed by expelling the excess of carbonic acid by heat; the carbonate and a portion of the sulphate of calcium, also magnesium carbonate if present, are thus precipitated. A similar precipitation takes place in rivers, from the water of which, owing to its extended surface, the carbonic acid gas is mostly given off; hence *river-water* is usually soft. Both spring- and river-waters contain variable quantities of salts of alkalies in solution, of which they cannot be deprived except by distillation.

Rain- and snow-water are free from such saline compounds, except the portions falling first; these contain particles of dust and various organic and inorganic matters which had been suspended or dissolved in the air. Among them, ammonia, iodine, chlorine, and nitric acid have been found, the latter more particularly during a thunder-storm, the former two elements occasionally, while ammonia or allied compounds are always present in inhabited regions. It is advisable, therefore, to collect rain-water only some time after the rain has commenced falling, and as far removed from dwellings as possible; it will then contain a little carbonic acid, which has been dissolved from the air.

The purity of running and well-water is affected by the nature of the surrounding soil and the proximity of decaying animal or vegetable matter, the decomposition-products of which may find an outlet into the former by natural drainage, sometimes from a considerable distance, and render such water unwholesome and unfit for many purposes. The refreshing taste of spring-water is mainly due to the carbonic acid dissolved therein. Of secondary importance is the small quantity of saline compounds contained in it. When the latter is permanently increased beyond a certain quantity the spring is called a *mineral spring*. (See AQUÆ MINERALES.)

Most spring-waters are unfit for chemical and pharmaceutical uses, but may often become adapted therefor after boiling and filtering. River-water, if not naturally bright and transparent, is improved by filtration through sand and charcoal, and may then be employed if nearly free from organic matter, the amount of which may be approximately ascertained by a dilute solution of permanganate of potassium, which will permanently impart its color to the water as soon as the organic matter and other deoxidizing agents accidentally present have been destroyed or oxidized. But distilled water is best for all the purposes indicated. It taste is insipid, owing to the absence of carbonic acid or to the minute quantity of this gas absorbed by contact with air.

At the temperature of 0° C. (32° F.) water freezes, forming transparent crystals of ice; if entirely undisturbed, it may be cooled to several degrees below this point without freezing, and if now slightly agitated will at once congeal, the temperature rising to the freezing-point in consequence of the liberation of latent heat. Water impregnated with salts, particularly such as are readily soluble in it, freezes at a lower temperature, the ice being free from the compounds which were dissolved in the water. Hence, water equal in purity to distilled water may be obtained by melting perfectly clear and transparent ice under conditions which preclude the admixture of dust and other impurities. *Sea-water*, which has the specific gravity 1.027 and contains about 3½ per cent. of salts, yields ice of as great purity as river-water.

The boiling-point of water is 100° C. (212° F.), and rises beyond this temperature if notable quantities of salts, etc. are dissolved in it or if the pressure is increased; on the reduction of pressure water boils at a lower temperature.

The density of distilled water at 15° C. (59° F.) or at 15.5° C. (60° F.) is by general consent regarded as the unit by which the density of liquid and solid bodies is measured. In Europe, however, this unit is sometimes taken from water at its greatest density, and several of the tables published in the U. S. Pharmacopœia (1880) are based upon this unit. The specific gravity of water decreases with the rise of temperature, and increases gradually as the temperature is lowered until + 4° C. (39° F.) is reached, when it has its maximum density, becomes lighter again toward the freezing-point, and expands very considerably when passing into the solid state, ice having the specific gravity 0.916. When converted into vapor, water expands to nearly seventeen hundred times its bulk, and forms a transparent and colorless gas having the specific gravity 0.455 at 100° C. (212° F.); it has therefore less than one-half the density of atmospheric air. When mixed with air it condenses into minute drops, to which the opaqueness of steam is due; the over-saturation of air with aqueous vapor causes a similar condensation in the atmosphere, hence the appearance of clouds.

Tests of Purity.—Water is "a colorless limpid liquid, without odor and taste at ordinary temperatures, and remaining odorless while being heated to boiling, of a perfectly neutral reaction, and containing not more than 1 part of fixed impurities in 10,000 parts. The transparency or color of water should not be affected by hydrosulphuric acid or sulphide of ammonium (absence of metallic impurities). On heating 100 Ccm. of water, acidulated with 10 Ccm. of diluted sulphuric acid, to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1000) to impart to the liquid a decided rose-red tint, this tint should not be entirely destroyed by boiling for 5 minutes (absence of more than traces of organic or other oxidizable matters)."—*U. S.*

Pharmaceutical Uses.—Aqua destillata, *U. S.*, *Br.*—The utility of water as a solvent and vehicle is well known; it is employed in preparing most chemicals, constitutes the solvent of the medicated waters, decoctions, and infusions, and most solutions and syrups, and as an addition to alcohol is present in many of the fluid extracts, tinctures, etc.

Physiological Action of Cold Water.—Water constitutes by far the larger portion of the bulk of all organized beings, and is essential to their organic constitution as well as to the molecular actions and movements by which life is manifested. It is important, therefore, as an article of food which directly supplies one constituent of the body; it is not less so as a means of promoting the solution of solid food in the digestive organs and facilitating its absorption; it is equally the solvent of all the secretions and excretions, and the vehicle by which the latter are carried out of the body. But all natural water is not adapted for food. The greater part of the water in the world is contained in the ocean; another large portion consists of spring- and of river-waters which are so mineralized as to be unfit for ordinary drinking, or of other waters in certain sluggish rivers and in marshes which contain too large a portion of animal or vegetable matter to be wholesome. The purest natural waters are rain-water, which is, however, insipid and contains but little air, and certain springs which are remarkable for their purity as well as the vivacity of their taste. For pharmaceutical, and indirectly for medicinal, purposes, water must be deprived, as far as possible, of its foreign constituents—an object which is most perfectly attained by distillation. But for many of such objects water that has been boiled or filtered rain- or snow-water has been found sufficiently pure.

In a general way, water acts chiefly as a direct means of modifying the temperature of the body. But the mechanism by which the temperature is raised or lowered is identical with that which quickens or retards organic processes, for it is chiefly upon the degree of activity of the latter that the animal temperature depends. Water at a temperature higher than that of the body is a direct stimulant of the circulation, and therefore of all the functions; cold water, on the other hand, robs the body of a portion of its caloric, and therefore is a direct sedative of the circulatory and the other functions. But cold may indirectly become a stimulant of the animal functions, since it is a property of living organisms to react against whatever powerfully tends to depress them, and this the more vigorously and abruptly the depressing influence has been exerted. Therefore, cold applied to the body in a certain measure and for a given time produces a diminished activity of function, which is followed by a degree of activity greater than that which originally existed. In this manner the primary effect of heat and the secondary effect of cold resemble one another. But cold and heat are conventional terms; they do not designate definite temperatures. The normal animal temperature being about 98° F., whatever is higher than this may be described as heat, whatever is lower as cold. Hence different degrees of heat may be expected to produce different grades of effect, from a mild to a powerful stimulation, and even to the destruction of vitality; and in like manner coolness, cold, congelation, etc. are terms applied to the different degrees in which caloric has been abstracted. It is evident, therefore, that the action of water, and consequently its uses in medicine, will vary between very remote extremes—that it may stimulate moderately or violently, and soothe gently or depress more or less profoundly, according to the conditions which have been pointed out for illustration. The effects of cold water upon the living body are complex: they comprise the direct abstraction of caloric, the diminished production of it, and a multitude of reflex effects due to the relations between the skin and the internal organs. The loss of caloric by the contact of cold water with the skin is more or less completely balanced by the generation of caloric through the organic changes which are incessantly active in every tissue. Hence the interior of the body in health maintains a certain average temperature, or within two or three degrees of it, whatever may be the temperature of the surrounding medium. With the abstraction of caloric all the vital processes are depressed, the skin grows pale and shrivelled, and the internal organs are overloaded with blood; the pulse beats slowly, the secretions are diminished, and the muscles torpid. Taken internally, cold water occasions a sense of coolness in the throat and stomach, and afterward in the rest of the body; but if the water be very cold and taken in large quantity, it may produce in the stomach severe pains which radiate to the chest and abdomen and give a violent shock to the whole nervous system—effects which are accompanied by spasm or by collapse, or by both in succession. If these effects are not fatal, reaction, with fever, is apt to occur. The transient application of cold to the skin is so quickly followed by reaction that the effects seem to be those of direct stimulation; the cutaneous circulation becomes more active, a sense of warmth with gentle perspiration ensues, and through this reflux and flux of the blood and the excitation of the nervous system all of the functions are quickened. Indeed, it cannot, we think, be doubted that the chief value of cold water applied to the skin in disease consists not in its direct action as cold, but in its indirect action as a stimulant of all the functions. Yet the direct abstraction of caloric may in certain exceptional cases be useful. The local effects of cold water, as distinguished from those of cold applied in other ways, are essentially the same as those which have been described—viz. diminished circulation and calorification, followed by a more or less distinct reaction.

Medical Uses of Cold Water.—According, then, to the circumstances under which it acts, cold water may be refrigerant, excitant, sedative, astringent, tonic, debilitating, or perturbating. It may be used to check febrile and inflammatory processes, to stimulate a torpid and oppressed nervous system, to arrest spasm, to relieve congestion and pain, to abate excessive secretion, hæmorrhage, etc. Among the diseases in which it has proved most useful are *continued fevers*, in which the temperature is extremely high, and provided no intercurrent inflammation complicates them. Cold water in the form of douche, baths, sponging, and wet wrappings has been employed with decided benefit in many cases of *typhus fever*, *typhoid fever*, *scarlet fever*, *variola*, etc.; and the douche or other similar shock with cold water has proved curative in various forms of *intermittent fever*. It may be used in either of several conditions: (1) To reduce the hyperpyrexia; (2) to provoke a reaction in the rapidly adynamic forms of these diseases;

and (3) to lessen the delirium, stupor, and other cerebral and spinal symptoms which arise at the height of the attack. Of these the last is by far the most important in relation to the use of cold water. But apart from quite exceptional cases, all the benefits derivable from the cold immersion or the douche-bath may be obtained by simply sponging the skin repeatedly with cold water and giving cool water to drink as much as the patient desires or tolerates, for the use of cold water as a drink in fevers is prescribed by instinct as well as reason. The same is true of it in *inflammation of the stomach.* Pounded ice mixed with bran forms a most efficient poultice for *sore throat*, including *tonsillitis* and *diphtheria*, and its efficacy is increased by ice melting in the mouth. The same or any other convenient mode of applying cold has often been successful in preventing the formation of *abscesses*, mammary, inguinal, and others. The application of wet compresses around the inflamed joints in acute articular *rheumatism* has not produced the bad consequences which it was supposed would follow from a repercussion of the morbid fluxion, and such applications, when made with an alkaline liquid, have often proved extremely salutary. The general cold bath has been used in this disease with hyperpyrexia, but sometimes with the result of inducing inflammatory complications of the heart and lungs, and sometimes of causing death (*Practitioner*, x. 79; xi. 263). But in a certain number of cases of hyperpyrexia, with symptoms of cerebral rheumatism—a complication of the gravest description—cold baths have appeared to mitigate the gravity of the attack and bring about a cure (Woillez, *Bull. de thér.*, xcix. 344; Raynaud, *Arch. gén.*, Jan. 1881, p. 105). The average temperature of the baths used in these cases may be stated as 68° F., and the extremes as 60° F. and 75° F. On reviewing the cases the relation between the cerebral symptoms and the hyperpyrexia is far from being apparent, and the benefit derived from cold baths appears to have been due far more to the calming influence of the low temperature upon the nervous system than upon the mere abstraction of caloric. Cold water is one of the best applications for a variety of local inflammations, such as *burns*, *scalds*, *intertrigo*, and the *stings* of insects. Cold is one of the most potent means of arresting *hæmorrhage*, whether from the nose, lungs, stomach, bowels, or uterus, or from wounds. In such cases it should be applied as near as possible to the source of bleeding. In uterine hæmorrhage ice and iced water have been introduced into the uterus with complete success and without injury. *Scrofula*, *chlorosis*, and *anæmia* are diseases which have some elements in common, chief among which is impoverishment of the blood. Whether this condition be primary or secondary, the use of cold water internally and externally improves nutrition, and thereby tends more or less to moderate or to remove the defects of nutrition upon which the diseases depend. It is in this way—that is, by its direct stimulant and indirectly corroborant action—that cold water in the form of baths, and especially salt and surf baths, tends to remedy *nervous exhaustion* produced by mental or physical excesses. A state of debility, here as elsewhere, requires that so powerful an agent as this should be cautiously applied. In most of the diseases last referred to cold water is used as a stimulant or as an indirect agent for promoting perspiration, but in some others its aid is sought for its direct and continuous action in repressing vascular action and its consequences. Thus in all cases of *hyperæmia of the brain*, whether arterial or venous, the excitement of the one and the stupor of the other condition may be mitigated by cold water duly applied to the head. Irrigation with cold water, or the constant application of an ice-poultice to the scalp, with the hair closely clipped, and, still more powerful, the cold douche, will often succeed in allaying violent delirium or restoring consciousness in deep coma. *Insanity*, when acute and accompanied with heat of head, yields to the same method, especially if the body be at the same time immersed in a bath at 95° F. and the treatment be continued daily for several hours at a time. The same method is entirely applicable to the treatment of *mania-à-potu* in violent patients and for the relief of narcotism in *poisoning by opium.* In *sunstroke* the brain-symptoms appear to be due not only to an excess of blood within the cranium, but also to the excessive heat of the blood itself, which is denoted by a surface temperature of 109° to 111° F. Cold water and ice frictions appear to be the most successful, as they are plainly the most natural, remedies for this fatal affection.

Most of the spasmodic affections may be treated by cold water. *Hysteria* is favorably modified by cold bathing, as by all influences that strengthen the system generally and the nervous functions in particular. *Convulsions* of whatever sort, attended with fulness of the cerebral blood-vessels, should be treated by cold applications to the head and the nape of the neck; *coma* with stertor, and also spasms induced by anæsthetics in very nervous women, have been relieved by applying ice over the side of the neck, *Epilepsy* has been favorably affected by the use of ice-bags to the cervical spine, and *tetanus* of the idiopathic form has been repeatedly cured in ancient and in modern times by cold affusions. Even traumatic tetanus has got well under the direct application of ice to the spine. A number of cases of anomalous *paralytic* and *spasmodic* affections, caused by fatigue, fright, and other mental impressions, have been cured by a course of hydropathic regimen after the failure of other remedies (Friedmann, *Monthly Abst.*, vi. 540). *Chorea* was formerly treated by cold affusions on the spine and by the ice-bag, but the former was apt to affright the timid children who are most frequently affected with the disease, and the latter was difficult of application. Sulphuric ether applied to the spine in spray is perhaps more efficient, but is only palliative. Cold bathing, and especially sea-bathing, are of great value in this disease. Among diseases of the digestive organs amenable to treatment by cold water is *constipation*, as the oldest and most recent records demonstrate. It has often been employed successfully by causing the patient to walk upon a cold stone pavement, to have cold water dashed over the limbs, or to have it applied to the abdomen by means of wet compresses, while copious draughts of the same liquid were taken. The last-mentioned methods have been successfully employed to overcome the obstinate constipation of *lead colic*. Apparently hopeless *intussusception* of the bowel appears to have been overcome by large enemata of ice-water (Kormann, *Practitioner*, xxv. 212).

In surgery the applications of cold water are important and numerous. It is the most convenient as well as the most efficient remedy for *contusions*, including those to which a joint has been subjected by its *dislocation* or the soft parts by *fractures* of bones, etc. The full benefit of the treatment is best secured by its earliest possible application after the injury, for then it prevents the excessive exudations which embarrass and retard the cure. The utility and the mode of action of the remedy are just the same in the treatment of *wounds* which are not likely to unite directly or by the first intention ; and, indeed, even these heal more readily under its use, provided that the severed surfaces are maintained in close apposition ; while contused and lacerated wounds, whose union is usually hindered by inflammation, close all the more readily when this process is abated by cold water. The repressive action of cold water is well illustrated by its power of preventing the development of local non-traumatic inflammations, such as *boils*, *carbuncles*, *whitlows*, *acute orchitis*, etc. In all of these affections, if steadily maintained, it arrests their development, but its intermittent application is useless or worse. *Ulcers*, especially of an indolent and ill-conditioned sort, are often cured by cold and moisture combined, by which the nutrition of the part is rendered more active and normal. The water may be applied on compresses, by washing, and, above all, by the douche. The two former are the most appropriate for irritable, and the last for indolent, ulcers. The repressive power of cold water is well exhibited in the treatment of *burns* and *scalds;* provided that it be applied immediately after the injury and steadily kept in operation, it will tend to prevent ulterior changes of tissue dependent upon inflammation. The more extensive the injury the less appropriate does this method become. The strangulation of *hernia* is often due to a distension of the blood-vessels of the tumor, and in so far its reduction may be facilitated by whatever tends to disgorge the swelling of its blood ; cold water has proved efficient for this purpose in many cases. Even ice and freezing mixtures have been applied with the same object, but they are not free from the danger of producing mortification. In like manner, certain *venous dilatations* have been diminished, particularly those of the *rectum*, the *uterus*, and the *penis*. No better palliative for *hæmorrhoids* exists than frequent ablutions with cold water, especially after stool. It is most efficiently applied with a sponge. Acting in a similar manner, pellets of ice have been administered to produce contraction of the *œsophagus* above and around a *foreign body* impacted in it, and render the use of the probang more efficient (*Bull. de thérap.*, cii. 374). Ice has been extensively and efficiently employed to produce anæsthesia and local congelation, and facilitate the performance of many minor surgical operations, such as *opening abscesses*, *removing tumors*, *evulsion of toe-nails*, and even the destruction of *cancers* by chloride of zinc and their obliteration by systematic pressure (Arnott, *Times and Gazette*, 1879, i. 347, 396, 533). The hypodermic injection of cold water has been used as an anodyne in *neuralgia*, *toothache*, and *articular rheumatism*, and as a substitute for *morphia injections* where it was desired to cure the habit of using the latter. That the mitigation or the suspension of pain by this operation is real in many cases cannot be doubted, but it is almost certain that such relief is due, chiefly if not entirely, to expectant attention. (See *Med. News*, xii. 258, 361.) This opinion is strengthened by the fact that the effect has been obtained by the injection of warm as well as of cold water. Cold water or ice may be used to relieve various local pains, whether inflammatory or neuralgic. Abscesses are examples of the first, and neuralgia of the face is an instance of the second.

The internal use of cold water requires to be cautiously guarded; the risk of drinking it too freely when the system is exhausted by heat has been pointed out. It is not readily absorbed from the stomach in other atonic states of this organ, and if largely taken during or too near a meal it is very apt to interfere with digestion. It should not be used freely during pulmonary, and especially bronchial, inflammations, nor in diarrhœa. It is better tolerated and is often salutary in acute *dysentery.* Baths at a lower temperature than 50° F. are unsafe for children and old persons at all seasons, and when serious disease exists of any organ essential to life the temperature should not be lower than 75°. In any case cold baths should be of very short duration, and active exercise used during and after them. If local applications of cold water occasion chilliness, they should not be continued. Cold baths should not be taken immediately after a meal, nor when the air is chilly, nor when the mind is distressed. Early morning baths are invigorating, but cold baths before bedtime are of great utility in summer by rendering sleep sounder and more refreshing. In cold bathing the head should always be wetted before the rest of the body, and after the bath the skin should be stimulated by rubbing it with coarse cloths.

Local cold baths, applied to the head, the pelvis, and the feet, are employed to relieve congestion and stimulate the circulation in these parts, and thus prevent or remove the effects of vascular stagnation. Their sedative or their stimulant operation will be determined by their duration, the temperature of the water, the manipulations employed at the same time, etc. Cold water is often employed by *irrigation*—that is, by directing a stream of it over some portion of the body; in an *epithem* or mass of lint, sponge, or other porous material kept saturated with the liquid, or by means of pounded ice, which is sometimes mixed with nitrate of potassium and chloride of ammonium in order to form a freezing mixture; by *ablution*, which consists in applying cold water, with more or less friction, to the surface of the body in order to allay the heat of skin and promote diaphoresis in febrile states, etc.; by *affusion*, in which large quantities of cold water are poured over the body, previously washed or not with hot water and soap, by which means the functions of the skin are quickened and sometimes a salutary crisis is brought about. The *douche* is a form of affusion in which a continuous stream of water falls from a height upon the body, adding a mechanical stimulus to that produced by the cold water; the *shower-bath* is a modification of the same method, in which the stimulus is very gentle, and therefore adapted to persons who are comparatively feeble. The so-called *hydropathic* measures, which consist essentially in enveloping the body in wet wrappings, which are in turn surrounded by dry ones, while the patient drinks abundantly of cold water, have for their object the production of profuse perspiration, by means of which the blood may become purged of deleterious matters circulating with it. The purification may become general or be made local by restricting the application of wet compresses to the ailing parts. This last-named method is of very general application, and is useful in all injuries of joints and other local injuries, as well as in almost all internal inflammations, including those of the joints, lungs, and abdominal and pelvic viscera. The sweats produced by topical as well as by general wet applications have sometimes an offensive smell, which probably shows that effete, and therefore deleterious, substances are eliminated by means of them.

Physiological Action and Medical Uses of Warm Water.—Water of a higher temperature than that of the body may be applied in the form of vapor or of liquid. A vapor-bath at 120° F. may increase the pulse-rate to 145 or more, rendering the respiration difficult, causing hæmoptysis, producing fulness of the head, congestion of the brain, and even apoplexy. The more fully the atmosphere is charged with moisture, the greater is the suffering of the system in proportion to the elevation of the temperature, because the less caloric is lost by radiation; under the same circumstances, however, the body rapidly loses weight by perspiration. The internal secretions, and the urine particularly, are notably diminished. These conditions are carried to an extreme limit in the Russian vapor-bath, and are intensified by other methods of stimulating the skin, such as violent frictions and flagellation with slender softened rods. It has been found that a person unaccustomed to such baths may lose nearly a pound in weight by the operation of a single one. For domestic and medical purposes a vapor-bath may be constructed by merely surrounding the patient, seated in a chair, with a tent of blanket or other impermeable stuff and introducing steam within the enclosure. The head need not be included in the covering. Very soon active diaphoresis will commence. The vapor of warm water may also be diffused throughout an apartment by boiling a kettle or other convenient vessel or by slaking lime in the neighborhood of the patient. The latter expedient is to be recommended in cases of *membranous croup;* the others are usually employed in the treatment of acute and chronic muscular *rheumatism*, in chronic articular rheumatism and *gout*, and in cases of *paralysis* that require muscular stimulation. This vapor-bath is also beneficial in *dropsy*, especially when it is produced by cold and in the scarlatinous form; in *eruptive fevers* when the eruption is tardy and imperfect; in all chronic *diseases of the skin* in which the integument is torpid, dry, and hard; and in cases of profuse *sweating* due to a relaxed state of the skin.

As the capacity of water for caloric is three thousand times greater than that of air, the former is capable of producing the phenomena of heat much more energetically than the latter. When water warmer than the body (99° to 113° F.) is swallowed, it excites a local and diffusive warmth, quickens the pulse, and increases the perspiration and urine. The hotter the water the more decided are these effects. The *warm bath* (100° to 105°) tends to check exhalation from the parts of the body immersed, but increases it from the surface exposed to the air; but before this effect takes place the exposed parts become congested and a sense of fulness and discomfort is experienced in the head and face. The skin grows red, the pulse and respiration are quickened. Sweating follows the bath, especially if encouraged by warm bed-clothing, and there is a general sense of relaxation, and usually an inclination to sleep. The local action of water of the temperature mentioned is to relax the tissues and allow the blood to accumulate in them, thereby tending to withdraw it from remoter parts. Hence the utility of this measure in lessening *congestions* of the brain and other internal organs, and in relieving *pain*, *muscular spasm*, and *fever*. The greater the surface exposed to the action of the bath the more efficient is its operation, particularly in relaxing spasm and allaying internal pain, as is familiarly exhibited by the efficacy of this agent in cases of *dislocations of joints*, in *spasms* of the *gall-ducts*, *ureters*, *intestines*, *uterus*, etc. If the body, after the action of a hot bath, is subjected to the sudden contact of cold water, a reaction occurs which is usually accompanied with profuse perspiration.

The general warm bath is an important hygienic instrument, by means of which the skin is cleansed of its accumulation of effete secretions and its functional activity is augmented. It is also an almost indispensable agent in modifying the nutrition of the skin, and thereby promoting the cure of many *cutaneous diseases* in their chronic forms. Warm baths have long been used in the treatment of fevers, whether in the *eruptive fevers* in which the exanthem appears tardily or imperfectly, or in these and in *typhus* and *typhoid fevers* for the purpose of moderating delirium, diminishing stupor, or calming nervous symptoms, such as spasm, twitching, etc. It has even been claimed that when the last named of these fevers is treated by "permanent" warm baths the temperature is rapidly lowered, the course of the attack is shorter and milder, and the mortality is diminished (Reiss, *Zeitsch. f. klin. Med.*, iii. 389). If even these statements were accepted literally, the difficulties of employing the method, especially in diarrhœal affections, are sufficient to render it practically unavailable. It is one of the most efficient agents in the treatment of chronic *rheumatism*, especially in the form of sulphurous mineral waters. It is an important adjuvant in all the varieties of *albuminuria* and of *diabetes*. Prolonged warm baths are most efficient auxiliaries in all excito-motor derangements, but especially in *convulsion* and muscular *spasm*, and also in *insanity* of nearly every type. In certain cases of *paralysis*, and particularly in rheumatic paraplegia, the efficiency of the warm bath is sometimes remarkable. Its stimulant and revulsive operation is valuable in various intestinal disorders, and notably in *cholera infantum* and *acute dysentery*. Its depurative action is frequently available in *scrofula*, *chlorosis*, and constitutional *syphilis*. According to Mosler, enemata of hot water stimulate the discharge of bile in catarrhal *jaundice*. The hot bath tends to relieve extreme muscular exhaustion, and is available in cases of apparent death from *asphyxia*, *strangulation*, and *intoxication*, and when the new-born child fails to breathe, or does so imperfectly, owing to debility and not to cerebral congestion.

Partial warm baths are applied to the feet, the hips, and sometimes to the hands. Warm foot-baths (at about 98° to 100° F.) draw the blood away from the brain, and thereby promote sleep and relieve pain and congestion of the head and trunk. They are very efficient in arresting the formation of *coryza*, *sore throat*, *pulmonary catarrh*, *laryngitis*, especially of the spasmodic form, and muscular *rheumatism*, and in promoting the *menstrual flow*. If the water is hot enough to produce a painful impression on the skin, it stimulates the whole system, and is more apt to occasion a sense of fulness than relief, and to prevent sleep instead of promoting it. The warm hip-bath is used at about the same temperature (98° to 101° F.), and is especially adapted to allay painful *abdominal* and *pelvic disorders*, such as *biliary*, *renal*, and *uterine colic* and *strangury*, to relieve *reten-*

tion of urine, and bring on retarded *menses* and the *hæmorrhoidal flow*. Fomentations with warm water by means of cloths, sponges, spongio-piline, poultices, etc. may be regarded as partial warm baths, and are used to relieve the tension of the skin in local phlegmonous inflammations, and at the same time, by increasing the amount of blood in the part, to promote suppuration. Such fomentations of the mammæ favor the *secretion of milk*, and, through the sympathy of these glands with the uterine system, sometimes excite the *menstrual flow*. This last effect has been secured by prolonged injections of warm water into the vagina, which are also useful in recalling suppressed *lochia* and allaying pain in the pelvis. Enemas of warm water are habitually used to evacuate the bowels. It is alleged that irrigation of the rectum with water at from 100° to 110° F., and repeated every two hours during the active stage of *dysentery*, has a marked influence, not only in palliating the tenesmus, but in shortening the attack (Reid, *New York Jour. of Med.*, xxiv. 603). Warm sand- or mud-baths are often employed at thermal springs in the treatment of chronic *rheumatism*, *gout*, general *dropsy*, etc. Water so hot that its contact can just be borne without scalding is sometimes used to arrest certain inflammations in debilitated parts, such as *panaris*, *frost-bite*, the effects of *local contusions*, etc.; to arrest local *perspirations* and general *colliquative sweats;* to check *capillary hæmorrhage;* and to relieve various pains, such as *earache*, *toothache*, *neuralgia*, *colic*, *uterine pain*, etc. Its stimulant power is familiar in its arresting the bleeding from *leech-bites* and similar small wounds. Following a German method, Dr. F. H. Hamilton applied successfully, in the treatment of lacerated and contused *wounds*, local baths of warm water, and also fomentations of cotton batting soaked in water at 95° to 110° F. and renewed every half hour. Subsequently, he employed the same method successfully in arresting *traumatic gangrene* (*Trans. Med. Soc. of State of New York*, 1875 and 1879). Water at 160° F. has been used to check the capillary *hæmorrhage* which is apt to follow the removal of Esmarch's tourniquet. But Dr. C. T. Hunter has found that similar hæmorrhages are efficiently checked by water at 125° or 130° F. (*Phila. Med. Times*, x. 89). Hot-water injections have been used with prompt effect to arrest *uterine* hæmorrhage (Barker), and that variety of it produced by laceration of the cervix or hæmorrhage from a like injury of the vulva has been controlled by means of water at 110° to 115° F. A stream of such water directed upon the undilated cervix uteri at term will bring on *labor*, or thrown into the cavity of a relaxed and bleeding uterus will induce its contraction (A. H. Smith). In various inflammatory and congested states of the *eye* the stimulant action of hot water is at once the simplest and most efficient remedy. The water, it is recommended, should be as hot as the patient can comfortably bear with the hand, and should be applied by drenching or by being thrown against the eye with the hand while the face is bent over a basin containing the water. This operation should be repeated every hour or two or only two or three times a day, as may be required (Connor, *Am. Jour. of Med. Sci.*, Oct. 1881, p. 466). Still better, the face may be immersed in the water while the eye is kept open. According to Pétrequin, warm water is a better solvent for *cerumen* than oil, glycerin, etc. Boiling water may be employed to produce a powerful stimulant or revulsive action, as in cases of *asphyxia* and prolonged *syncope*. Its use requires great caution, and is not as safe as the application of a hammer or similar metallic instrument previously immersed in boiling water.

AQUÆ MEDICATÆ.—Medicated Waters.

Aquæ destillatæ, P. G.; *Aquæ stillatitiæ.—Distilled waters*, E.; *Eaux distillées*, *Hydrolats*, Fr.; *Destillirte Wässer*, G.

Preparation and Properties.—The above names are applied to waters which have been impregnated with volatile substances. All odorous plants and parts of plants impart their odor, and to a certain extent also their taste, to water which is distilled therefrom. This is due to a considerable extent to the volatile oils passing over with the vapor of water; but in many instances the flavor of such distilled waters differs more or less from that of the aqueous solutions of the corresponding volatile oils, and we must therefore assume that besides the volatile oils other volatile compounds, acids, and probably ethers, pass over and remain dissolved in the water, whereby the flavor is modified and nearly always becomes more agreeable. In preparing medicated waters distillation should be resorted to whenever practicable.

The drugs are preferably used in the fresh state if they can be thus obtained, since during the drying process more or less of the volatile constituents are lost by evaporation, and, in common with the others, often modified in composition. In some cases where the oil-cells are well protected, as in cinnamon-bark, or the oil is produced only by contact with water, as in bitter almonds, the material may be preserved in the dry state for a long time without deterioration. In all cases where the oil-cells are not situated on the surface, as they are in many leaves, the drug should be suitably comminuted, so that it may be easily penetrated by the hot water and the oil-cells ruptured.

In distilling medicated waters over a naked fire great care should be taken to prevent the material from being burned, otherwise an empyreumatic odor and taste will be imparted to the distillate; this is obviated by placing the drug upon a diaphragm, or setting within the still another vessel perforated on the sides and bottom, so that the vapors will pass through it without unnecessary obstruction. If steam is used the danger of burning is avoided; in this case a jet of steam may be conducted to the bottom of the still, the contents of which are thereby heated to the boiling-point. If dry material is used, allowance must be made for its swelling on becoming thoroughly permeated by the water, as it might otherwise fill the still and pass into the condenser. Some materials when boiled in water foam considerably, and portions of the decoction are then apt to be carried over mechanically, rendering the distillate colored and otherwise impure. This tendency to foam over will be lessened by adding to the contents of the retort a small quantity of a fixed oil.

The rapidity with which medicated waters are distilled is of importance, since it has a considerable influence on their flavor and stability. In all cases the waters should be rapidly and thoroughly cooled in the condenser, to prevent the action of the hot water and of the acids which are frequently present upon the tin, and to avoid changes in the volatile oil, which, in its finely-divided condition, are apt to occur. Waters which have been insufficiently cooled very frequently become ropy in keeping. It is advisable, therefore, to distill them slowly and cool the condenser well with a sufficient supply of water.

A peculiar odor is observed in some waters immediately after they have been distilled from tin vessels or condensed in tin worms, but not when glass vessels have been used. If the waters are exposed to the air in loosely-closed vessels for a few days, this still-odor disappears and the natural odor of the water becomes apparent.

Distilled waters which, like orange-flower water, are not completely saturated with volatile oil, are advantageously prepared of double or triple the officinal strength, either by distilling off only one-half or one-third of the necessary quantity of water, or by having recourse to the process of cohobation, in which case the proper quantity of water is distilled off and a second or third time distilled from fresh portions of the same material. When wanted for use they are diluted with distilled water in the proper proportions. The German Pharmacopœia (1872) directed *concentrated medicated waters* to be prepared of German chamomile, melissa, sage, elderflowers, and linden-flowers, by distilling from 10 parts of the drugs 100 parts of water, adding to the distillate 2 parts of alcohol, and again distilling 10 parts. For use 1 part of these waters was diluted with 9 parts of distilled water.

Distilled waters are best preserved in well-corked bottles, which should be completely filled and protected from the light. Exposed to air and light, they gradually turn sour and lose their agreeable odor.

The U. S. Pharmacopœia allows most medicated waters to be prepared by dissolving the volatile oil in distilled water. To facilitate the solution the oils are now directed to be thoroughly distributed through double the weight of absorbent cotton by gradually adding the oil and picking the cotton apart after each addition; this is a somewhat laborious operation, which is perhaps best facilitated by combing or carding the cotton. When uniformly impregnated the cotton is firmly packed in a glass funnel and exhausted by percolating distilled water through it. The division of the volatile oils was formerly accomplished by triturating them with carbonate of magnesium; but a minute quantity of this salt is always dissolved and the acids which may be naturally contained in the oils are neutralized. In some cases, as in cinnamon-water, a yellow or brownish color is also produced. One of the most important objections to the use of magnesia or magnesium carbonate is found in the action upon the salts of poisonous alkaloids and metals, which are decomposed thereby, with the precipitation of the alkaloids or metallic oxides, unless some acid be added to neutralize the magnesia (T. H. Powers, 1833). Other substances which are completely insoluble in water have been recommended for this purpose, such as powdered silica, kaolin, glass, pumice-stone, paper-pulp, calcium phosphate, and purified animal charcoal. G. G. Percival recommends the dissolving of the volatile oils directly in hot distilled water, and filtering after cooling, whereby a strong and otherwise pure medicated water is obtained.

Tests for Purity.—Medicated waters should evaporate in a clean porcelain capsule without leaving any appreciable residue. The water should not acquire a brown or black color by sulphuretted hydrogen or sulphide of ammonium (metals), or yield with the latter a white sediment, after having been previously rendered alkaline by the addition of ammonia (zinc).

AQUA AMMONIÆ, *U. S.*—Water (Solution) of Ammonia.

Liquor ammoniæ, Br.; *Liquor ammonii caustici*, P. G.; *Spiritus salis ammoniaci causticus, Ammonia aqua soluta.—Ammoniaque liquide, Eau (Solution, Liqueur) d'ammoniaque*, Fr.; *Salmiakgeist, Aetzammoniak, Ammoniak-Flüssigkeit*, G.

An aqueous solution of ammonia having the specific gravity 0.959 (*U. S., Br.*), 0.960 (*P. G.*), and containing 10 per cent. by weight of the gas.

Stronger water of ammonia has the specific gravity 0.891 (*Br.*), 0.900 (*U. S.*), and contains 32.3 (*Br.*), 28 (*U. S.*) per cent. by weight of the gas.

Formula of ammonia gas NH_3. Molecular weight 17.

Production.—Ammonia is produced during the putrefaction of all organisms and of many organic compounds containing nitrogen; it exists in the air and in the soil in the free state, mostly in combination with acids in the air, as carbonate and nitrite. Ammoniacal salts are met with in most plants and animals. The products of the dry distillation of many nitrogenated compounds contain ammonia, and it is from such a source—namely, from the so-called gas-liquor, a by-product of the manufacture of illuminating gas—that ammoniacal salts are principally obtained. (See Ammonii Chloridum and Ammonii Sulphas.)

Preparation.—1. Ammonia-Water. Take of Chloride of Ammonium in small pieces, Lime, each 12 troyounces; Water 6 pints; Distilled Water a sufficient quantity. Pour a pint of the water upon the lime in a convenient vessel, and after it has slaked stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the water and mix the whole thoroughly together. Decant the milky liquid from the gritty sediment into a glass retort of the capacity of 16 pints, and add the chloride of ammonium. Place the retort on a sand-bath and adapt to it a washing-bottle, previously connected with a two-pint bottle, by means of a glass tube reaching nearly to the bottom of the bottle, containing a pint of distilled water. Surround the bottle with ice-cold water and apply heat, gradually increased until ammonia ceases to come over. Remove the liquid from the bottle, and add to it sufficient distilled water to raise its specific gravity to 0.960. Lastly, keep the liquid in small bottles, well stopped.—*U. S.*, 1870.

According to the British Pharmacopœia, 1 pint of strong solution of ammonia is mixed with 2 pints of distilled water.

2. Aqua Ammoniæ Fortior, *U. S.;* Liquor ammoniæ fortior, *Br.*—Stronger water (Strong solution) of ammonia, *E.;* Eau d'ammoniaque forte, *Fr.;* Starker Salmiakgeist, *G.* Take of Chloride of Ammonium in coarse powder 3 pounds; Slaked Lime 4 pounds; and Distilled Water 32 fluidounces. Mix the lime with the chloride of ammonium, and introduce the mixture into an iron bottle placed in a metal pot surrounded by sand. Connect the iron tube, which screws air-tight into the bottle in the usual manner, by corks, glass tubes, and caoutchouc collars, with a Woulf's bottle capable of holding a pint; connect this with a second Woulf's bottle of the same size; the second bottle with a matrass of the capacity of 3 pints, in which 22 ounces of the distilled water are placed, and the matrass, by means of a tube bent twice at right angles, with an ordinary bottle containing the remaining 10 ounces of distilled water. Bottles Nos. 1 and 2 are empty, and the latter and the matrass which contains the 22 ounces of distilled water are furnished each with a siphon safety-tube charged with a very short column of mercury. The heat of a fire, which should be very gradually raised, is now to be applied to the metal pot, and continued until bubbles of condensable gas escape from the extremity of the glass tube which dips into the water of the matrass. The process being terminated, the matrass will contain about 43 fluidounces of strong solution of ammonia.

Bottles 1 and 2 will now include, the first about 16, the second about 10 fluidounces, of a colored ammoniacal liquid. Place this in a flask closed by a cork which should be perforated by a siphon safety-tube containing a little mercury, and also by a second tube bent twice at right angles and made to pass to the bottom of the terminal bottle used in the preceding process. Apply heat to the flask until the colored liquid it contains is reduced to three-fourths of its original bulk. The product now contained in the terminal bottle will be nearly of the strength of solution of ammonia, and may be made exactly so by the addition of the proper quantity of distilled water or of strong solution of ammonia.—*Br.*

When ammonium salts are treated with the hydrate of a metal of the alkalies or alkaline earths, the corresponding salts of the metals are formed and ammonia and water are set free. In both the above processes chloride of ammonium and hydrate of calcium are used, the reaction resulting in the production of calcium chloride, ammonia, and water, as follows: $2NH_4Cl + Ca2HO$ yields $CaCl_2 + 2NH_3 + 2H_2O$. But while the two processes are identical as far as the chemical reaction is concerned, they differ very considerably in the manipulation. In the first process the materials react upon each other in the presence of much water, resulting, even at the ordinary temperature, in the liberation of much ammonia, and permitting the completion of the process, including the disengagement of the ammonia, at the boiling temperature and in glass retorts. It is important to heat the mixture gradually, so that much of the gas may be given off before the boiling temperature is reached. A rapid heating is apt to cause the extrication of the gas with such violence that the contents of the retort will boil over.

In the British process the materials act upon each other in the dry state, requiring a higher heat, and, in consequence thereof, the employment of an iron retort. This process is mostly followed in the preparation of ammonia on the large scale, when sulphate of ammonium is often substituted for the chloride on account of the cheapness of the former salt. The dry process necessitates greater care in the purification of the gas, which is indicated already by the dark color acquired by the liquid in the wash-bottle. The impurities in the gas are chiefly decomposition-products, resulting from the impurities contained in the ammonia salt and lime. Although the latter is used in excess, carbonate of ammonium may form either from calcium carbonate possibly present or from the decomposition of organic matter. If the wash-bottle is charged with milk of lime, the organic decomposition-products are better retained, and any carbonate of ammonium contained in the gas will be decomposed, yielding ammonia and carbonate of calcium. In preparing ammonia on the large scale it is advantageous to connect the wash-bottle with a series of stoneware receivers shaped like Woulf's bottles, so that the gas which is not absorbed in the first will pass into the second receiver, and so on.

The employment of a considerable excess of hydrate of calcium has been found advantageous to ensure the complete decomposition of the ammonium salt. On account of this excess the residue in the retort will contain a basic calcium chloride having the composition $CaCl_2.3CaO$, which, after having been filtered from the lime, may be neutralized by hydrochloric acid and evaporated to dryness, to be utilized as chloride of calcium.

On the large scale ammonia-water is usually made with common water, the natural impurities of which it contains, together, frequently, with notable quantities of iron derived from the iron delivery-tubes employed. Chemically pure ammonia-water may be obtained from this by heating it, or, preferably, the commercial stronger ammonia-water, in a glass flask or retort, and conducting the gas, a considerable amount of which is evolved below the boiling-point of water, by means of glass tubes, into distilled water.

Gaseous ammonia is obtained by passing the gaseous products in the above processes over dry potassa or calcium chloride.

Properties.—1. GASEOUS AMMONIA. Ammonia is a colorless gas having a strong penetrating odor and an acrid alkaline taste. It has the specific gravity 0.593. By a pressure of seven atmospheres at 15° C. (59° F.), or when cooled to $-40°$ at the ordinary atmospheric pressure, it condenses into a colorless liquid much lighter than water, which boils a few degrees above this temperature and crystallizes when placed in a mixture of solid carbonic acid and ether at about $-75°$ C. ($-102°$ F.).

2. AMMONIA-WATER.—The aqueous solutions of ammonia constitute colorless, transparent liquids possessing the odor and taste of the gas, being lighter than distilled water and having a lower freezing-point than this liquid. They impart a brown color to turmeric-paper, a blue color to red litmus-paper, and a green color to the juice of violet-flowers, and evolve dense white fumes when a glass rod moistened with hydrochloric or acetic acid is held over the liquid. Ammonia neutralizes all acids, forming salts which are mostly colorless and crystallizable, possess a sharp saline taste, and when heated to redness are entirely volatilized, without leaving any residue unless the acid be non-volatile; even the solutions of most ammonium salts, when evaporated or heated to boiling, lose a portion of the ammonia. For the neutralization of 8.5 Gm. of ammonia-water 50 Ccm. of the

volumetric solution of oxalic acid should be required (*U. S.*, *Br.*) or 23.5 Ccm. of volumetric hydrochloric acid for 4 Gm. of ammonia-water (*P. G.*).

3. Stronger Ammonia-water.—It has the properties of ammonia-water, from which it differs chiefly in specific gravity and greater strength. To neutralize 3.4 Gm. of it should require 56 Ccm. of the volumetric solution of oxalic acid (*U. S.*). 5.23 Gm. require 100 Ccm. (*Br.*), corresponding, the former to 28 per cent., the latter to 32.3 per cent., NH_3.

The following table gives the specific gravities of ammonia-waters of different strengths at 14° C. (57.2° F.), as ascertained by Carius, 1856:

Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.
36	0.8844	27	0.9052	18	0.9314	9	0.9631
35	0.8864	26	0.9078	17	0.9347	8	0.9670
34	0.8885	25	0.9106	16	0.9380	7	0.9709
33	0.8907	24	0.9133	15	0.9414	6	0.9749
32	0.8929	23	0.9162	14	0.9449	5	0.9790
31	0.8953	22	0.9191	13	0.9484	4	0.9831
30	0.8976	21	0.9221	12	0.9520	3	0.9873
29	0.9001	20	0.9251	11	0.9556	2	0.9915
28	0.9026	19	0.9283	10	0.9593	1	0.9959

Tests.—The solutions of ammonium salts yield orange-colored crystalline precipitates with platinum chloride, and, if not too dilute, white ones with tartaric acid or acid tartrate of sodium. The most delicate tests for ammonia are those of Einbrodt (1852) and of Nessler (1856). *Einbrodt's reagent* is an aqueous solution of corrosive sublimate, rendered slightly alkaline by the addition of a minute quantity of potassium carbonate. The test is applied to an alkaline solution, or if the solution has an acid reaction it should be rendered faintly alkaline by the addition of potassa or soda, when the test-liquid will produce a white cloudiness if only $\frac{1}{500000}$ of ammonia is contained in the solution.

Nessler's reagent is a solution of iodo-hydrargyrate of potassium, made either by saturating a solution of potassium iodide with mercuric iodide, and rendering this alkaline by potassa, or it is prepared from potassium iodide and mercuric chloride. (See Hydrarg. Iodidum Rubrum.) With solutions of ammonia or ammoniacal salts it gives a brown-red precipitate, or if very dilute an orange color. It may be used for the quantitative determination of minute quantities of ammonia by diluting the liquid so far that with Nessler's solution only an orange tint is produced, which is compared with that obtained from a solution of ammonium chloride of known strength by diluting the latter until the same coloration is produced with the test liquid.

Tests of Purity.—Water of ammonia should evaporate at the temperature of boiling water without leaving any residue (salts). On being neutralized with an acid no empyreumatic odor should be observed. It should not yield a precipitate with lime-water (carbonate), with oxalate of ammonium (calcium), or, either before or after neutralizing by means of nitric acid, with sulphuretted hydrogen. After acidulation with nitric acid it should not be precipitated by nitrate of silver (chloride, etc.) or nitrate of barium (sulphate). A faint cloudiness is permitted on mixing ammonia-water with five times its volume of lime-water, indicating a minute trace of carbonate.

Pharmaceutical Uses and Preparations.—Ammonia-water is extensively employed as a precipitant in the manufacture of most alkaloids, of phosphate of calcium, hydrate of iron, and purified chloride of ammonium; it is used for nearly neutralizing solutions in preparing digitalin and subcarbonate and subnitrate of bismuth, and as a solvent for impurities in the process for santonin. Combined with citric acid as ammonium citrate, it acts as a solvent for certain salts of iron and bismuth which are insoluble in water; it is employed in the preparation of benzoate, phosphate, and citrate of ammonium and of hydrargyrum ammoniatum, and forms an ingredient in the following officinal preparations:

1. *Stronger ammonia-water:* Spiritus ammoniæ, *U. S.;* Linimentum camphoræ comp., Spiritus ammoniæ aromaticus, Spir. ammon. fœtidus, Tinct. opii ammoniata, *Br.*

2. *Ammonia-water:* Linimentum ammoniæ, *U. S.*, *Br.;* Linim. hydrargyri, *Br.;* Spir. ammon. aromat., *U. S.;* Tinct. quiniæ ammoniata, *Br.*

Physiological Action.—The vapor of ammonia causes plants to fade and shrivel and asphyxiates animals immersed in it. Caustic water of ammonia given to animals occasions distress, frequent pulse and respiration, prostration, and rigid spasm before death. The gastro-intestinal mucous membrane is injected, softened, and covered with bloody mucus, while the blood in the vessels coagulates imperfectly and its corpuscles are disintegrated. It does not appear to increase the alkalinity of the blood or of the secretions, and it is found in the urine oxidized. When ammonia-water is injected into the veins of an animal exhausted by loss of blood and exposure of the viscera, and the congested heart has almost ceased to beat, immediately the heart resumes its action and normal color and the aorta is filled with bright-colored blood (Griswold, *Med. Record*, xv. 532). Applied to the human skin, caustic ammonia excites a sense of warmth, followed by burning pain and more or less vesication, or, if the application be excessive and prolonged, by gangrene of the part. Blisters caused by ammonia are very painful and slow to heal. Ammoniacal vapors in contact with the eye occasion severe pain and inflammation. Inhaled through the nose, they produce sneezing, lachrymation, and burning. In the air-passages they excite violent irritation unless greatly diluted, and if inhaled during a state of insensibility fatal asphyxia may result. The passage of the vapor through the mouth under such circumstances may produce severe inflammation of its lining membrane. Internally, its action upon the healthy system is slight and transient, but in states of nervous exhaustion it is very prompt and distinct. A sense of tension in the temples, exhilaration of the feelings, a consciousness of increased strength, greater warmth of the skin, and an augmented secretion of sweat, urine, and bronchial mucus, are among its most sensible effects, which are not, as in the case of alcohol, followed by a corresponding depression. The action of large doses is not uniform. Sometimes death follows in a few minutes, with symptoms of cauterization of the fauces and larynx, sometimes later with those of gastro-enteritis, accompanied or not with delirium, stupor, and spasm. A drunkard, having swallowed nearly 2 fluidounces of "aqua ammoniæ," survived 4¼ days (*Boston Med. and Surg. Jour.*, Aug. 1880, p. 166). After death may be found inflammation and œdema of the fauces and larynx, sometimes of the bronchia also, and generally of the œsophagus, stomach, and small intestine. The mucous membrane may even look charred. In other cases, in spite of large doses of the poison and violent symptoms denoting local irritation and nervous exhaustion, the patients recover, although it may be after a long time.

Medical Uses.—*Externally*, ammonia is commonly employed both as an ingredient of stimulating liniments and as a caustic. Under the first-named form it is a very popular palliative for the pains of muscular *rheumatism*, *neuralgia*, *muscular spasms*, etc., and for relieving *congestions*, particularly of the *larynx*, lungs, *throat*, and bowels. In the latter its greatest utility is limited to the first period of the attack. In neuralgia its caustic is more important than its stimulant action, and is best secured by vesicating the skin wherever the affected nerve is found to be tender, either at its point of emergence from bones, muscles, etc. or where it is ultimately distributed to the skin. The vesication must be superficial for superficial nerves, and deeper for profound ones. It is best effected by saturating a disk of cloth with ammonia, applying it accurately to the skin, and holding it there, covered with some solid substance, until vesication has been accomplished. A salt of morphia dissolved in the ammonia used renders the relief more certain. *Amenorrhœa* has been successfully treated by vaginal injections of a weak solution of ammonia, and the same is true of vaginal *leucorrhœa*. Other cases in which the local substitutive irritation of ammonia is available are—a tendency to *amaurosis* from exhaustion of the retina, in which case the vapor may be cautiously allowed to come in contact with the conjunctiva; superficial *burns* and *frost-bite;* and a general exhaustion or depression of the nervous system in *low fevers*, when a weak solution of ammonia in hot water may be applied by sponging to the whole skin. Ammonia enters into most of the liniments and washes that are used to prevent the *hair* from falling out or to stimulate its growth. *Vulvar pruritus* is said to be benefited by vaginal injections consisting of half a fluidrachm or more of stronger water of ammonia in half a pint of common water. This may possibly be true of pruritus connected with amenorrhœa, but the remedy is useless in most of the other forms, except as a very transient palliative.

By inhalation the vapor of ammonia has been used to arrest the development of catarrhal affections of the throat and air-passages (*bronchitis*, *coryza*, and *pharyngitis*). It is recommended to employ a weak solution. The most successful application of this method is, perhaps, to chronic dryness of the *pharynx* and to chronic *hoarseness*. It has been used as an antidote to *chlorine* and to *bromine*. *Acidity* of the stomach from feeble digestion is benefited by this medicine, and so is the *tympanites* which is often associated with it. In two affections in which spasm of the larynx is a more or less prominent symptom, *whooping cough* and *epilepsy*, the inhalation of ammoniacal fumes has been known to delay or prevent the paroxysm. The same means are popularly employed to relieve *syncope* from all causes, and also the various conditions which lead to it and to which nervous women are subject. Hence it is the basis of most of the "smelling-salts." It may be cautiously used in all cases of suspended animation, whether from syncope or *asphyxia*. It is, if promptly employed, an antidote to *hydrocyanic acid* and to *alcoholic intoxication*. The best mode of administering it in the former case is by intra-venous injection. For this purpose the officinal ammonia-water, which is a 10 per cent. solution, is diluted with an equal quantity of pure water, and about a fluidrachm at a time is cautiously injected. The revival of the insensible and apparently lifeless patient is usually very prompt. (Compare *Glasgow Med. Jour.*, iv. 493; *Lancet*, 1879, p. 158; *Med. Record*, xv. 532.) This expedient has been employed successfully in poisoning by privy-gas (*Boston Med. and Surg. Jour.*, Sept. 1882, p. 309). Locally applied, ammonia-water relieves the pain of the stings and bites of *bees*, *wasps*, *spiders*, *mosquitoes*, etc., and a large amount of evidence exists to prove its antidotal power against the bites of *serpents*, both when administered by the stomach and when injected into the veins. The latter method is alleged to be by far the most efficient. The median-cephalic vein is the one generally selected for the operation, and from 5 to 20 drops of strong solution of ammonia in a fluidrachm of water are thrown into the vein with a hypodermic syringe. The clinical facts relied upon for establishing the efficacy of the method are numerous, but the experiments on animals by Fontana in the last century and by some recent observers gave only negative results (*Times and Gaz.*, Dec. 1873, p. 712; *Lancet*, Sept. 19, 1874). Ammonia has been administered in large doses for the purpose of causing *resolution of fibrin* in the right side of the heart and in the great vessels. In three out of four cases the treatment was apparently successful. It is found experimentally that ammonia mixed with blood preserves it fresh and fluid for a long time (Richardson).

Administration.—The dose of water of ammonia is from 10 to 30 drops (Gm. 60–2.00), largely diluted. The stronger preparation is for external use. It may be applied to the skin on some porous tissue saturated with it and covered with an impermeable substance. In from 3 to 10 minutes the desired effect may be expected. Gondret's paste is formed by adding concentrated water of ammonia to a mixture of melted lard and tallow. It may be applied in a disk-shaped layer an inch or two in diameter. It is apt to cauterize the skin too deeply. As a rubefacient ammonia is generally associated with oil or some unctuous substance, and should be applied with gentle friction to the skin.

As an *antidote* any mild vegetable acid (vinegar, lemon-juice) may be employed to neutralize the uncombined ammonia in the stomach. The local irritant effects require demulcent and protective remedies.

AQUA AMYGDALÆ AMARÆ, *U. S.*—BITTER-ALMOND WATER.

Aqua amygdalarum amararum, P. G.—*Eau d'amandes amères*, Fr.; *Bittermandelwasser*, G.

Preparation.—Oil of Bitter Almonds 1 part (11 grains); Distilled Water 999 parts (25 oz. av. or 24 fluidounces); to make 1000 parts. Dissolve the oil in the distilled water and filter through a well-wetted filter.—*U. S.*

Made by this process, bitter-almond water is a very unreliable preparation, owing to the variable amount of hydrocyanic acid contained in the oil of bitter almonds. The following will yield a water of definite strength in hydrocyanic acid; and since in this form the latter is scarcely prone to decomposition, such or a similar preparation deserves to take the place of the officinal hydrocyanic acid and of the present bitter-almond water (see *Amer. Jour. of Pharmacy*, 1874, p. 217):

Bruise Bitter Almonds 12 parts, and express as much fixed oil as possible without the aid of heat. Powder the press-cake, mix it thoroughly with water 80 parts and alcohol 1 part, macerate for 12 hours; distil off 11 parts into a receiver containing alcohol 1 part; determine the amount of hydrocyanic acid in the distillate, and then dilute with a mixture of alcohol 1 part and distilled water 5 parts, so that 1000 parts of the mixture contain 1 part of hydrocyanic acid.

Thus prepared, bitter-almond water is nearly clear, and has a strong odor of hydrocyanic acid and oil of bitter almonds, the latter remaining after the hydrocyanic acid has been removed by means of nitrate of silver.—*P. G.*

In making bitter-almond water by the latter process the fixed oil is removed, because it hinders the reaction between the amygdalin and emulsin, to complete which maceration of the expressed almonds with water for about 10 or 12 hours is advisable at a temperature of about 30° or 35° C. (86° or 95° F.). The almond mixture is then placed upon a perforated diaphragm and heat applied to the still. Pettenkofer's process, which has been adopted by the Austrian Pharmacopœia, differs in this: that 11 parts of the powdered bitter almonds are twice mixed with hot water and boiled to dissolve the amygdalin; the expressed decoctions, when cold, are mixed with 1 part of powdered bitter almonds, macerated and distilled as before; the emulsin contained in 1 part of the almond is sufficient to decompose the whole of the amygdalin, and, there being only a small amount of insoluble matter in the still, the distillation proceeds without difficulty even over a naked fire.

When the requisite quantity of water has distilled over, 27 Gm. of the distillate are diluted with 54 Gm. of distilled water, mixed with sufficient magnesia, previously rubbed with water, to render it milky, and with a few drops of solution of potassium chromate; decinormal (volumetric) solution of nitrate of silver is then added until the red color produced by the latter ceases to disappear on stirring; each Ccm. of the silver solution represents .01 per cent. of HCy. A bitter-almond water containing .1 per cent. of hydrocyanic acid will require 10 Ccm. of the silver solution. The strength may also be determined gravimetrically by adding to 1000 grains of the water first a little ammonia, then a slight excess of nitric acid, and finally solution of silver nitrate until a precipitate ceases to appear; this, when washed and dried, should weigh exactly 5 grains; if it weighs more the distillate must be diluted; should it weigh less, which may happen if the almond-powder has not been macerated with water or if the bitter almonds have been mixed with sweet almonds, it is best to redistil the water, adding, if necessary, some common water to the retort, and recovering a quantity calculated beforehand from the weight of the precipitate.

This bitter-almond water has exactly one-twentieth the strength of the diluted hydrocyanic acid, but is much stronger than that of the U. S. Pharmacopœia, the latter corresponding perhaps better with the *Aqua amygdalarum amararum diluta* (vel *Aqua cerasorum*) which the German Pharmacopœia (1872) prepared by mixing 1 part of the above almond-water with 19 parts of distilled water. If the oil of bitter almonds has been previously deprived of its hydrocyanic acid, the bitter-almond water prepared from it will possess no virtues except for imparting flavor.

Medical Action and Uses.—This uncertain—and unsafe as well as uncertain—preparation, as directed by U. S. P., is not officinal in the British Pharmacopœia. If hydrocyanic acid must be given internally, it may be administered with less risk in the form of cyanide of potassium. The dose of the concentrated German preparation is from 20 to 50 drops (Gm. 1–3), and of the diluted preparation of the same Pharmacopœia, as well as of the American, is 1 or 2 teaspoonfuls (Gm. 4–8).

AQUA ANETHI, *Br.*—DILL-WATER.

Eau d'aneth, Fr.; *Dillwasser*, G.

Preparation.—Take of Dill-Fruit bruised 1 pound; Water 2 gallons. Distil 1 Imperial gallon (= 10 pounds).—*Br.*

The water, which is at first slightly milky if prepared by this process, possesses the odor and taste of dill-fruit.

Medical Uses.—It does not increase the lacteal secretion, but imparts to it an aromatic flavor, which renders its administration in this way convenient in cases of infantile *colic*. It, however, has no advantage in taste or action over anise-water, which it in all respects resembles. It is seldom used in this country.

AQUA ANISI, *U. S., Br.*—ANISE-WATER.

Eau d'anis, Fr.; *Aniswasser*, G.

Preparation.—Oil of Anise 2 parts (22 grains); Cotton 4 parts (44 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av. or 24 fluidounces). Add the oil to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack it firmly in a conical percolator and gradually pour on distilled water until 1000 parts of percolate are obtained.—*U. S.*

Anise-fruit bruised 1 pound; Water 2 gallons. Distil 1 Imperial gallon (= 10 pounds).—*Br.* Distilled from the fruit, anise-water has a more pleasant odor and taste than that made from the oil.

Medical Action and Uses.—Anise-water is an agreeable and useful vehicle for medicines intended to expel *flatus* and to allay *colic* and the pain of laborious digestion. It is often used to mitigate the *griping* of senna, rhubarb, jalap, and other purgatives, and as a suitable vehicle for magnesia. It is thought also to be an appropriate excipient for expectorant medicines. *Dose*, a fluidrachm (Gm. 4) and upwards.

AQUA AURANTII FLORUM, *U. S.*—ORANGE-FLOWER WATER.

Aqua aurantii floris, Br.; *Aqua florum aurantii*, P. G.; *Aqua florum naphæ.—Eau (Hydrolat) de fleur d'oranger*, *Eau de naphe*, Fr.; *Orangenblüthenwasser*, G.

Preparation.—Recent Orange-flowers 40 parts (40 oz. av.); Water 200 parts (200 oz. av. or 12 pints); to make 100 parts (100 oz. av. or 6 pints). Mix them, and by means of steam distil 100 parts. Keep the product in well-stopped bottles, excluded from light.—*U. S.*

The French Codex directs the distillation, by means of steam, of twice the weight of the fresh orange-flowers used. Thus prepared, it is called in commerce *double orange-flower water*, and if it is diluted with its own weight of distilled water it is known as *simple orange-flower water*. The so-called *triple* and *quadruple orange-flower waters* are also met with in commerce, the former being obtained by distilling 3 parts, the latter by distilling 2 parts, of water from 2 parts of fresh orange-flowers.

Distilled orange-flower water is a clear and colorless or slightly opalescent liquid of a very agreeable odor and aromatic taste, which cannot be imitated by preparing the water from the oil of orange-flowers (neroli). As distilled from the flowers, it possibly contains some volatile ethers, which are freely soluble in water and not contained in the volatile oil. The Pharmacopœia process, however, is of practical value only to those pharmacists who are fortunate enough to be able to procure the recent flowers; if preserved by the addition of one-half their weight of table-salt, 60 (instead of 40) parts should be used. Occasionally, commercial orange-flower water has separated mucilaginous flocks, which may be removed by agitation with powdered kaolin and filtration. If it has acquired an acid reaction it is advisable to distil it over magnesia. The total absence of metallic salts, resulting from the use of a metallic condenser or from keeping the water in metallic vessels, is proved by its remaining unaffected by hydrosulphuric acid and by sulphide of ammonium. Occasionally distilled orange-flower water has been met with which acquires a red color on the addition of an acid; the cause of this abnormal behavior has not been ascertained, but may perhaps be due to some accidental impurity.

Pharmaceutical Uses.—It forms the base of Syrup. aurantii flor., *U. S.*, *Br.*, and the flavoring constituent of Trochisci acidi tannici, Troch. catechu, Troch. krameriæ, Troch. sodii santon., and Troch. ipecacuanhæ, *U. S.;* in the last, orange-flower syrup is used.

Medical Action and Uses.—Orange-flower water is more remarkable for its delicate and refreshing perfume than for its active medicinal properties. It forms a pleasant flavoring ingredient of many potions, and may be prescribed for nervous persons during attacks of neuralgic *headache*, *palpitation* of the heart, and a variety of minor *hysteroidal* disorders, the offspring of indolence and self-indulgence.

AQUA CAMPHORÆ, *U. S., Br.*—CAMPHOR-WATER.

Aqua camphorata.—Eau camphrée, Fr.; *Kampferwasser*, G.

Preparation.—Camphor 8 parts (88 grains); Alcohol 16 parts (176 grains or 3¾ fluid drachms); Cotton 16 parts (176 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 ounces av. or 24 fluidounces). Dissolve the camphor in the alcohol, and add the solution to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition. Expose the cotton to the air until the alcohol has nearly evaporated; then pack it firmly in a conical percolator, and gradually pour on distilled water until 1000 parts of percolate are obtained.—*U. S.*

Take of camphor broken in pieces half an ounce; distilled water 1 gallon. Enclose the camphor in a muslin bag, and attach this to one end of a glass rod, by means of which it may be kept at the bottom of a bottle containing the distilled water. Close the mouth of the bottle, macerate for at least 2 days, and then pour off the solution when it is required.—*Br.*

This is intended to be a saturated solution of camphor in water. R. Rother (1871) has shown that very cold water dissolves more camphor than can be retained in solution at the ordinary temperature, the excess crystallizing out, leaving, after filtration, such a saturated solution as is intended by the pharmacopœias. In preparing camphor-water by the above processes cold water should therefore be used. Prepared with the aid of magnesium carbonate by the process of the U. S. P. 1870, camphor-water contained, according to G. F. H. Markoe (1865), 2 grains of camphor in the fluidounce; that of the British Pharmacopœia, only half a grain. W. B. Addington suggested (1873) that a still stronger camphor-water may be obtained by dissolving the camphor in a small quantity of alcohol before triturating with the magnesium carbonate (calcium phosphate is preferable), by which means it is very finely divided.

Medical Action and Uses.—The proportion of 1 grain of camphor which is contained in each ½ fluidounce of this preparation is not sufficient to develop the more potent effects of the drug, yet quite enough to sustain the nervous system in the minor grades of exhaustion and prostration into which it is apt to fall in *low fevers* on the one hand, and in states of *nervous debility* and disorder on the other. Its anodyne and antispasmodic influence is shown in mild attacks of *neuralgia*, of nervous *headache*, of *colic*, of *dysmenorrhœa* depending upon an irritable state of the uterus, in *after-pains*, in *hiccup*, and in nervous *palpitation of the heart*. The average dose is about a tablespoonful (Gm. 16), which may be repeated at intervals of an hour or two.

AQUA CARUI, *Br.*—CARAWAY-WATER.

Aqua carui.—Eau distillée de carvi, Fr.; *Kümmelwasser*, G.

Preparation.—Take of Caraway Fruit bruised 1 pound (avoirdupois); Water 20 pounds. Distil 10 pounds (avoirdupois) (1 gallon Imperial).—*Br.*

This water has the flavor of the fruit in a marked degree.

Medical Uses.—The properties of caraway-water are almost identical with those of anise-water; it may be given in the dose of a fluidrachm (Gm. 4) or more.

AQUA CHLORI, *U. S.*—CHLORINE-WATER.

Liquor chlori, Br.; *Aqua chlorata*, P. G.; *Aqua chlorinii*, U. S. 1870; *Chlorum solutum*, *Aqua oxymuriatica.—Solution of chlorine*, E.; *Eau chlorée*, *Chlore liquide*, Fr.; *Chlorwasser*, G.

An aqueous solution of chlorine containing at least .4 per cent. (*U. S.*, *P. G.*), not less than .6 (*Br.*), of the gas.

Symbol of chlorine Cl. Atomicity univalent. Atomic weight 35.4.

Origin.—Chlorine was discovered by Scheele (1774), and was at first called dephlogisticated muriatic acid, afterward *oxymuriatic acid*, under the supposition that it was a compound of muriatic acid with oxygen. Gay-Lussac and Thénard (1809) showed that from its behavior it might be regarded as an element, a view which was strengthened by the researches of Humphry Davy (1810), who called it chloric gas, which name was changed to chlorine by Gay-Lussac (1813). Chlorine is widely distributed in nature, but owing to its affinity for other elements it is never found in the isolated state. It exists in many minerals, in most spring-waters, in sea-water, in plants, and in animals, and is liberated from the chlorides by the combined action of sulphuric acid and an oxidizing agent.

Preparation.—Take of Black Oxide of Manganese 10 parts (90 grains); Hydrochloric Acid 40 parts (360 grains or 6 drachms); Water 75 parts (675 grains or 1½ fluidounces); Distilled Water 400 parts (3600 grains or 8 fluidounces). Place the oxide in a flask; add the acid, previously diluted with 25 parts (225 grains or ½ fluidounce) of water, and apply a gentle heat. Conduct the generated chlorine, by suitable tubes, through the remainder of the water, contained in a small wash-bottle, to the bottom of a bottle having the capacity of 1000 parts (20 fluidounces), into which the distilled water has been introduced, the neck of which is loosely stopped with cotton, and which is to be kept during the operation at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating until the distilled water is saturated. Finally, pour the chlorine-water into dark amber-colored glass-stoppered bottles, which must be completely filled therewith, and keep them in a dark and cool place.—*U. S.*

This process is identical with that of the British Pharmacopœia, except as to weights and measures, but both aim at a saturated solution of chlorine and water with the simplest manipulation. In following the Pharmacopœia the best corks should be used for the generating-flask and wash-bottle, since porous corks are readily penetrated and destroyed by chlorine gas. This gas is generated by the action of hydrochloric acid upon binoxide of manganese, chloride of manganium, chlorine, and water being produced; $MnO_2 + 4HCl$ yields $MnCl_2 + Cl_2 + 2H_2O$. If the undiluted acid of the Pharmacopœia is employed the evolution of chlorine gas will commence, without heat being applied, and will continue for some time. Diluted as directed, the application of heat is necessary from the beginning. A strong heat should not be used at first, since hydrochloric acid gas would be carried over into the wash-bottle. The loss of acid may be entirely avoided if the oxide of manganese is used in small lumps instead of in powder, and in sufficient quantity so as not to be covered by the acid. Although chlorine is soluble in water to a considerable extent, it does not dissolve very readily; hence gas-bubbles will soon pass through the water without being much diminished in size. The pharmacopœias direct the use of receiving-bottles which are but partially filled with water. The atmosphere in the upper part of the bottle will gradually be displaced by the heavier chlorine, and when the latter begins to escape from the mouth of the bottle, this is disconnected from the apparatus, loosely corked, and agitated, when the gas will be absorbed. The bottle, which should be protected from the light, is then replaced, and the operation repeated until no further diminution of the pressure is observed in the bottle on being gently agitated when filled with chlorine. The British Pharmacopœia directs the agitation of the bottle only after the evolution of chlorine gas has ceased; much of the gas may be lost by not repeating the agitation several times.

The temperature best suited for dissolving the chlorine in water is 10° C. (50° F.). Near the freezing-point of water a solid chlorine hydrate, $Cl.5H_2O$, is formed, which is less soluble in water than the gas. At the temperature indicated water dissolves, according to Schönfeld, 2.585 times its volume of gas, the solubility being gradually lessened as the temperature rises. When the operation is finished it is well to pour the chlorine-water at once into small glass-stoppered vials, which should be completely filled and kept in a cool and dark place. The stoppers should be secured by twine, or, as suggested by Hager, by bladder which has been previously coated with a mixture of collodion and paraffin.

For the preparation of chlorine on the large scale, as in the manufacture of chlorinated lime, sulphuric acid is sometimes used in addition to the black oxide of manganese and hydrochloric acid, when all the chlorine contained in the latter is obtained and manganous sulphate is left in solution. Or the generation of hydrochloric acid and of chlorine is effected in one operation by the use of sulphuric acid, sodium chloride, and black oxide of manganese, in which case the sulphates of sodium and of manganese remain behind.

For special purposes chlorine may be prepared by the action of hydrochloric acid upon potassium bichromate; $14HCl + K_2Cr_2O_7$ yield $3Cl_2 + 2KCl + Cr_2Cl_6 + 7H_2O$, the result being chlorine, potassium chloride, chromic chloride, and water. Or potassium chlorate may be decomposed by hydrochloric acid, with the formation of chlorine, potassium chloride, and water; $6HCl + KClO_3$ yields $3Cl_2 + KCl + 3H_2O$, but the gas is in this case apt to be contaminated with hypochlorous acid.

During the preparation and handling of chlorine-water the operator should be careful not to inhale the gas, on account of its irritating and poisonous properties. Should its effects be perceived, it is advisable to carefully inhale a little sulphide of ammonium, which is decomposed by the chlorine into chloride of ammonium and sulphur. It should, however, be cautiously used, since an excess of this compound is likewise poisonous. A little ammonia, sufficiently diluted, may also be taken with advantage.

Properties.—Chlorine is a greenish-yellow, irrespirable, corrosive gas, having the spec. grav. 1.47, and becoming liquid at 15° C. (59° F.) under a pressure of four atmospheres. Liquid chlorine is dark yellow, does not congeal at −90° C. (−130° F.), and boils at −33.6° C. (−28.5° F.). Chlorine is not inflammable, but is capable of supporting combustion.

Chlorine-water is a clear, greenish-yellow liquid possessing the suffocating odor and acrid, irritating taste of chlorine, evaporating without leaving any residue, but separating crystals of chlorine hydrate when cooled to the freezing-point of water. Its specific gravity is 1.003 (*Br.*) when saturated at 6° C. (42.8° F.) (Berthollet). It instantly discharges the color of a diluted solution of indigo and bleaches vegetable coloring matters generally. Exposed to light, it is decomposed into hydrochloric acid and oxygen. It is a powerful oxidizing agent, and this property serves to readily ascertain its strength. A fluidounce of it, mixed with a solution of 14 grains of pure ferrous sulphate, does not produce a blue precipitate with ferricyanide of potassium, indicating that the salt has been completely oxidized to ferric sulphate, and proving that the water contains 0.4 per cent. of chlorine.

Tests.—Chlorine-water should evaporate without leaving any residue. Agitated with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid reddens litmus-paper but faintly, if at all (hydrochloric acid). The test of the British Pharmacopœia indicates a strength of 0.6 per cent. It is applied as follows: A solution of 20 grains of iodide of potassium in an ounce of water yields with 439 grains (1 fluidounce) of chlorine-water a deep red-colored liquid, which requires for the discharge of its color 750 grain-measures of the volumetric solution of hyposulphite of sodium, corresponding to 2.66 grains of chlorine.

On mixing 35.4 Gm. of chlorine-water with a solution of 0.09 Gm. of iodide of potassium in 20 Gm. of water, the resulting deep-red liquid should require for complete discoloration at least 40 Ccm. of the volumetric solution of hyposulphite of sodium (corresponding to at least 0.4 per cent. of chlorine).—*U. S.* The requirements of the German Pharmacopœia are identical with these, 25 Gm. of chlorine-water, 1 Gm. potassium iodide, and 28.2 Ccm. of the hyposulphite solution being used, and the determination made in the presence of starch solution, whereby the red color of dissolved iodine is changed to blue.

Physiological Action and Medical Uses.—Although not directly relating to chlorine-water, it may here be mentioned that Binz inferred from his experiments that in the frog the primary action of chlorine is to paralyze the nerve-centres, and that it has no direct poisonous action upon the heart (*Archiv exper. f. Pathol. u. Pharmakol.*, xiii. 155). The action of chlorine-water in large doses and internally is that of an irritant poison. In a diluted state it acts locally as a stimulant and disinfectant, and on absorption is supposed to quicken all the functions and purify the blood in typhoid forms of disease depending upon an animal poison generated within the system or absorbed from without. It is highly probable that this view of its operation is derived chiefly from its power of neutralizing the foul odors of decomposition. Clinical reports of its effects in zymotic diseases demonstrate the incapacity of the reporters to observe and judge, rather than the virtues possessed by the medicine. When the types of the several diseases described are considered, and their inherent tendency to recovery or to death, the share in the results to which other medicines were equally with this one entitled, and the partial exclusion by its use of more active and probably hazardous remedies, it is difficult to accept the positive and laudatory accounts of its virtues as representing even an approach to truth. We believe, therefore, that the efficacy of chlorine in *typhus fever*, in *scarlet fever*, in *diphtheria*, in *small-pox*, etc. is wholly undemonstrated, except as far as it is a palliative of certain local and subordinate symptoms, such as *putrid angina* and a burning heat of the skin. In all forms of *sore throat* attended with fetid discharges and an ulcerated or torpid condition of the mucous membrane washes and gargles of chlorine-water may be used with the same advantage as other stimulant disinfectants. A like statement may be made regarding other forms of disease in which the intestinal discharges are peculiarly fetid, as in certain cases of *typhoid fever* and of typhoid types of *dysentery*, *small-pox*, etc. Chlorine-water is to be commended as a wash or dressing for all forms of *sores* which have a fetid discharge, even for *cancerous* ulcers, and as a lotion for the skin when the crusts formed by *small-pox* pustules become offensive. Chlorinated water has been reputed to have the power of preventing the infection of *syphilis* and of *puerperal fever*—in the one case by its use in washing the genitals after impure coition, and in the other by cleansing the hands of accoucheurs after attendance upon cases of the disease. Supposing the alleged effect to be real, which is by no means proven, it is not quite clear that an equally diligent use of soap would not have been followed by an equal degree of immunity. Chlorinated oil, made by passing chlorine gas through olive oil, has been found efficient in *scabies* and a parasiticide generally. At one time chlorine gas was used by inhalation in various bronchial affections, and especially in *phthisis* and *fetid bronchitis*, but atomized chlorine-water is preferable.

The *dose* of chlorine-water is from 1 to 4 fluidrachms (Gm. 4–16), largely diluted. For inhalation, when atomized, a solution of from 5 to 10 drops (Gm. 0.30–0.60) in water may be used. *Antidotes:* after emesis with warm water, albumen in the form of milk, white of egg, veal-broth, etc., flour and water, or lime-water.

AQUA CHLOROFORMI, *Br.*—CHLOROFORM-WATER.

Eau de chloroforme, Fr.; *Chloroformwasser*, G.

Preparation.—Take of Chloroform 1 fluidrachm; Distilled Water 25 fluidounces. Put them into a two-pint stoppered bottle and shake them together until the chloroform is entirely dissolved in the water.—*Br.* A fluidounce represents about 2 minims of chloroform.

Medical Uses.—The dose prescribed by the British Pharmacopœia is from ½ fluidounce to 2 fluidounces.

Beurmann claims that chloroform remains unchanged for a long time in its watery solution (*Bull. de thérap.*, cv. 97). It is well adapted for a mouth-wash or gargle, both to relieve the pain of *toothache* and *sore throat* and to stimulate the mucous membrane of the mouth and pharynx, and internally to relieve all abdominal pains, but especially those of *gastralgia.* The acrid taste of the preparation may be removed by mint-water, orange-flower water, etc. On the other hand, it may be used to mask the taste of various medicines or to render the stomach more tolerant of them.

AQUA CINNAMOMI, *U. S., Br., P. G.*—CINNAMON-WATER.

Eau de cannelle, Fr.; *Zimmtwasser*, G.

Preparation.—Oil of Cinnamon 2 parts (22 grains); Cotton 4 parts (44 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av. or 24 fluidounces). Add the oil to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on distilled water until 1000 parts of percolate are obtained. —*U. S.*

The British Pharmacopœia directs the distillation of 1 Imperial gallon (10 pounds) of cinnamon-water from 20 ounces of bruised Ceylon cinnamon, or in proportion of 8 parts of water from 1 part of bark. The present German Pharmacopœia recognizes as *Aqua cinnamomi* a distilled water formerly called *Aqua cinnamomi spirituosa* (*s. vinosa*), and made by distilling 10 parts from a mixture of sufficient water, 1 part of alcohol specific gravity 0.832, and 1 part of Chinese cinnamon.

Properties.—Obtained by any one of these processes, cinnamon-water is somewhat turbid, but gradually becomes clear. Made from the oil, it has the odor and a somewhat harsh taste of cinnamon, but if distilled from the bark its odor is more fragrant and its taste decidedly sweet. Cinnamon-water made with magnesia has a yellowish color, unless carbonic acid gas is passed through it or a small quantity of some other acid is added. In contact with the air the volatile oil is oxidized, and crystals of cinnamic acid and small particles of a brownish resin are frequently separated.

Off. Prep.—Mistura cretæ, *U. S., Br.;* Mist. guaiaci, Mist. spiritus vini gallici, *Br.*

Medical Action and Uses.—Cinnamon-water possesses the stimulant and carminative properties of the bark from which it is derived, but is seldom used except as a vehicle for other medicines with which it can co-operate. It is most commonly employed in mixtures for flatulent *colic* and *diarrhœa*, and in the latter affection as a vehicle for chalk, astringents, and opiates.

AQUA CREASOTI, *U. S.*—CREASOTE-WATER.

Eau créosotée, Fr.; *Kreosotwasser*, G.

Preparation.—Creasote 1 part (55 grains); Distilled Water 99 parts; to make 100 parts (12½ oz. av. or 12 fluidounces). Agitate the creasote with the distilled water until dissolved, and filter through a well-wetted filter.—*U. S.*

Medical Uses.—This preparation contains in every 2 fluidrachms rather more than 1 minim of creasote, and is a convenient form of that medicine for all the cases in which it should be given diluted, and also as a topical application in *leucorrhœa*, *gleet*, *burns*, *chilblains*, *ulcers* (especially such as are attended with an excessive, thin, or fetid discharge), *gangrene*, and various cutaneous eruptions, particularly *prurigo*, *eczema*, *sycosis*, etc. *Dose*, from 1 to 4 fluidrachms (Gm. 4–16).

AQUA DESTILLATA, *U. S., Br., P. G.*—Distilled Water.

Eau distillée, Hydrolat simple, Fr.; *Destillirtes Wasser*, G.
Composition H_2O. Molecular weight 18.

Preparation.—Water 1000 parts; to make 800 parts. Distil the water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 50 parts and throw them away. Then collect 800 parts, and keep the distilled water in glass-stoppered bottles.—*U. S.*

Take of water 10 gallons. Distil from a copper still connected with a block-tin worm; reject the first half gallon and preserve the next 8 gallons.—*Br.*

When ordinary water is heated to ebullition the gases and volatile compounds dissolved therein are also vaporized and carried off with the vapors of the water, which, if condensed, would then be more highly charged with these volatile compounds; hence the necessity of rejecting the first portion of the distillate, as directed by the pharmacopœias. On the other hand, if the distillation is continued until all the water is vaporized from the still, the last portions are apt to be contaminated with volatile products resulting from the decomposition of ammonia compounds and organic matter. The pharmacopœias avoid this possibility by discontinuing the distillation when 15 per cent. of the water is left in the still.

The material of which the distillatory apparatus used for this purpose is constructed is of considerable importance, but more particularly in relation to the condenser. Iron, copper, and lead condensers must not be used, since the water corrodes these metals, traces and sometimes larger quantities of which will always be found in the distillate. Where a glass condenser is available it may be regarded as the most desirable, apparatus made of metals (silver and platinum) which are not in the least corroded during distillation being too costly for general use. The material best adapted for practical purposes is block-tin, of which the condenser and all those portions of the apparatus should be made from which the vapors are made to descend. A minute quantity of tin is nearly always dissolved, but separates again on standing for a few days in contact with the air. The occasional appearance of confervæ in distilled water depends upon its direct contact with the air, and may be prevented by keeping it in vessels arranged in such a manner that the air can enter only after having passed through a layer of cotton, by which the spores are retained.

Properties and Tests.—Distilled water is a colorless, limpid liquid, without odor or taste, and of a neutral reaction. On evaporating 1 liter of distilled water no fixed residue should remain. The transparency or color of distilled water should not be affected by hydrosulphuric acid or sulphide of ammonium (absence of metals), by test solutions of chloride of barium (sulphate), nitrate of silver (chloride), oxalate of ammonium (calcium), or mercuric chloride, with or without the subsequent addition of carbonate of potassium (ammonia and ammonium salts). On heating 100 Ccm. of distilled water acidulated with 10 Ccm. of diluted sulphuric acid to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1000) to impart to the liquid a decided rose-red tint, this tint should not be entirely destroyed by boiling for 5 minutes (absence of organic or other oxidizable matters).—*U. S.* Distilled water should not be affected by solution of lime (absence of carbonic acid).—*Br.* On continued exposure to the air distilled water will dissolve carbonic acid gas, and then become cloudy with clear lime-water.

AQUA FŒNICULI, *U. S., Br.*—Fennel-Water.

Eau de fenouil, Fr.; *Fenchelwasser*, G.

Preparation.—Oil of Fennel 2 parts (22 grains); Cotton 4 parts (44 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av. or 24 fluidounces). Add the oil to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on distilled water until 1000 parts of percolate are obtained.—*U. S.*

Take of bruised fennel 1 pound av.; water sufficient; distil 1 gallon Imperial measure or 10 pounds av. (*Br.*), 30 pounds av. (*P. G.*) If a good fennel is employed the water last mentioned separates a small portion of oil on standing, and is therefore a saturated solution.

Medical Action and Uses.—Fennel-water is stimulant and carminative, and, like its associates, is used as a vehicle for medicines intended to correct *acidity* and relieve *flatulence* and *colic*. *Dose*, 1 drachm (Gm. 4) or more, according to the age of the patient and the degree of the derangement.

AQUA LAUROCERASI, *Br.*—CHERRY-LAUREL WATER.

Eau distillée de laurier-cerise, Fr.; *Kirschlorbeerwasser*, G.

Preparation.—Take of fresh leaves of Cherry Laurel 1 pound; Water 2½ pints (50 ounces). Chop the leaves, crush them in a mortar, and macerate them in the water for 24 hours; then distil 1 pint (20 ounces) of liquid. Shake the product, filter through paper, and preserve it in a stoppered bottle.—*Br.*

To facilitate distillation, Pettenkofer suggests for this water the process recommended by him for bitter-almond water. (See AQUA AMYGDALÆ AMARÆ.) The distillate contains oil of bitter almonds and hydrocyanic acid, and is similar to bitter-almond water; the British Pharmacopœia now orders this water to contain 0.1 per cent. of HCy, and the German Pharmacopœia (1872) required it to be of the same strength as bitter-almond-water.

Medical Action and Uses.—This preparation has no virtues which it does not owe exclusively to the hydrocyanic acid it contains. Like all distilled waters, its strength is very uncertain, and it is altogether less eligible than a definite solution of hydrocyanic acid or of oil of bitter almonds in water, not only because its strength is variable, but because the inequality of its effects may lead to disastrous results. The dose is stated to be from 5 to 30 minims (Gm. 0.30–2.00), very cautiously administered.

AQUA MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—PEPPERMINT-WATER.

Eau de menthe poivrée, Fr.; *Pfefferminzwasser*, G.

Preparation.—Oil of Peppermint 2 parts (22 grains); Cotton 4 parts (44 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av. or 24 fluidounces). Add the oil to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on distilled water until 1000 parts of percolate are obtained. —*U. S.*

Take of Oil of Peppermint 1½ fluidrachms; Water 1½ gallons; distil 1 gallon (10 pounds).—*Br.*

P. G. distils 10 parts of water from 1 part of the herb; *Fr. Cod.*, 1 part from 1 part of the fresh herb.

Off. Prep.—Mistura ferri aromatica.—*Br.*

Medical Action and Uses.—Peppermint-water is used as a vehicle for many medicines which are unpleasant to the taste or which occasion nausea or griping. It is the most common domestic remedy for flatulent *colic*, and in hot water is frequently resorted to for relief from the pains of *dysmenorrhœa.* Like other diffusible and aromatic stimulants, it palliates *headache*, *palpitation*, *hiccup*, etc. produced by laborious digestion. *Dose*, half a fluidounce (Gm. 16) or more.

AQUA MENTHÆ VIRIDIS, *U. S., Br.*—SPEARMINT-WATER.

Eau de menthe verte, Fr.; *Römisch-Minzwasser*, G.

Preparation.—Oil of Spearmint 2 parts (22 grains); Cotton 4 parts (44 grains); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av. or 24 fluidounces). Add the oil to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on distilled water until 1000 parts of percolate are obtained.—*U. S.*

Take of Oil of Spearmint 1½ fluidrachms; Water 1½ gallons. Distil 1 gallon (10 pounds).—*Br.*

On the continent of Europe curled-mint water is used instead. *Aqua menthæ crispæ*, *P. G.*, is prepared by mixing curled-mint leaves 1 part with sufficient water, and distilling 10 parts.

Medical Action and Uses.—Spearmint-water has the same virtues as peppermint-water, but is much milder in its action. It is particularly appropriate in cases of infantile *colic*, for which it may be prescribed with a little bicarbonate of sodium or magnesia in doses of a teaspoonful. The average *dose* for an adult is half a fluidounce (Gm. 16).

AQUA PIMENTÆ, *Br.*—Pimento-Water.

Eau de piment de la Jamaïque, Fr.; *Nelkenpfeffer-Wasser*, G.

Preparation.—Take of Pimento, bruised, 14 ounces; Water 2 gallons. Distil 1 gallon (10 pounds).—*Br.*

On standing it separates a brownish resin.

Medical Action and Uses.—Pimento-water is a stimulant carminative. Its effects are less transient than those of fennel- and anise-water, for example, and more like such as are produced by an infusion of cloves. *Dose*, half an ounce or more for an adult (Gm. 16).

AQUA ROSÆ, *U. S., Br., P. G.*—Rose-Water.

Aqua Rosarum.—*Eau distillée de rose*, Fr.; *Rosenwasser*, G.

Preparation.—Recent Pale Rose 40 parts (40 oz. av.); Water 200 parts (200 oz. av.); to make 100 parts (100 oz. av. or 96 fluidounces). Mix them, and by means of steam distil 100 parts.—*U. S.* If preserved by the addition of one-half the weight of table-salt, 60 (instead of 40) parts of such preserved rose-petals should be used.

This is in the proportion of 2 parts of fresh petals to 5 parts of distillate. *Br.* and *Fr. Cod.* direct the distillate to be equal in weight to the petals; *P. G.* 1872 obtained 5 parts of water from 1 part of fresh petals; but in the recent edition it is directed to be prepared by dissolving 4 drops of oil of rose in 1000 Gm. (33.8 fluidounces) of lukewarm water, and when cool filtering.

Off. Prep.—Rose-water is an ingredient of Confectio rosæ, *U. S.;* Mistura ferri composita, *U. S.*, *Br.;* Trochisci bismuthi, *Br.;* Unguentum aquæ rosæ, *U. S.*

Medical Uses.—Rose-water has no strictly medicinal virtues. It is an agreeable excipient for collyria, urethral injections, and lotions.

AQUA SAMBUCI, *Br.*—Elderflower-Water.

Eau distillée de sureau, Fr.; *Fliederblumen-* (*Hollunderblüthen-*) *Wasser*, G.

Preparation.—Take of Fresh Elderflowers, separated from the stalks, 10 pounds (or an equivalent quantity of the flowers preserved while fresh with common salt); Water 5 gallons. Distil 1 gallon (10 pounds).—*Br.*

Elderflowers 1 part; Water sufficient. Distil 10 parts.—*P. G.* 1872.

On standing it is inclined to separate a mucilaginous sediment, which must be removed by filtration.

Medical Uses.—Elderflower-water is used in England as an agreeable excipient for medicines. It possesses no definite virtues. *Dose*, an ounce or more (Gm. 32).

AQUÆ MINERALES.—Mineral Waters.

Eaux minérales, *Eaux médicinales naturelles*, Fr.; *Mineralwässer*, G.

These are spring-waters which are charged with certain gases or salts to such a degree that they are unfit for ordinary use, and exert a peculiar operation on the economy.

The following summary gives the composition of a few of the most important mineral waters, which may be divided into the following classes:

1. Sulphuretted waters contain sulphides and sulphuretted hydrogen, in consequence of which they possess a more or less fetid odor:

Barèges.—The *Source de l'entrée* contains in 10,000 parts: 0.360 sodium sulphide, 0.219 sodium chloride, 0.240 alkaline carbonates, 0.300 sodium sulphate, and traces of iodine and organic matter (Henry).

Baden (Austria), *Leopoldsquelle.*—10,000 Gm. contain 0.065 sodium carbonate, 0.800 calcium carbonate, 1.780 sodium sulphate, 3.467 calcium sulphate, 0.610 potassium sulphate, 0.700 magnesium chloride, 0.030 silica, 0.013 magnesium sulphate, 1.705 sodium chloride, 1340.19 Ccm. carbonic acid, 2836.09 nitrogen, 335.19 oxygen, and 232.73 sulphuretted hydrogen (Keller).

Harrowgate, *Old Sulphur Well.*—10,000 parts contain 0.26 calcium sulphate, 1.75 calcium carbonate, 11.55 calcium chloride, 7.86 magnesium chloride, 9.14 potassium chloride, 122.38 sodium chloride, 2.19 sodium sulphide, 0.03 silica, and traces of fluoride, bromide, iodide, and carbonate of sodium, calcium, ammonium, iron, and manganese, and organic matter. Also the following gases in 1 Imperial gallon: 22 cubic inches carbonic acid, 5.3 sulphuretted hydrogen, 5.8 carburetted hydrogen, and 2.9 nitrogen (A. W. Hofmann).

Massena, St. Regis.—1 U. S. gallon contains 79.692 grains sodium chloride, 0.508 potassium chloride, 29.927 magnesium chloride, 0.673 magnesium bromide, 4.852 calcium bicarbonate, 0.488 ferrous bicarbonate, 60.931 calcium sulphate, 3.501 sodium sulphate, 1.320 sodium phosphate, 4.205 sodium hyposulphite, 1.405 sodium sulphide, 11.176 sodium silicate, and organic matter; total, 198.678 grains, and 5.307 cubic inches of sulphuretted hydrogen (F. F. Mayer).

2. ALKALINE WATERS.—Carbonate of sodium predominates, and free carbonic acid is often present in considerable quantity:

Ems, Kränchen.—10,000 parts contain the following carbonates: 13.651 sodium, 1.559 calcium, 1.292 magnesium, 0.016 iron, 0.007 manganese, 0.001 barium; 9.224 sodium chloride, 0.004 phosphate of aluminium, 0.494 silica, traces of iodide of sodium and carbonate of lithium, and 9991 Ccm. carbonic acid (Fresenius).

Vichy, Source Lucas.—10,000 parts contain the following bicarbonates: 50.04 sodium, 2.82 potassium, 2.75 magnesium, 0.05 strontium, 5.45 calcium, and 0.04 iron; 2.91 sodium sulphate, 0.70 sodium phosphate, 0.02 sodium arseniate, 5.18 sodium chloride, 0.50 silica, and 17.51 carbonic acid; total solids, 70.46 (Bouquet).

The water of the Grande Grille spring has nearly the same composition with 70.33 solids, but contains only 9.08 parts of carbonic acid. Tichborne found in 16 ounces of the bottled water 44.408 grains of solids.

Gettysburg.—1 Imperial gallon contains 46.05 grains bicarbonate of sodium, with lithium, 76.05 magnesium bicarbonate, 81.00 calcium bicarbonate, 53.20 calcium sulphate, 10.00 silica, with traces of potassium and iron chlorides and phosphates; total, 266.30 grains (Mayer).

3. SALINE WATERS contain various salts of alkalies and alkaline earths, occasionally bromides and iodides. Dieulafait (1881) believes that the saline waters of Western Europe are mineralized in the salt-bearing strata of the Trias and Tertiary formation, and that the mineralizing compounds were formerly contained in ordinary seas, and have been deposited by simple evaporation.

Bedford Springs, Pa.—1 pint contains calcium sulphate 11.274 grains, magnesium sulphate 3.974 grs., aluminium and iron sulphates 1.280 grs., sodium sulphate 3.092 grs., sodium chloride 0.343 gr., calcium carbonate 2.120 grs., sulphuric acid (?) 0.128 gr., organic matter and silica trace (J. C. Morris).

Cheltenham, Royal Old Wells.—10,000 parts contain 34.202 sodium chloride, 1.141 magnesium chloride, 13.541 sodium sulphate, 0.970 magnesium carbonate, 2.433 calcium carbonate, 0.436 magnesium bromide, 0.069 magnesium iodide, 0.381 silica, 1.473 crenic acid, 2.574 organic matter, and 92 Ccm. carbonic acid (Abel and Rowney).

Carlsbad (Bohemia), *Sprudel.*—10,000 parts contain 24.05 sodium sulphate, 18.612 sodium bicarbonate, 10.223 sodium chloride, 4.638 calcium bicarbonate, 2.537 magnesium bicarbonate, 1.862 potassium sulphate, .141 lithium chloride, .715 silica, .051 sodium fluoride, .041 ferrous bicarbonate, .040 sodium borate, and much smaller quantities of sodium phosphate, strontium, manganese, and alumina, besides carbonic acid; total solids, 62.928 (Ludwig). The numerous other Carlsbad springs analyzed by Ludwig (1879) have a similar composition, the total solids decreasing to 60.798 parts in the water of the *Schlossbrunnen.*

Friedrichshall (Saxe-Meiningen) *Bitter-water.*—16 ounces contain 61.102 sodium chloride, 46.510 sodium sulphate, 39.533 magnesium sulphate, 30.252 magnesium chloride, 3.992 magnesium carbonate, .876 magnesium bromide, 1.523 potassium sulphate, 10.341 calcium sulphate, .113 calcium carbonate; total salts, 194.242 grains; carbonic acid 5.322 cubic inches (Liebig). The bottled water contains in 16 ounces 99.722 grains sodium chloride, 71.535 sodium sulphate, 64.138 magnesium sulphate, 50.114 magnesium chloride, 2.102 magnesium carbonate, .275 magnesium bromide, 2.518 potassium sulphate, 17.130 calcium sulphate, .440 silica; solids, 307.974 grains, and carbonic acid (Tichborne).

Hunyadi Jànos.—16 ounces of the bottled water contain free carbonic acid and 337.066 grains of solids, consisting of 157.957 sodium sulphate, 156.350 magnesium sulphate, .716 potassium sulphate, 10.531 sodium chloride, 6.051 calcium carbonate, 5.152 sodium carbonate, .20 strontium carbonate, and .029 iron and alumina (Tichborne).

Seidlitz.—16 ounces contain 104 grains sulphate, 3 grains carbonate, and 3 grains chloride of magnesium, 8 grains carbonate and 8 grains sulphate of calcium; total, 126 grains (Naumann).

4. Acidulous saline waters contain various salts and are sparkling from the large amount of carbonic acid contained in them:

Neuenahr, Apollinaris.—16 ounces of the bottled water contain free carbonic acid and 25.868 grains of salts, consisting of 10.621 sodium bicarbonate, 5.023 sodium chloride, 2.402 sodium sulphate, .141 potassium sulphate, 4.50 magnesium carbonate, 2.880 calcium carbonate, .10 ferric oxide, .080 alumina, .121 silica, and traces of sodium phosphate, lithium, ammonia, and nitric acid (Tichborne).

Grosskarben, Taunus.—16 ounces of the bottled water contain 32.403 grains of free carbonic acid and 31.262 grains of solids, consisting of 18.004 sodium chloride, 1.890 potassium chloride, 9.590 calcium carbonate, 1.232 magnesium carbonate, .140 sodium carbonate, .406 calcium sulphate, and traces of calcium phosphate, silica, and alumina (Taylor, Tichborne).

Pyrmont, Hauptquelle.—160 ounces contain the following sulphates: 0.023 grain barium, 0.280 strontium, 60.897 calcium, 1.266 potassium, 3.220 sodium, and 34.813 magnesium; the following chlorides: 12.202 sodium, 0.161 ammonium, and 0.076 lithium; the following bicarbonates: 86.832 calcium, 6.160 magnesium, 5.919 iron, and 0.344 manganium; 0.001 sodium iodide, 0.007 sodium bromide, 0.012 sodium nitrate, 0.006 aluminium phosphate, 0.004 calcium phosphate, 2.441 silica, 183.956 grains carbonic acid, and a trace of sulphuretted hydrogen (Fresenius).

Selters.—16 ounces contain 0.248 grain sodium sulphate, 16.285 sodium chloride, 5.855 sodium carbonate, 1.595 magnesium carbonate, 1.867 calcium carbonate, 0.154 ferrous carbonate, 0.281 sodium phosphate, 0.289 silica, and 31 cubic inches carbonic acid (Bischof).

Saratoga, Empire Spring.—1 U. S. gallon contains 506.63 grains sodium chloride, 4.292 potassium chloride, 0.266 sodium bromide. 0.006 sodium iodide, 2.769 potassium sulphate, 0.023 sodium phosphate, 1.458 silica, 0.418 alumina, with the following bicarbonates: 42.953 magnesium, 109.656 calcium, 2.080 lithium, 9.022 sodium, 0.070 barium, 0.793 iron, and trace of strontium; also traces of calcium fluoride, borax, and organic matters; total, 680.436 grains, and 344.67 cubic inches carbonic acid (Chandler and Cairns).

The acidulous saline waters of the numerous other springs of Saratoga have a similar composition; in the following table they are arranged according to the abundance of carbonic acid gas, in addition to which we give, in grains, the total solids and the weight of the most important saline constituents contained in one gallon:

Name.	CO_2, cub. inch.	Total solids.	NaCl.	$NaHCO_3$.	$MgO(CO_2)_2$.	$CaO(CO_2)_2$.	$FeO(CO_2)_2$.	$LiHCO_3$.
Champion	465.458	1195.583	702.236	17.624	193.912	227.070	0.647	6.247
Geyser	454.082	991.546	562.080	71.232	149.343	168.392	0.979	9.004
High Rock	409.458	628.039	390.127	34.888	54.924	131.739	1.478	
Star	407.650	617.397	398.361	2.662	61.912	124.459	1.213	1.586
Congress	392.289	700.859	400.440	10.775	121.757	143.399	0.340	4.761
Union	384.969	701.174	453.299	17.010	109.685	96.703	0.269	2.605
Vichy	383.071	315.176	128.629	82.873	41.503	45.522	0.052	1.760
Hathorn	375.747	888.403	509.968	4.288	176.463	180.646	1.128	11.447
Washington	363.770	350.227	182.733	......	65.973	84.096	3.800	
Kissingen	361.500	644.627	338.500	67.617	70.470	140.260	1.557	5.129
Putnam	348.880	361.010	214.000	14.320	51.600	68.800	7.000	
Pavilion	332.458	687.275	459.903	3.764	76.267	120.169	2.570	9.486
Seltzer	324.080	302.017	234.291	29.428	40.339	89.869	......	1.703
Crystal	317.452	537.155	328.468	10.064	75.161	101.881	2.038	4.326
Hamilton	316.000	460.326	297.300	27.036	35.200	92.400	5.390	
Excelsior	250.000	514.746	370.642	15.000	32.333	77.000	3.215	
United States	245.734	331.837	141.872	4.666	72.888	93.119	0.714	4.847
Eureka	239.000	258.365	166.811	8.750	29.340	41.321	3.000	
Saratoga, A	212.000	656.911	565.300	6.752	20.480	56.852	......	1.724

The temperature of these springs is between 45° F. (Washington) and 52° F. (High Rock and Star); the water of the Kissingen springs is 40° F.

Whitehall (N. Y.) Adirondack Springs.—1 Imperial gallon contains 14.340 grains sodium chloride, 11.134 calcium sulphate, 18.543 calcium carbonate, 16.618 magnesium carbonate, 5.040 ferrous carbonate, 5.317 potassium carbonate, 5.135 sodium carbonate, 0.023 lithium carbonate, traces of magnesium carbonate and alumina, 7.42 insoluble residue, and 67.3 cubic inches of carbonic acid (Collier).

Kissingen, Rakoczy.—16 ounces contain 0.242 grain ferrous carbonate, 0.131 magnesium carbonate, 8.148 calcium carbonate, 0.043 calcium phosphate, 0.099 silica, 2.990 calcium sulphate, 44.713 sodium chloride, 4.509 magnesium sulphate, 2.203 potassium chloride, 2.333 magnesium chloride, 0.064 sodium bromide, 0.071 sodium nitrate, 0.153 lithium chloride, 0.007 ammonium carbonate; total, 65.706 grains, and 41.77 cubic inches of carbonic acid (Liebig).

5. CHALYBEATE WATERS.—This name is applied to those mineral waters which contain iron in sufficient quantity to impart to them a ferruginous taste. The iron is present either as sulphate or frequently as ferrous carbonate, held in solution by excess of carbonic acid, sulphuretted hydrogen being also occasionally present. Iron being found in several of the waters named before in larger quantities than mere traces, it is evident that the classification must be somewhat arbitrary.

Homburg, Stahlbrunnen.—16 ounces contain 0.937 ferrous carbonate, 7.534 calcium carbonate, 10.667 calcium chloride, 5.330 magnesium chloride, 79.864 sodium chloride, 0.176 potassium sulphate, 0.146 calcium sulphate, 0.315 silica; total, 104.969 grains, and 46.90 cubic inches carbonic acid (Liebig).

Spa, Source du Pouhon.—10,000 parts contain the following bicarbonates: 1.266 sodium, 0.105 potassium, 1.730 calcium, 1.674 magnesium, and 0.714 iron; 0.203 sodium sulphate, 0.256 sodium chloride, 0.629 silica, and 21.409 carbonic acid (Plateau).

Pyrmont, Trinkquelle.—16 ounces contain 0.490 ferrous carbonate, 1.126 magnesium chloride, 0.323 magnesium carbonate, 0.048 manganium carbonate, 5.988 calcium carbonate, 0.014 aluminium phosphate, 0.496 silica; and the following sulphates: 2.697 magnesium, 7.221 calcium, 0.020 strontium, 0.009 lithium, 0.042 potassium, and 2.145 sodium; total, 20.619 grains, and 1.68 volumes of carbonic acid (Struve).

Cheltenham (chalybeate).—1000 parts contain 0.066 ferrous carbonate, 0.159 calcium carbonate, 0.735 calcium chloride, 0.484 magnesium chloride, 0.390 potassium chloride, 2.262 sodium chloride, 0.020 silica, 0.040 organic matter; total, 4.156. 1 gallon contains also 19.5 cubic inches carbonic acid and 5 cubic inches carburetted hydrogen (A. W. Hofmann).

Church Hill Alum-Water.—1 U. S. gallon contains 24.991 grains ferrous sulphate, 51.270 ferric sulphate (neutral), 83.355 ferric sulphate (one-third basic), 72.928 aluminium sulphate, 86.064 magnesium sulphate, 88.836 calcium sulphate, 0.643 ammonium sulphate, 2.444 potassium sulphate, 1.943 sodium sulphate, 4.627 sodium chloride, 10.429 silica, and a trace of phosphoric acid; total, 427.530 grains (J. C. Booth).

6. THERMAL SPRINGS.—Their temperature is above that of the locality in which they are situated, and they serve an important use for baths, although most of these waters are also used internally. In the following we give some of the best known, arranged according to their temperature:

Carlsbad, Sprudel.—Temperature 73.5° C. (172.4° F.). (See above, under SALINE WATERS.) The temperature of eight other hot springs ranges between 60.2° and 43° C. (140.4° and 109.4° F.), and the average amount of solids is 61.966 in 10,000 parts.

Wiesbaden, Kochbrunnen.—Temperature 68.8° C. (155.8° F.). 10,000 parts of the water contain 68.356 sodium chloride, 1.458 potassium chloride, .002 lithium chloride, .167 ammonium chloride, 4.710 calcium chloride, 2.039 magnesium chloride, .035 magnesium bromide, .902 calcium sulphate, .004 calcium phosphate, 4.180 calcium carbonate, .104 magnesium carbonate, .056 ferrous carbonate, .006 manganum carbonate, .001 calcium arseniate, .604 silica and alumina, and .34 volumes carbonic acid; total solids, 82.624 (Fresenius). The temperature of other springs ranges from 66° to 49.5° C. (150.8° to 120.2° F.).

Baden-Baden.—The temperature of nine springs ranges between 68.63° and 44.4° C. (156° and 112° F.), and the solid constituents of 10,000 parts between 29.528 and 27.0213, of which between 22.244 and 18.892 parts are sodium chloride.

Hot Springs, Arkansas.—The fifty-seven springs range in temperature between 65.5° and 33.9° C. (150° and 93° F.); the solid constituents amount to a little over a grain in the pint.

Aix-la-Chapelle (Aachen).—Four springs range in temperature between 55° and 45.4° C. (131° and 113.7° F.), and the solids in 10,000 parts between 44.4815 and 40.1446, of which 60 per cent. is sodium chloride and 20 per cent. sodium bicarbonate.

Bath, King's Spring.—Temperature 46.2° C. (115° F.). 10,000 parts contain 20.597 solids, consisting of 11.425 calcium sulphate, 0.662 potassium sulphate, 2.744 sodium sulphate, 1.259 calcium carbonate, 0.047 magnesium carbonate, 0.152 ferrous carbonate, 1.802 sodium chloride, 2.081 magnesium chloride, 0.425 silica, with traces of lithia, manganese, and iodine; carbonic acid not determined (Merck and Galloway).

Gastein, Wildbad.—Temperature 49° to 25° C. (120.2° to 77° F.); salts, 3.483 in 10,000 parts.

Ems.—Thirteen springs range in temperature between 46.64° and 27.9° C. (116° and

82.2° F.). 10,000 parts of water contain 31.74 to 38.194 solids, mostly carbonates with chlorides.

Idaho Springs, Colorado.—Range of temperature 46.1° to 29.5° C. (115° to 85° F.). A gallon contains 107 grains of salts, mostly sulphates with carbonates.

Vichy.—Eight springs range in temperature between 43.5° and 22° C. (108.5° and 71.6° F.). (See above, under ALKALINE WATERS.)

Hot Springs, Virginia.—Temperature between 43.3° and 25.5° C. (110° and 78° F.). A gallon of water contains 18 to 33 grains of salts, mostly carbonates with chlorides and sulphates.

ARTIFICIAL MINERAL WATERS have been manufactured and used for many years both in Europe and the United States; many of these are close imitations of the natural waters. Works giving instructions on the manufacture of such waters have been published by (among others) Dr. H. Hager, Dr. Græger, and recently (1883) by Dr. F. Raspe. We append here a few formulas which have been recommended as yielding tolerably good substitutes for the waters of the springs named:

Baden (*chalybeate*).—Chloride of sodium 28 grains, chloride of magnesium 2 grains, chloride of calcium 13 grains, sulphate of sodium 11.5 grains, tartrate of iron and potassium ⅓ grain, water 21 fluidounces; dissolve and impregnate with carbonic acid gas (Soubeiran).

Carlsbad.—Sulphate of sodium 54 grains, sulphate of magnesium 5¼ grains, carbonate of sodium 36¾ grains, chloride of sodium 7 grains, chloride of calcium 7 grains, tartrate of potassium and iron ⅛ grain, water 21 fluidounces; proceed as before (Soubeiran).

Seidlitz.—Sulphate of magnesium 7½ drachms, water 22 fluidounces; proceed as before; or

Dissolve 7½ drachms sulphate of magnesium and 1 drachm of bicarbonate of sodium in 22 fluidounces of water; add 1 drachm of crystallized tartaric acid, and cork the bottle well (*Fr. Cod.*).

Sulphur-water (to imitate *Barèges*, *St. Sauveur*, etc.).—Crystallized sulphide of sodium and chloride of sodium 2 grains, water previously boiled to deprive it of air 22 fluidounces; dissolve (*Fr. Cod.*).

Vichy.—Carbonate of sodium 112 grains, carbonate of potassium 2½ grains, sulphate of magnesium 5 grains, fused chloride of calcium 4½ grains, chloride of sodium 1¼ grains, arseniate of sodium $\frac{1}{22}$ grain, powdered iron $\frac{1}{65}$ grain, water 21 fluidounces; dissolve and impregnate with carbonic acid gas (Lefort).

Physiological Action.—The use of spring-waters more or less impregnated with substances imbibed by them in the bowels of the earth has existed in all ages. A knowledge of their virtues, as of many other useful medicines, was very probably learned by observing the instinctive use of them by the lower animals. Tradition runs that some of the most famous of German springs owe their reputation originally to their use by sick animals, and that others were eagerly visited by the kine at certain seasons of the year. It is certain that our own Saratoga, which is now annually crowded by gay votaries of fashion as well as by the dejected victims of a morbid civilization, was long resorted to by the aboriginal savages for the cure of their infirmities. In ancient Greece temples were in many places erected near mineral springs, whose waters were used under the direction of the priests, who thus became the earliest physicians, and who taught that hygiene and medicine must go hand in hand, and proved that faith has no small share in the cure of disease. But the "scientific medicine" of the present day treats the human body as if it were so much brute matter to be subjected to analytical and synthetical reagents for the purpose of evolving definite results; the true physician, on the other hand, never neglects the vital and physical elements of man, and sagaciously enlists in behalf of his patients all the powers of external nature as well as the quickening influences of faith and hope. Formerly, mineral waters could be made use of by those persons only who were able to visit the springs, but now they are carried to great distances, and even across the ocean, for those who require them; their saline residue, after evaporation of the water, has equally become an article of commerce; and chemical ingenuity has imitated the solid constituents of the most important springs, without, however, securing the effects produced by the natural combinations.

Attempts to explain the action of medicines exclusively by scientific methods have not resulted satisfactorily. Upon this subject we are entirely in accord with Trousseau, who addressed his clinical class in these words: "Distrust medical theories that originate in the laboratory. Although Chemistry may be the handmaid of Medicine, she goes beyond her sphere when she applies the conclusions of the laboratory to the treatment of the sick. Chemistry stands no nearer to Medicine because she teaches us how to prepare or to analyze medicines, than she does to the art of painting because she prepares the painter's colors. . . . Say what the chemists may, mineral waters do not operate alone by means of their predominant mineral constituent. It is associated with many others which they have demonstrated, and probably with others still that have escaped their research; and nature has done for this element what we attempt every day to do in pharmacy when we seek to enhance or to mitigate the power of a medicine by associating it with others." Then, referring to the well-known fact that the therapeutical reputation and efficacy of mineral waters do not depend upon the amount of their mineral constituents, this sagacious teacher in substance observed: "The *malarial cachexia*, for instance, is wonderfully modified by springs whose mineral elements really elude discovery, and are far less than those which impregnate the drinking-water of Paris; and certain intractable dyspeptic disorders are cured by them in a manner which I neither can nor seek to explain. Under their salutary influence the appetite revives, the constitution becomes reorganized; patients affected with dropsy or visceral engorgements arrive at Plombières or Bigorre in a deplorable condition, and after a single season have been greatly improved and often most unexpectedly cured." Even anciently it was understood that the medicinal virtues of a spring do not depend altogether upon the degree of its mineralization, for Pliny refers to the Paduan waters as having neither taste nor smell. It would, however, be unjust to these natural medicines to suppose that they are not, on the whole, valuable in proportion to their mineralization; indeed, we may go further, and measure and define their value by the proportion of their predominant ingredient, be it saline, alkaline, sulphurous, or chalybeate, for if we subtract this one element the special virtues of the water vanish. On the other hand, it is notorious that the medicinal use of such elements isolated from their natural associations no longer produce the effects of the original mineral waters. In these facts again we perceive the excellency of nature and the insufficiency of self-sufficient art.

There are, indeed, two classes of patients who require the use of very different mineral waters. The first is composed of that large body of invalids in whom there exists no organic change of structure, but whose functions are merely weakened or clogged by the strain of business, the exhaustion of pleasure, sensual excesses in eating or drinking, or, in this country especially, by the manifold errors committed in the preparation and consumption of food and the disregard of hygienic rules in their habits of living. The second consists of that smaller but still numerous class of persons who, besides being more or less injured by the causes of ill-health just enumerated, have been affected with definite diseases, and especially rheumatism, gout, calculous disorders, cutaneous eruptions, scrofula, syphilis, diabetes, paralysis, uterine disorders, etc. Of these two classes, the former are benefited most by a visit to the less mineralized springs, while the latter require a course of active medicinal treatment such as the stronger mineral waters afford. In both classes of patients, but particularly in the first, the action of the waters is only one out of many influences that combine to restore their health. Toward that end a total change of habits is one of the most influential agencies in very many cases. Escape from the anxieties and fatigue of business, from the excitement of fashionable life, the mental tension of political and professional pursuits, the worrying annoyances of domestic affairs, endured perhaps in a large city with all its enervating social duties, its Babel-like sounds, and its polluted atmosphere,—escape from these alone ought to suffice to restore the disturbed balance of health. When we consider how much more probable must this result become when fatigue, anxiety, contention, wearisome routine, and foul air are exchanged for repose and peace in the midst of novel scenes and new associates and freedom from the onerous conventionalities of fashionable life, different apartments, food, and occupation, it may even seem doubtful whether, after all, some other new residence would not profit the invalid as much as the frequented springs. But there are two reasons against this conclusion: the one is, that with many persons relief would be impossible without an exercise of the faith which gives potency to waters as well as to other remedial agents; and the other is, that even the purest of these waters, systematically used, especially in conjunction with bathing and regular exercise, do in a greater or less degree depurate the system through the kidneys, bowels, and skin, and by a gentle but sustained action gradually remove the effete products of tissue-change from the system and free the organs from the burdens that oppressed and the poisons that tainted them. Judiciously used under the advice of a competent physician, these almost neutral waters and the milder saline springs are capable in a few weeks of changing the languid, indifferent, pale, and feeble invalid into the lively and energetic leader of the gay crowd. Such rapid transformations are frequently witnessed, especially at the hot springs of Virginia and certain

European springs, such as Wildbad, Gastein, and Pfeffers, none of which contain any considerable proportion of mineral ingredients. But these waters, whether drunk warm or cold, if they are largely used act as organic purgatives, and increase materially the total amount of solids, and especially of urea, excreted with the urine, without causing the debility which an equal discharge from the bowels would occasion.

Waters of the other class, rich in mineral ingredients, have a more direct relation to certain special forms of disease. Alkaline waters, for example, are particularly adapted to the treatment of *gout* and *rheumatism;* sulphurous waters to that of the same diseases and of scaly *eruptions* of the skin; ferruginous waters to the cure of *anæmic* disorders; salines, to that of chronic *dyspepsia*, *constipation*, *hæmorrhoids*, etc. But as these several waters are classed only according to their predominant ingredient, and each one contains several others of real even if of secondary importance, it is evident, as before intimated, that neither their physiological nor their curative operation can be regarded as the effect of only one of their constituents, although it may happen to be the principal one. Moreover, it cannot be assumed that the same water or class of waters has but a single mode of action; for, although it is probably true that alkaline waters cure both gout and rheumatism in virtue of their alkalinity, yet sulphurous waters which cure rheumatism, but do not cure gout, must necessarily produce their effect in a different manner. It is evident, therefore, that while it may be possible to determine a certain scientific relation between particular mineral waters and the diseases they generally relieve, we are as far from comprehending their *modus operandi* as we are from understanding the actions of mercury, iodine, opium, quinia, or colchicum in the several conditions which they palliate or cure.

The temperature at which mineral waters are used materially influences their effects, whether they are taken internally or employed as baths. Indeed, as above stated, some hot springs which have for ages maintained their fame are but faintly or not at all mineralized; but there is hardly an instance of a cold spring destitute of active medicinal properties that enjoys much credit as a medicine. The operation of warm and hot water is described elsewhere. The highest reputation belongs, perhaps, to those mineral waters which are both hot and strong, and which modify nutrition in every part and quicken depuration through the bowels, the kidneys, and the skin. The energy with which they act is shown by the occurrence of phenomena which are known as "crises" when they are caused by the internal use of thermal waters, and as the "bath fever" when due to their external application. Both have in common a feverish condition, attended by languor, debility, and lightness of the head—symptoms which appear to be due to a rapid and excessive loss of tissue, for they are identical with the effects of over-fatigue. When this state is induced by bathing it is usually accompanied with papular, vesicular, or erythematous eruptions upon the skin, which may be ascribed in part to the copious sweating induced, but partly also to the irritating action of the caloric and of the mineral elements of the waters.

It may be proper to add that the use of mineral waters by persons suffering from organic heart disease, obstruction of the glandular portion of the kidneys (Bright's disease), a tendency to cerebral disease, the advanced stages of pulmonary consumption, etc., should be very cautiously advised and very watchfully conducted.

Medical Uses.—To describe with any detail the application of mineral waters to the cure of diseases is here impossible; we shall only endeavor to sketch an outline of the subject, which is deserving of far more attention than it generally receives:

1. *Sulphur-Waters.*—Their virtues vary greatly according to the qualities of the waters themselves, and particularly according to their purgative action and their internal or external use. That they affect the whole system is proved by the elimination of sulphuretted hydrogen during their use, so that silver articles worn near the skin are blackened. They differ from other mineral waters in having a sedative operation when applied externally, especially when their sulphurous element exceeds their saline or calcareous in energy. They are employed in a great variety of disorders, both internally and externally. The more purgative varieties have a great vogue in almost all forms of chronic *dyspepsia*, but especially in those which result from high living and are attended with congestion of the liver, constipation, and jaundice. In such cases the non-purgative sulphur-waters are more injurious than useful, causing plethora and its consequences. Indeed, the dyspeptic cases held to be profited by these waters are much more so by the non-sulphurous salines. Sulphurous waters, on the other hand, are more useful in chronic *skin diseases*, including eczema, psoriasis, pityriasis, lichen, and acne, and they are most so when used in baths. Their internal use, apart from special indications, is superfluous.

Such indications may be presented by *scrofula*, especially of the glandular sort, in which a long-continued but moderate use of the waters is most profitable. In this affection the baths should be prolonged as much as possible. When *gout* is connected with the above conditions these waters are less serviceable than the saline and alkaline. Probably, in the cure of chronic *rheumatism* more than in that of any other disease sulphur-waters stand pre-eminent—in the muscular forms first, and in the articular less conspicuously. They probably act as diaphoretics and diuretics, and hence as eliminants, when taken internally; while in warm baths, which is the best mode of using them, they both promote elimination and by their local action remove the pain, swelling, and stiffness of the joints. The hotels at sulphur springs often contain museums of crutches, wheel-chairs, etc. left behind by patients who arrived as cripples and departed with supple limbs. In ancient times such articles would have formed *ex-voto* offerings in the temples. As *syphilis* is a specific poison in the system, it might be supposed that the searching operation of sulphur-waters, in their several modes of application, would tend to remove it, but such is seldom the result; and, indeed, very often the use of these waters revives the signs of the disease in persons who had been regarded as entirely cured. On the other hand, when there is a cachectic condition present, induced by an excessive mercurial treatment, such waters may greatly contribute to improve the health. *Lead-poisoning*, it is well known, in its chronic and constitutional forms, is more successfully treated by sulphur-baths than by any other agent except iodide of potassium. They form a most important adjuvant to the latter medicine. Their utility in *paralysis* will depend upon its nature, as whether it be of central origin with substantial lesions, or due to imperfect nutrition, or else wholly peripheral. In the first they can only be adjuvants; in the other cases they may effect a cure. But it is probable that they act in no other way than by promoting the general health through their internal use, and stimulating the paralyzed muscles externally in the same way as friction, electricity, etc. In paralysis following cerebral or spinal apoplexy there is great danger in using thermal sulphur-waters to excess. Of local diseases for which the waters are useful may be mentioned—first, chronic *pharyngitis*, especially of that granular form, which is so often associated with dyspepsia, and was formerly known as "clergyman's sore throat." Saline sulphur-waters internally and applied locally by atomization are very successful in relieving it. The same may be said of chronic *bronchitis*, especially when it occurs in gouty or rheumatic persons and with dilatation of the bronchia, and in a less degree of chronic *laryngitis* of the simple form. Yet the tubercular and the syphilitic forms may sometimes be improved by them. Sulphur-waters have been much used in diseases of the uterine system, especially in *sterility*, *amenorrhœa*, and *leucorrhœa;* but little is to be expected from them in such affections unless they are used as baths, warm or cold according to the patient's condition. The feebler sulphur-waters, if they contain iron, may be drunk with advantage. Finally, sulphur-waters are useful in various *surgical diseases*, but chiefly waters of the thermal variety, which operate by their heat rather than by the sulphurous compounds they contain. It may be admitted, however, that the latter elements increase their stimulating power.

2. *Alkaline Waters.*—The dominant part which the chemical reaction of the animal humors plays in vital processes explains the extraordinary potency of alkaline, and in some degree of saline, mineral waters; for the functions of digestion, respiration, etc. depend in a great measure upon the relative amount of acidity or alkalinity of the animal fluids. Alkaline mineral waters, then, may be used so as to neutralize or diminish this acidity, and thereby produce a corresponding change in the physiological action. In point of fact, these waters have long been known as the most efficient in chronic gout and rheumatism and the numerous disorders which depend on them; and the form of *dyspepsia* most successfully treated by their use is attended with excessive acidity of the gastro-intestinal secretions, with sour or rancid eructations and regurgitations, flatulent distension of the abdomen, tenderness of the epigastrium, etc.; and all the more so if it is connected with a gouty diathesis. The waters are most efficient when they are highly charged with carbonic acid gas. If there is gastric irritability they must be taken in small doses. *Skin diseases* are not favorably influenced by alkaline waters internally or in baths, and the same is true of *scrofula*. Among all the known alkaline springs, there is only one which can be regarded as pre-eminently curative in *gout*, and that is at Vichy in France. The waters are most usefully as well as conveniently employed internally, but care must be taken not to drink of them too copiously, lest plethoric phenomena arise, nor to run the risk of impoverishing the blood by using them for too long at a time. In this country there is no alkaline spring, properly so called; the nearest approach

to belonging to the category of such springs is made by the St. Louis Spring, Mich., but its water contains only 7.684 grains of carbonate of sodium to the pint, while the Grande Grille Spring at Vichy contains nearly three times as much. Moreover, the former spring holds carbonate and sulphate of lime in large amount, while the latter contains a very small proportion of the former, and of the latter none at all. *Gastralgia*, occurring paroxysmally, is reputed to be frequently cured by these waters taken hot and in the intervals between the paroxysms. It may be doubted whether the heat does not act curatively—as much, at least, as the mineral constituents of the water. Certainly, solutions of bicarbonate of sodium will not relieve gastralgia unless great acidity of the stomach is also present. In chronic *rheumatism* (which is the only form of rheumatism in which the medication by alkaline mineral waters can conveniently be tried), whether muscular or articular, alkaline waters are very highly esteemed, but they are chiefly used in warm baths. No doubt can exist in regard to the efficacy of alkaline waters in removing the symptoms of *gall-stones*. Some persons suppose that these concretions are dissolved by the waters, but of this there is no proof whatever. Others believe that the bile itself is rendered more watery by their use. It is certain that the salts of Vichy and of Carlsbad waters even in this country relieve the symptoms of this affection, provided they are administered in hot water and so as to represent nearly the strength of the natural springs. In the treatment of acid *urinary concretions* and their effects alkaline waters are of great value. They operate as diuretics, and also by neutralizing the excessive acidity of the urine. In the former way they often cause a copious discharge of acid sand. By removing the chief cause of irritation in the urinary passages they tend to cure the catarrh which may affect their mucous membrane. The usefulness of alkaline waters in *diabetes* does not admit of any doubt, however difficult it may be to explain their mode of action. It has been remarked that they are more efficacious when the patient is stout than when he is thin. In favorable examples the progress of the disease may be stayed by them for years. But "diabetes mellitus is an incurable disease," even by Carlsbad water. (See Mayer, *Med. Record*, xvii. 120.)

3. *Alkaline-saline* mineral waters, which form some of the most famous European springs, including those of Carlsbad, are represented in this country chiefly by the Gettysburg Spring, Pa., the St. Louis Spring, Mich., Capon Springs, Va., Sheldon Springs, Vt., and several in California. They are more or less purgative and diuretic, and are used with great advantage in the same diseases for which alkaline waters proper are employed, but especially in chronic *dyspepsia*, disorder of the *liver*, *gall-stones*, *gout*, *rheumatism*, *gravel*, and morbid *mental* conditions associated with digestive derangements. They are very useful in *uterine* engorgements and *irritability*. They are palliatives of saccharine *diabetes* and of *Bright's disease*, especially those of them which contain a considerable proportion of iron; they have also some repute in the treatment of chronic inflammation of the *pharynx* and *larynx*. According to the purpose for which they are used, the dose should be large or small—the former when a purgative operation is desired, the latter when an alterative action is sought. In the laryngeal and pharyngeal affections named these waters are very useful in the form of an atomized spray.

4. *Acidulous saline* waters are employed in almost the same diseases as the last-mentioned class. Their usefulness is notably increased by the carbonic acid gas with which many of them are charged, and which serves to mask the taste of the sulphates of sodium and magnesium or of the chloride of sodium which they contain, and to make them more acceptable to the stomach. Their mode of action is through a gradual elimination of the accumulated tissue-waste, and the increased activity which is thereby communicated to the whole glandular system. The most celebrated of American springs of this class are those of Saratoga. They are said to attract more than eighty thousand persons annually. Although they are not identical in composition, they differ so little from one another as to exert essentially the same influence on the system. It is so far from negative or indifferent that the use of such waters at unseasonable times and in improper quantities, and by persons who do not need them at all, has been the cause of incalculable mischief. Every one who requires them is also in need of judicious advice in using them. This is seldom to be obtained from the resident physicians or from those who are casual visitors. On the continent of Europe every mineral spring is provided with one or several physicians who are entitled by their knowledge and skill, as well as by their official station, to give wholesome advice regarding the use of the waters. Medical advisers of like competency are greatly needed at the popular watering-places of this country.

5. *Chalybeate* mineral waters are the best representatives of ferruginous medicines,

because they not only enter the system more readily, and therefore improve the blood more rapidly, than artificial preparations of iron, but because the hygienic conditions attending their use are of the most salutary effect. When they contain sulphate of iron (as in the Rockbridge Alum Springs and several others in Virginia) they are especially serviceable in profluvia, as chronic *diarrhœa*, *dysentery*, *diabetes*, *bronchorrhœa*, *leucorrhœa*, etc.

ARALIA.—Aralia.

Aralie, Fr., G.
Nat. Ord.—Araliaceæ.

The following plants have been employed:

1. Aralia nudicaulis, *Linné*, *U. S.* 1870.—False or wild sarsaparilla, Small spikenard, Wild liquorice, *E.;* Racine d'aralie à tige nue, Petit nard, *Fr.;* Nackte Aralienwurzel, *G.*—It is a perennial plant indigenous to Canada and the United States, where it grows in rich and rocky woodlands as far south as Carolina and Tennessee. The rhizome sends up a single petiole about 12 inches (30 Cm.) long and three-parted at the summit, each division bearing five ovate or oval-serrate and subsessile leaflets. The scape is about 6 inches (15 Cm.) high, and divided into three or five peduncles, each about 2 inches (5 Cm.) long and bearing a globose umbel of many greenish flowers. The rhizome, which is the part employed, is several feet long, horizontal, with some slender branches, and sparingly beset with a few radicles. The internodes are indistinct and the undeveloped buds alternate. The dry rhizome is about $\frac{1}{4}$ inch (6 Mm.) in diameter; the few scape-scars are shallow, cup-shaped, and approximate at the upper annulated end of the branches; the bark is longitudinally wrinkled, of a somewhat glossy pale brownish-gray color externally, the corky layer being easily removed from the white inner bark, which does not firmly adhere to the cylindrical wood. The latter is about $\frac{1}{8}$ inch (3 Mm.) in diameter, of a yellowish color, and encloses a spongy white amylaceous pith. The rhizome breaks with a short fracture, is somewhat aromatic, and has a mawkish taste.

2. Aralia racemosa, *Linné.*—American spikenard, Spignet, Pettymorrel, *E.;* Nard américain, *Fr.;* Amerikanische Narde, *G.*—This plant grows in rich and rocky woods in Canada and the United States. It has an herbaceous stem about 40 inches (1 M.) high, and ternately and quinately divided leaves with ovate or heart-ovate doubly serrate leaflets; the flowers are in small umbels arranged in branching racemes. The rhizome with the roots was, like the preceding drug, formerly known as *Nardus americanus.* The rhizome is oblique, 4 to 6 inches (10 to 15 Cm.) long, and half as wide; the nodes are approximate, and the stem-scars prominent, about 1 to $1\frac{1}{2}$ inches (25 to 38 Mm.) in diameter, the older ones deeply concave. The roots are numerous, from 20 to 30 inches (50 to 75 Cm.) long, about 1 inch (25 Mm.) or more thick near the rhizome, and little branched below. It has a stronger aromatic odor and taste than the preceding.

The *California spikenard* (Aralia californica) resembles the preceding, but the plant and the root are much larger.

3. Aralia spinosa, *Linné*, *U. S.* 1870.—Aralia-bark, Angelica tree, Toothache bush, Prickly ash, Prickly elder, Hercules' club, *E.;* Ecorce d'aralie épineuse, *Fr.;* Dornige Aralienrinde, *G.*—This shrub or low tree is indigenous to the Southern States, and cultivated farther north. It grows to the height of 12 or, in favorable locations, 30 feet (3.5 to 9 M.); the leaves, which are crowded near the summit, are often from 4 to 6 feet (1.2 to 1.8 M.) in length, and bi- or tripinnate, with ovate pointed, serrated, and sessile leaflets, which are glaucous beneath. All parts of it are medicinal, but the bark is usually employed. It is in thin quills or curved pieces, the inner surface of which is nearly smooth and yellowish; the outer surface gray, scarcely fissured, smooth or with slight longitudinal ridges, and beset with slender prickles in transverse rows or marked with some short transverse ledges. The layer beneath the thin cork is green or brownish-green; the inner bark whitish, composed of concentric layers, and breaks with a rather tough but nearly smooth fracture. The bark has a slight aromatic odor and a bitterish, pungent, and acrid taste.

Constituents.—These drugs contain a little volatile oil, resin, starch, sugar, pectin, etc. L. H. Holden (1880) has isolated from aralia-bark the bitter principle *aralin* in the form of pale yellow scales, and J. K. Lilly (1882) obtained it in a purer state by precipitation with subacetate of lead. It is insoluble in benzin, chloroform, and ether, soluble in alcohol, and freely soluble in water, this solution forming a persistent froth on agitation. On boiling with dilute hydrochloric acid glucose is formed and white, tasteless *araliretin*, which is insoluble in water. The acrid taste of the bark is due to a resin soluble in alcohol, but insoluble in ether.

4. ARALIA EDULIS, *Siebold*, is indigenous to Japan, and cultivated there. In appearance and size the rhizome resembles Solomon's seal, but the circular stem-scars are somewhat spirally arranged, about half an inch apart, and the wood is in radiating bundles.

5. ARALIA PAPYRIFERA, *Hooker*, indigenous to Formosa, contains a thick white pith, which, cut into thin layers, constitutes the so-called Chinese *rice-paper*.

Medical Action and Uses.—The name of "false sarsaparilla" applied to Aralia nudicaulis denotes the qualities which have been attributed to it—viz. of being stimulant, diaphoretic, and alterative. But the proofs of its virtues are unsatisfactory. It is used in decoction and infusion, both internally and externally.

Aralia spinosa is thought to be more stimulating than A. nudicaulis, but its uses are nearly the same. In South Carolina it was reputed to be a valuable remedy for chronic *rheumatism* and diseases of the skin, and it is said to be implicitly relied upon by the negroes as an antidote to the *rattlesnake's bite*. The bark is used for this purpose both internally and externally. A saturated tincture is said to have been given in the dose of half a fluidounce (Gm. 16) three times a day, and a decoction was used prepared with an ounce (Gm. 32) of the bark and a quart of water.

ARECA, *Br. Add.*—ARECA-NUT.

Semen Arecæ.—*Betel-nut*, E.; *Noix d'arec*, Fr.; *Arekanuss*, *Betelnuss*, G.

The seed of Areca Catechu, *Linné*, the betel-nut tree. Bentley and Trimen, *Med. Plants*, 276.

Nat. Ord.—Palmæ.

Origin.—This elegant palm, which attains a height of about 50 feet (15 M.), is indigenous to the East Indies and the East Indian Islands, and is extensively cultivated there and in the Philippine Islands. The orange-colored fruit is of about the size and shape of a hen's egg, and contains under a fibrous pericarp a single seed.

Description.—The seed, which is the so-called areca- or betel-nut, is about an inch (25 Mm.) in length, roundish-conical in shape, and somewhat depressed at the base. It is of a brown color externally, with numerous reddish veins, originating at the hilum and forming a network which penetrates into the white albumen, and gives to the latter internally a marbled appearance; the small embryo is situated near the base of the seed. Areca-nuts are heavy, very hard, and have, when recently broken, a feeble somewhat cheese-like odor and an astringent and slightly acrid taste.

Constituents.—Areca-nuts contain about 14 per cent. of fixed oil, which is solid and crystalline at the ordinary temperature, and about the same amount of a red tannin which is insoluble in ether, slightly soluble in water, and resembles catechu-tannic acid in producing a green and afterward a brown color with ferric salts. Catechin is not present. The nuts yield 2.26 per cent. of ashes containing ferric oxide and magnesium phosphate (Flückiger and Hanbury). The aqueous extract of these seeds yields a kind of catechu.

Medical Uses.—Areca is astringent, and is chiefly used for the expulsion of *tapeworms*. From 2 to 3 drachms (Gm. 8–12), powdered and mixed with syrup, is stated to be the proper dose. Before being used to destroy these parasites in man it was largely employed for a similar purpose in dogs.

ARGEMONE.—PRICKLY POPPY.

Argémone, F.; *Stachelmohn*, G.

Argemone mexicana, *Linné*.

Nat. Ord.—Papaveraceæ.

Description.—This annual is indigenous to Mexico, Colorado, and the West Indies, but has been introduced and naturalized in most tropical and subtropical countries. It is about 2 feet (60 Cm.) high, has alternate sessile, sinuate-lobed leaves with prickly teeth and white spots, and yellow or white flowers, about 1½ inches (38 Mm.) in diameter, with 6 petals and many stamens. The ovate prickly capsule is about an inch (25 Mm.) thick, crowned with the nearly sessile radiate stigmas, and contains numerous blackish finely-pitted seeds. The plant has a bitter and acrid taste, and when wounded exudes a yellowish milky juice.

Constituents.—Charbonnier (1868) claims to have found a small proportion of morphine in the leaves and capsules; like several allied plants, it probably contains sanguinarine. (See CHELIDONIUM.) The seeds yielded him 36.2 per cent. (by pressure 18 per cent., Lepine, 1861) of a drying fixed oil of a light-yellow color and bland taste. O. Frölich (1871) obtained from the oil a pretty hard soda-soap, and found in the soap-liquor butyric, valerianic, acetic, and a little benzoic acid. According to Flückiger (1871), the oil has the spec. grav. .919 at 16.5° C. (61.8° F.), remains clear at $-6°$ C. (21.2° F.), dries slowly and incompletely, is not soluble in 6 volumes of 90 per cent. alcohol, as stated by Charbonnier, and has a mild purgative effect in doses of 4 or 5 grains.

Medical Action and Uses.—The principal quality of this plant appears to be its acrimony, in which, as well as in the physical properties of its inspissated juice, it resembles gamboge. In Mexico and in Java its fresh juice is applied to *warts* and indolent *ulcers* and in *psorophthalmia* and *opacities of the cornea.* The fresh leaves are also bruised and used as a dressing for ulcers. The juice is employed as a hydragogue cathartic in *dropsy.* Some narcotic virtue has been ascribed to the seeds, which are said to be used for smoking when mixed with tobacco. But while one authority describes them as suitable, like opium, for checking diarrhœa, another compares them to ipecacuanha, a third holds them to be purgative, and a fourth as purgative and anodyne also. The oil, derived by expression from the seeds, is reported to purge in the dose of 30 drops (Gm. 2). An infusion of the herb is stated to be used in Mexico as a sudorific.

ARGENTI CYANIDUM, *U. S.*—CYANIDE OF SILVER.

Argentum cyanatum.—Cyanure d'argent, Fr.; *Silbercyanid, Cyansilber*, G.

Formula AgCN = AgCy. Molecular weight 133.7.

Preparation.—Take of Nitrate of Silver, Ferrocyanide of Potassium, each 2 troyounces; Sulphuric Acid 1½ troyounces; Distilled Water a sufficient quantity. Dissolve the nitrate of silver in a pint of distilled water and pour the solution into a tubulated glass receiver. Dissolve the ferrocyanide of potassium in 10 fluidounces of distilled water, and pour the solution into a tubulated retort previously adapted to the receiver. Having mixed the sulphuric acid with 4 fluidounces of distilled water, add the mixture to the solution in the retort, and distil by means of a sand-bath, with a moderate heat, until 6 fluidounces have passed over or until the distillate no longer produces a precipitate in the receiver. Lastly, wash the precipitate with distilled water and dry it.—*U. S.* 1870.

On distilling ferrocyanide of potassium with sulphuric acid, hydrocyanic acid passes over (see ACIDUM HYDROCYANICUM), which reacts with the nitrate of silver, forming nitric acid, and cyanide of silver, which precipitates; $HCy + AgNO_3$ yields $HNO_3 + AgCy$. To avoid loss of silver the distillation should be continued as long as a precipitate is produced in the solution.

Properties.—Cyanide of silver, when dry, forms a white amorphous, inodorous, and tasteless powder, which gradually turns brown on exposure to the light, and is best preserved in amber-colored or black vials. When heated it fuses, giving off one-half of its cyanogen, and suffering further decomposition by a higher heat, leaving finally metallic silver. It is insoluble in simple solvents and in diluted acids, but is decomposed by chlorine-water, by warm solutions of chlorides and iodides, and by boiling concentrated acids, with the evolution of hydrocyanic acid, furnishing with boiling nitric acid nitrate of silver, but crystallizing from hot diluted nitric acid, partly in minute prisms. It is readily soluble in ammonia and hyposulphite of sodium, somewhat soluble in ammoniacal salts, and forms soluble double salts with the alkaline cyanides. Dilute hydrochloric acid decomposes it, yielding chloride of silver and hydrocyanic acid.

The only use of this salt in medicine is to serve for the extemporaneous preparation of diluted hydrocyanic acid.

ARGENTI IODIDUM, *U. S.*—IODIDE OF SILVER.

Argentum iodatum.—Iodure d'argent, Fr.; *Silberjodid, Jodsilber*, G.

Formula AgI. Molecular weight 234.3.

Preparation.—Dissolve 1 part each of nitrate of silver and potassium iodide separately in 10 or 12 parts of water; pour the silver solution gradually and with continued stirring into the solution of potassium iodide; collect the precipitate upon a filter; wash it well with distilled water and dry it upon bibulous paper. 1 ounce of silver nitrate yields 1.34 to 1.37 ounce of silver iodide. By mutual decomposition of the two salts silver iodide and potassium nitrate are produced; $AgNO_3 + KI$ yields $AgI + KNO_3$. The former salt, being insoluble in water, is freed from the latter by washing with distilled water. The use of a slight excess of the potassium salt ensures the stability of the silver iodide in the light (H. Vogel). Should the potassium iodide be contaminated with chloride, the precipitate will likewise contain silver chloride, which, being freely soluble in ammonia, is readily removed by adding to the mother-liquor before decantation 1 or 2 parts of ammonia-water, stirring well and allowing to settle. It is advisable to keep the salt in amber-colored vials, protected from the light.

Properties.—Silver iodide is "a heavy, amorphous, light-yellowish powder, unaltered by light if pure, but generally becoming somewhat greenish-yellow, without odor and taste, and insoluble in water, alcohol, diluted acids, or in solution of carbonate of ammonium; soluble in about 2500 parts of stronger water of ammonia. When heated to about 400° C. (752° F.) it melts to a dark-red liquid, which on cooling congeals to a soft, yellow, slightly translucent mass. When mixed with water of ammonia it turns white, but regains its yellowish color by washing with water. It is dissolved by an aqueous solution of cyanide of potassium, and the resulting solution yields a black precipitate with hydrosulphuric acid or sulphide of ammonium. If a small quantity of chlorine-water be agitated with an excess of the salt, the filtrate acquires a dark-blue color on the addition of gelatinized starch."—*U. S.* The color of melting silver iodide varies according to the temperature between yellow, red, and dark red-brown. At a white heat the salt may be sublimed, but when heated before the blowpipe upon charcoal it burns with a green flame and white smoke, leaving a little silver behind. Warm potassa solution imparts a brownish color to the salt and decomposes it on continued boiling. A concentrated solution of potassium iodide dissolves the salt, which is reprecipitated on dilution with water.

Tests.—"If the salt be boiled with test solution of carbonate of ammonium previously diluted with an equal volume of water, the resulting filtrate, on being supersaturated with nitric acid, should not be rendered more than faintly opalescent (absence of chloride)."—*U. S.* The Pharmacopœia omits to give a special test for silver bromide, which salt, however, on exposure to light speedily acquires a dark-purple color.

Action and Uses.—This appears to be superfluous addition to the Pharmacopœia. Long since obsolete, it was at one time vaunted in the treatment of *syphilis*, of visceral *neuralgia*, *asthma*, *chorea* (Guibert, *Nouveaux médicaments*, p. 427), and even of *whooping cough* (*Practitioner*, iv. 373). The dose prescribed varied from ⅛ grain to 2 grains.

ARGENTI NITRAS, *U. S., Br.*—NITRATE OF SILVER.

Argentum nitricum crystallisatum, *Azotas* (*Nitras*) *argenticus*.—*Nitrate* (*Azotate*) *d'argent*, *Nitre lunaire*, Fr.; *Silbernitrat*, *Salpetersaures Silberoxyd*, *Silbersalpeter*, G.

Formula $AgNO_3$. Molecular weight 169.7.

Preparation.—Take of Purified Silver 3 ounces; Nitric Acid 2½ fluidounces; Distilled Water 5 ounces. Add the nitric acid and the water to the silver in a flask, and apply a gentle heat till the metal is dissolved. Decant the clear liquor from any black powder which may be present into a porcelain dish, evaporate and set aside to crystallize; pour off the liquor and again evaporate and crystallize. Let the crystals drain in a glass funnel, and dry them by exposure to the air, carefully avoiding the contact of all organic substances. Nitrate of silver must be preserved in bottles carefully stoppered.—*Br.*

When silver is dissolved in nitric acid, nitrate of silver is formed and hydrogen set free; the latter reacts with another portion of nitric acid, forming water and nitric oxide, which is a colorless gas, but on contact with the atmosphere is oxidized, so as to form red vapors of hyponitric acid. These reactions are explained by the following equations: $6HNO_3 + 3Ag_2$ yields $6AgNO_3 + 3H_2$; $3H_2 + 2HNO_3$ yields $4H_2O + 2NO$; $2NO + O_2$ yields $2NO_2$. The final results of the process under the circumstances stated are, therefore, water, nitrate of silver, which remains in solution, and hyponitric acid, which escapes. If insufficient heat is applied during the reaction the nitric oxide generated remains wholly or in part in solution, reducing the excess of nitric acid to nitrous and hyponitric acids. Should the solution be made in a porcelain capsule, it will be found of advantage to invert a glass funnel over the mixture, whereby not only some nitric acid, which would otherwise escape, is condensed and flows back into the dish, but the loss of silver solution by sputtering is likewise prevented. Since the best refined silver usually contains minute quantities of other metals, particularly copper, their removal becomes necessary, and is effected either by crystallization, when the impurities, together with some silver, will remain in the mother-liquor, or the solution is evaporated to dryness and the crystalline or granular mass further heated until it is fused and ceases to give off acid vapors. The nitrate of copper and other metals are decomposed by heat before the silver nitrate is affected, and the fused mass acquires a more or less dark-gray color in proportion to the amount of cupric oxide contained in it. The latter, being insoluble in water, is easily removed by dissolving the cooled salt in distilled water and decanting or filtering the solution before evaporating it. The purification of the silver nitrate by fusion was the process recommended by the U. S. P. 1870. In following it, unless the heat be very carefully regulated, some nitrate of silver will be reduced to nitrite, and contact with organic matter will tend to deoxidize it. It is therefore advisable to acidulate the solution with a little nitric acid.

Both processes are applicable in cases where the metallic impurities are small in quantity. If silver coin is used, the first crystallization will not be pure, and if evaporated to dryness and fused a portion of oxide of silver will be separated. In such a case it is advisable either to treat the first crop of crystals by fusion or to purify the silver by one of the processes given elsewhere. (See ARGENTUM.)

Properties.—Nitrate of silver exists in colorless shining tabular crystals of the rhombic system, which are inodorous and have a caustic and strongly metallic taste and a neutral reaction. Kremers (1854) ascertained that 1 part of silver nitrate dissolves at 0° C. (32° F.) in 0.82 parts, at 11° C. (51.8° F.) in 7.83 parts (Schnauss), at 19.5° C. (67° F.) in 0.44 parts, at 54° C. (129.2° F.) in 0.20 parts, and at 110° C. (230° F.) in 0.09 parts of water. Eder found the salt soluble at 15° C. (59° F.) in 26 parts, at 50° C. (122° F.) in 13.7 parts, and at 75° C. (167° F.) in 5.5 parts of alcohol (sp. gr. .817). It is likewise, though less freely, soluble in ordinary ether, but nearly insoluble in absolute ether, freely soluble in diluted but sparingly soluble in strong nitric acid. It melts at 198° C. (388.4° F.), and on cooling congeals to a white crystalline mass; at a higher temperature nitrous vapors are given off, leaving oxide and nitrite of silver; heated to a dull-red heat, metallic silver is left. The crystals and the aqueous solution are permanent in the air and light, except in the presence of organic matter, whereby they acquire a dark color. The alcoholic solution when exposed to the light is gradually reduced, silver being separated. Hydrochloric acid produces in the solution a white curdy precipitate of argentic chloride, which is insoluble in dilute nitric acid, but dissolves readily in ammonia. Stains produced by nitrate of silver upon the skin are removed by rubbing them with a strong solution of cyanide of potassium, or by moistening them first with a solution of iodine and afterward with hyposulphite of sodium. The solution of silver nitrate acidulated with nitric acid and heated with alcohol produces the violently explosive compound known as *fulminating silver.*

Nitrate of silver contains no water of crystallization.

Tests.—1 Gm. of nitrate of silver, when completely precipitated by hydrochloric acid, should yield 0.84 Gm. dry chloride of silver, *U. S.;* 10 grains of the nitrate yield 8.44 grains of chloride, *Br.* The salt should yield with ammonia a clear and colorless solution (absence of copper, lead, etc.), and its aqueous solution, when precipitated by an excess of hydrochloric acid, should yield a filtrate which is not colored by hydrosulphuric acid, and when evaporated leaves no residue (absence of other salts). The aqueous solution, mixed with four times its volume of diluted sulphuric acid and heated to boiling, should not be turbid, *P. G.* This test indicates the absence of lead, the sulphate of which is insoluble, while silver sulphate is soluble in 68.6 parts of boiling water.

Pharmaceutical Uses.—Nitrate of silver is used in the preparation of the other medicinal compounds of silver and of indelible ink.

INDELIBLE INK is frequently made of nitrate of silver. From the numerous formulas recommended we select the following: Dissolve 2 drachms of nitrate of silver in 7 fluidrachms of distilled water, and add 1 fluidrachm of mucilage of gum-arabic, colored with sap-green or other coloring matter. This ink is used after a mordant, which is a solution of carbonate of sodium and gum in water, of the strength of 1 part of the former to from 5 to 10 of the latter (Cooley).

1 part of silver is dissolved in 6 parts each of distilled water and mucilage of gum. It is to be used with a mordant composed of 1 part of hypophosphite of sodium, 2 of gum-arabic, and 16 of distilled water (Kuhr).

The following indelible inks are used without mordant:

8 parts of nitrate of silver and 3 parts of tartaric acid are triturated together; a little water is then added, and afterward a sufficient amount of ammonia-water to neutralize

the free acid and dissolve the tartrate of silver; lastly, a little gum and coloring matter is added (Reade).

Nitrate of silver and bitartrate of potassium, of each 8 drachms, are rubbed together and dissolved in 4 ounces of ammonia-water; 4 drachms of archil, 6 of white sugar, and 10 of powdered gum are added, and when solution has taken place sufficient water to make the whole measure 6 fluidounces (Redwood).

ARGENTI NITRAS DILUTUS, *U. S.*—Diluted Nitrate of Silver.

Argenti et potassii nitras, Br.; *Argentum nitricum cum kalio-nitrico*, P. G.; *Argentum nitricum fusum mitigatum*, *Lapis infernalis nitratus.—Nitrate of silver and potassium*, *Mitigated caustic*, E.; *Azotate d'argent mitigé*, *Pierre infernale dilué*, Fr.; *Salpeterhaltiger Höllenstein*, G.

Preparation.—Nitrate of Silver 50 parts; Nitrate of Potassium 50 parts; to make 100 parts. Melt the salts together in a porcelain crucible at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then cast it in suitable moulds. Keep the product in dark amber-colored vials, protected from light.—*U. S.*

Silver nitrate 1 part, potassium nitrate, 2 parts.—*P. G.*, *Br.*

Properties.—"A white, hard solid, generally in form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in presence of organic matter; odorless, having a caustic metallic taste and a neutral reaction. Each of its constituents retains the solubility in water and in alcohol mentioned respectively under Argenti Nitras and Potassii Nitras."—*U. S.* The pencils are less fragile and more opaque than those made of pure silver nitrate. They will contain silver nitrite, and blacken on exposure to light if the salts had been melted at too high a heat. If made with sodium nitrate they become superficially moist in a damp atmosphere.

Tests.—"An aqueous solution of 2 Gm. of the compound, acidulated with nitric acid, when completely precipitated by hydrochloric acid should yield not less than 0.84 Gm. of dry chloride of silver. The filtrate, separated from the precipitate, when evaporated to dryness leaves a residue which is completely soluble in water, and which yields a white, crystalline precipitate with a concentrated solution of bitartrate of sodium."—*U. S.* The filtrate from the silver chloride should not be affected by hydrosulphuric acid or solution of sodium carbonate. The Pharmacopœia permitting the presence of a trace of chloride in potassium nitrate, a minute quantity of silver chloride may remain on dissolving the diluted silver nitrate in distilled water.

Action and Uses.—This is merely a mitigated form of moulded nitrate of silver, and may sometimes be found convenient when a slight caustic action is intended.

ARGENTI NITRAS FUSUS, *U. S.*—Moulded Nitrate of Silver.

Argentum nitricum (fusum), P. G.; *Lapis infernalis*, *Azotas (Nitras) argenticus fusus.—Fused nitrate of silver*, *Lunar caustic*, E.; *Nitrate (Azotate) d'argent fondu*, *Pierre infernale*, Fr.; *Höllenstein*, *Geschmolzenes salpetersaures Silberoxyd*, G.

Preparation.—Nitrate of Silver 100 parts; Hydrochloric Acid 4 parts. Melt the nitrate of silver in a porcelain capsule at as low a temperature as possible; then add to it gradually the hydrochloric acid; stir well, and when nitrous vapors cease to be evolved cast the melted mass in suitable moulds. Keep the product in dark amber-colored vials, protected from light.—*U. S.*

To obtain the nitrate in rods, fuse the crystals in a capsule of thin porcelain or platinum, and pour the melted salt into proper moulds.—*Br.*

The reasons for the cautious application of heat when fusing nitrate of silver have been pointed out above. (See Argenti Nitras.) The salt being decomposed by nearly all the metals when heated with them, capsules of platinum or of the best porcelain are the only vessels suitable for this operation. When fused it has the appearance of a colorless, transparent, oily liquid, and is then ready to be poured into the moulds, which should be faced with pure silver. Brass moulds are sometimes used, but they are liable to contaminate the product with copper. Steel or porcelain moulds may be used after they have been rubbed with some powdered French chalk, which prevents the fused salt from adhering to the mould. If the moulds have been previously warmed to about 40° or 50° C. (104° or 122° F.), the fused mass will not congeal too rapidly. Oiling the moulds should be avoided, lest a reduction of the salt should take place.

Properties.—Moulded *pure* silver nitrate is met with in nearly colorless thin cylinders or pointed cones, which when broken show a crystalline texture upon the fractured surface; in solubility, chemical behavior, and composition it agrees with the crystallized nitrate. It is not affected by light unless it has been partly reduced by too high a heat to nitrate of silver or been in contact with organic matter; wrapping the sticks in paper or handling them with the fingers should therefore be avoided. The pencils are rather brittle, but the addition of a little silver chloride, as proposed by Dr. Squibb (1858), renders the sticks more opaque and tough. This is now recognized by the U. S. P., and contains about 5 per cent. of silver chloride, which is left undissolved on treatment with water; it is likewise insoluble in dilute nitric acid, but is completely soluble in ammonia-water. "Toughened caustic," *Br.*, consists of silver nitrate 95 parts, and potassium nitrate 5 parts.

Tests.—"A filtered aqueous solution of 2 Gm. of the salt, acidulated with nitric acid, when completely precipitated by hydrochloric acid should yield 1.6 Gm. of dry chloride of silver."—*U. S.* This test allows a little over 5 per cent. of AgCl. For the pure lunar caustic the same tests may be applied as for the crystals. Oxide or metallic silver in very fine division is occasionally present, either in consequence of too high a heat having been employed or because the sticks have been in contact with organic matter; it will be left behind as a black powder on treating the sticks with distilled water. A convenient and readily-applied test for the purpose of detecting the presence of alkaline salts is the following: A small portion of fused nitrate of silver, rubbed into fine powder with twice its weight of sugar, forms a mixture which when burned upon a surface of glass or porcelain leaves a tasteless residue.—*U. S.* 1870. The salts of alkalies, if present, will impart a saline or alkaline taste.

Physiological Action.—*On Animals:* Experiments upon animals show that when a solution of nitrate of silver is injected into a vein the symptoms produced are dyspnœa, choking, spasms of the limbs and then of the trunk, signs of vertigo consisting of inability to stand erect or walk steadily, and finally retching and vomiting, and death by asphyxia. These symptoms, which have usually been attributed to the coagulating action of the salt upon the blood, have been shown not to depend upon that change, which indeed does not occur, but upon a direct paralyzing operation upon the cerebro-spinal centres and upon the heart; but the latter action is subordinate and secondary, and the former is fatal through asphyxia. Experiments with hyposulphite of silver injected into the cellular tissue have furnished substantially the same results, but with a predominance of nervous phenomena, including debility, torpor, somnolence, impaired muscular co-ordination, convulsion, spasm, and paralysis, during or subsequent to which, and as a consequence of the muscular disorder, respiration becomes labored and the lungs are at last engorged. The heart continues to act after the other muscles have become paralyzed. These effects, however, and some resembling them, are met with in animals that have taken silver salts internally; but there is not the slightest analogy between them and the action of those salts on man, even when they have been used long enough to thoroughly impregnate the system. The toxical action of nitrate and albuminate of silver, given internally or hypodermically to animals, is described in the results obtained by Bogoslowsky. The fundamental effect is upon the blood, which grows darker and more liquid; the red corpuscles lose their hæmoglobulin and become transparent and pale, while their lost coloring matter goes to augment that of the bile. The feces increase and grow darker, while the urine is diminished in quantity, its specific gravity is raised, and it contains albumen. The mucous membranes are affected with catarrh, the muscles waste, and the blood stagnates in the vessels or transudes through the serous membranes. The liver, kidneys, heart, and fatty deposits undergo more or less atrophy. All of these effects are ascribed to a derangement of nutrition, which is equivalent to fatty degeneration—a lesion like that produced by phosphorus, arsenic, and antimony, and which reduces the organic power of the whole system. The experiments of Rózsahegzi appear to show that animals under the use of this salt steadily lose weight—that the tracheal and bronchial mucous membranes become darkly hyperæmic, while the lung-tissue is congested and may contain hepatized nodules. The epithelium of the air-passages is degenerated and the vesicles are distended with cells. The liver is at first congested and enlarged, but subsequently undergoes fatty degeneration and resorption of its cells, as well as consecutive hypertrophy of its connective tissue. In the kidneys the changes are very similar, and their tubules are distended with epithelial débris. The muscular tissue, including that of the heart, loses its color and firmness, and suffers more or less fatty change; the animal temperature is lowered by full doses of the salt; the increased waste of tissue is not indicated by the fecal discharges, nor do they contain more than a very minute proportion of the salt, which is excreted chiefly with the urine. The conclusion drawn from these results of experiment is, that the action of nitrate of silver consists essentially in causing a degradation, dissolution, and waste of the tissues, and mainly by modifying the constitution of the blood-corpuscles, as above mentioned. It would be very difficult to harmonize the various actions attributed to nitrate of silver—its primary operation upon the blood on the one hand, and its primary action upon the nervous system upon the other; nor does either theory explain very satisfactorily the virtues attributed to the medicine in the one or two nervous diseases for which alone its systemic operation is claimed to be beneficial.

On Man: Applied to a mucous membrane or to the raw skin, nitrate of silver causes a severe smarting and burning pain, and forms a white pellicle by coagulating the albumen and fibrin of the part, which speedily dries. Upon the sound skin its prolonged application occasions vesication with a surrounding red border, but it does not cause ulceration of the chorion, and the superficial loss of substance is rapidly restored. The cauterized surface, by exposure to the light, gradually turns brown, and even black. The case is recorded of a man who for the space of a year was accustomed to dye his hair and beard with a solution of nitrate of silver. He suffered from general depression, giddiness, mental debility, hardness of hearing and tinnitus, spasm of the muscles of the eyes and face; all of which symptoms speedily disappeared on ceasing to use the hair-dye. Taken internally, by far the larger portion of the salt is discharged as a chloride of silver with the feces, but that a portion also is retained is certain, partly from its therapeutical effects, but more evidently from the peculiar violet discoloration of the exposed portions of the skin produced by its prolonged use, as well as from its detection in the kidneys, choroid plexuses, etc. An analogous stain is sometimes observed on the gums and inner surface of the cheeks before the skin is affected. As long ago as 1814, Roget reported the case (*Med.-Chir. Trans.*, vii. 290) of a lady who, after taking nitrate of silver for some time, "observed that the tongue and fauces had acquired a dark color as if stained with ink," and that subsequently the complexion grew dark. In some instances the internal organs have been found discolored as well as the skin. In the tissues the deposit is stated to exist as an oxide or as metallic silver. Several cases are recorded in which the characteristic stain followed repeated applications of lunar caustic to the throat, but doubtless the salt was swallowed (*Phila. Med. Times*, ix. 479). Nitric acid and also iodide of potassium taken internally are reported to lessen the intensity of the discoloration caused by the absorption of this salt. It is worthy of notice that when discoloration of the skin is produced by the prolonged use of small doses of the salt no other symptoms occur which can be attributed to its operation.

Doses of one-half a grain occasion no special symptoms, but larger quantities are apt to cause gastric heat, pain, and nausea. But much depends upon whether the stomach contains food or not. In poisonous doses it occasions gastric irritation and diarrhœa as its direct effect, and indirectly loss of consciousness, anæsthesia, convulsions, muscular exhaustion, a faint pulse, and a cold, clammy skin. In some cases of chronic poisoning by it a scorbutic condition is alleged to have been observed resembling that produced by this salt in animals, as already narrated. Nitrate of silver by its long-continued use has ulcerated the stomach, and a portion of fused nitrate has been arrested in the fauces and caused swelling of the glottis, in both instances destroying life.

Medical Uses.—*Internally:* In various disorders of the *stomach*, including morbid sensibility of that organ from chronic *inflammation*, *neuralgia*, and chronic *ulcer*, the use of nitrate of silver has sometimes relieved pain, checked vomiting and acid eructations, and restored health by promoting healthy digestion. The difficult diagnosis of such cases renders the application of the remedy uncertain, but its benefits are sometimes striking. *Diarrhœa*, whether dependent upon debility of the intestine or upon ulceration due to tuberculosis, or chronic dysentery, or prolonged typhoid fever, is favorably modified by nitrate of silver. In *dysentery* which is either subacute or has not entirely passed into the chronic stage enemata containing the salt are to be preferred. For these purposes about a quarter of a grain may be given by the mouth in pill, and a grain by the rectum in solution. Even in Asiatic *cholera* the medicine may be advantageously exhibited both by mouth and rectum. There is some evidence of its utility in chronic *jaundice* from an accumulation of thick bile in the ducts. Its sedative action upon the heart, demonstrated by experiments upon animals, receives a confirmation from experience, which shows it to be a palliative of abnormal action of the *heart* in organic as well as functional disease of that organ. In like manner, its action upon the lungs is illustrated by its beneficial effects in some cases of *bronchitis* with muco-purulent expectoration and hectic fever. But its efficacy in nervous diseases is still more evident in the apparent cures of *epilepsy* attributed to its use. The special forms of the disease which it most favorably influences are undetermined. It must be given for a long time, commencing with doses of one-quarter of a grain three times a day, and gradually increased. Every 3 or 4 weeks its administration should be suspended for a few days in order to diminish the risk of staining the skin. Since the introduction of the bromides this medicine has, like many other antiepileptic remedies, been almost entirely neglected. In that form of paralysis known as *locomotor ataxia* (sclerosis disseminated or limited to the lateral columns) nitrate of silver is reported to have effected cures; but a close scrutiny of the matter shows that the cases cured were not examples of this disease, but of *congestion of the cord*, generally associated with rheumatism, but sometimes resulting from concussion (ex. gr., *St. Bart.'s Hosp. Rep.*, xv. 176). In not a few instances this salt, in doses of from one-tenth to one-fifth of a grain several times a day, has effected cures when other methods failed. Relief of *dysmenorrhœa* has been attributed to the internal use of this medicine in doses of one-eighth of a grain three times a day (Blackwood, *Phila. Med. Times*, xii. 518).

Locally: Lunar caustic has been extensively employed in the treatment of *diphtheritic exudations* of all kinds in *diphtheria*, *croup*, etc., and there is no doubt that it sometimes appears to modify favorably the affected surfaces and to prevent the increase and extension of false membranes. In the case of laryngeal croup it was at one time the custom to introduce into the larynx a strong solution of the salt (40 grains to the ounce of water) by means of a sponge or brush, but more recently an atomized solution of the same strength has been substituted. In pharyngeal diphtheria, in which the existence and condition of the false membrane are more demonstrable, as well as the influence of treatment upon it, the tendency of opinion among the most judicious physicians is less favorable than formerly to any form of local cauterization. It is alleged—and our own observation leads us to believe—that this method, which was at one time regarded as essential, is often injurious by the irritation it causes and the extension of the deposit which follows its use. In laryngeal *croup* the results of the treatment appear to be more favorable, but it must not be forgotten that the diagnosis of the disease from simple laryngitis is often obscure, and also that the immediate dependence of life upon the freedom of the larynx and trachea from obstruction must modify the conclusions arrived at in regard to the laryngeal as compared with the pharyngeal affection. The advantages of nitrate of silver in *chronic ulceration* and *simple inflammation* of the larynx and trachea are unequivocal. It exerts here the same stimulant and protective influence that it does over similar lesions elsewhere, and thus promotes the restoration of the parts to health as far as possible. As ulcers of the larynx are never primary, but always dependent upon a diathetic influence (tubercle, syphilis, cancer), a cure of them by local treatment alone is not to be expected; but this method is invaluable for the relief it affords to suffering by palliating the symptoms which the local lesions occasion. In *simple chronic laryngitis* the same treatment may suffice for a permanent cure. Many cases of *aphonia* depending upon this affection may thus be permanently cured. The stimulant action of solutions of nitrate of silver, applied by sponge, brush, syringe, or atomizer, is most efficient in the various forms of simple laryngitis, and also in nervous aphonia and in *whooping cough.* In the last-mentioned affection the pharynx as well as the larynx should be impressed by means of an atomized solution of the salt. In all the inflammations of the *pharynx*, whether acute or chronic, solutions of nitrate of silver have been used, diluted in the more acute and superficial forms and strong in the chronic follicular and ulcerous affections of the part. They are signally useful in that form known as *clergyman's sore throat*, and are the best palliatives of *tubercular* and *syphilitic* ulcers of this part. A comparatively weak atomized solution is more efficient in these cases than a strong solution applied with a sponge or brush.

If in any case it is possible to prevent *tonsillitis* from passing into *quinsy*, this end may be most securely reached by the application of lunar caustic freely to the swollen gland. But the termination in suppuration can never, in a particular case, be predicted with certainty. It sometimes happens also that this use of the caustic appears to promote and not to hinder suppuration. Local vesication by means of a saturated solution of the crystallized salt or with the fused nitrate is an efficient means of treating various local ailments. It may be used over the superficial portions of nerves in various *neuralgiæ;* superficially also over *lymphatic vessels* and *glands* in the first stage of inflammation; *paronychia* and other forms of local inflammation, such as *abscesses*, may be treated in the same way. It has been used to blister the brow in *iritis*. It has been also applied by deep injection in *sciatica*. The value of this treatment may be measured by the fact that a precisely similar result ensued upon the injection of pure water. The silver salt so injected causes severe pain, followed by abscess. The substitutive action of nitrate of silver is pre-eminently useful in *ophthalmia* or *conjunctivitis*. In different degrees of strength it may arrest the development of a mild inflammation or so modify the membrane as to cure the most chronic forms of this affection. The disused practice of producing counter-irritation in these affections by blistering the brow with this caustic has been recommended anew (*Med. Times and Gaz.*, Dec. 1879, p. 635). In treating *ulcers* of the *cornea* care should be taken lest the undissolved or precipitated salt should permanently stain the structure and form an obstacle to distinct vision. *Blepharitis*, or inflammation of the follicles of the edges of the lids, is said to be well treated with an ointment of nitrate of silver (gr. iij to ℥j), but it is better to touch the parts with a strong solution of the salt and then cover them with simple ointment. Of all agents for modifying *ulcers*, none is so frequently applied as nitrate of silver. Its internal use for this purpose has already been noticed, but it is still more commonly applied to ulcers of the external integument—to the irritable in weak solution as an astringent, stimulant, and protective, and to the indolent in caustic form to destroy inert tissue, or rather to revive its dormant vitality. Probably no other single agent is so useful in the treatment of ulcers, or none whose effects can be so readily modified by the degree of action allowed in its application. Thiersch has used a solution of 1 part of the salt to 1000 of water to make subcutaneous injections around and beneath indurated ulcers, with the effect of curing some which resisted all other methods. The operation is painful and should be performed during anæsthesia (*Boston Med. and Surg. Jour.*, May, 1881, p. 500). Fused nitrate of silver, in the form of a fine point, is an efficient means of arresting hæmorrhage from *leech-bites*. This caustic has been used with advantage in treating punctured and lacerated *wounds*, and especially *poisoned* wounds. In the former case it produces a protective film, and in the latter probably tends to destroy the virus. It is one of the best remedies for *mercurial sore mouth* in its ulcerative stage. Its stimulant and protective actions combined make it a useful application to *ulcers* of the skin, and especially to those of an indolent character; and these, as well as its action upon the specific virus of *chancres*, render it a valuable agent in their first stage. It is generally held that if induration have already taken place this treatment will not prevent constitutional infection, but some maintain that it is useless, no matter how early it is employed. A similar ectrotic method has been used to prevent pitting in *small-pox*, and often with apparent success. The application of a strong solution of the salt during the papular, or early in the vesicular, stage sometimes arrests the development of the pocks. The same method has been used in *zona*, *herpes*, and *intertrigo*, but in the last-named affection the solution should be weak (gr. v to f℥j). In the treatment of *sore nipples* the caustic pencil may be applied to the fissures or ulcers or the part may be enveloped with lint wet with a weak solution of the salt. A case is recorded in which a *vascular nævus* of the hand was injected with a few drops of a concentrated solution of the salt. Intense pain immediately followed and coldness of the limb, and two fingers became black and dry up to the second joint, and subsequently were amputated (*Phila. Med. Times*, xi. 795).

Burns, if superficial, may be treated with the fused preparation, or merely brushed over with a strong solution of the nitrate and then closely enveloped in lint or carded cotton. The same method has been much employed in *erysipelas* when it affects the face alone, and also when it involves the scalp. A strong solution is to be preferred, and the earlier in the attack it is used the more apt are its effects to be beneficial. It must, however, be remembered that erysipelas of the face is not usually a local inflammation merely. Nitrate of silver is of great value in treating several diseases with purulent discharges, as *otorrhœa*, *gonorrhœa*, and *leucorrhœa*. In the second of these affections it should be cautiously used, at least in the male, during the acute stage; too strong a solution has been known to cause violent inflammation of the urethra and bladder, orchitis, etc. The former custom of treating inflammation of the *neck of the bladder* by means of Lallemand's *porte-caustique* has been imitated by injecting a solution (1 part to 50) from a hypodermic syringe with a very long nozzle enclosed in a fenestrated bougie with an olive-shaped extremity (*Bulletin de thérap.*, xcvii. 580). It is the best application in gonorrhœa of the glans penis, or *balanitis;* if the prepuce cannot be withdrawn a solution of the salt may be injected. It should be of the strength of gr. xx–xxx to f℥j, and a similar one may be used for gonorrhœa in the female and for leucorrhœa. If the latter affection has its source in the neck or body of the uterus, the solution or the solid caustic may be introduced into that organ. But this is an operation attended with serious risks unless performed with the utmost caution. It has been successfully employed to cure *amenorrhœa* from uterine torpor, a solution of 1 or 2 grains to the ounce being injected into the cavity of the uterus. Braun of Vienna, who is opposed to the production of abortion to relieve the *vomiting of pregnancy*, states that he has arrested this symptom completely by applying to the vaginal portion of the neck of the uterus a 10 per cent. solution of nitrate of silver (*Practitioner*, xxviii. 447).

A solution of 1 or 2 grains to the ounce injected into the bladder is efficient in the treatment of *vesical catarrh*. *Ascarides* of the rectum are said to be destroyed by injections of nitrate of silver containing about 3 grains of the salt to an ounce of water. *Strictures of the urethra* are habitually treated with the solid nitrate applied by means of the caustic-holder of Lallemand. This method is most applicable to linear and spasmodic strictures. The same treatment, applied to the prostatic portion of the urethra, has been much in vogue as a remedy for *involuntary seminal emissions*, and is often efficient where these discharges depend upon debility, and therefore morbid excitability, of the sexual organs, induced by prolonged self-abuse. Nitrate of silver may assist in removing *corns* after the hardened and thickened cuticle has been removed by prolonged maceration in warm water or by a poultice. As often as the blackened lamina exfoliates the operation should be repeated.

Administration.—By the mouth, nitrate of silver is nearly always given in a pill, which should be made with some bitter vegetable extract, but not with bread-crumb, which contains salt. But even such precautions do not long prevent its decomposition. It should be administered when the pills are freshly made and the stomach is empty, in order to delay this result. Such, at least, is the usual direction, but it is pretty certain that under no circumstances is the nitrate of silver absorbed unchanged. The dose is from ¼ grain to 1 grain (Gm. 0.01–0.06) three times a day. A convenient mode of preserving fused nitrate of silver is to dip the stick into melted sealing-wax, which gives it a coating that protects it from the air and prevents its staining the fingers. A tougher preparation than the fused nitrate is prepared by mixing with the latter a portion of oxide of silver. 5 parts of nitrate of silver melted with 1 part of nitrate of lead form another compound, of which cylinders are made not liable to fracture and that can be cut like a lead-pencil. The stick of lunar caustic may be pointed by rotating it upon a hot silver coin. The stain of nitrate of silver upon the skin, clothing, etc. may be removed by a solution of cyanide, and somewhat less perfectly by a solution of iodide of potassium; or the stain may be moistened with tincture of iodine, and then with ammonia, and the colorless residue removed with water. A solution of 1 part each of ammonium chloride and corrosive sublimate in 10 parts of distilled water will remove the stains from the skin, and from woven stuffs without injuring the fabric. It must be kept in glass-stoppered bottles (Kaetzer). Flaxseed mucilage is also recommended for the same purpose. The proper *antidote* to nitrate of silver in the stomach is a large draught of a weak solution of table-salt, so as to decompose the nitrate and induce vomiting. The resulting irritation may be allayed by milk, which should also serve for food until the stomach is restored. The excessive action of the nitrate upon the fauces, vagina, skin, etc. may also be checked by salt and water.

ARGENTI OXIDUM, *U. S., Br.*—Oxide of Silver.

Oxidum argenticum, *Argentum oxydatum*.—*Argentic oxide*, E.; *Oxyde d'argent*, Fr.; *Silberoxyd*, G.

Formula Ag_2O. Molecular weight 231.4.

Preparation.—Take of Nitrate of Silver in crystals ½ ounce; Solution of Lime 70 fluidounces; Distilled Water 10 fluidounces. Dissolve the nitrate of silver in 4 ounces of the distilled water, and, having poured the solution into a bottle containing the solution of lime, shake the mixture well and set it aside to allow the deposit to settle. Draw off the supernatant liquid, collect the deposit on a filter, wash it with the remainder of the distilled water, and dry it at a heat not exceeding 100° C. (212° F.). Keep it in a stoppered bottle.—*Br.*

A similar process, but using a sufficient amount of solution of potassa in place of the lime-water, was recognized by the U. S. P. 1870. In both cases the nitrate of silver is decomposed, yielding oxide of silver, water, and nitrate of potassium or calcium; $2AgNO_3 + 2HKO$ yields $Ag_2O + H_2O + 2KNO_3$, and $2AgNO_3 + Ca2HO$ yields $Ag_2O + H_2O + Ca2NO_3$. It is important that these alkaline solutions, in place of which solution of soda may be used, should be free from chlorides, which would precipitate a portion of the metal as chloride of silver, and the presence of carbonate in the potassa or soda solution would cause the oxide to be contaminated with carbonate of silver. Oxide of silver may be likewise obtained, according to Gregory, by boiling recently precipitated moist chloride of silver with an excess of potassa solution, specific gravity 1.25 to 1.3, until a portion of the sediment is completely soluble in diluted nitric acid. To prevent the chloride from caking together, Mohr recommended the diffusion of it in some water and its gradual addition to the boiling potassa solution.

Properties.—Prepared by precipitation from the nitrate, oxide of silver is an inodorous olive-brown or blackish powder, having the spec. grav. 7.52 and a disagreeable metallic taste. Obtained by Gregory's process, it is black or bluish-black. It is slightly soluble in 3000 parts (Bineau) of water, the solution having an alkaline reaction and a metallic taste; the solution acquires a reddish tint in the light, and in the presence of carbonic acid becomes at first turbid and afterward clear again. The oxide is insoluble in alcohol and ether, forms carbonate when kept moist, and is slowly decomposed by exposure to light, and rapidly and completely by heating it to 300° C. (572° F.), into silver and oxygen; it should therefore be well dried and kept in dark amber-colored bottles, protected from light. Freshly-prepared oxide of silver is wholly, after drying and keeping only partly, soluble in ammonia-water, leaving a black powder, *Berthollet's fulminating silver*, and the solution depositing black crystals of the same compound, which is violently explosive. The oxide, moistened with creasote or when mixed with tannin, amorphous phosphorus, precipitated sulphur, the sulphides of arsenic and antimony, or with other readily oxidizable or combustible substances, renders these spontaneously inflammable.

Oxide of silver is soluble in solution of nitrate of barium, and yields with solutions of chlorides, bromides, and iodides the corresponding silver salts. It combines with acids, forming salts, many of which are colorless or white, and become dark-colored on exposure to light, some only in the presence of organic matter. Many metals, like zinc, lead, iron, copper, etc., precipitate metallic silver from the solutions of its salts, and a similar reaction takes place with phosphorus, phosphorous acid, many organic compounds, and deoxidizing agents.

The most characteristic reactions of solutions of silver salts are obtained with chromate of potassium, which produces a deep purplish-red precipitate soluble in nitric acid. Chlorides and cyanides yield white curdy precipitates insoluble in dilute nitric acid, soluble in ammonia and cyanide of potassium; bromides give a yellowish-white precipitate little soluble in ammonia; and with iodides a yellowish precipitate is obtained which is nearly insoluble in ammonia. The lemon-yellow precipitate obtained with orthophosphate of sodium is readily soluble in ammonia and nitric acid.

Tests.—Oxide of silver should be completely dissolved without effervescence in dilute nitric acid, and the solution, when precipitated by an excess of hydrochloric acid, should yield a filtrate leaving no residue on evaporation to dryness. 29 grains of the oxide, when heated to redness, leave a residue of metallic silver weighing 27 grains.—*Br.* 1 Gm. of the oxide, when treated with an excess of hydrochloric acid, should yield 1.236 Gm. of chloride of silver.—*U. S.*

Medical Action and Uses.—Oxide of silver appears to possess the virtues which belong to the nitrate, but in a much less degree. It is slightly caustic, and its prolonged internal use occasions a purplish color of the skin. It was at one time supposed to possess a peculiar power over passive *hæmorrhages*, particularly from the uterus, but it is not to be compared with several salts of iron, or even with certain vegetable astringents, in this respect. Owing to its less caustic qualities it may possibly be preferable to the nitrate in *gastralgia*, simple *gastric ulcer*, and painful *dyspepsia* depending upon irritability of the mucous membrane of the stomach. In all local affections which call for a mild stimulant and astringent, such as *catarrhal affections* of the nostrils, throat, larynx, vagina, urethra, etc., a weak solution of the nitrate of silver is greatly to be preferred. *Dose*, from ½ to 2 grains (Gm. 0.03–0.13) two or three times a day, incorporated with a vegetable extract. An ointment is used containing from 40 to 80 grains (Gm. 2.60–5.20) of the oxide to an ounce of lard.

ARGENTUM.—SILVER.

Argentum purificatum, Br.—*Refined Silver*, E.; *Argent*, *Argent raffiné*, Fr.; *Silber*, *Raffinirtes Silber*, G.

Symbol Ag. Atomicity univalent. Atomic weight 107.7.

Origin.—This metal was known and in use in the earliest historic period, and was called *Luna* or *Diana* by the alchemists. It is found pure and in combination with various metals, and with sulphur, chlorine, bromine, iodine, etc., the richest silver ores being in the Western United States, Mexico, Peru, Norway, Russia, Germany, and Spain.

Preparation.—The extraction of the metal is effected by different processes, the details varying considerably with the richness and the composition of the ore. The process of *amalgamation* is based upon the formation of an alloy between metallic mercury and silver. The finely-powdered ore is intimately mixed with chloride of sodium and then roasted, when the mass contains, besides metallic silver, its chloride, the latter being converted to the metallic state by agitation in a revolving cylinder with water and iron. Mercury is now added and the agitation continued, when the silver, gold, and copper unite with the mercury, the amalgam being obtained by subsidence and washing, and afterward separated into a liquid and solid portion by subjecting it to pressure in strong linen or leather bags. By distilling the solid portion the mercury is evaporated off and recovered, while the silver remains behind, containing copper and gold.

In the process of *cupellation* the galena containing silver is first reduced and the metallic lead allowed to cool slowly, when almost pure lead crystallizes, and is removed by means of a ladle or by carefully draining off the liquid portion, which is rich in silver. This is exposed to a red heat, and air directed upon it by means of a blast, whereby the lead is oxidized and the litharge blown off, leaving silver containing some lead. This is now transferred to a dish made of bone-ash and heated to redness; the plumbic oxide formed is absorbed by the porous vessel, and finally almost chemically pure silver is left.

By the careful roasting of the ore containing the metals as sulphides these are converted into sulphates, which are treated with hot water; from this solution the silver is precipitated by metallic copper, the latter being subsequently recovered by precipitation with iron.

Many modifications of these and some other processes are employed, the silver obtained on the large scale always retaining a small portion of other metals.

Chemically pure silver is obtained in various ways from the chloride, which is readily prepared free from other chlorides by precipitating the solution in nitric acid with hydrochloric acid and washing it thoroughly with water. The chloride of silver is then reduced by boiling it with glucose and sodium carbonate; the powdered silver thus obtained is well washed with acetic acid and water and then fused. Or the chloride is mixed with acidulated water and a rod of zinc introduced, the silver being afterward fused with borax and saltpetre. Or a mixture of the chloride with carbonate of sodium and of potassium is heated, whereby silver, alkali chlorides, carbonic acid, and oxygen are formed; $2AgCl + KNaCO_3$ yields $Ag_2 + KCl + NaCl + CO_2 + O$.

Properties.—Silver is a brilliant white metal, very ductile and malleable, having the specific gravity 10.47 when obtained by fusion; the pressed and the distilled silver have a density of 10.57. It may be drawn into very fine wire and beaten into very thin *silver-leaf, Argentum foliatum.* It melts at about 1000° C. (1832° F.), absorbs oxygen, which on cooling is again given off, but it does not oxidize in contact with the air or at a red or white heat, and distils at the heat of the oxyhydrogen blast. It tarnishes superficially through the sulphuretted hydrogen contained in the atmosphere, and dissolves completely in diluted nitric acid.

Tests.—The solution of chemically pure silver in hot diluted nitric acid, when precipitated by hydrochloric acid, yields a filtrate which is not darkened by hydrosulphuric acid, and on evaporation to dryness leaves no residue.

Pharmaceutical Uses.—Metallic silver is employed for making the officinal silver compounds, and in the form of silver-leaf serves occasionally as a coating for pills.

Medical Uses.—In its metallic form silver possesses no direct medicinal virtues. Its ductility, malleability, and slight susceptibility to oxidation fit it peculiarly for a vast number of uses in surgery.

ARMORACIÆ RADIX, *Br.*—HORSERADISH-ROOT.

Raifort sauvage, Moutarde des moines, Radis de cheval, Fr.; *Meerrettig, Merrettig,* G.

The fresh root of Cochlearia Armoracia, *Linné,* s. Armoracia (Cochlearia, *Lamarck*) rusticana, *Gærtner,* s. Arm. sativa, *Heller.* Bentley and Trimen, *Med. Plants,* 21.

Nat. Ord.—Cruciferæ, Siliculosæ.

Origin.—This perennial plant is indigenous to the eastern part of Europe, and cultivated in Western Europe and North America, where it has been naturalized. It has large oblong crenate or sometimes pinnatifid root-leaves on long channelled petioles, lanceolate stem-leaves, and a long racemose inflorescence; the flowers are white and the ascending pods roundish.

Description.—The root attains a length of from 1 to 2½ feet (30 to 75 Cm.) and a thickness of ½ to 1 inch (12 to 25 Mm.); it is cylindrical in shape and crowned with several annulated heads. It is covered with a light yellowish-brown corky layer, and breaks with a short fracture, exhibiting the fleshy white interior. The bark is thin, contains a number of yellow thick-walled cells, and is separated by a dark-colored cambium-line from the meditullium, in which the radiate arrangement of the vascular bundles and medullary rays, and frequently also the circles of annual growth, are easily discernible. A large central pith is found in the head. In its unbroken state it is nearly inodorous, but when broken or bruised it has a very pungent odor and a sharp acrid taste. It is employed in the fresh state only.

Constituents.—The volatile oil to which the odor and taste of horseradish are due has the same chemical composition as oil of mustard, $CSN.C_3H_5$, though it differs from it somewhat in odor; the crude oil, of which about $\frac{1}{20}$ per cent. of the weight of the fresh root is obtained, is of a light-yellow color; the rectified is nearly colorless, of 1.01 specific gravity, and becomes dark-colored by age. It does not pre-exist in the root, but, according to Boutron and Frémy (1840), is formed in a manner similar to that of the volatile oil of mustard. Besides the volatile oil, Gutret (1792) ascertained the presence of some bitter resin, extractive, sugar, starch, gum, albumen, acetates, and other salts, 12.5 per cent. of lignin, and 78.1 per cent. of water. Mutschler (1878) found the fresh root to lose 83.45 per cent. on drying, and then to yield 11.75 per cent. of ash, consisting mainly of potassium and calcium salts.

Off. Prep.—Spiritus armoraciæ compositus, *Br.*

Medical Action.—Horseradish, in the fresh state or pickled, has a very pungent and acrid taste, irritates the fauces and the nostrils, and causes a flow of tears. It is a familiar condiment, especially for beef. It excites a sense of warmth in the stomach, stimulates the appetite, and promotes digestion. In excessive doses it occasions burning at the epigastrium, nausea, and vomiting. It augments the urine, and probably the perspiration also, and gives to the former a peculiar odor. Externally applied, it reddens and sometimes blisters the skin. These qualities depend upon its volatile oil, which has at first a sweetish and then an extremely acrid taste and a pungent and very diffusive odor.

Uses.—Horseradish has had great renown as a remedy for *scurvy*, and the resemblance of its taste to that of scurvy-grass (Cochlearia officinalis) is noteworthy. The disease is much less common now than when anti-scorbutics were in vogue, and when this medicine ranked high among them. In the treatment of *dropsy* it has been replaced by more potent drugs. Nevertheless, it deserves its reputation as a diuretic in all forms of cardiac, renal, hepatic, and splenic dropsy which are characterized by a feeble, atonic condition of the system. It is advantageous as a condiment in many cases of *dyspepsia* with feeble appetite, oppression after eating, and flatulence, and in gastric debility attended with *vomiting* even when excited by reflex irritation. As a local irritant it is sometimes used to relieve *toothache*, to stimulate the *fauces*, to correct relaxed states of the mucous membrane, and to remove the hoarseness produced by congestion of the *larynx*. For these purposes it may be employed as a masticatory, or a strong infusion of it may be applied as a gargle. It may be resorted to as a counter-irritant in all the cases in which mustard is appropriate, to arouse sensibility, to relieve pain, excite motility, etc. A mixture of the juice with vinegar has been used to remove *freckles* and *tan* (*ephelis*). The compound spirit of horseradish is a convenient addition to diuretic infusions and mixtures. An infusion may be made with an ounce (Gm. 32) each of freshly-grated horseradish and bruised mustard-seed in a pint of hot water, macerated for 2 hours. A wine-glassful may be taken three or four times a day.

ARNICA.—ARNICA.

Arnique, *Arnica*, Fr.; *Wohlverleih*, *Fallkraut*, *Arnika*, G.

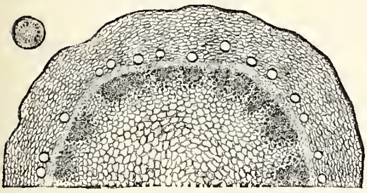
Arnica montana, *Linné.* Woodville, t. 17; Bentley and Trimen, *Med. Plants*, 158.
Nat. Ord.—Compositæ, Senecionideæ.

Officinal Parts.—1. ARNICÆ FLORES, *U. S.;* Flores arnicæ, *P. G.*—Arnica-flowers, *E.;* Fleurs d'arnica, *Fr.;* Arnikablüthen, *G.* The flowers.

2. ARNICÆ RADIX, *U. S.;* Arnicæ rhizoma, *Br.*—Arnica-root, *E.;* Racine d'arnica, *Fr.;* Arnikawurzel, *G.*—The rhizome and rootlets.

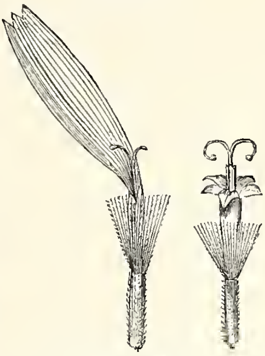
Origin.—This species of arnica is indigenous to Europe, growing upon the mountains of Switzerland and Germany and farther north in the plains. It is likewise met with in Northern Asia and in the north-western part of America. It bears a tuft of ovate or oblong-obtuse radical leaves with a nearly entire and ciliate margin, and produces a stem about 10 to 12 inches (25 to 30 Cm.) high, with a few lanceolate leaves and a few branches, each of which bears one flower. The flowers appear in May, and on drying lose about 80 per cent of their weight.

Fig. 30.



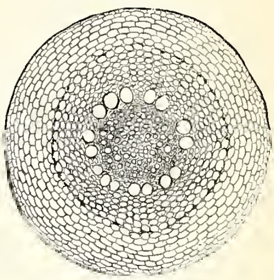
Arnica: transverse section of rhizome, natural size and magnified 10 diam.

Fig. 31.



Arnica montana, *Linné:* ray- and disk-floret.

Fig. 32.



Arnica: section through rootlet, magnified 25 diam.

Description.—1. The Rhizome. It is horizontal, somewhat contorted, 2 or 3 inches (5 to 7 Cm.) long, and ⅛ or ⅙ inch (3 or 4 Mm.) or less in diameter, longitudinally wrinkled, uneven, and rough from the scars of the decayed stems and leaves. Its color externally is dark-brown; the rather thick bark has about one-eighth the diameter of the rhizome, is internally whitish, and contains a circle of brown-yellow resin-cells. The yellowish wood forms broad wedge-shaped bundles and encloses a large central spongy pith. The numerous rootlets issue from the lower side of the rhizome, are 2 to 4 inches (5 to 10 Cm.) long, thin and fragile, and consist of a thick bark and a thin cylindrical cord of yellowish wood, which is surrounded by a circle of resin-cells.

Arnica-root is collected in the spring, and is occasionally found in the market with the radical leaves, which should be removed when used for medicinal purposes. It has a faintly aromatic odor and a rather persistent acrid taste.

2. The Flowers. The heads, which are from 1 to 2 inches (25 to 50 Mm.) in diameter, are surrounded by an involucre consisting of a double row of imbricated equal and hairy scales. The flat, finely-pitted, and chaffy receptacle is about ¼ inch (6 Mm.) in diameter, and bears fifteen to twenty pistillate bright-yellow, parallel ten-veined, and three-toothed ligulate ray-florets about an inch (25 Mm.) in length, and many perfect tubular five-toothed disk-florets. The brown and hairy akenes are slender, spindle-shaped, obtusely five-angled, brown, short-hairy, about ¼ inch (6 Mm.) long, and are crowned by a pappus consisting of a single row of denticulate gray hairs about ⅓ inch (8 Mm.) in length. The odor of the flowers is feebly aromatic and their taste acrid and bitter. The German Pharmacopœia directs the removal of the involucre and receptacle. The flowers, and more particularly the receptacle, are often attacked by the black larvæ of the arnica-fly, Trypeta arnicivora, *Loew.*, which must be removed. The powder of arnica-flowers is irritant and sternutatory.

Constituents.—Besides gum, wax, and salts the root and flowers contain two different volatile oils. The dry root yields about ½ to 1 per cent. of volatile oil, of nearly the density of water, and isobutyric acid, with small quantities of formic and angelic acid; old root yields more acids and less volatile oil than fresh root. The volatile oil, which boils between 214° and 263° C. (417° and 505° F.), is remarkable for containing at least three rare ethers—phloryl-isobutyrate, a phlorol-methylic ether, and, in largest proportion, the dimethylic ether of thymo-hydroquinone (Sigel, 1873). The name of *arnicin* has been applied to different principles found in the root and flowers. Pavesi's arnicin (1859), obtained by the process for preparing santonin, is a dark-yellow, sticky resin of a disagreeable bitter taste, which is not freely soluble in alcohol and ether, but readily in alkalies, from which solutions it is again precipitated by acids. Bastick's arnicine (1851) was obtained by exhausting the flowers with alcohol acidulated with sulphuric acid, treating the tincture with an excess of lime, adding to the filtrate sufficient sulphuric acid, evaporating, diluting with water, filtering, neutralizing with carbonate of potassium, again filtering, treating the liquid with excess of carbonate of potassium, and agitating with ether, on the evaporation of which arnicine is left. It is stated to have a bitter taste and alkaline reaction, and to yield with acids crystallizable salts. The arnicin of Walz

(1861) is a golden-yellow amorphous acrid mass, which is slightly soluble in water and soluble in alkaline liquids, in alcohol, and in ether. It may be prepared from the flowers, which contain it in larger proportion than the root, by passing the tincture through animal charcoal, evaporating, and treating the residue with ether, which dissolves arnicin and fat, the former of which is afterward dissolved by alcohol of 0.85 specific gravity. It is also obtained by precipitating the watery decoction with tannin, exhausting the precipitate with alcohol, and removing the tannin by oxide of lead, and the lead by sulphuretted hydrogen. By decomposition with alkalies and acids, resin, oil, and a volatile acid have been obtained.

Arnica root and flowers appear also to contain several resins, at least one of which is insoluble in ether and has an acrid taste. The root contains 10 per cent. of inulin, according to Dragendorff (1870).

Adulterations and Substitutions.—The flowers are said to be occasionally adulterated with other yellow composite flowers, but are easily distinguished by the characters given above: those of calendula and anthemis are destitute of pappus; those of inula, doronicum, and senecio have a naked receptacle; and those of scorzonera and tragopogon have all the florets ligulate. The rhizomes and roots of other Compositæ which are said to be occasionally collected by mistake for arnica-root differ from it in physical characters; there is no difficulty in distinguishing the latter from the root of Geum urbanum, noticed as an adulteration by E. M. Holmes (1874).

Off. Prep.—Of the flowers: Tinctura arnicæ florum, *U. S.* Of the root: Extract. arnicæ radicis, Extr. arnicæ rad. fluid., Tinct. arnicæ rad., *U. S.*; Tinct. arnicæ, *Br.*

Physiological Action.—*On Animals:* Experiments upon horses, in which an infusion of arnica was administered by the stomach or by the veins, proved this preparation to be a direct stimulant of the arterial and nervous systems of these animals, increasing the temperature and the secretion of urine; but its secondary effects consist of muscular tremors, depression, debility, and apparently anæsthesia. These effects are, however, transient.

On Man: The local action both of the root and the flowers of arnica is irritant, but that of the flowers is the more powerful. The tincture, applied for insignificant injuries, has occasioned inflammation and vesication. Fayrer relates that 6 days after having applied it to his wrist for a sprain the part was slightly stung by a nettle; immediately an inflammation of the skin arose, limited accurately to the previous contact of the arnica, but causing inflammation of the lymphatics of the limb (*Practitioner*, xvi. 52). Internally, a strong infusion irritates the throat, produces a burning pain in the stomach, tends to excite vomiting, increases the frequency of the heart's action, the respiration, and the secretions of the skin, bronchia, and kidneys, and occasions headache, giddiness, inability to stand or walk, and disturbed sleep. These symptoms are followed by depression and exhaustion. After excessive doses the phenomena of stimulation are not observed, but in their stead vomiting, purging, giddiness, oppression, debility, cold extremities, frequent pulse, dilated pupils, muscular spasms, and collapse, with infrequent pulse. Death is reported to have occurred in the case of a man who drank from 2 to 2½ ounces of the tincture (*Lancet*, July 10, 1880). The nauseant properties are said to belong to the flowers rather than to the root.

Medical Uses.—The conclusions respecting the operation of arnica to be drawn from the foregoing phenomena are essentially the same as those which its use as a medicine indicates. Its vogue has always been greatest in the treatment of affections that require stimulation. Especially has it been reputed to be an efficient stimulant in all diseases presenting the *typhoid state*, in the continued fevers which most frequently assume that condition, and in the various inflammations which it may complicate. As a disease which partakes of both natures, and which often presents the typhoid type, *dysentery* may be mentioned, and arnica is said to have been efficient in its treatment. Its stimulant local action has been thought sufficiently powerful to suggest its use in liniments and tinctures applied by friction to paralyzed muscles. In Germany this action has long been popularly employed for the relief of local *paralyses*, *bruises*, *sprains*, *abrasions*, slight *wounds*, etc.; whence its name *Fallkraut*, which may be translated *accident-plant*. It is alleged that only the infusion or decoction, and not the tincture, should be used for these purposes—a statement which popular experience would seem to contradict. Frictions with the tincture need not, however, prevent the more permanent influence of fomentations made with the flowers steeped in water or vinegar. Powdered arnica-flowers are said to limit the progress of *mortification*. 1 part of an extract of fresh arnica-flowers and 2 parts of honey, thickened with an inert powder if necessary, and kept applied to *boils*, is said to arrest their development at any stage (Planat, *Amer. Jour. of Med. Sci.*, Apr. 1878, p. 545). The watery preparations are, however, more suitable internally in the cases above alluded to of febrile disease, and also in those of exhaustion from shock; but their use should not prevent the more serviceable employment of alcoholic stimulants. The *dose* of the powdered root may be stated to be from 10 to 30 grains (Gm. 0.60–2.00). A decoction may be made with 120 grains (Gm. 8) of the root in 9 fluidounces of water reduced by boiling to 6 fluidounces. Of this the dose is a tablespoonful or more every 2 hours. An infusion is made of a drachm, and from that to an ounce (Gm. 4–30) of the flowers, in 6 fluidounces of water. *Dose*, a tablespoonful or more.

ARNOTTA.—ANNOTTA.

Orellana, Orleana.—Rocou, Terre de la Nouvelle-Orléans, F.; *Orlean*, G.

A coloring matter obtained from the seeds of Bixa Orellana, *Linné*.

Nat. Ord.—Bixaceæ.

Origin and Preparation.—This medium-sized tree is indigenous to tropical America, and produces roundish, heart-shaped, or subreniform capsules, containing numerous obovate, angular, whitish seeds, which are about ⅛ inch (3 Mm.) long and are covered with a dark-red pulp. The seeds are soaked or allowed to ferment in water, rubbed between the hands and upon a sieve, crushed, and finally completely mashed and again washed with water. The coloring matter subsides and is formed into cakes; the water likewise contains a coloring matter. (See paper by Th. Peckolt, in *Amer. Jour. Phar.*, 1859, p. 360.) The importation of annotta-cake and seed into this country has increased from 160,500 pounds in 1876 to 412,610 pounds in 1882.

Description.—Annotta, also called *annatto*, exists in cakes which are either plastic or hard, of a nearly blood-red color, becoming red-brown on exposure, of a peculiar odor and disagreeable saline and bitter taste. It is nearly insoluble in water, but colors it yellow, and dissolves almost completely in alcohol, ether, fixed oils, and alkalies, with an orange-red or dark-red color.

Constituents.—According to the investigations of John Kerndt (1849), Piccard (1861), Mylius (1864), and W. Stein (1867), annotta contains *orellin*, a yellow coloring matter soluble in water, and bright red *bixin*, which is not freely soluble in cold alcohol and ether, but readily dissolves in alkalies. The latter is colored blue by strong sulphuric acid, and with nitric acid produces a yellow body of a musk-like odor. Its composition is, according to Stein, $C_{15}H_{18}O_4$, according to Etti (1878), $C_{28}H_{34}O_5$. Annotta contains also a fatty acid, a turpentine-like body, and various other compounds. A. E. Ebert (1868) obtained from the air-dry seeds 5.15 per cent. of ash, the chief constituents of which are potassa, silica, and phosphoric acid.

Uses.—It is to some extent employed as a dyestuff for silk and other fabrics, and for the coloring of plasters and ointments, as well as of butter and cheese. For *butter-coloring* annotta is digested with alcohol until completely disintegrated, and then heated with four or five times its weight of olive or other bland oil; for *cheese-coloring* a little turmeric is added.

Adulterations with ochre, brickdust, sand, gypsum, and the like are discovered by their insolubility in hot alcohol.

ARSENII IODIDUM, *U. S., Br.*—IODIDE OF ARSENIC (ARSENIUM).

Ioduretum arseniosum, Arsenicum (Arsenum) jodatum; Arsenici iodidum, U. S. 1870.—*Arsenious iodide*, E.; *Iodure d'arsenic*, Fr.; *Arsenikjodür*, G.

Formula AsI_3. Molecular weight 454.7.

Preparation.—Triturate in a mortar finely-powdered metallic arsenic 75 grains and iodine 380 grains until they are thoroughly mixed. Put the mixture into a small flask or test-tube loosely stoppered, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine which may have condensed on its surface may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and when it is cold break it into pieces and keep it in a well-stoppered bottle. This is the process of the U. S. P. 1870, with the iodine slightly increased in quantity, so as to correspond with the combining weights of the two elements, the union of which is readily effected by the aid of heat. The salt may be prepared in an ordinary prescription-vial placed in a sand-bath; after the fused mass has cooled the vial is broken to obtain the compound; loss of iodine is thereby avoided. Although sufficiently pure for medicinal purposes, it is difficult to produce in this way a uniform chemical compound, which, according to Berzelius, is obtained on subjecting the mechanical mixture to sublimation from a retort the body of which is completely imbedded in sand. Or the iodine is dissolved in carbon disulphide; the solution is gently heated, and, after the gradual addition of the powdered arsenic, is digested until the purple color of free iodine has disappeared; the clear solution is decanted if necessary, and the solvent distilled or evaporated, when the arsenious iodide is obtained in crystals and may be recrystallized from alcohol.

Properties.—Obtained by fusion, iodide of arsenic is a glossy orange-red crystalline mass; if made by sublimation or crystallization it appears in shining brick-red or orange-red hexagonal scales. It has an iodine-like odor and taste, and slowly gives off iodine on exposure to the air. Its density is 4.39. It is soluble, with a neutral reaction and without decomposition, in water, alcohol, ether, and carbon disulphide, but is gradually decomposed on being boiled with water or alcohol. It is soluble in 3.5 parts of water and in 10 parts of alcohol at 15° C. (59° F.). "The aqueous solution has a yellow color, and on standing gradually decomposes into arsenious and hydriodic acids. On passing hydrosulphuric acid through the solution a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid vapor of iodine is given off."—*U. S.*

Tests.—The purity is ascertained by the complete solubility of the salt in water and alcohol, and by its volatilizing on the application of heat without leaving any residue.

Off. Prep.—Liquor arseni et hydrargyri iodidi, *U. S.*

Medical Action and Uses.—The action of this medicine in small doses may be called alterative; in large doses it is an irritant poison.

The continued use of from gr. $\frac{1}{16}$ to $\frac{1}{12}$ (Gm. 0.004–0.005) twice a day occasions perspiration, with dryness of the throat and intestines; sometimes headache is complained of, but neuralgic pain in the head, if it has previously existed, may disappear. At one time it was supposed on very good authority to possess the power of preventing the development of *scirrhous tumors* of the breast, but continued observation has not confirmed the belief, although it has shown that when such tumors affect persons of a feeble and cachectic constitution their progress may be retarded by the improvement of the general health under the use of this medicine. Its influence upon certain *cutaneous diseases* is more demonstrable, particularly upon psoriasis, lepra, chronic eczema, and tinea capitis; but as identical results are obtained from arsenic alone, the influence of the iodine in the combination is very questionable. The quantity of iodine in the small dose of the compound administered ($\frac{1}{20}$ to $\frac{1}{4}$ grain) is too minute to be considered efficient. Indeed, most of the benefits said to have been derived from it were in reality obtained from mixtures of Fowler's arsenical solution with iodide of potassium in true medicinal doses. (See ACIDUM ARSENIOSUM.) The *dose* of iodide of arsenic should at first not exceed $\frac{1}{20}$ grain (Gm. 0.003) three times a day, and it should gradually be increased until derangement of the stomach or dryness of the throat denotes its full effect. It is best given in solution. An ointment containing 3 grains of the iodide to an ounce of lard (Gm. 0.20 in Gm. 32.00) has been used as a local application in the diseases above mentioned. Where the skin is broken it should not be employed.

ARSENIUM.—ARSENIC.

Arsenum, Arsenicum.—Arsenic, Fr.; *Arsen, Arsenik*, G.

Symbol As. Atomicity trivalent and quinquivalent. Atomic weight 74.9.

Origin.—Arsenic, which is classed by some chemists with the metals, by others with the non-metallic elements, is widely diffused in nature, but is found usually in small quantities. It exists in the uncombined state as *native arsenic*, known also under the name of *cobaltum* or *flystone*, but more frequently in combination with sulphur and sulphides, as *red orpiment* or *realgar*, As_2S_2; *yellow orpiment*, As_2S_3; *arsenical pyrites* or *mispickel*, $FeS_2.FeAS_2$; *cobalt-glance*, $CoS_2.CoAs_2$; *tin-white cobalt*, $CoAs_2$; and in other minerals. It was first obtained in the metallic state by Albertus Magnus in the thirteenth century by heating together white arsenic and soap.

Preparation.—On heating arsenical pyrites in earthen cylinders most of the arsenic volatilizes and is collected in iron receivers, where it congeals. $FeS_2.FeAs_2$ yields $As + 2FeS$. A portion of the arsenic remains behind with the iron sulphide, and may be recovered as arsenious acid by roasting. The crude metallic arsenic should be purified by mixing it with charcoal and subliming at the heat of a sand-bath. It is obtained on a small scale by mixing arsenious acid with half its weight of powdered charcoal, introducing the mixture into a crucible, covering it with a layer of granular charcoal 2 or 3 inches thick, and cementing over the crucible in an inverted position another one having a small hole drilled through the bottom; on heating the crucible the arsenious acid is reduced to arsenic, which sublimes, carbonic oxide escaping; $As_2O_3 + C_3$ yields $As_2 + 3CO$.

Properties.—It is a brittle, steel-gray, crystalline mass having a bright metallic lustre, gradually changing on exposure to the air to a grayish-black color devoid of gloss. Its specific gravity is 5.73 to 5.96. Heated in a sealed tube, it fuses, but if heated in the open air it volatilizes, without melting, at a temperature of 180° C. (356° F.), a portion of it being oxidized to arsenious acid. Its vapor has a yellow color and a garlic-like odor. On immersing the metal in water the air dissolved in the latter oxidizes a portion to arsenious oxide, which explains the use of cobaltum as a fly-poison. Metallic arsenic is insoluble in simple solvents, but dissolves on heating in some fixed oils, and unites readily with most of the metals, with sulphur, chlorine, iodine, and other elements.

Compounds of Arsenic.—Arsenious hydride or arsine, AsH_3, is a colorless gas of a garlic-like odor and the density 2.695, and when ignited burning with a bluish flame, yielding water and arsenious oxide; but on cooling the flame, by holding in it a piece of porcelain or glass, metallic arsenic is deposited. Arsenious hydride is generated in applying Marsh's and several other tests for arsenic. (See pages 27, 28.)

Arsenic oxide, As_2O_5, is a white mass melting at a low-red heat, and at a higher heat decomposed into arsenious oxide and oxygen; in damp air or in contact with water it deliquesces to an oily-looking liquid, which is a concentrated solution of *arsenic acid*, H_3AsO_4. This is poisonous, however, in a less degree than arsenious oxide; the concentrated solution is corrosive. It is much employed in the manufacture of certain aniline colors and for other purposes in the arts. *Pyroarsenic* and *meta-arsenic acids* are analogous to the corresponding phosphoric acids, but on dissolving in water yield at once the above *orthoarsenic acid.*

Arsenious chloride, As_2Cl_3, is a colorless, oily, very poisonous liquid, which has the specific gravity 2.205, boils at 134° C. (273.2° F.), and is by water decomposed into HCl and As_2O_3. (See Liquor Acidi Arseniosi.)

Arsenious bromide, As_2Br_3, is formed from the two elements in the presence of carbon disulphide, like the iodide. It is colorless, crystalline, of a peculiar odor, has the density 3.66, melts at above 20° C. (68° F.), and boils at 220° C. (428° F.). It is deliquescent, and by water decomposed into As_2O_3 and HBr.

Three sulphides of arsenic are known, but the pentasulphide, As_2S_5, is of no practical importance.

Realgar, or red orpiment, As_2S_2, is a mineral which consists of handsome orange-red scales. It is made by fusing together 5 parts of arsenious acid and 3 parts of sulphur, when sulphurous acid gas is given off. It burns with a blue flame, but when mixed with potassium nitrate with a brilliant white flame; a mixture for fireworks and signal-lights consists of red orpiment 2 parts, sulphur 7 parts, nitrate of potassium 24 to 26 parts.

Orpiment, King's yellow, or auripigmentum, As_2S_3, is likewise a mineral, crystallizes in prisms or scales, and is artificially obtained by fusing together 5 parts of arsenious acid with 4 to 5 parts of sulphur. It was formerly much employed as a pigment; at present it is used in fireworks, and occasionally, mixed with considerable lime, as a depilatory.

The medicinal action and uses of arsenic are treated of under Acidum Arseniosum.

ARUM.—Indian Turnip.

Wake-robin, Dragon-root, E.; *Gouet à trois feuilles*, Fr.; *Dreiblättriger Aron*, G.

The tuber (corm) of Arisæma (Arum, *Linné*) triphyllum, *Torrey*.

Nat. Ord.—Araceæ.

Origin.—The plant is indigenous to North America, produces one or two leaves, which are divided into three elliptical-ovate acuminate leaflets, and a green or dark-purple often striped spathe which is convolute at the base, bent hood-like at the apex, and encloses the club-shaped spadix, having the flowers sessile at the base. The fruit is a scarlet berry.

Description.—The tuber is of a depressed globular shape, with a flat and rugose base and slightly conical above. The numerous simple rootlets are attached to the upper half of the tuber, leaving the base free. It is of a brown-gray color externally, and internally white, with scattered vascular bundles. It is inodorous, and has a burning acrid taste, which it retains, to some extent, for a long time if carefully dried and preserved.

The tuberous rhizome of the European Arum maculatum, *Linné*, or *cuckoo-pint*, is similar in appearance, but of an oblong shape, and larger than the former; in commerce it is usually found in transverse slices or pieces which are of a mealy aspect. The starch was formerly prepared from it on the isle of Portland on the south coast of England, and used as *Portland arrow-root.*

Constituents.—The two tubers are most likely similar in composition, but their acrid principle has not been obtained in an isolated state. The European arum has been analyzed by Bucholz and Enz, and the American by D. S. Jones, who proved the presence of starch, sugar, gum, albumen, resin, fat, and extractive, besides the volatile acrid principle, which is soluble in ether. Enz (1858) obtained also saponin, and Bird believes that a volatile alkaloid may be present.

Allied Plants.—Colocasia esculenta, *Schott*, s. Caladium (Arum, *Linné*) esculentum, *Ventenat*, and Colocasia antiquorum, *Schott*, s. Arum Colocasia, *Linné*, are extensively cultivated in many tropical and subtropical countries under the name of *cocco* or *eddoes*, the thick starchy rhizomes being used for food. These and several other species are often seen under cultivation in our gardens for their ornamental foliage. All are more or less acrid in the fresh state.

Richardia (Calla, *Linné*) æthiopica, *Kunth*, Egyptian calla, a well-known ornamental plant, has likewise an acrid and farinaceous tuber.

Allied Drugs.—Tonga. A drug introduced under this name from the Fiji Islands was found by A. W. Gerrard (1880) to be a mixture of bark, leaves, and woody fibre tied into bundles by means of the inner bark of the cocoanut tree. E. M. Holmes (1880) referred the fibrous material to Rhaphidophora vitiensis, *Seemann;* F. von Mueller ascertained this to be correct. The plant belongs to the natural order of Araceæ, and is a creeper having a stem from the size of a quill to an inch or more in diameter. The scraped stem is used, and contains prismatic rhaphides and starch, the latter resembling arum starch. Gerrard found potassium chloride and a volatile alkaloid, *tongine*, which has not been further examined.

The bark comes from Premna taitensis, *De Candolle*, nat. ord. Verbenaceæ, which is shrubby or a large tree; the inner bark is sweet and slightly astringent, and, according to Gerrard, contains a little volatile oil, sugar, pectin, and fat.

Medical Action and Uses.—The juice of the fresh plant applied to the skin may cause vesication, and when a portion of the corm is chewed, it leaves in the mouth and fauces a burning and acrid taste. The acrid principle, however, is dissipated by drying and by heat. In a partially dry state the corm has been used to relieve *flatulence* and *colic* and as a remedy for chronic *bronchitis*, but its virtues are not very decided. Its powder made into a paste with honey or syrup has been applied to *aphthous* sores of the mouth, and an ointment formed by stewing the fresh root with lard has been applied to *ringworm* and other local cutaneous affections. The *dose* of the powder is stated to be 10 grains (Gm. 0.60) or more. It may be administered in honey or syrup.

In 1880, Ringer and Murrell employed a liquid extract of *tonga* in the treatment of *neuralgia* with "gratifying results." They gave half-ounce doses at intervals of half an hour, and repeated them again in 2 hours without producing any effect except slight drowsiness (*Lancet*, March 6, 1880). One or two cases reported by Wallace gave similar results, although he prescribed only half-drachm doses of the fluid extract (*Med. Record*, xxii. 91). Further evidence of its virtues is desirable.

ASAFŒTIDA, *U. S., Br.*—Asafetida.

Assafœtida, Br.; *Asa fœtida*, P. G., F. Cod.; *Gummi-resina Asafœtida.—Asafœtida*, E.; *Ase fétide*, Fr.; *Asant, Stinkasant, Teufelsdreck*, G.

A gum-resin obtained by incision from the living root of Ferula Narthex, *Boissier*, s. Narthex Assafœtida, *Falconer*, and Ferula Scorodosma, *Bentham et Hooker*, s. Scorodosma fœtidum, *Bunge.* Bentley and Trimen, *Med. Plants*, 126, 127.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Both plants are large perennial herbs. Narthex, which was discovered by Falconer in 1838, is indigenous to Western Thibet, and probably to Cashmir. It produces a stem 6 to 10 feet (2 to 3 M.) high, which is considerably branched, and bears large bipinnate leaves with large, sheathing, inflated petioles, the upper ones being destitute of laminæ; the pale-yellow polygamous flowers are in solitary dense umbels, terminating the lateral branches; and the fruit is about half an inch (12 Mm.) long, dorsally flattened, with broad vittæ, and has a winged margin. Scorodosma was found by Lehmann (1841) in Turkestan and Bokhara, and by Bunge (1858) in Western Afghanistan. It is largely cultivated in Northern and Western Afghanistan, and grows wild in the barren regions between the Sea of Aral and the Persian Gulf, south to Laristan. Its stem is from 5 to 7 feet (1.5 to 2 M.) high, and has but few bipinnate leaves, which are very much smaller than the large radical leaves. The numerous umbels are long-stalked and crowded at the summit of the stem, and the flat and winged fruit has very inconspicuous vittæ. Ferula alliacea, *Boissier*, of North-eastern Persia, has likewise a strong asafetida odor.

Collection.—Asafetida is obtained from the roots of both plants, which attain a considerable size, being several inches in thickness. In April, after the leaves commence to wither, a pit about 6 inches wide and 6 inches deep is dug around the root, so as to bare its upper portion, which is protected against the sun by a layer of leaves and earth, and left in this condition for about 40 days. Near the latter end of May the covering is removed, a slice of the root is cut off, and the exuded juice scraped off on the third day. The cutting of the root, which is in the mean time sheltered from the sun, is repeated twice, after which the root remains undisturbed for a week, when the same operation is repeated and a much thicker milk-juice is obtained. After another rest of several weeks the root, early in July, is again cut, and this operation is continued until the root is exhausted.

This is substantially the account of Kämpfer, who witnessed the collection of asafetida in Laristan in 1687. Dr. H. W. Bellew gives a similar account of the collection of asafetida, which he observed in 1857 near Kandahar, but it differs from the former account in the statement that the newly-sprouted radical leaves and the withered stem of the previous year are cut off from the root, in the upper bare part of which deep incisions are made, where the milk-juice concretes in tears, or, if very abundant, flows into the trench dug around the root.

Commerce.—Asafetida enters commerce by way of Bombay, to which port it is shipped from Persia and from Afghanistan, the Afghanistan drug being probably derived in part from Narthex, and the Persian chiefly from Scorodosma. It comes packed in skins and in boxes, the purest kind, which is called *hing*, being often soft, but gradually becoming hard and translucent and of a yellowish-brown or golden-yellow color. The brown variety, which comes principally from Abushaher and Bunder Abbas, is, according to W. Dymock (1875), the produce of Ferula alliacea, *Boissier.* The yellow variety is brought from Kandahar and is principally consumed in Northern India. The asafetida which reaches Bombay from Laristan is known as *anghuzeh i Lari*, and is mostly shipped abroad. The inferior qualities, the *hingra* of the Bombay market, are more or less adulterated at the place of collection, and constitute the varieties which are found in the European and American markets. The transparent *hing* may probably be obtained from the stem. In the fiscal year 1866–67, 51,869 pounds of asafetida were imported into the United States, against 173,000 pounds in 1879–80 and 78,010 pounds in 1882.

Description.—Occasionally asafetida is met with in a fluid or semi-fluid condition of a uniformly whitish color, which gradually becomes darker. Mostly, however, it forms masses of larger or smaller opaque tears of a white color internally, which are imbedded in a yellowish- or brownish-gray sticky and more or less granular mass, in which gypsum, sand, and other earthy admixtures are found. It has a strong garlicky odor and an alliaceous, acrid, and bitter taste. The tears, separated from the granular mass, are sometimes met with in the market, and should alone be used in medicine; they are externally brownish, internally milk-white; they break with a conchoidal fracture, and the surface acquires in a few hours a bright-pink color, which changes gradually to brown. Incinerated, they leave rather less than 1 per cent. of ash. When triturated with water they readily form a milk-white emulsion, which becomes yellow on the addition of potassa or soda. Ether dissolves the volatile oil and a little resin. Rubbed with strong sulphuric acid, then diluted with water and neutralized with an alkali, a slightly colored liquid is obtained which exhibits a bluish fluorescence. Exposed to cold, asafetida becomes quite brittle and readily pulverizable, and when broken into small pieces and dried for a week or two over unslaked lime in a close box it may likewise be powdered on cool days. The powder should be preserved in paper bags kept over lime, when it will retain its pulverulent condition (Hager).

A very impure asafetida is occasionally met with, which consists altogether of earthy matter mixed with a very small proportion of the milk-juice. For medicinal uses asafetida consisting of well-defined and large tears, and containing but little of the intervening sticky mass, should be selected. Asafetida should yield to alcohol at least 60 per cent. of soluble matter (*U. S.*). In contact with hydrochloric acid only slight effervescence should be produced, and after 6 hours the acid should remain almost uncolored; when incinerated, asafetida should leave not over 10 per cent. of ash (*P. G.*).

Constituents.—The odor is due to a volatile oil which is obtainable to the amount of from 6 to 9 per cent. (Flückiger), and is a mixture of several sulphides of ferulyl or laseryl, C_6H_{11}. It is of a light-yellow color, and becomes darker on exposure to the air, acquiring at the same time an acid reaction and changing in odor. Spread upon water, it acquires a violet-red color with the vapor of bromine, at the same time becoming heavier than water; dissolved in disulphide of carbon, it is colored red by sulphuric acid (Flückiger). The gum amounts to between 20 and 30 per cent., and from 45 to 65 or 71 per cent. of the asafetida is resin, a small portion of which is insoluble in ether. It contains *ferulaic acid*, $C_{10}H_{10}O_4$, which was obtained by Hlasiwetz and Barth (1866) in iridescent, inodorous, and tasteless needles soluble in boiling water, and yielding, when fused with potassa, among other products, acetic and protocatechuic acids. It dissolves in alkalies with a yellow color, and gives with ferric chloride a brown precipitate. It is chemically related to vanillin, eugenol, and cinnamic acid. The amorphous red-brown resin is likewise acid, but when fused with potassa yields resorcin, $C_6H_6O_2$, and on dry distillation furnishes a small quantity of unbelliferon, $C_9H_6O_3$, and blue-colored oils. The so-called gum of which, in Kandahar *hing*, Flückiger found 47.9 per cent. with only 10.8 per cent. of resin, is but little soluble in water; the insoluble portion dissolves in alkalies and is reprecipitated by acids; both portions differ in their behavior from gum-arabic. According to older analyses, asafetida contains also formic, acetic, valerianic, and malic acids.

Impurities.—Besides the earthy admixtures mentioned above, pieces of a translucent gum are sometimes found in asafetida; they do not yield an emulsion with water. The amount of earthy admixtures in commercial asafetida of good appearance sometimes reaches 40 per cent.

Off. Prep.—Emplast. asafœtida, *U. S.;* Enema asafœtida, *Br.;* Mistura asafœtida, *U. S.;* Pilulæ aloes et asafœtidæ, *U. S.*, *Br.;* Pil. asafœtidæ, *U. S.;* Pil. asafœtidæ comp. (galbani comp., *U. S.*), Spiritus ammon. fœtid., *Br.;* Tinct. asafœtidæ, *U. S.*, *Br.*

Physiological Action.—*On Animals and Man:* Experiments on animals prove the ready absorption and diffusion of the odorous principle of this substance, for when a solution of asafetida is injected into the peritoneal cavity its smell is presently detected in the blood and the breath. Asafetida in substance, or its volatile oil, acts as a general and local stimulant, but during health the former operation is scarcely perceptible. This stimulation seems to be due entirely to this oil, and so is the peculiar garlicky or alliaceous odor exhaled by the breath and discharges of wind from the stomach and rectum. But in appropriate disorders, those especially connected with a depressed and therefore excitable condition of the nervous system, and in cases of gastro-intestinal flatulence associated with atony of the bowels, it displays incontestable and highly salutary powers. Its use as a condiment in Persia for the very same purposes for which garlic is employed in European cookery proves it to be a stimulant of the bowels and a promoter of digestion.

Medical Uses.—Asafetida is generally regarded as a nervine and as remarkable for its usefulness in *hysteria*. In two ways it may influence this disease: by allaying the nervous disorder of the paroxysm when it is announced by premonitory symptoms, or by moderating its violence when fully formed; and, on the other hand, by tending to correct some of those derangements which predispose to the attacks. In the former way, however, its influence is most distinct. For this purpose it is best exhibited in enema. It is also of use in preventing or in mitigating the tympanites which is so common in hysteria. In the allied disorder, *hypochondriasis*, the medicine is often of service in removing the digestive ailments with which the mental disorder is apt to be associated. In *chronic bronchitis* attended with spasmodic dyspnœa it is probable that asafetida both diminishes the secretion in the lungs and controls the spasmodic element. The latter action is sometimes evident in *whooping cough*, and possibly both actions may concur. When *constipation* and *tympanites* are met with, as they often are, in persons of a feeble and nervous habit, this medicine is one of the very best that can be employed, either as a temporary remedy for the latter symptom or as a more permanent cure for the former when combined with appropriate purgatives, of which aloes is the best. The compound pills of galbanum, which contain also myrrh and asafetida, are exceedingly useful under these circumstances. But in tympanites a large enema of asafetida mixture often gives prompt and complete relief. This condition, when it occurs in typhoid fever, may be greatly reduced by such an enema, which also acts favorably upon the typhoid element of the disease. The exhausted condition of the nervous system and the partial paralysis which often follow *nervous apoplexy* may be removed more or less by the same means, as well as by administering the drug by the mouth. Asafetida should not be neglected in *chorea* occurring in feeble, nervous girls about the age of puberty, particularly when the nervous disorder is accompanied with tardy or irregular menstruation.

Administration.—In substance the dose of asafetida is from 3 to 15 grains (Gm. 0.20–1.00). It should be given in pill or in the officinal mixture. For prompt effect the latter form or the tincture is to be preferred.

ASARUM.—WILD GINGER.

Radix asari canadensis.—*Canada snakeroot*, E.; *Asaret du Canada*, Fr.; *Canadische Haselwurzel*, G.

The rhizome with rootlets of Asarum canadense, *Linné.*

Nat. Ord.—Aristolochiaceæ.

Origin.—The plant is indigenous to North America, growing in rich woodlands as far south as South Carolina, but is more frequent in the States farther north and in Canada. The creeping rhizome sends up a very short stem, bearing at its summit two broad reniform leaves upon petioles about 6 or 8 inches (15 or 20 Cm.) in length, from the fork of which a single brownish-purple nodding flower is produced.

Description.—The rhizome, which is in some places known as *colt'sfoot-root*, is from 3 to 6 inches (7 to 15 Cm.) long and about $\frac{1}{8}$ inch (3 Mm.) thick, somewhat bent and curved and with few branches. It is finely wrinkled longitudinally; the internodes are about half an inch (12 Mm.) or more in length, the nodes often of a jointed appearance from the remnants of leaves, and beset with several thin nearly simple radicles 2 or 3 inches (50 to 75 Mm.) in length. Externally the color is deep purplish-brown, internally whitish. The bark is about one-sixth the diameter of the rhizome, and contains volatile oil in many of its parenchyma-cells; the wood is in about twelve small wedge-shaped bundles, forming an interrupted circle and enclosing a large pith. The rootlets have a thick bark and a thin, soft woody cord. Wild ginger has an aromatic odor and a warm, pungent, and bitterish taste. It resembles *asarabacca*, the rhizome and rootlets of Asarum europæum, *Linné;* the latter, however, is always thinner, about $\frac{1}{16}$ or $\frac{1}{12}$ inch (1.5 to 2 Mm.) in diameter, and usually quadrangular in the dry state.

ASARUM SIEBOLDII, *Miquel.* This plant grows in Japan, where it is known as *to-sai-shin.* The slender rhizome somewhat resembles serpentary, is marked by numerous stem-scars, and has dense tufts of pale-brown simple rootlets attached, which are about 4 inches (10 Cm.) long, and are internally mealy, white, and with a thin yellow ligneous cord. The drug has a slight aromatic odor and a taste which is at first aromatic, resembling a mixture of nutmeg and sassafras, and afterward very pungent and irritating.

Constituents.—Wild ginger contains a yellowish volatile oil and an acrid bitter resin, to which its medicinal properties are probably due. Van Gorder (1876) obtained 2 per cent. of aromatic volatile oil and a neutral resin having a different agreeable odor and a pungent, warm, and lasting taste. It also contains starch, gum, fixed oil, coloring matter, and salts. F. B. Power (1880) ascertained also the presence of a yellow coloring matter corresponding to Graeger's *asarin*, which is precipitated by basic lead acetate and colored dark-green by ferric salts, but not precipitated by tannin. A minute quantity of a body was found giving precipitates with most group-reagents for alkaloids. The volatile oil, of which Dr. Squibb obtained 3.12 per cent., had the specific gravity .953 at 17° C. (62.6° F.). It is of a yellowish- or greenish-amber color, and consists of a very small amount of *asarene*, $C_{10}H_{16}$, of the acetic and a small amount of the valerianic ether of *asarol*, $C_{10}H_{18}O$, of an indifferent neutral body, *asarin*, $C_{12}H_{16}O_2$, and of a small amount of dark-blue azulene. The volatile oil has been introduced for use in perfumery, and, according to Boerner (1878), is also adapted for the preparation of a medicated water and for flavoring elixirs. The fully-dried root yielded 13.43 per cent of ash.

The impure bitter principle of asarabacca has been named *asarin.* The camphor-like bodies *asaron* and *asarit* appear to be chemically identical, differing only in the latter separating from the watery distillate in fine crystals, while asaron or asarum camphor separates first in an oily condition before it crystallizes. It is inodorous and tasteless, has the composition $C_{20}H_{26}O_5$, and volatilizes with the production of irritating vapors.

Medical Action and Uses.—Canada snakeroot is an aromatic and tonic stimulant. In hot infusion it is diaphoretic; it palliates *colic*, and is sometimes used in low forms of *febrile disease* as a substitute for serpentaria. An infusion may be made with half an ounce (Gm. 16) of the root and a pint of boiling water, and given in doses of a wineglassful. The European species of asarum is not officinal. It is much more irritating than the native plant, producing violent vomiting and purging. The powder of its root is employed as an errhine.

ASCLEPIAS, *U. S.*—Asclepias.

Pleurisy-root, E.; *Racine d'asclépiade tubereuse*, Fr.; *Knollige Schwalbenwurzel*, G.

The root of Asclepias tuberosa, *Linné*.

Nat. Ord.—Asclepiadaceæ.

Origin.—This perennial plant, which is known also as *butterfly-weed* and *orange swallow-wort*, is a native of the United States south to Georgia and west to Texas, and grows in sandy fields. The large fusiform, tuberous root sends up several rather weak and branching hirsute stems, with alternate lanceolate or lance-linear leaves and a terminal corymb of numerous umbels, the flowers being of a handsome bright orange-red color.

Description.—The root is usually found in the market in pieces from 1 to 6 inches (2 to 15 Cm.) in length, and ½ to 1 inch (12 to 25 Mm.) or more thick. The head is irregular, knotty, and slightly but closely annulate, and, like the longitudinally wrinkled root, externally of a brownish-orange color and white or yellowish-white within. It has an irregular, tough fracture, a very thin bark (composed of an outer brownish and an inner white layer) and a distinctly striate meditullium composed of yellowish ligneous and large white medullary rays. It is inodorous and has a bitterish, slightly acrid taste. When long kept it acquires a gray color externally and internally.

Constituents.—Besides starch, which is present in considerable proportion, the root contains, according to Elam Rhoads (1861), tannin, albumen, pectin, gum, two resins—one soluble, the other insoluble in ether—fixed oil, an odorous volatile matter, and a peculiar principle possessing the taste of the root, which is precipitated by tannin from the concentrated infusion. This precipitate, if decomposed by oxide of lead and exhausted by alcohol, yields the principle as a yellowish-white powder which is soluble in alcohol, ether, and much water. Alton Clabaugh (1881) observed that this principle is colored brown by sulphuric acid, and pink, changing to purple, by nitric acid. The stearopten melted at 41° C. (106° F.), and was sublimable in prismatic needles. The air-dry root yielded 5.4 per cent. of ash, of which 21.5 per cent. was soluble in water.

Allied Plants.—1. Asclepias incarnata, *Linné*.—Flesh-colored asclepias, Swamp milkweed, E.; Asclépiade incarnate, Fr.; Fleischfarbige Schwalbenwurzel, G.—The plant is indigenous to Canada and to the United States as far south as South Carolina. It grows in wet grounds, and consists of a smoothish or pubescent stem about 3 feet (.9 M.) high, bearing petiolate oblong-lanceolate and acute leaves, umbels of rose-purplish flowers, and smooth pods. The variety named *pulchra* has shorter petioles and broader hairy leaves. The rhizome is irregularly globular, an inch (25 Mm.) or less in diameter, above with several more or less elongated branches, bearing the scars of the over-ground stems and frequently remnants of the same. Externally the color is yellowish-brown, internally whitish. The bark is thin, and covers a firm wood having fine medullary rays. The rhizome is surrounded on all sides with nearly simple light-brownish rootlets about 4 to 6 inches (10 to 15 Cm.) long, having a thick white bark and a thin ligneous cord in the centre. In the fresh state the rhizome has a somewhat heavy odor, which is but slightly apparent after drying; the taste is sweetish, somewhat acrid, and afterward bitter.

Examined by Jos. Y. Taylor (1875), the root contains a trace of volatile oil, two acrid resins, an alkaloid which was not obtained in the pure state, fixed oil, albumen, pectin, starch, glucose, and yields 8.25 per cent. of ash.

2. Asclepias cornuti, *Decaisne*, s. A. syriaca, *Linné*.—Milkweed, Common silkweed, Wild cotton, E.; Asclépiade à la soie, Herbe à la ouate, Fr.; Schwalbenwurzel, Seidenpflanze, G.—The rather stout and smoothish stem of this common plant, which is indigenous to Canada and the United States, is about 3 or 4 feet (.9 or 1.2 M.) high, nearly simple, and bears oval-oblong acute and shortly petiolate opposite leaves, which are about 6 to 8 inches (15 to 20 Cm.) long, and three or four axillary umbels near the summit of the stem, with numerous sweet-scented, light greenish-purple flowers. It grows along roadsides and in waste places. The rhizome is horizontal, a foot (30 Cm.) or more in length, slightly branched, ¼ to 1 inch (6 to 25 Mm.) thick, externally grayish-brown, finely wrinkled longitudinally, beset with few simple rootlets or marked with their scars, but often tuberculated or knotty from undeveloped branches or stem-scars. When dry it breaks with a short fracture, exhibiting a thick white bark containing slender milk-vessels, and a soft, brittle, porous, yellowish wood dissected by rather broad medullary rays. It is without odor and has a bitterish, unpleasant taste. The parenchyma contains starch. John found in the milk-juice of the plant caoutchouc and resin, and List separated from it (1849) a white, crystalline, tasteless principle, *asclepion*, having the composition $C_{20}H_{34}O_3$, by exhausting the congealed milk-juice with ether. Sultz found (1845) in 80 parts of the milk-juice 69 water, 3½ wax and fat, 5 caoutchouc, ½ gum, and 2 sugar and salts. W. L. Hinchman (1881) ascertained also the presence in the rhizome of a little volatile oil, tannin, gummy matter, and a bitter principle

which was not obtained in the pure state; the fresh rhizome appears to contain a volatile acrid principle.

3. Asclepias curassavica, *Linné.*—This perennial herb is indigenous to South America and the West Indies. The root, known as *bastard ipecacuanha* (see Ipecacuanha), and the leaves are used. The latter are petiolate, 2 to 4 inches (5 to 10 Cm.) long, lanceolate or oblong-lanceolate, acute at both ends, and smooth. The flowers are bright-red, occasionally white. The glossy seed-hairs, sometimes called *vegetable silk*, are firmer than those of the preceding species.

4. Calotropis (Asclepias, *Willdenow*) gigantea, *Rob. Brown*, and Cal. procera, *R. Brown*, s. Cal. Hamiltonii, *Wight* (Bentley and Trimen, *Med. Pl.*, 176), are shrubs 6 to 10 feet (2 to 3 M.) high, the former being indigenous to Southern India and the East Indian Islands, the latter to Northern India and westward through Asia and tropical Africa. Both species yield *mudar-bark*, which consists of irregular fragments ⅕ inch (5 Mm.) or less thick, externally yellowish-gray, fissured, or after separation of the corky layer whitish, and upon the transverse section striate with the narrow brown bast-rays. The bark is brittle, of a slight odor, and of a mucilaginous bitter and acrid taste, and has often attached to it fragments of the light-yellow fibrous wood. It contains starch, an acrid acid resin soluble in alcohol and ether, and a colorless bitter principle soluble in alcohol, ether, and chloroform and precipitated by tannin, but not by lead acetate (*Pharmacographia*).

Medical Action and Uses.—The qualities of the three species of Asclepias are practically identical, but those of A. tuberosa are best known. Like many other medicines, it has been alleged to possess specific powers in the cure of particular diseases, but a comparison of the reports concerning it show that it is one of the numerous class of vegetable products which under certain conditions act as emetics, and even purgatives, and more commonly as sudorifics, expectorants, carminatives, and anodynes. Being an irritant, it has not escaped being ranked as a cholagogue. A. syriaca is said to be diuretic. Its general qualities account for the reputation of the officinal plant as a diaphoretic in the forming stage of *fevers*. It is, however, thought to produce sweating, not by stimulating but by lowering the action of the heart. The same characteristic renders it useful in acute *rheumatism*, *bronchitis*, *pneumonia*, and *pleurisy*, so far as sedation of the nervous and circulatory systems can be so; that is, by lessening local congestions. The "pleurisy" it is credited with relieving was most probably muscular rheumatism of the walls of the chest. Flatulent *colic* and *dyspepsia* are affections to which it has been regarded as peculiarly appropriate. The milky juice of A. syriaca, applied to the skin, soon becomes a tough, adhesive pellicle, and has been used to coat recent *wounds* and superficial *ulcers* and promote their cicatrization. The *dose* of the powdered root is from 20 to 60 grains (Gm. 1.30–4.00). A decoction is made with an ounce (Gm. 32) of pleurisy-root to a quart of water, and is given in doses of 4 fluidounces every 2 hours as a diaphoretic. A fluid extract has also been prepared.

In 1881, Dr. Guimaraës described the physiological action of A. curassavica, a native of Brazil. He found it to act directly upon the organic muscular system, and especially upon the heart and blood-vessels, causing great constriction of the latter and distension of the larger arteries. Secondarily, it occasioned great dyspnœa, vomiting, and diarrhœa (*Times and Gaz.*, Dec. 1881, p. 661).

ASPARAGUS.—Asparagus.

Asperge, Fr.; *Spargel*, G.

Asparagus officinalis, *Linné.*

Nat. Ord.—Liliaceæ, Asparagineæ.

Origin and Description.—This herbaceous perennial is indigenous to Europe, and is extensively cultivated. Its stem is 4 or 5 feet (1.5 M.) high, has the thread-like leaves (branchlets, *Gray*) clustered in the axil of a short, ovate sheathing bract (leaf, *Gray*), and small, greenish, axillary, nodding flowers, producing red berries. The following parts have been medicinally employed:

1. Asparagi radix consists of a short horizontal rhizome about three-quarters of an inch (19 Mm.) thick, on the upper side marked by stem-scars, and below by numerous long, whitish, nearly simple roots, which on drying become deeply wrinkled longitudinally. It is inodorous and has an insipid sweetish taste.

2. Asparagi turiones, the well-known young shoots which are used as food.

Constituents.—Examined by Dulong, the root was found to contain yellow resin, sugar, gum, albumen, chlorides, phosphates, malates, and acetates. Vauquelin and Robiquet (1805) discovered *asparagin* in the shoots, which has since been found in many other plants (see p. 162). Reinsch (1870) found in the berries considerable grape-sugar and *sparganein*, an orange-red sublimable coloring matter soluble in ether and crystallizing in scales. The seeds contain fixed oil, aromatic resin, crystallizable sugar, and a crystallizable bitter principle, *spargin*.

Pharmaceutical Uses.—Syrupus asparagi, which is employed in France, is prepared by dissolving 190 parts of sugar in 100 parts of the clarified juice of asparagus-shoots.

The tubers of Asparagus ascendens, racemosus, and sarmentosus, *Linné*, are employed in India like salep.

Medical Uses.—The offensive odor given to the urine of persons who eat the young asparagus-plant is well known; some attribute to it a diuretic virtue which there is no reason to accept; others have reported that it may cause urethritis; and one, at least, that it renders the urine saccharine. If any part of the plant is diuretic, it is probably the root. It has no true medicinal virtues.

ASPIDIUM, *U. S.*—Aspidium.

Filix mas, Br., U. S. 1870; *Rhizoma filicis*, P. G.; *Radix filicis maris.—Male fern, Male shield fern*, E.; *Rhizome (Racine) de fougère mâle*, Fr.; *Wurmfarnwurzel, Waldfarnwurzel, Johanniswurzel*, G.

The rhizome, covered with portions of the stipes, of Aspidium (Nephrodium, *Brown*, Polypodium, *Linné*) Filix mas, *Swartz*, and of Aspidium (Nephrodium, *Michaux*, Polypodium, *Linné*) marginale, *Willdenow*. Woodv., *Med. Bot.*, plate 271; Bentley and Trimen, *Med. Plants*, 300.

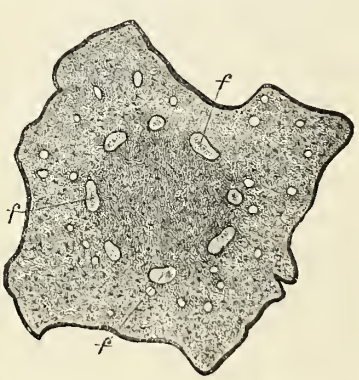
Nat. Ord.—Filices.

Origin.—Male fern is indigenous to Canada westward to the Pacific Ocean, thence south along the Rocky Mountains to Mexico and a considerable portion of South America; to some of the Polynesian Islands; to the greater portion of Asia north of the Himalaya Mountains; and to Europe and some parts of Africa. The marginal shield fern grows in rich rocky woods in Canada and the United States. The fronds of both species are from 1 to 2 or 3 feet (30 to 60 or 90 Cm.) high, bipinnate, at the tip pinnate or pinnatifid, lanceolate, or the latter ovate-lanceolate in outline and evergreen; the circular fruit-dots are situated on the veins—in the male fern near the midrib of the lower half of the pinnules, or in the marginal shield fern at the base of the serratures along the margin of the lower side of the pinnules, and are covered with an orbicular heart-shaped indusium. The fronds arise from the living somewhat ascending end of the horizontal rhizome, which is 6 to 12 inches (15 to 30 Cm.) long, and the old portion densely covered with the remnants of the stipes. It is collected early in autumn or in summer, as directed by the British Pharmacopœia.

Fig. 33.

Aspidium: surface of peeled rhizome.

Fig. 34.



Aspidium Filix mas, *Sw.*: transverse section of rhizome; *f*, fibro-vascular bundles.

Description.—As found in commerce, it is 3 to 6 inches (7 to 15 Cm.) long, and with the closely imbricated and slightly curved remnants of the stipes 2 to 3 inches (50 to 75 Mm.) thick. The latter remain green in their lower portion for several years, and are, like the rhizome itself, densely covered with a brown, glossy, and soft chaff consisting of thin transparent scales; between the stipes are the black wiry rootlets. The rhizome itself is fleshy, ½ to 1 inch (12 to 25 Mm.) in diameter, externally dark-brown, internally of a pale-green color and spongy texture, and shows upon the transverse section near the surface eight to twelve larger fibro-vascular bundles arranged in an interrupted circle, outside of which are a number of smaller ones. The stipes have about eight small vascular bundles in a loose circle. The rhizome of the marginal shield fern corresponds with this description in all respects, except that it has about six fibro-vascular bundles and does not fully attain the diameter of the thickest male fern rhizomes. The spongy texture is due to the thin-walled parenchyma and to the large intercellular spaces, into which stalked glands project which exude a green liquid. These glands were observed in male fern by Herman Schacht (1863), and in marginal shield fern by Flückiger (1880); many allied species do not contain such glands. Aspidium has a slight disagreeable odor and a sweetish afterward somewhat bitter astringent and nauseous taste. For medicinal purposes the dead portions of the stipes and rhizome must be removed, and the green part only retained, which should be at once dried, powdered, and exhausted by ether for preparing the oleoresin.

Constituents.—Male fern has been frequently analyzed. Geiger (1826) obtained 6.9 per cent. of green fixed oil, which Luck (1851) found to consist of the glycerides of *filixolic* and *filosmylic acids*, the last of which is volatile. The tannin of older authors was separated by Luck into two acids, *tannaspidic* and *pteritannic acids*, the last only being soluble in ether, both coloring ferric salts green. Malin (1867) found only one tannin, *filitannic acid*, which on being boiled with dilute sulphuric acid is split into sugar and *filix-red*, the latter in an impure condition, being Luck's tannaspidic acid. Peschier (1826) obtained from the ethereal extract granular crystals, which Luck named *filicic acid*. Grabowski (1867) gave it the formula $C_{14}H_{18}O_5$, and found it to be *dibutyryl-phloroglucin*, which is decomposed by potassa near the fusing-point into phloroglucin and butyric acid. Pavesi's *aspidin* (1861) is a very impure filicic acid, which is probably the main active ingredient. Bock (1851) determined the tannin to amount to 10 per cent., and found also a trace of volatile oil, wax, chlorophyll, gallic acid, albumen, pectin, starch, gummy matter, sugar, and 2 to 3 per cent. of inorganic salts. J. L. Patterson (1875) obtained from the rhizome of the marginal shield fern filicic acid and a tannin similar to, if not identical with, that of filix mas; and C. H. Cressler (1878) found the oleoresin effectual in several cases of tape-worm.

Allied Drugs.—Aspidium rigidum, *Swartz.* This fern grows on the eastern slope of the Coast Range of California and in the alpine regions of Europe. The stipe-bases are only loosely imbricated, and, after these, the brown chaff, and the numerous wiry rootlets are removed, leave a pale-green rhizome 4 to 10 inches (10 to 25 Cm.) long, $\frac{2}{5}$ to $\frac{4}{5}$ inch (1 to 2 Cm.) thick, and having about six broad fibro-vascular bundles in a circle; its odor is somewhat aromatic. W. J. Bowman (1881) ascertained its constituents to be analogous to those of the above species. It is used in California like male fern.

Aspidium athamanticum, *Kunze*, is indigenous to the southern part of Africa, from Natal to Angola. The rhizome is known as *uncomocomo* or *panna-root*, is thicker and denser than male fern, often densely covered with dark-brown stipes and red-brown chaff, and is internally pale-brownish, showing numerous black resin-dots and a circle of ten to thirteen large and small fibro-vascular bundles.

Asplenium thelypteroides, *Michaux*, of North America, has a rhizome resembling the next.

Asplenium filix fœmina, *Bernhardi*, has a thin rhizome, which is densely covered with black, thin, almost two-edged remnants of the stipes, and has numerous black roots, but little scaly chaff. Analyzed by Bock (1851), the constituents were found to be similar to those of male fern; the presence of filicic acid has not been shown.

Aspidium spinulosum, *Swartz*, has a thin rhizome, with about six small fibro-vascular bundles, and with dark-brown nearly cylindrical stipe-remnants, between which little or no chaff is found.

Osmunda regalis, *Linné*. The rhizome is about half an inch (12 Mm.) thick, densely covered with numerous brown stipe-remnants, and of a mucilaginous, slightly bitter taste.

Polypodium vulgare, *Linné* (Meehan, *Nat. Flowers*, ii. 161). The rhizome is thin, flattish, with rather distant and very short stipe-remnants on the upper side, and with hair-like roots on the lower side. Desfosses (1828) found in it fat, starch, gum, sugar, a glutinous substance, albumen, astringent, extractive, malic acid, and salts.

The last four species are indigenous to Europe and North America.

Medical Action and Uses.—Male fern was anciently known to be a remedy for *tænia* and other intestinal worms, but its reputation was more firmly established in the last century. It is more efficacious in removing the unarmed than the armed tænia, unless the latter be young. The methods employed by different physicians in the treatment of tænia by male fern are for the most part very complicated, and seem devised more in a spirit of charlatanism than of art. It is, as a rule, essential that the bowels should contain no accumulation of partially-digested food or of feces, and that the vigor of the parasite should be reduced by as low and simple a diet as can well be borne, and chiefly in a liquid form, as milk or broth. Early in the morning, fasting, the patient should take from 30 to 90 grains (Gm. 2–6) of powdered male fern, at a single dose or in divided doses at short intervals. The oleoresin of male fern, in the dose of from 10 to 20 drops (Gm. 0.60–1.30), may be administered along with the powdered root, or in feeble persons by itself. About an hour after either preparation an active purge of calomel with jalap or gamboge is sometimes administered, but generally an ounce of castor oil will suffice. Some prefer Epsom salts. It is by certain authorities recommended to give a full dose of sulphuric ether shortly after the specific medicine, for the purpose of rendering the detachment of the parasite easier. The oleoresin is conveniently administered in gelatin capsules. The *dose* of filicic acid is about 30 grains (Gm. 2).

Aspidium marginale appears to possess the same properties as male fern. Suesserott employed a fluid extract of it in the treatment of *tænia* with entire success (*Trans. Med. Soc. Penna.*, 1875, p. 637), and Cressler, who gave the oleoresin in capsules containing each about 10 minims, caused the expulsion of tænia on two occasions. The usual associate treatment of abstinence from food before the medicine and a purgative after its administration was also carried out (*Amer. Jour. Pharm.*, June, 1878).

ATROPINA, *U. S., Br., F. Cod.*—ATROPINE.

Atropia, Atropinum.—Atropia, E.; *Atropine*, Fr.; *Atropin*, G.
Formula $C_{17}H_{23}NO_3$. Molecular weight 289.

Preparation.—Take of Belladonna-Root, recently dried and in coarse powder, 2 pounds; Rectified Spirit 10 pints; Slaked Lime 1 ounce; Diluted Sulphuric Acid, Carbonate of Potash, each a sufficiency; Chloroform 3 fluidounces; Purified Animal Charcoal a sufficiency; Distilled Water 10 fluidounces. Macerate the root in 4 pints of the spirit for 24 hours, with frequent stirring. Transfer to a displacement apparatus, and exhaust the root with the remainder of the spirit by slow percolation. Add the lime to the tincture placed in a bottle and shake them occasionally several times. Filter, add the diluted sulphuric acid in very feeble excess to the filtrate, and filter again. Distil off three-fourths of the spirit, add to the residue the distilled water; evaporate at a gentle heat, but as rapidly as possible, until the liquor is reduced to one-third of its volume and no longer smells of alcohol; then let it cool. Add very cautiously, with constant stirring, a solution of the carbonate of potash, so as to nearly neutralize the acid, care, however, being taken that an excess is not used. Set to rest for 6 hours, then filter, and add carbonate of potash in such quantity that the liquid shall acquire a decided alkaline reaction. Place it in a bottle with the chloroform, mix well by frequently-repeated brisk agitations, and pour the mixed liquids into a funnel furnished with a glass stopcock. When the chloroform has subsided, draw it off by the stopcock, and distil it by a water-bath from a retort connected with a condenser. Dissolve the residue in warm rectified spirit; digest the solution with a little animal charcoal; filter, evaporate, and cool until colorless crystals are obtained.—*Br.*

The British process is that proposed by Mein, except that the alkaloid, instead of being simply precipitated from the watery solution of its sulphate, is removed by agitation with chloroform, in accordance with the suggestion of Rabourdin (1850). The lime, on being agitated with the tincture of the root, removes considerable resin and fat, the little lime which enters into solution being afterward precipitated by sulphuric acid as sulphate of calcium, while the atropine remains in the liquid as sulphate, which is readily soluble in alcohol and water. On neutralizing the free acid with carbonate of potassium another quantity of resin is separated, and on rendering the liquid alkaline the atropine is set free, and is taken up by the chloroform on being agitated with it. Treatment with alcohol and animal charcoal is resorted to for the purpose of removing the last traces of coloring matter and obtaining the alkaloid crystallized.

A process similar to the preceding was proposed by Prof. Wm. Procter, Jr., in 1860, who, after treating the tincture with lime and sulphuric acid and evaporating the alcohol, as described above, removed most of the remaining oil and resin by diluting the residue with water, filtering, and agitating with chloroform, in which the sulphate of atropine is insoluble; after the addition of caustic potassa, chloroform was used for extracting the alkaloid, of which 0.39 per cent. was obtained in a crystalline condition and of a fawn color, which was removed by treating the alcoholic solution with animal charcoal. The process of the U. S. P. 1870 arrived at the same result by converting the alkaloid contained in the tincture of belladonna-root into a sulphate. After most of the alcohol had been distilled off, the residuary liquid was poured into water, which retained the sulphate of atropine in solution, while nearly all the resin and oil was separated and removed by filtration. By means of potassa and chloroform the alkaloid was obtained, on evaporating the latter, in yellowish crystals, which, although then considered sufficiently pure for medicinal purposes, contain variable amounts of impurities; these, however, are removed without much trouble and loss by recrystallization from alcohol of 50 per cent.

In all the above-mentioned processes it is of importance that the treatment with the alkalies and alkaline carbonate should take place at a low temperature and not be unnecessarily prolonged, since carbonate of potassium alters the atropine and renders it inert when acting upon its aqueous solution at an elevated temperature; caustic potassa effects a similar decomposition already in the cold during a contact for 24 hours.

Properties and Tests.—Pure atropine is in colorless or white, glossy acicular crystals without odor, and has a disagreeably bitter and acrid taste. It melts at 113.5° C. (236.3° F.), according to Ladenburg (1880); at 115.5° C. (240° F), according to E. Schmidt (1881); when carefully heated it volatilizes at 140° C. (284° F.), partly unchanged, and at a higher heat is completely decomposed, leaving no residue. It is soluble in 300 parts (Von Planta), 500 parts (Geiger), 600 parts (*U. S. P.*), of water at 15° C. (59° F.), and in 35 parts (*U. S. P.*), or on continued boiling in 30 parts of boiling water (Geiger and Hesse). It is very freely soluble in alcohol, dissolves in warm oil of turpentine; according to Geiger and Hesse, in 63 parts (36 parts, Brandes) of ether, in 3 parts of chloroform, 38 parts of olive oil, also in 50 parts of glycerin. It has a strong alkaline reaction and neutralizes acids, forming salts which are crystallizable with difficulty and are soluble in water and alcohol, but insoluble in ether and chloroform. The solutions of the salts are not precipitated by platinic chloride except when very concentrated; their characteristic reactions, according to Ladenburg, are the following: With tannin, a white precipitate soluble in diluted acids; with iodine, a brown oily precipitate, becoming crystalline; with potassio-mercuric iodide, a white curdy precipitate; with picric acid, a crystalline precipitate; with chloride of gold, a yellow oily precipitate, crystallizing after some time, the dry crystals melting at 135° C. (275° F.), and when recrystallized from boiling diluted hydrochloric acid are again deposited in minute crystals, and after drying form a dull, lustreless powder (difference from hyoscyamine); the alcoholic solution of atropine, on passing cyanogen gas through it, becomes blood-red (Hinterberger, 1851); warmed with sulphuric acid and potassium bichromate after the addition of water, atropine develops a pleasant benzoin-like odor, the liquid becoming green (Ludwig, 1861); with cold sulphuric acid it yields a colorless solution, and on warming gives an odor resembling orange-flowers (Gulielmo, 1863). The sulphuric acid solution is not colored red by nitric acid (difference from morphine, narcotine, etc.), nor blue or purple by binoxide of manganese or potassium bichromate (difference from strychnine); the last-named reagent causes a green color.

When heated with baryta-water, soda, or strong hydrochloric acid, atropine is decomposed, yielding tropic acid, $C_9H_{10}O_3$ (by continued action atropic and isatropic acids, $C_9H_8O_2$), and tropine, which is a crystallizable, strongly alkaline compound having the formula $C_8H_{15}NO$ (Kraut, 1863; Lossau, 1864); it crystallizes in white hygroscopic needles or plates, is freely soluble in water, alcohol, and ether, and may be distilled in a current of hydrogen. Tropine tropate has no effect on the eye, but when heated with excess of dilute hydrochloric acid in a water-bath separates at first an oil, and when now treated with potassium carbonate yields atropine (Ladenburg, 1879).

According to Hübschmann (1858), commercial atropine frequently contains an uncrystallizable alkaloid, *belladonnine*, which is sparingly soluble in water and has a faintly bitter, burning, acrid taste. It may be removed from atropine by adding to the watery solution of the salt a small quantity of carbonate of potassium, when it is precipitated before any atropine is liberated; its identity with hyoscyamine has been suggested by Ladenburg. But Buchheim (1876) stated that it is decomposed by alcoholic potassa (not by barium hydrate) into tropine and *belladonnic acid*. In 1850, Von Planta stated atropine to be chemically identical with daturine, the alkaloid of stramonium; and since that time it is said the latter alkaloid has not unfrequently been manufactured and sold as atropine, notwithstanding the researches of Von Schroff and others have proved it to exert a more powerful physiological action than the latter. Ladenburg (1880) has shown that after the removal of belladonnine the product from belladonna consists of atropine, described above, and a small quantity of light atropine or hyoscyamine, while daturine is a mixture of the same two alkaloids, but hyoscyamine predominating.

Apatropine, $C_{17}H_{21}NO_2$, according to Pesci (1882), is obtained by treating atropine with fuming nitric acid, and is converted into *hydro-apoatropine*, $C_{17}H_{13}NO_2$, by treatment with sodium-amalgam.

Off. Prep.—Atropiæ sulphas, Liquor atropiæ, Unguent. atropiæ, *Br.*

ATROPINÆ SULPHAS, *U. S., Br.*—Sulphate of Atropine.

Sulfas atropinæ, F. Cod.; *Atropinum sulfuricum*, P. G.—*Sulphate of atropia*, E.; *Sulfate d'atropine*, Fr.; *Atropinsulfat*, *Schwefelsaures Atropin*, G.

Formula $(C_{17}H_{23}NO_3)_2H_2SO_4$. Molecular weight 676.

Preparation.—Take of Atropia 120 grains; Distilled Water 4 fluidrachms; Diluted Sulphuric Acid a sufficiency. Mix the atropia with the water and add the acid gradually, stirring them together until the alkaloid is dissolved and the solution is neutral. Evaporate it to dryness at a temperature not exceeding 37.7° C. (100° F.).—*Br.*

In preparing this salt it is important that the acid be very carefully neutralized, and that in evaporation the heat be cautiously applied. The salt is left behind in an amorphous condition, but may be obtained crystalline by dissolving it in absolute alcohol and evaporating spontaneously, or by pouring this solution into anhydrous ether. Ch. Maitre (1856) proposed a process which was recognized in the U. S. P. 1870. The atropine is dissolved in anhydrous ether, and sulphuric acid diluted with strong alcohol is carefully dropped in until the liquid just acquires a permanent acid reaction; the precipitate is washed with a little ether and dried at a low temperature.

Properties.—Atropine sulphate is "permanent in the air, odorless, having a very bitter, nauseating taste and a neutral reaction; soluble in 0.4 part of water and in 6.5 parts of alcohol at 15° C. (59° F.); very soluble in boiling water and in boiling alcohol; also soluble in 0.3 part (30 parts, Hager) of absolute alcohol. When heated on platinum-foil the salt is decomposed and wholly dissipated, emitting acrid vapors. On adding test solution of carbonate of sodium to a concentrated aqueous solution of the salt a white precipitate is obtained, which answers to the reactions of atropine. (See Atropina.) The salt or its solution when applied to the eye strongly dilates the pupil. An aqueous solution of the salt yields with test solution of chloride of barium a white precipitate insoluble in hydrochloric acid."—*U. S.* "It is soluble in 3 parts of alcohol sp. gr. 832, in 1 part of water, and is insoluble in ether and in chloroform. Heat .001 Gm. of it in a test-tube until white vapors are visible; then add 1.5 Gm. sulphuric acid; heat again until the mixture begins to turn brown, and dilute with 2 Gm. of water; a characteristic very agreeable odor should be given off; now add a small crystal of potassium permanganate, when the odor of oil of bitter almonds should be developed. The aqueous solution should be rendered turbid by solution of soda, but not by ammonia-water; 1 part of the salt dissolved in 1000 parts of water should have a distinct acrid and bitter taste."—*P. G.*

Off. Prep.—Liquor atropiæ sulphatis, *Br.*

Allied Salt.—Atropinæ salicylas, *Salicylate of atropine*, is prepared by Tichborne (1877) by dissolving 289 grains of atropine and 138 grains of salicylic acid in about 20 ounces of water, and evaporating, when 432 grains of the salt will be obtained as an uncrystallizable colloidal mass, which it is difficult to powder, and which is soluble in alcohol and in 20 parts of water at 15° C. (59° F.).

Physiological Action.—*On Animals:* Herbivorous animals and birds are but little affected by doses of atropine which are fatal to Carnivora; pigeons will often recover after the hypodermic injection of 2 grains of the alkaloid, and their pupils are not dilated by any dose of it. Even upon dogs the toxical action of atropine is relatively slight. The injection of 2 or 3 grains into the cellular tissue of these animals may produce a staggering gait and agitation; and the same quantity thrown into the crural vein, although it may cause rigidity and apparent death, will not necessarily destroy the animal's life. In a few hours it may appear entirely well. The action upon the several physiological systems varies with the dose of atropine. In non-poisonous doses it causes great acceleration of the heart's action with diminished vascular tension, while a general quieting effect on the cerebro-spinal system is observed. Poisonous doses seem to render morbidly acute the general and the special senses, although the perceptions do not appear to be normal, and there is no tendency to narcotism. Death, apparently, is due to exhaustion of the forces which move the heart and the respiratory organs, and is preceded by general muscular paralysis. On examination, the heart, lungs, and brain are found surcharged with blood. The experiments of Cavazzani on frogs seem to show that the action of atropine on the circulation is to weaken, and then paralyze, the heart, while it constricts the capillaries, and that either in this manner or more directly the red blood-corpuscles lose their power of absorbing oxygen (*Phila. Med. Times*, ix. 623). A vast amount of labor in experiment and great ingenuity in reasoning have been employed to illustrate and explain the mode of action of atropine. Even if the results were uniform their rationale would be uncertain, for the most contradictory explanations of identical phenomena are proposed by different experimenters; and necessarily so, since the physiological laws upon which the phenomena depend are as far as possible from being determined. But the results of apparently identical experiments are also the reverse of constant and uniform, and hence the only purpose for which they can interest physicians is unattained. (For illustrations see *Med. Record*, xix. 255.)

The physiological antagonisms of atropine are both interesting and practically important. Those relating to opium and morphine are discussed elsewhere. (See BELLADONNA.) Another very important one concerns jaborandi and its alkaloid, pilocarpine. Ringer has shown experimentally that atropine antagonizes these poisons, which weaken the heart, and restores active contractions to its ventricle (*Practitioner*, xxvi. 5). His conclusions have been abundantly confirmed. It has also been demonstrated, particularly by Strauss, Luchsinger, and Vulpian, that the power of atropine to render the skin dry is due to the local action of the alkaloid, for when injected subcutaneously its influence is first exhibited immediately around the puncture. In animals or in man the dose of atropine that will arrest the sweating caused by pilocarpine is extremely small. One-millionth of a gram of atropia will have this effect in man, and in the cat one-one-hundred-thousandth of a gram is sufficient (*Lancet*, Sept. 1879). One of the most complete antagonisms is that between atropine and muscarine. It is stated by Falck as follows: "When an animal has been poisoned by muscarine, and for hours together has suffered from profuse salivation and diarrhœa, with contracted pupils, and the heart is so depressed that only a few pulsations in a minute can be detected, when respiration has almost ceased and the animal lies cold and senseless on its side, the injection of the minutest fraction of atropine will in a few minutes entirely change its condition. The pulse rises, the heart beats, the breathing revives, the discharges from mouth and bowels subside, sensibility and consciousness return, and in a little while after the atropine was used the animal, although feeble, is able to walk about" (*Samml. klin. Vorträge*, 1879). The antagonism of atropine to physostigmin is also to be noticed. The former dilates the pupil contracted by the latter.

On Man: The hypodermic injection of one-twentieth of a grain of atropine causes the pulse in 20 minutes to rise from 72 to 110, the mouth to grow dry, and the pupils to begin to dilate; the sight grows indistinct, and usually there are grotesque hallucinations, and sometimes actual delirium; there is giddiness, with an inclination to sleep, and the dryness of the mouth and throat may last for 24 hours, with more or less nervousness and instability in walking. An erythematous eruption of the skin closely resembling that of scarlatina is generally observed (*e. g. Med. Record*, xxiii. 457), but occasionally there is an "erythematous and pseudo-erysipelatous swelling of the face and neck" (*Times and Gaz.*, April, 1880, p. 431). The recovery of children after poisoning by this alkaloid is very remarkable. An infant nineteen months old swallowed about three-quarters of a grain of sulphate of atropine. In half an hour the skin was bright scarlet, the limbs in constant spasmodic action, with dominant rigidity, and especially rigid flexion of the thumbs and great toes. Delirium, hallucinations, drowsiness, dilated pupils existed as in other cases, but complete recovery took place in 24 hours (*Phila. Med. Times*, x. 164). Often the pulse is very rapid, the respiration is hurried at first, and then interrupted or suspended, owing sometimes to mucus obstructing the air-passages; there may be dysphagia, convulsions, retention of urine, and, after recovery, desquamation of the cuticle (*Med. Record*, xxi. 375). A feeble child of six years recovered within 24 hours after taking about half a grain of atropine, and another of half that age after as large a dose. There have been cases in which even a grain and a half of atropine has not proved fatal (*Med. News*, Dec. 1881, p. 758). An adult recovered after a dose of nine-tenths of a grain administered hypodermically (*Med. News*, May, 1881, p. 307). A case of extreme atropine-poisoning from instilling a solution of the alkaloid into the eye is recorded by Sink (*Jour. Amer. Med. Assoc.*, i. 455). On the other hand, in a case in which an excessive quantity of the alkaloid was applied to a blistered surface there were, besides the above-mentioned symptoms, including dyspnœa with dysphagia, injection of the conjunctiva and choreic movements of the limbs; the pulse grew thready, and the patient died within 2 hours. Sometimes a striking degree of cutaneous anæsthesia has been observed, and to this effect may be attributed in part the inability to direct the movements of the limbs to definite purposes, such as grasping small objects, etc. A man was found dead after taking 2 grains of atropine, and another person died from the application of an ointment of atropine to the denuded skin. The symptoms consisted of agitation, followed by coma, a rapid and thready pulse, rigidity of the muscles, interrupted respiration, convulsions, and coma. After death by atropine the skin is usually discolored, the lungs and the right side of the heart distended with blood, the left side less so or quite empty, the brain usually congested, and the blood generally uncoagulated. The dilatation of the pupil by atropine applied to the eye has been variously explained, one view being that the medicine paralyzes the oculo-motor and excites the sympathetic and trigeminus nerves. These opposite actions of the same agent at the same moment, it is true, are not very intelligible. It is apparently proved by ordinary clinical experience, as well as by physiological experiment, that the dilating action of atropine upon the pupil is a local one; but whether it is the result of combined actions upon the muscles of the iris, or of a single one which is stronger than the normal opposing force, or whether it is not due in part or chiefly to the power of the agent to contract the blood-vessels which supply the iris, are questions which are not, perhaps, conclusively settled. (Further details upon the action of atropine will be found under the head of BELLADONNA.) Homatropine and atropine have been compared relatively to their mydriatic properties by Galizowski, Berteau, and others, and also by Schell, Oliver, Risley, and Schæffer, who confirmed previous results and showed that the former agent is identical with the latter in the nature of its action upon the eye, but that its effects are less complete and durable. The transient influence of homatropine renders it more eligible for the examination of the chambers of the eye (*Amer. Jour. of Med. Sci.*, July, 1881, p. 150; *Phila. Med. Times*, xi. 7; *Archives of Opthalmology*, x. 196).

Medical Uses.—For the relief of *pain* atropine is, next to opium, of the highest value, and especially for two of its severest forms, the pain of *neuralgia* and the pain of *spasm*. It should be employed in both hypodermically. Sciatica is the most unyielding, and intercostal neuralgia the most amenable, to this medicine. Neuralgia of the trigeminus holds in this respect a middle position. In sciatica the dose must be large. One-sixteenth of a grain has been used with curative effect. For the pain of *cancer*, and other local pains of analogous origin, a solution of 1 part of atropine in 1000 of water has been applied with great advantage on compresses covered with oiled silk or sheet rubber (Auger). A 1 per cent. solution instilled into the ear is one of the most efficient remedies for *earache*, especially when due to inflammation of the middle ear. Spasm itself, as it occurs in *tetanus* and in *poisoning by strychnia*, has been successfully combated by the hypodermic use of atropine. In such cases the dose must be large, being not less than one-twentieth of a grain repeated at intervals of not more than an hour until its characteristic effects are developed. In a case of traumatic *tetanus* the dose, varying from $\frac{1}{60}$ to $\frac{1}{40}$ of a grain, was given from two to four times a day for 11 days, when convalescence was established. The usual physiological effects of the drug were not developed (*Practitioner*, xxiii. 209). As more convenient for administration than belladonna, atropine may be used in the treatment of *whooping cough*, in the dose of $\frac{1}{120}$ grain once a day or oftener, and avoiding the production of its physiological effects. Various other forms of spasm are more or less subject to the power of this medicine. They will be found more fully described in connection with BELLADONNA, but it may be stated that almost every spasmodic affection may be influenced by that medicine or by atropine. It may be mentioned here, however, that sulphate of atropine administered hypodermically in the dose of from $\frac{1}{100}$ to $\frac{1}{50}$ of a grain has prevented the full development of the *epileptic* paroxysm and lessened the frequency of its occurrence. Indeed, it has been claimed to be more certain in its results, and attended with less inconvenience to the patients, than bromide of potassium (Weiss, *Centralbl. f. Therapie*, i. 268). In the following spasmodic disorders it may also be employed: spasm of the *anus*, the *urethra*, the *bladder*, the *ureter*, the *uterus*, the *vagina*, the *rectum*, the *large and small intestine*, the *biliary ducts*, the *bronchia*, the *larynx*, the *œsophagus*, etc. In all of these affections the hypodermic injection of atropine may be substituted for the use of any preparation of belladonna, internal or local. In the very opposite condition which occurs in poisoning by *Calabar bean* it has been proved that atropine is a true antidote in nearly the whole range of its action. But atropine counteracts or prevents the lethal action of physostigma when given in doses which are far below the minimum fatal doses of the former. Sulphate of atropine should be injected subcutaneously in doses of from $\frac{1}{50}$ to $\frac{1}{30}$ of a grain, and repeated until the pupils become dilated, the pulse-rate increased, and the secretion of bronchial mucus is checked. The therapeutical antagonism of belladonna and atropine to opium and morphine is confirmed by many cases of *opium-poisoning* treated by the hypodermic injection of atropine. Johnson of Shanghai is said to have used this treatment successfully in upward of three hundred cases (*Practitioner*, xxvi.

138). The hypodermic dose of atropine and the frequency of its repetition have varied in different cases between remote extremes. In one, for example, five doses, each of $\frac{1}{12}$ grain, were given within as many hours, and the case was of a desperate character, but ended in recovery (*Med. News*, xl. 318). In another instance with a like termination $\frac{1}{10}$ grain of atropine was injected, and afterward $\frac{1}{4}$ grain (*Practitioner*, xxiii. 123). It is evident that the dose must be determined by the exigencies of each case. It has been proposed to use atropine as a physiological antidote to *chloroform* by administering a hypodermic injection of $\frac{1}{120}$ to $\frac{1}{60}$ grain of atropine with $\frac{1}{8}$ or $\frac{1}{12}$ grain of a morphine salt before the inhalation of the anæsthetic is commenced (Fraser). The effects of *heat-exhaustion* (one of the forms of sunstroke) have been treated with alleged success by the hypodermic injection of atropine, strengthening the heart, stimulating the brain, restoring consciousness, and preserving life.

In various diseases of the eye the use of atropine is peculiarly appropriate; it is now universally employed for dilating the *pupil* so as to permit the inspection of the parts behind the iris and to facilitate the operation for *cataract*, but, owing to its more transient action, homatropine is to be preferred for this purpose, and also because it is less irritating than atropine. In inflammations of the cornea and of the iris it diminishes the congestion of the eye, and thereby lessens the pain and photophobia, and favors the healing of ulcers in the former tissue; and when *prolapse* of the *iris* takes place through a corneal ulcer, or when adhesion occurs between the two, the action of atropine, by contracting the iris toward its periphery, tends to prevent permanent deformity of the organ and impairment of the sight. *Myopia*, or short-sightedness, being often produced by an excessive strain of the eyes through spasm of accommodation, may sometimes be prevented from reaching its full development by resting the organs and maintaining for several weeks a paralysis of accommodation by means of atropine. By a similar method it is claimed that a number of cases of *strabismus* in its early stage have been cured (*Phila. Med. Times*, xi. 144). Atropine should never be used in *glaucoma*. It is probably through the power involved in these operations that atropine has been found efficient in cases of *profuse sweating* and also of *sialorrhœa* and *galactorrhœa*. The power of sulphate of atropine to control the *night-sweats* of *phthisis* and other debilitating diseases is well established. About $\frac{1}{100}$ grain hypodermically is the average commencing dose required. The condition of the patient in other respects need not influence the use of the medicine—not even the fact of perspiration having already commenced. Sometimes existing profuse perspiration is checked by the medicine within a few minutes. Its effects may also extend over several nights, but occasionally they are not immediate, but are developed at the end of 24 hours or more. It is not essential to give the injection at bed-time. It may be administered hypodermically, or by the mouth in camphor-water, or in pill. In the latter way the commencing dose should be about $\frac{1}{75}$ grain (*Practitioner*, xxiii. 93). Homatropine, used for the same purpose, is decidedly inferior not only to atropine, but also to "Dover's powder, picrotoxin, and other means" (Murrell). Atropine has been found useful in serous *diarrhœa;* in the *salivation* of the insane; in the forming stage of *coryza*, when given in very minute doses (*Boston Med. and Surg. Jour.*, Aug. 1883, p. 151); and in *incontinence of urine* and *œsophagism* (Girard, *Bull. de thérap.*, xcviii. 481). In *spermatorrhœa*, due to atony and morbid irritability of the genital system, erections may be produced by the use of atropine and the passive seminal discharges arrested. This alkaloid, used along with morphine in hypodermic injections, tends to prevent the nausea and vomiting which are apt to be caused by morphine alone. *Menorrhagia* has been controlled by injecting hypodermically $\frac{1}{200}$ grain of atropine twice a day (Tacke). *Urticaria* has been cured, temporarily at least, by means of $\frac{1}{15}$ grain of sulphate of atropine taken twice a day (Schwimmer). Atropine is a physiological antidote to *jaborandi* and *pilocarpine*, promptly arresting the profuse sweating induced by those articles. The antagonism of atropine and *prussic acid* has been both maintained and denied; but even if it were real in a physiological sense, it would practically be of little importance, since the rapid action of a lethal dose of prussic acid cannot be overtaken by the slower operation of atropine.

Administration.—Except where otherwise stated, a solution of atropine used for any of the above purposes, including hypodermic injection, should not exceed the strength of 1 part in 100 of water. It may be applied to the eye by means of a fine camel's-hair brush while the lower punctum lachrymale is compressed to prevent the passage of the solution into the nasal passages and its consequent absorption. Several cases of atropine-poisoning have arisen in this manner. Klein recommends a mixture of 1 part of sulphate of atropine to 200 parts of vaseline as preferable to a solution. Thin gelatin disks, imbued with a solution of the salt, 1 : 100, are sometimes inserted between the lower lid and the eyeball, in order to prevent the accident just alluded to. A solution of homatropine hydrobromate containing 16 grains to the fluidounce of distilled water is convenient for ophthalmological purposes. An ointment of atropine may be used containing 1 grain of the alkaloid to a drachm of lard (Gm. 0.06 to Gm. 4.00).

AURANTII AMARI CORTEX, *U. S.*—BITTER ORANGE-PEEL.

Aurantii cortex, Br.; *Cortex fructus aurantii*, P. G.; *Cortex aurantiorum*, *Cortex pomorum aurantii.—Écorce (zestes) d'orange amère*, *Écorce de bigarade*, Fr.; *Pomeranzenschale*, G.

The rind of the fruit described below.

AURANTII FRUCTUS, *Br.*—BITTER ORANGE.

Poma aurantiorum, *Aurantia.—Seville Orange*, E.; *Orange amère*, *Bigarade*, Fr.; *Pomeranzen*, G.

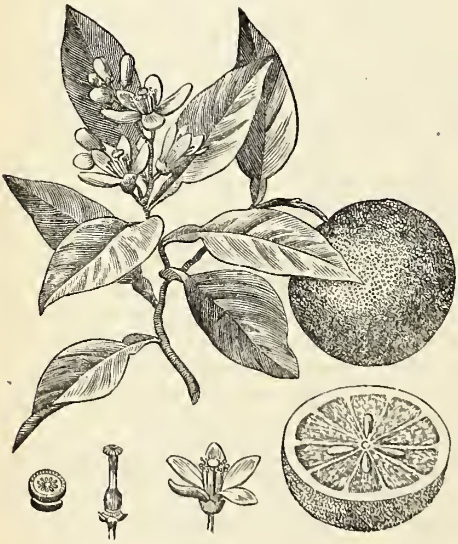
The ripe fruit of Citrus vulgaris, *Risso*, s. C. Aurantium, var. amara, *Linné*, s. C. Bigaradia, *Duhamel.* Bentley and Trimen, *Med. Plants*, 50.

Nat. Ord.—Aurantiaceæ.

Origin.—The bigarade orange is a small tree which is indigenous to the northern portion of India, but is largely cultivated near the Mediterranean, and in some of the West India Islands, and in that part of the United States which borders on the Gulf of Mexico. It closely resembles the sweet orange, excepting in the fruit, leaves, and flowers, the latter being more fragrant.

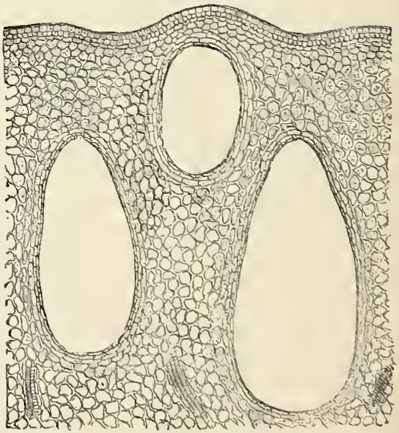
Description.—1. THE FRUIT. The unripe fruit falling from the tree is collected and extensively used on the continent of Europe, where it is known as orange-berries (E.), *orangettes* or *petits grains* (Fr.), *Unreife Pomeranzen* (G.), and is officinal as *Fructus (Baccæ) aurantii immaturi* vel *Aurantia immatura*, P. G. They are globular or ovate-globose, $\frac{1}{8}$ to $\frac{3}{5}$ inch (3–15 Mm.) in diameter, with a circular depressed scar at the base surrounded by eight to twelve smaller depressions, and with a slightly projecting remnant of the style at the apex. They are greenish to brownish-black in color, densely rugose, and consist of eight to ten or twelve cells having a central placenta, and two rows of ovules in each cell. Their odor is agreeably aromatic, their taste aromatic and bitter, the aromatic properties being due to a volatile oil which is contained in large oil-cells situated in the pericarp near the epidermis.

FIG. 35.



Citrus vulgaris, *Risso.*

FIG. 36.



Orange-peel; transverse section; mag. 65 diam.

The ripe fruit is of the size and shape of a sweet orange, but is rougher externally, and of a reddish-orange color, the spongy parenchyma underneath being white, and the juice having an acid and bitter taste. It has been made officinal in the British Pharmacopœia for the purpose of preparing the Tinctura aurantii recentis.

2. THE PEEL. Orange-peel is dried in narrow, thin bands or in quarters, the epidermis being glandular and of a dark brownish-green color; it has a fragrant odor and an aromatic, bitter taste. It should have very little of the spongy, white inner layer adhering to it. In commerce it is usually found in flat or curved elliptical pieces, about 3 inches (37 Mm.) long and ⅛ inch (3 Mm.) or more in thickness, the surface being of an uneven somewhat glandular appearance, covering the numerous large oil-cells and the spongy white parenchyma. This latter is directed to be removed by most pharmacopœias, only the yellowish rind (*flavedo aurantii*) being used. The Curaçoa orange-peel is obtained from a variety of the bitter orange cultivated in the island of Curaçoa. It is scarcely half the thickness of the ordinary orange-peel, and externally of a dark-greenish color. The commercial article sold under this name frequently consists merely of thin slices or spiral bands cut from the fully-developed but still unripe fruit grown elsewhere. The white parenchyma is colored yellow by alkalies and black by ferric salts.

3. THE LEAVES, *Folia aurantii*, are smooth, ovate, or ovate-oblong, entire or slightly crenate on the margin, pellucid-punctate, aromatic, and have a jointed petiole, with a broadly obovate or obcordate wing.

Constituents.—The white parenchyma of orange- and lemon-peel, but more particularly the unripe bitter orange, contains a crystalline bitter principle which was named *hesperidin* by Lebreton, its discoverer (1828). Hilger (1876) obtained from 5 to 8 per cent. of it from orange-berries by exhausting them first with water, afterward with diluted alcohol containing 1 per cent. of potassa, and precipitating the tincture with hydrochloric acid. Crude hesperidin is purified by Ed. Hoffman (1876) by recrystallization from hot alcohol, when it is obtained in white needles requiring about 5000 parts of hot water for solution; it is insoluble in ether, benzol, fats, and volatile oils, but is readily soluble in alcohol and hot acetic acid; its solutions in alkalies become yellow and orange-colored; the potassa solution, evaporated and the residue warmed with dilute sulphuric acid, shows a red and violet color. Hesperidin, $C_{22}H_{26}O_{12}$, melts at 245° C. (473° F.), becomes brown-red (dingy blackish-brown on warming, Flückiger) with ferric chloride, and by dilute acids is split into glucose and *hesperetin*, which melts at 223° C. (433.4° F.) and is soluble in alcohol and ether. Orange-peel also contains gum, albumen, some fixed oil, resin, volatile oil (see OLEUM AURANTII CORTICIS), and a principle resembling tannin in its behavior to iron salts.

The volatile oil obtained by the distillation of orange-berries with water was formerly known as *essence de petit grain*, but much of that which is now found in commerce is obtained from the leaves and young shoots. In chemical composition it resembles the oil of orange, but differs from it in odor, which varies even to some extent in the different cultivated varieties of the bitter orange.

Pharmaceutical Preparations.—ELIXIR AURANTIORUM COMPOSITUM, s. Elix. viscerale Hoffmanni, *P. G.* Macerate for 8 days bitter orange-peel 50 parts, cinnamon 10 parts, and potassium carbonate 2.5 parts in sherry wine 250 parts; express, and dissolve in the liquid 5 parts each of the extracts of gentian, wormwood, buckbean, and cascarilla; set aside and filter.

ELIXIR AMARUM, *P. G.*, Bitter Elixir. Dissolve extract of absinth 2 parts and oil sugar of peppermint 1 part in water 5 parts, and add bitter tincture and aromatic tincture of each 1 part.

TINCTURA AMARA, *P. G.*, Bitter tincture. Digest for a week centaury, gentian, of each 3 parts, bitter orange-peel 2 parts, orange-berries and zedoary of each 1 part, in alcohol (spec. gr. .894) 50 parts; express and filter.

Off. Prep.—Of the fruit: Tinct. aurantii recentis, *Br.* *Of the peel:* Extract. aurant. amari fluid., *U. S.;* Infusum aurantii, Infus. aurantii comp., Infus. gentianæ comp., Mistura gentianæ, Spiritus armoraciæ comp., *Br.;* Tinct. aurantii amari, Tinct. cinchonæ comp., Tinct. gentianæ comp., *U. S.*, *Br.*

Medical Uses.—The simple and compound infusions of orange-peel (*Br.*) are used as vehicles for other medicines and to allay *indigestion*, *flatulence*, and *colic*. They may be taken in doses of 1 or 2 fluidounces (Gm. 32–64).

AURANTII DULCIS CORTEX, *U. S.*—SWEET ORANGE-PEEL.

Cortex aurantiorum dulcium.—Écorce (zestes) d'orange douce, Fr.; *Apfelsinenschalen*, G.

The rind of the fruit of Citrus Aurantium, *Risso*, s. Cit. dulcis, *Link.* Woodville, *Med. Bot.*, 188; Risso, *Hist. Orang.*, 3, 39; Bentley and Trimen, *Med. Plants*, 51.

Nat. Ord.—Aurantiaceæ.

Origin.—This variety of the orange tree, known as the sweet or Portugal orange, is extensively cultivated in warm countries; it differs from the preceding in the leaves having the petioles more narrowly winged, and in the fruit having an agreeable sweetish acidulous taste; many varieties have been produced by cultivation.

Description.—Sweet orange-peel agrees in structure and in most of its physical properties with bitter orange-peel; it is, however, always of a lighter and more yellow color, of an agreeable sweetish aromatic odor, and of a slightly bitter taste. Its composition is the same as that of the bigarade orange, except the bitter principle, which is present in much smaller proportion. (See also Oleum Aurantii Corticis.)

Pharmaceutical Preparations.—Confectio aurantii corticis, *U. S.* 1870; Conserva aurantii.—Confection of orange-peel, *E.;* Conserve d'écorce d'orange, *Fr.;* Apfelsinenschalen-conserve, *G.*—Take of sweet orange-peel, recently separated from the fruit by grating, 1 part, and beat it with sugar 3 parts, gradually added, until they are thoroughly mixed.—*U. S.* 1870.

Off. Prep.—Syrup. aurantii, Tinct. aurantii dulcis, *U. S.*

Physiological Action and Uses.—Orange-peel is a mild stimulant of digestion, because it contains an essential oil which, in the fresh bitter orange, is endowed with very active irritant properties and acts upon the nervous system, in small doses stimulating it, but in large doses or by continued use depressing and deranging all the nervous functions. Dried orange-peel and its preparations are employed along with pure bitters to render them stimulant and more acceptable to the stomach, as well as to improve their taste. They are also associated with purgatives which tend to *gripe* and when the bowels are *flatulent.* Orange-peel is prescribed as an addition to many infusions and decoctions. It should not be added to the latter until ebullition has terminated. The confection of orange-peel (Pharm. 1870) may be used for disguising the taste and qualifying the acrid action of various medicinal powders, especially those of the cathartic class.

AURANTII FLORES, *U. S.*—Orange-Flowers.

Flores naphæ.—Fleurs d'oranger, Fr.; *Orangenblüthen*, *Pomeranzenblüthen*, G.

The partly-expanded flowers of Citrus Aurantium and of C. vulgaris, *Risso.*

Origin.—See Aurantii Fructus.

Description.—The flowers grow singly in the axils of the upper leaves, and consist of a small cup-shaped five-toothed calyx, and of five oblong, obtuse, fleshy, and glandular punctate petals, which are white, or in the dried state pale brownish-white, and about ½ inch (12 Mm.) long. The numerous (about twenty) stamens are united by the lower part of their filaments into three or more bundles. The globular ovary rises from a small fleshy disk, and bears a cylindrical style with a globular stigma. Orange-flowers have a highly fragrant odor, the bitter variety being more aromatic than the sweet; their taste is aromatic and bitterish.

When it is desired to keep fresh orange-flowers for some time, they may be preserved by mixing them well with half their weight of chloride of sodium, pressing the mixture in a suitable jar and keeping it, well closed, in a cool place.—*U. S.*

Lemon-flowers are externally of a reddish color and have a different odor.

Constituents.—Boullay found (1828) in orange-flowers, besides the volatile oil (see Oleum Aurantii Florum), gum, bitter extractive, acetic acid, and salts. The bitter taste is probably due to the presence of hesperidin. (See Aurantii Amari Cortex.)

Off. Prep.—Aqua aurantii florum, *U. S.*

Medical Action and Uses.—Orange-flowers are chiefly used to prepare a distilled water which is an agreeable vehicle for some medicines, and is believed to stimulate the nervous system slightly, allaying its superficial disorders in very susceptible persons.

AURI ET SODII CHLORIDUM, *U. S.*—Chloride of Gold and Sodium.

Auro-natrium chloratum, P. G.; *Chloruretum aurico-sodicum.—Chloraurate de sodium, Chlorure d'or et de sodium*, Fr.; *Natriumgoldchlorid*, G.

A mixture composed of equal parts of dry chloride of gold [$AuCl_3$; 302.4. — $AuCl_3$; 302.4] and chloride of sodium [$NaCl$; 58.4. — $NaCl$; 58.4].

Preparation.—Dissolve with the aid of a gentle heat pure gold 65 parts in a mixture composed of nitric acid 65 parts and hydrochloric acid 240 parts; dilute the solution with water 200 parts, add pure dry sodium chloride 100 parts, and evaporate in a water-bath and with constant stirring to dryness. Result, 200 parts.—*P. G.*

This is an improvement on the process of the former German Pharmacopœia, according to which the gold solution was evaporated nearly to dryness before it was mixed with the sodium chloride. Constant stirring is necessary during the final evaporation, in order to secure a uniform mixture, which persistently retains from 6 to 7 per cent. of water.

Properties.—This preparation is "an orange-yellow powder slightly deliquescent in damp air, odorless, having a saline and metallic taste and a slightly acid reaction. The compound is very soluble in water; at least one-half of it should be dissolved by cold alcohol. When exposed to a red heat it is decomposed and metallic gold is separated. A fragment of the compound imparts an intense, persistent yellow color to a non-luminous flame. Its aqueous solution yields, with test solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia."—*U. S.*

The French Codex orders the crystallized double salt, $NaCl.AuCl_3.2H_2O$ (mol. weight 396.8), to be prepared by dissolving the auric chloride prepared from 10 parts of gold in sufficient distilled water, adding 3 parts of chloride of sodium and evaporating to crystallization. It forms orange-colored rhombic prisms or plates which are soluble in water and alcohol, not deliquescent, fusible, and at a red heat are gradually decomposed, 49.4 per cent. of metallic gold being separated. It is known in France as *sel de Chrestien* and *sel de Figuier.*

Tests.—"On bringing a glass rod dipped into water of ammonia close to a portion of the compound no white fumes should make their appearance (absence of free acid). If 0.5 Gm. of chloride of gold and sodium be dissolved in 20 Ccm. of water, and treated with a clear solution of 2 Gm. of ferrous sulphate in 20 Ccm. of water acidulated with a few drops of sulphuric acid, a brown precipitate of metallic gold will be thrown down. If after at least 2 hours this precipitate be separated, well washed, dried, and ignited, the residue of metallic gold should weigh not less than 0.162 Gm. (corresponding to 32.4 per cent. of metallic gold)."—*U. S.* If .5 Gm. of it be slowly heated to redness and afterward washed with water, the residue after drying should weigh not less than .150 Gm., corresponding to 30 per cent. of gold.—*P. G.* This test corresponds to 46.27 per cent. of $AuCl_3$ and to 60.67 per cent. of $NaCl.AuCl_3.2H_2O$. The gold test of the U. S. P. corresponds to 49.94 and 65.53 per cent. respectively.

AURUM.—GOLD.

Or, Fr.; *Gold*, G.

Symbol Au. Atomicity univalent and trivalent. Atomic weight 196.2.

Origin and Properties.—This well-known metal is chiefly found in the metallic state, always associated with other metals and frequently in various native sulphurets. It is the most ductile of all metals, softer than silver, fuses at nearly 1200° C. (2200° F.), has the density 19.3, and is of a reddish-yellow color and metallic lustre, but when powdered of a brown color, acquiring lustre by pressure. It is not altered by exposure to air and water, and does not dissolve in acids, but is soluble in liquids containing or generating chlorine. The following preparations of gold have been used:

AURUM FOLIATUM, *gold-leaf*, is used for coating pills; is transparent, with blue or green color; it should not be attacked by nitric acid nor become tarnished by ammonia.

AURI PULVIS, *powdered gold*, may be prepared by triturating gold-leaf with crystals of milk-sugar, potassium sulphate, or other hard soluble substance, until the metallic lustre has completely disappeared, when the compound is washed out with water. A solution of chloride of gold yields the metal in a finely-divided condition when added to solution of ferrous sulphate, oxalic acid, or other oxidizable compound.

AURI CHLORIDUM, *chloride of gold* or *auric chloride*, $AuCl_3$. On dissolving pure gold in nitro-muriatic acid and crystallizing, yellow *hydrogen-gold chloride*, $AuHCl_4.4H_2O$, is obtained, which in a dry atmosphere loses $1H_2O$ (Julius Thomsen, 1878, 1883). But on evaporating the solution to dryness, dissolving in water, filtering from some aurous chloride, AuCl, and again evaporating, auric chloride is obtained as a dark-red or red-brown salt. It is decomposed above 150° C. (302° F.), dissolves readily in water, and is also soluble in alcohol, ether, and volatile oils, which solutions are gradually reduced. Its solution yields with stannous chloride a dark-brown or purple precipitate known as *purple of Cassius*, the exact composition of which is still unknown. J. A. Koenig (1882) ascertained that an aqueous solution of gold chloride in contact with charcoal previously deprived of all foreign constituents is slowly reduced to metallic gold, hydrochloric acid and carbonic acid gas being formed at the same time.

Auri et ammonii chloridum, *ammonio-chloride of gold.* Equal parts of auric chloride and chloride of ammonium are dissolved in water, acidulated with hydrochloric acid, and the solution evaporated to dryness (Dorvault). It resembles the preceding.

Auri cyanidum, *cyanide of gold*, is best prepared, according to Figuier (1847), by dissolving pure auric chloride in water, and adding a solution of an equivalent weight of pure potassium cyanide, when a lemon-yellow precipitate will be obtained; a larger quantity of the latter solution would change the color to brownish- or orange-yellow. It is inodorous and tasteless, and contains 75 per cent. of gold. With an excess of cyanide of potassium, used in a concentrated hot solution, *auro-potassium cyanide*, containing 55 per cent. of gold, is obtained in colorless tabular crystals, which on exposure become white from loss of water of crystallization.

Auri iodidum, *iodide of gold*, AuI_3, is obtained by precipitating a solution of auric chloride with potassium iodide, avoiding an excess of the latter, washing with water, and drying carefully. It is a dark-green powder, which is soluble in solution of potassium iodide, and on exposure loses iodine, being first converted into yellow *aurous iodide*, AuI, and finally into metallic gold.

Auri oxidum, *auric acid, hydrate (oxide) of gold*, AuH_3O_3. Pelletier directs the boiling of a solution of auric chloride with an excess of magnesia or oxide of zinc, collecting the precipitate upon a filter, and washing it first with dilute nitric acid (which must be free from chlorine), and afterward with water. Frémy (1850) adds to auric chloride sufficient solution of potassa until the precipitate is redissolved, the solution is boiled for 15 minutes, or until its dark-brown color has changed to light-yellow, when it is acidulated with sulphuric acid and the precipitate washed and dried; it retains a trace of potassium. Hydrate of gold is a blackish-brown powder which is readily soluble in hydrochloric and hydrobromic acids, and when heated to 245° C. (473° F.) or boiled with alcohol yields metallic gold.

Physiological Action.—The action of gold has, to some extent, an analogy with that of mercury, its salts producing local effects varying between irritation and causticity, and internally developing a state of erethism which resembles strongly mercurial fever. Within this limit it is represented as stimulating the functions generally, and in man especially the genital activity, while in women it is said to augment the menstrual flux. Some of the most detailed and minute descriptions of its effects are drawn from the poetical observations of Italian physicians (Gozzi).

Medical Uses.—It appears that gold compounds, when persistently employed, may, through the febrile erethism above referred to, tend to eliminate the *syphilitic* poison from the system and arouse the sluggish vital forces as they exist in *scrofula*. Indeed, it is said that this action sometimes goes so far as to give a destructive energy to the morbid process. It is unnecessary to enter into much detail respecting a medicine which has deservedly fallen into disuse, and whose merits give it no present claim to a rehabilitation. It has, however, been used with apparent advantage by Martineau in a case of inveterate syphilis, thus: Water Gm. 1000; chloride of gold and chloride of sodium, of each 1 Gm. 1 to 3 teaspoonfuls daily (*Bull. et Mém. Soc. de thérap.*, 1883, p. 52). Powdered gold or its oxide is applied by friction upon the sides of the tongue in the dose of from $\frac{1}{5}$ grain to 3 or 4 grains (Gm. 0.01–0.20) daily. The oxide is given internally in pill, and in the dose of $\frac{1}{10}$ grain (Gm. 0.006), after meals, and gradually augmented. Chloride of gold and sodium is a caustic, but in a diluted condition may be applied to the interior of the mouth, as above mentioned. The salivation which follows this manœuvre is due to a local and not to a constitutional action of the metal. The dose of this preparation is about $\frac{1}{20}$ grain (Gm. 0.003). Chloride of gold is a caustic resembling in its action nitrate of silver. It has been applied to *lupoid*, *cancerous*, and other *ulcers*.

AVENÆ FARINA, *U. S.* 1870.—Oatmeal.

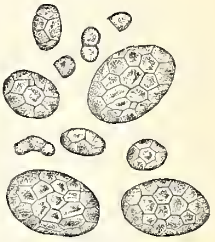
Farine d'avoine, Fr.; *Hafermehl*, G.

The meal prepared from the seed of Avena sativa, *Linné*. Bentley and Trimen, *Med. Pl.*, 292.

Nat. Ord.—Graminaceæ.

Origin.—The native country of oat has not been ascertained, though it is supposed to have originated from one of the wild species indigenous to Europe. It is cultivated in most civilized countries, even in the subarctic regions, and many varieties or species are known, all having a loose panicle and two- or occasionally three-flowered spikelets. The kinds more rarely found in cultivation, except in certain localities, are A. orientalis, *Schreber*, A. strigosa, *Schreber*, A. nuda, *Linné*, and A. brevis, *Roth*. The fruit is closely invested by the paleæ, lanceolate, pointed, and grooved on the inner side. Oats deprived of the paleæ or husk are called *groats*. By grinding the grains oatmeal is obtained.

Fig. 37.



Oat Starch, magnified 250 diameters.

Description.—Oatmeal is a grayish-white not uniform powder, in which fragments of the tissue are observed by the naked eye; it has a slight odor and a somewhat bitterish taste. Viewed under the microscope, the starch consists of medium-sized polyhedral or muller-shaped granules, with a rather distinct hilum, but without observable laminæ. Frequently two or three are united, or even a larger number, forming a nearly spherical mass with a checkered surface, and readily separating by pressure into the separate granules.

Constituents.—Oats consist on an average of 25 per cent. of husks and 75 per cent. of grain; the former contain 1 to 1½ per cent. of fixed oil, ½ to ¾ per cent. of sugar and gum, nearly 2 per cent. of protein compounds, and 6½ to 7 per cent. of ash, the remainder being cellulose. The grain contains 64½ to 66 per cent. of starch, 5 to 7 of fat, 18 to 21 per cent. of protein compounds, 1 to 3 per cent. of salts, the remainder being sugar, gum, and cellulose. The largest portion of the protein compounds is *avenin*, which may be obtained from oatmeal by treating it in the cold with a weak solution of potassa, decanting from the sediment, and precipitating by acetic acid; the impure avenin is washed with diluted and strong alcohol and ether, redissolved in weak potassa solution, and precipitated by acetic acid (Kreusler, 1869). Avenin closely resembles legumin in its behavior to solvents; it contains 17 per cent. of nitrogen and ¾ to 1 per cent. of oxygen.

Medical Action and Uses.—Oatmeal is an excellent article of food, but is apt to undergo fermentation in the stomach, producing flatulence and sour eructations. It is more nutritious than purely starchy articles, such as arrow-root and sago; and, being somewhat laxative, in consequence partly of its usually containing a portion of bran, it forms an appropriate article of diet in cases of habitual *constipation* and inertia of the intestines. The insoluble bran is, however, prone to accumulate, and sometimes forms concretions. Oatmeal gruel is prepared by slowly boiling from 1 to 2 ounces (Gm. 32–64) of oatmeal with 3 pints of water until reduced to 2 pints, straining the decoction, allowing it to stand until cool, and then rejecting the supernatant liquid. Its flavor may be improved by the addition of raisins toward the end of the boiling, and also by means of sugar and nutmeg. It has recently been claimed that an alcoholic tincture of oats has been used successfully in overcoming the *opium habit*, but without proof that any active element of oats is soluble in alcohol or any sufficient clinical evidence of the alleged virtues of the preparation.

AZEDARACH, *U. S.*—Azedarach.

Pride of India, *Pride of China*, E.; *Écorce d'azédarach*, *Écorce de margousier*, Fr.; *Zedrachrinde*, G.

The bark of the root of Melia Azedarach, *Linné*.

Nat. Ord.—Meliaceæ.

Origin.—Azedarach is a handsome tree which is indigenous to China and India, and cultivated as an ornamental tree in Southern Europe and in the United States from Virginia southward; in the Gulf States it has been completely naturalized. It grows rapidly to the height of 30 or 40 feet (9 to 12 M.), has large deciduous and glabrous bipinnate leaves, the leaflets being lance-ovate, acuminate, and serrate, and bears panicles of lilac-colored fragrant flowers and yellowish globular drupes of the size of a cherry, which by fermentation yield considerable alcohol. In the East Indies the bark of the *nim tree* or *margosa*, Melia Azadirachta, *Linné* (Azadirachta indica, *Jussieu*), is used as a tonic and febrifuge; the simply pinnate leaves are employed as a local stimulant, and a fixed oil which is expressed from the fruit has a strongly bitter taste and is employed as an anthelmintic, and externally in rheumatic complaints.—Bentley and Trimen, *Med. Plants*, 62.

Description.—The bark is met with in irregular curved pieces and quills, 1 or a few inches long and ¼ inch (6 Mm.) or more in diameter. The first layer of corky tissue is thin, of a blackish-brown color, somewhat glossy, and forms irregular longitudinal ridges or patches upon the bright red-brown cork underneath. In older barks the corky layer is rust-brown and two or three times thicker than the remaining portion of the white inner bark, which contains a few scattered pale-yellow bast-fibres and is tangentially striate. The inner surface is whitish or pale-brownish, uneven, and longitudinally striate. The bark breaks with a short and smooth, and in the inner portion more or less fibrous, fracture. The cork has very little taste, but the inner bark is at first sweetish, afterward bitter and nauseous. It should be collected from the smaller roots or deprived of the thick rust-brown nearly tasteless corky layer. It yields its virtues to hot water and diluted alcohol.

Constituents.—The bitter principle was isolated by Jacobs (1879) in the form of a yellowish-white resin which is almost insoluble in water, oil of turpentine, and petroleum benzin, slightly soluble in carbon bisulphide, and freely soluble in alcohol, ether, and chloroform. The inner bark contains no tannin. Its constituents may be analogous to those of *nim-bark*, in which Broughton (1873) found a bitter, dark-brown resin-like principle, $C_{36}H_{50}O_{11}$, which is slightly soluble in water, but dissolves in alcohol, benzol, carbon bisulphide, and ether. Another amorphous principle, more soluble in water, and a crystalline fatty substance, were likewise obtained. Cornish (1856) had separated a bitter crystalline principle, *margosin*, besides volatile oil, resin, and other widely-diffused constituents.

Allied Plants.—The bark and other parts of different species of Guarea and Moschoxylon, indigenous to the West Indies and tropical America, possess the odor of musk. The bark of several species of Trichilia, met with in India, Africa, and South America, is purgative and emetic. Carapa guianensis, *Aublet*, and Car. Touloucouna, *Guillemin et Perrottet*, yield anthelmintic bark and a bitter fixed oil, known as *crab oil, kundah, or callicoonah oil*, the latter being expressed from the seeds. Swietenia Mahagoni, *Linné*, indigenous to the West Indies and tropical America, particularly Mexico, yields the well-known *mahogany-wood*, and a similar wood is obtained in Western Africa from Khaya senegalensis, *Guillemin et Perottet;* both species have a bitter and strongly astringent bark. Cedrela odorata, *Linné*, is the *Jamaica red cedar;* all parts of it are bitter and unpleasantly odorous, but old wood is fragrant. Soymida (Swietenia, *Willdenow*) febrifuga, *Jussieu*, yields the East Indian *rohun-bark*, a useful astringent tonic. Mahogany-wood contains *catechin*, according to Cazeneuve and Latour (1875).

Physiological Action and Medical Uses.—Even from the period of Arabian medicine the poisonous properties of azedarach have been known, and then, as now, it was stated to have produced faintness, giddiness, dimness of sight, mental confusion and vomiting; later observers have added to these symptoms stertorous breathing, stupor, dilatation of the pupils, cold sweat, and purging. All of these effects resemble those produced by spigelia. The active properties appear to reside in the bark of the root. The berries are often eaten without injury by children and also by birds. Cows and horses are not injured by the leaves. Indeed, the latter are said to be given to horses infested with "bots," and the berries have been found an attractive and nutritious food for horses. In India and the southern portions of the United States azedarach-bark is said to be the most popular *vermifuge* for lumbricoid ascarides. It is usually administered in a decoction made by boiling 2 ounces (Gm. 64) of the bark (fresh, if possible) in a pint of water until reduced one-half. For a child the dose is a tablespoonful every 2 or 3 hours until it affects the stomach and bowels. It should be followed by a cathartic.

BALSAMUM PERUVIANUM, *U. S., Br., P. G.*—BALSAM OF PERU.

Balsamum peruvianum nigrum, Balsamum indicum.—Baume de Pérou, Baume des Indes, Fr.; *Perubalsam*, G.

A balsam obtained from Myroxylon (Myrospermum, *Royle*, Toluifera, *Baillon*) Pereiræ, *Klotzsch*. Bentley and Trimen, *Med. Plants*, 83.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Balsam of Peru was for a long time supposed to be derived from Myroxylon peruiferum, *Linné filius*, a tree growing in Brazil and near the west coast of South America. Pereira (1850) showed that the drug produced in the state of San Salvador in Central America comes from an apparently different species, which he provisionally distinguished as Myrospermum Sonsonate. Carson regarded the two species as identical, but, according to Royle, Klotzch, and others, they are specifically distinct. (See *Am. Jour.*

Pharm., 1860, pp. 296 and 411; 1864, p. 145.) The plant in question is a tree attaining a height of about 50 feet (15 M.), and branching from 7 to 10 feet (2 to 3 M.) above ground. It has imparipinnate leaves with the leaflets oval-lanceolate, somewhat attenuate above, and slightly emarginate, the flowers in subaxillary racemes, and oblanceolate indehiscent one-seeded legumes about 4 inches (10 Cm.) long.

Collection.—According to Dorat (1860, 1863) and Wyss (1878), at the beginning of the dry season, early in November or December, the bark for some distance up the trunk is beaten with the back of an axe or other blunt instrument until it has separated from the wood without breaking, This is done on four sides, leaving four intermediate strips untouched, so as not to destroy the vitality of the tree. Five or six days later the loosened bark is charred by means of torches, and in the course of another week the charred pieces fall off, when the bare wood is covered by rags, which absorb the exuding balsam, and which, when saturated, are gently boiled in water until most of the heavy balsam sinks to the bottom, the remainder being obtained by wringing the partly-exhausted rags in a bag made of stout rope. The wounds of the tree are covered with fresh rags as long as any balsam exudes during the dry season. The strips left untouched in one season are similarly treated the following year, and the tree will thus yield an annual supply of balsam for 30 years, but it is allowed to rest for some time after 5 or 6 years in order not to exhaust its productiveness. The balsam obtained from the rags by boiling and pressing is on the following day separated from the water and put into suitable vessels.

Commerce.—Balsam of Peru comes to us in earthen jugs and metallic drums, and is principally exported from the port of Acajutla on the Pacific coast and from Balize on the Atlantic side. Formerly it reached Europe by way of Peru, and was supposed to be a product of that country. The importation into the United States amounted in 1876 to 1271 pounds, and in 1878 reached 8924 pounds.

Description.—The balsam is a thick liquid of the consistence and appearance of molasses, of a dark brown-black color when examined in bulk; in thin layers, red-brown and perfectly transparent. It has an acid reaction, an agreeable, fragrant, slightly smoky odor and a warm bitterish taste, followed by a burning sensation in the fauces. Its specific gravity is 1.135 to 1.150 (1.137 to 1.145, *P. G.*). Exposed to the air, it is but little changed and scarcely thickened in the course of several years, but ultimately forms a soft solid. It is readily soluble in all proportions in pure acetone, absolute alcohol, chloroform, and glacial acetic acid, and with an equal bulk of alcohol and ether yields a clear solution, which on the further addition of the solvent becomes turbid and deposits a little resin. It yields a clear mixture with one-third its volume of carbon disulphide, but with more of the latter separates a blackish-brown resin. Petroleum benzin agitated with Peru balsam does not permanently mix with it, and remains colorless, but on evaporation leaves a colorless or pale-yellow oily liquid (cinnamein). Diluted alcohol and fixed and volatile oils dissolve only a small proportion of the balsam, but the latter takes up from 12 to 15 per cent. of castor oil, forming a clear solution.

By subjecting the fruit to pressure *white Peru Balsam* is obtained. It forms a thick yellowish-white liquid having an odor resembling that of tonka, and containing a crystallizable resin named *myroxocarpin.*

The tree exudes a gum-resin which, according to Attfield (1864), contains 77.4 per cent. of resin, but no aromatic principle or cinnamic acid.

Constituents.—The balsam has (1869 and 1870) been examined by K. Kraut and by J. Kachler, from whose analyses it appears to contain a little benzylic alcohol, benzylic benzoate and cinnamate (about 60 per cent.), cinnamic and benzoic acids, and resin (32 per cent., Kachler). Kraut obtained in the distillate also stilbene. After complete saponification with potassa, Kachler obtained 20 per cent. of benzalcohol and 46 per cent. of cinnamic acid. Delafontaine's statement (1868), that stryacin (cinnamylic cinnamate) is also present, was not corroborated by Kraut.

Benzylic cinnamate, or *cinnamein*, the principal constituent, has the composition $C_9H_7(C_7H_7)O_2$, and is when pure a colorless oily liquid of a faint agreeable odor and an aromatic sharp taste. Its specific gravity is about 1.095, and its boiling-point somewhat above 300° C. (572° F.). By caustic alkalies it is decomposed into benzylic alcohol and cinnamic acid.

Benzalcohol, or *benzylic alcohol*, C_7H_8O, is a colorless, faintly aromatic oil heavier than water and boiling at 204° C. (399.2° F.), and by oxidizing agents is converted first into oil of bitter almonds, and finally into benzoic acid. It is considered to be the *peruvin* of Frémy in a pure state; as obtained by that author it was lighter than water.

Benzylic benzoate, $C_7H_5(C_7H_7)O_2$, is a colorless oil which crystallizes at a low temperature and boils at about 340° C. (674° F.).

Stilbene, $C_{14}H_{12}$, forms colorless and inodorous pearly scales or prisms which are fusible and boil above 290° C. (554° F.).

Adulterations.—Balsam of Peru is frequently adulterated with alcohol, fixed oils, copaiba, Canada turpentine, rosin, etc. Peru balsam should not diminish in volume when agitated with an equal bulk of water (absence of alcohol).—*U. S.* If 10 drops of the balsam be triturated with 20 drops of sulphuric acid, a tough, homogeneous, cherry-red mixture should result. If this be washed after a few minutes with cold water, it should be converted into a resinous mass which is brittle when cold (absence of *fixed oils* and oleoresins).—*U. S.*, *P. G.* (For modifications in manipulation see *Am. Jour. Pharm.*, 1870, p. 404, and 1876, p. 166.) According to Schlickum (1882), the resin left on applying this test should be perfectly soluble in ether, an insoluble residue indicating the presence of benzoin or storax; treated with acetone or alcohol, such a residue will be completely dissolved unless storax was present, which will leave a small amount of a white powder undissolved, and yield it from chloroform in minute crystals. A mixture of 1 part of the balsam with 3 parts of disulphide of carbon separates from the balsam (about 40 per cent. of) black-brown resin. The liquid poured off from the latter should be transparent, should not have a deeper color than light-brownish, and should not exhibit more than a faint fluorescence (absence of gurjun balsam).—*U. S.*, *P. G.* Flückiger states that the resin separated sometimes amounts to 38 per cent.; it is insoluble in ether, but dissolves in alcohol and alkalies, and, according to Kachler (1869), yields protocatechuic acid when fused with potassium hydrate, and on dry distillation yields stryol, toluol, and benzoic acid. When distilled with 200 times its weight of water no volatile oil should pass over (absence of volatile oil, copaiba, etc.).—*U. S.*, *P. G.* The addition of volatile oils lessens the specific gravity of Peru balsam; on distilling it with water in a flask its volatile constituents remain behind, owing to their high boiling-points, while volatile oils distil with the vapors of water. If 1 Gm. of the balsam be agitated with 5 Gm. of benzin, and after separation 30 drops of the clear liquid be evaporated spontaneously, a yellowish oily residue should be left, which on being moderately heated should not evolve an odor of turpentine, storax, or copaiba, and when mixed with 5 drops of nitric acid should not produce a blue or blue-green color either in the cold or at a moderate heat (absence of turpentines, storax, copaiba, fixed oils, etc.).—*P. G.* Benzin, particularly when warmed with Peru balsam, takes up cinnamein, which after repeating the treatment may amount to 63 per cent. (Flückiger). The use of nitric acid in the above test was suggested by Doescher (1881); pure balsam gives a yellow color, but in the presence of storax the color is greenish-blue, and finally dingy green-yellow, and in the presence of rosin the same but brighter colors are produced. If 5 drops of the balsam be well agitated with 3 Ccm. of ammonia-water, only a slight, rapidly-disappearing foam should be produced, and the mixture on being set aside for 24 hours should not form a stiff jelly (absence of rosin, etc.).—*P. G.* By this test, which was proposed by Grote, turpentines and their resins are readily detected. Flückiger (1881) proposed the following: 10 drops of pure Peru balsam and 0.4 Gm. slaked lime form a mixture remaining soft, and which when warmed evolves a fatty odor in case castor oil or other fat be present.

Alcohol is best detected, according to Gavalowski (1875), by adding some of the suspected balsam to a solution of potassium bichromate, followed by concentrated sulphuric acid, when the characteristic odor of aldehyd, suggesting that of rotten apples, will be perceived. Or some of the balsam may be distilled with water and the distillate treated while warm with a little iodine, followed by caustic soda or potassa until decolorized. On cooling crystals of iodoform will separate (*Lieben's alcohol test*, 1869).

Pharmaceutical Uses.—Balsam of Peru is mixed with lard to preserve it from becoming rancid. A syrup is made of this balsam (see SYR. TOLUTANUS), and it is a constituent of the following:

MISTURA OLEOSO-BALSAMICA, s. *Balsamum vitæ Hoffmanni*, P. G. Three parts of balsam of Peru and 1 part each of the volatile oils of lavender, cloves, cinnamon, thyme, lemon, mace, and orange-flowers are dissolved in 240 parts of alcohol; after several days the brownish-yellow liquid is filtered.

Physiological Action and Medical Uses.—Balsam of Peru is a general stimulant, with a special tendency to the mucous membranes. In large doses it irritates the digestive canal, and may cause vomiting and diarrhœa; but in medicinal doses it occasions some heat of skin, increased frequency of pulse, and an augmented action of the kidneys. Locally, it hastens repair of tissue, and is reputed to be a germicide and antiseptic. As an internal medicine it is most useful in limiting bronchial secretion, and hence as a remedy in *chronic bronchitis* occurring alone or as a complication of pulmonary consumption. It should not be used if much fever exists. It may be prescribed for these purposes by inhalation, and also for the alleviation of *chronic laryngitis*. In chronic *dysentery* its action is similar, and is often extremely salutary; and the same may be said of its use in the *diarrhœa* which is apt to persist in some cases of prolonged typhoid fever. As a dressing for various *ulcers*, especially those of the indolent sort, it promotes their cure by stimulation and by its protective agency. It is well suited for treating *sore nipples*, applied pure or in an ointment or liniment, for moderating the discharge of pus in *chronic catarrh* of the nostrils, ears, vagina, etc., and as an application to *chilblains*. In some cases of obstinate local *eczema* its healing virtues are conspicuous. According to circumstances it may be applied pure or diluted with glycerin, almond or olive oil, lard, etc. It speedily kills itch-insects and destroys their eggs. In Germany it is much used in the treatment of *scabies*, as being no less efficient, and much more agreeable, than sulphur for this purpose. It causes but little smarting or irritation of the skin. Before applying it the patient takes a prolonged warm bath, with or without green soap, after which, and three times a day for about 2 days, all the body, the seats of the eruption particularly, are rubbed with about 40 drops of the balsam. At the end of the time mentioned the cure is complete (Husemann). Balsam of Peru is one of the most useful of all applications for *pruritus vulvæ* and other forms of pruritus, especially the *senile*. It is best applied pure with the finger or with a soft brush. The addition of catechu improves its healing qualities in some instances. Internally it may be given in the dose of half a fluidrachm (Gm. 2) in an emulsion of almonds, gum-arabic, or yelk of egg, with sugar or dissolved in glycerin.

Hoffmann's balsam is used in Germany as a nervine in doses of from 10 to 30 drops (Gm. 0.30–1.00), on sugar, in wine, or in appropriate mixtures.

BALSAMUM TOLUTANUM, *U. S., Br.*—BALSAM OF TOLU.

Baume de Tolu, Baume de Carthagène, Fr.; *Tolubalsam*, G.

A balsam obtained from Myroxylon toluifera, *Kunth*, s. Myrospermum toluiferum, *A. Richard*, s. Toluifera Balsamum, *Miller*. Woodville, t. 215; Bentley and Trimen, *Med. Plants*, 84.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This evergreen tree attains a height of 70 to 80 feet (21 to 24 M.), rising usually to about 40 or 60 feet (12 or 18 M.) from the ground without branching. Young trees always have a larger foliage than old ones, in which it is small and quite thin if they have been much bled. The leaflets are obovate, the flowers axillary-racemose, and the legume oblong-linear, not narrowed at the base. The tree is found in the high rolling country of Venezuela and New Granada. Prof. Baillon regards the tree yielding Peru balsam as identical with this, and the difference of the two products as due to the manner in which they are extracted (*Am. Jour. Pharm.*, 1874, p. 14).

Collection.—Two sloping notches are cut through the bark, meeting at their lower ends in a sharp angle, below which the bark and wood are hollowed out a little to receive the calabash cup into which the balsam flows. Similar cuts are made as high up as a man can reach, until often as many as twenty cups are found on one tree. When the lower part of the trunk is too full of scars a rude scaffold is sometimes made around the tree and new incisions made higher up. The balsam-gatherer collects the contents of the cups in flask-shaped bags made of raw-hide, a pair of them being slung over the back of a donkey. When filled these bags are sent to the ports of exportation on Magdalena River, where their contents are transferred into cylindrical tins (John Weir, *Am. Jour. Pharm.*, 1864, p. 449).

Commerce.—Tolu balsam is exported from the Venezuelan ports in tins holding 10 (and occasionally 25) pounds. The amount imported into the United States varies considerably. In 1876 it was 9221 pounds, and in 1880, 52,085 pounds.

Description.—Recently imported, Tolu balsam forms a semi-liquid mass which gradually hardens, becoming quite brittle in the cold, but softening between the teeth and fusing readily at a somewhat elevated temperature. In thin layers it is perfectly transparent and of a yellowish- or reddish-brown color. Viewed under the microscope, crystals of cinnamic acid are observed. It has an acid reaction, an agreeable aromatic odor, suggesting that of vanilla, which becomes more apparent on warming it, and a mild aromatic taste. It is readily soluble in alcohol, chloroform, potassa solution, and acetone; also in ether. Petroleum benzin, benzol, and carbon bisulphide scarcely act upon it.

Constituents.—The main constituent of Tolu balsam is an amorphous resin which, according to Kopp (1849), consists of a portion very soluble, and another but slightly soluble, in alcohol. Cinnamic acid, to the exclusion of benzoic acid, was found by Kopp (1849), Carles (1844), but Busse (1876) proved also the presence of benzoic acid and 8.5 per cent. of benzylic ethers of cinnamic and benzoic acids. On distillation with water about 1 per cent. of *tolene* is obtained, which is a colorless, thin, volatile oil boiling at 160° C. (170°, Deville), having a specific gravity of .858, an agreeable odor, an acrid peppery taste, and the composition $C_{10}H_{16}$. Dry distillation yields, in addition to the ethers and acids named above, also styrol (see Storax), phenol (see page 39), and toluol.

Toluol, or *toluene*, C_7H_8, is *methylbenzol*, $C_6H_5.CH_3$. It is found in coal-tar and among the products of destructive distillation of wood, various resins, and many organic compounds. It is a colorless, oily, strongly refractive liquid, of the spec. grav. .86, boiling at 111° C. (231.8° F.), and not congealing at —20° C. (—40° F.). Its odor is similar to that of benzol. By suitable treatment it is converted into benzoic acid. (See page 35.)

Adulterations.—Turpentines are sometimes added, and may be detected by their solubility in carbon bisulphide. Concentrated sulphuric acid imparts to pure Tolu balsam a cherry-red color; in the presence of turpentine the acid becomes black. Naylor (1878) met with a spurious balsam of Tolu, which had a warm acrid taste, and was completely soluble in carbon bisulphide, benzol, chloroform, ether, and hot alcohol; its origin is unknown.

Pharmaceutical Uses and Preparations.—Balsam of Tolu is used as a vehicle in Pilulæ phosphori, *U. S.*, *Br.* Syrupus tolutanus, *U. S.*, *Br.*, contains mainly the aromatic principle; and in Tinct. tolutana and Tinct. benzoini comp., *U. S.*, *Br.*, balsam of Tolu is completely dissolved in the alcoholic menstruum.

Allied Plants.—Myroxylon punctatum, *Klotzsch*, s. Myrospermum balsamiferum, *Ruiz et Pavon*, s. Toluifera punctata, *Baillon*, is the *quino-quino* tree of Peru, and by Bentley, Flückiger, and others is regarded as not being distinct from the tolu balsam tree.

Myroxylon peruiferum, *Linné filius*, s. M. pedicellatum, *Klotzsch*, s. Toluifera peruifera, *Baillon*. Peckolt (1879, 1880) showed that a balsam resembling Peru balsam may be obtained from it, which, however, has only the spec. grav. 1.031, an aromatic, astringent, and slightly pungent taste, yields clear solutions with alcohol and castor oil in all proportions, and with sulphuric acid does not yield a brittle resin, but a sticky, somewhat greasy mass.

Physiological Action and Medical Uses.—The general properties of balsam of Tolu resemble those of balsam of Peru, but are much less decided. Its agreeable flavor renders it an eligible ingredient of mixtures, lozenges, vapors, etc. intended to modify subacute and chronic inflammations of the mucous membrane, especially the *bronchial*. It is much used by perfumers in the manufacture of burning pastilles. It may administered in emulsion in doses of from 10 to 30 grains (Gm. 0.60–2.00). Its most usual form in medicine is the syrup.

BAPTISIA.—Wild Indigo.

Indigo sauvage, Fr.; *Baptisie*, G.

The root of Baptisia (Sophora, *Linné*, Podalyria, *Michaux*) tinctoria, *R. Brown*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Wild indigo is a common, smooth, perennial herb growing in dry, sandy ground in the United States and Canada. The branching stem is about 2 feet (60 Cm.) high; the leaves are trifoliate, the leaflets roundish-obovate and wedge-shaped at base; the stipules minute and caducous; the yellow flowers are in small, loose racemes. On drying, the herb becomes bluish-black.

Description.—The root consists of a short, knotty head which is 2 to 3 inches (50 to 75 Mm.) broad, with irregular and broad stem-scars above, and below divided into several long cylindrical branches about ½ inch (12 Mm.) in diameter, which are sparingly beset with branching fibres. The bark is externally of a dark-brown color, with small warts somewhat arranged in transverse rows or with a soft and friable corky layer; internally whitish, radially striate, thick, and covering a whitish, tough, and tasteless wood with indistinct medullary rays. Roots of 1 year's growth are smaller, of a light-brown color externally, and have the ligneous meditullium about as thick as the bark. The root is nearly inodorous and has a bitterish, acrid, and nauseous taste residing in the bark.

Constituents.—Wild indigo-root contains resin, but no volatile or fixed oil (Smedley, 1862). An alkaloid, of which the hydrochlorate has a nauseous and acrid taste, was obtained by J. A. Weaver (1871). Dr. F. V. Greene (1879) found the alkaloid to be insoluble in chloroform, benzin, and benzol, but to dissolve in water, alcohol, and ether.

Medical Action and Uses.—Its young shoots, like those of phytolacca, have been eaten in the same manner as asparagus. When more mature the stalks and roots are violently emetic and cathartic, especially when fresh. A decoction of the bark has like effects. Rutherford's experiments led him to conclude that "in the dog it is a hepatic and also an intestinal stimulant of moderate power." It would seem to be a general stimulant, since it has been held in great repute as a remedy in *scarlatina*, *typhus*, and epidemic *dysentery*, and also as a topical application in *aphthæ*, *mercurial sore mouth*, and various *ulcers*, especially those affected with gangrene. For the last-mentioned purpose it has been used in a poultice or an ointment. The leaves possess the same virtues as the root, but in a less degree. A tincture of the root, in the dose of from 1 to 5 drops every 1 to 4 hours, is credited with "almost entirely preventing delirium and diarrhœa, diminishing the heat and soon effecting a cure" of *typhoid fever*. But as it was associated in the treatment with "cool lotions, milk, and stimulants," it cannot be credited with the alleged results, which, indeed, are incompatible with the law of typhoid fever (*Am. Jour. Pharm.*, l. 89). Wild indigo is given in decoction made with an ounce of the recent root to a pint of boiling water; the dose is about a tablespoonful (Gm. 16) every 3 or 4 hours; its tendency to occasion vomiting and purging may be diminished by lessening the dose or adding laudanum to the liquid.

BARIUM.—Barium.

Barium, E., G.; *Baryum*, Fr.

Symbol Ba. Atomicity bivalent. Atomic weight 136.8.

Origin.—The mineral *heavy spar* first attracted attention about 1602 through the discovery of a phosphorescent compound obtained by igniting a mixture of the mineral and organic substances. The presence in the mineral of sulphuric acid was demonstrated by Marggraf (1750), and of a peculiar earth by Scheele (1774) and Gahn (1775). Crawford (1787) first used the barium chloride medicinally. An amalgam of barium was obtained (1808) by Berzelius and Pontin, and in the same year Davy isolated the metal by distilling the mercury from the amalgam.

Properties.—Barium is a lustrous, light-yellow metal of the spec. grav. 3.6, and is rapidly oxidized on exposure to air and in water. The following compounds are more or less employed in medicine, in chemistry, or in the arts:

1. Barii hydras.—Barium hydrate, *E.;* Hydrate de baryte, *Fr.;* Barythydrat, *G.* Formula BaH_2O_2. Mol. weight 170.8.—*Oxide of barium* is first prepared by calcining barium nitrate, or a mixture of this salt with barium sulphate; the oxide is dissolved in water, the solution decanted, if necessary, from the insoluble matter, then evaporated to dryness and heated to redness. It forms a white crystalline mass or a white powder, has the spec. grav. 4.5, a strong alkaline reaction, and is freely soluble in water. It is employed for the decomposition of sulphates, carbonates, etc. Its purity is determined in the same manner as that of barium carbonate; it does not effervesce with acids.

2. Barii peroxidum.—Barium peroxide, *E.;* Peroxyde de baryum, *Fr.;* Barium hyperoxyd, *G.* Formula BaO_2. Mol. weight 168.8.—It is prepared by conducting oxygen or atmospheric air over barium oxide or hydrate heated to dull redness. It is a gray porous mass or white powder, which parts with 1O at a bright-red heat, and with hydrochloric acid yields hydrogen dioxide.

3. Barii carbonas, *U. S.* 1870; Barium carbonicum, Baryta carbonica, Carbonas baryticus.—Carbonate of barium, *E.;* Carbonate de baryte, *Fr.;* Kohlensaures Barium, Kohlensaurer Baryt, *G.* Formula $BaCO_3$. Mol. weight 196.8.—Carbonate of barium is found native, as *witherite*, in large quantities in the lead-mines at Alston Moor and at Anglesark in Lancashire, England. It is also met with in Scotland and Sweden. It may be obtained artificially by precipitating a soluble barium salt with an alkaline carbonate, or by heating to redness and fusion a mixture of 10 parts of heavy spar (barium sulphate), 2 of carbon, and 5 of potash, and washing the fused mass with water, when barium carbonate is left behind. Its formation is explained by the following equation: $BaSO_4 + C_2 + 2HKO = BaCO_3 + K_2S + CO_2 + H_2O$.

Witherite is found in pale-yellowish or grayish fibrous masses or in rhombic crystals varying in specific gravity between 4.3 and 4.56. The artificially-prepared barium carbonate forms a soft, white, amorphous or crystalline, tasteless powder. Its specific gravity is 4.22 to 4.307. It requires over 15,000 parts of boiling water for solution, but dissolves more readily in solutions of chloride and some other salts of ammonium, and is also slightly soluble in some carbonates, and even sulphates. When recently precipitated it decomposes the solutions of many salts, precipitating the metals either as hydrates or carbonates. Owing to its solubility in hydrochloric and other acids, it acts as a poison when taken internally.

Barium carbonate should be completely soluble, with effervescence, in dilute hydrochloric acid (absence of barium sulphate). The solution is not colored or precipitated by ammonia or hydrosulphuric acid (absence of lead and other metals). When the solution is precipitated by an excess of sulphuric acid the filtrate, on being evaporated, should leave no fixed residue (absence of alkalies), and should yield no precipitate with carbonate of sodium (absence of calcium and other earths).

4. Barii sulphas.—Heavy spar, *E.;* Spath pesant, *Fr.;* Schwerspath, *G.* Formula $BaSO_4$. Mol. weight 232.8.—This is a mineral from which other barium compounds are prepared by converting it first into soluble sulphide in the manner indicated below: on treating its solution with dilute sulphuric acid, sulphate of barium is again formed, and this is used under the name of *permanent white* or *blanc fix* for glazing cards and by painters in place of white lead.

5. Barii chloridum, *U. S.* 1870; Baryum chloratum, Baryta muriatica.—Chloride of barium, *E.;* Chlorure de baryum, *Fr.;* Chlorbaryum, Chlorbarium, *G.* Formula $BaCl_2.2H_2O$. Mol. weight 243.6.—It is prepared by dissolving barium carbonate in diluted hydrochloric acid, evaporating the solution, and crystallizing. On the large scale it is obtained sometimes as a secondary product, as in the preparation of ammonium carbonate (see page 177), or it is made from native sulphate of barium (heavy spar) by igniting its mixture with charcoal, so as to form barium sulphide, and carbonic acid, according to the equation $BaSO_4 + C_2 = BaS + 2CO_2$. The barium sulphide thus obtained is then dissolved in water and boiled with some excess of hydrochloric acid, whereby sulphuretted hydrogen is given off, barium chloride remaining in solution; $BaS + 2HCl$ yields $BaCl_2 + H_2S$. By evaporating the solution the salt is obtained in crystals.

Barium chloride exists in colorless, translucent rhomboidal tables or lamellæ. It is permanent in the air at the ordinary temperature, but loses one-half of its water above 55° C. (131° F.), and becomes anhydrous at 121° C. (250° F.). 100 parts of water retain at 105° C. (221° F.) 60 parts, at 40° C. (104° F.) about 41, at 20° C. (68° F.) 35.7, and at 10° C. (50° F.) 34.3 parts of the salt in solution (Mulder). The aqueous solutions are partly precipitated by strong hydrochloric and nitric acids, in which the salt is less soluble than in water. It is insoluble in absolute alcohol, but dissolves in spirit containing water, and imparts to the alcohol-flame a yellow color. It possesses the persistently bitter and disagreeable astringent taste of the soluble barium salts. Its solution yields with nitrate of silver and with potassium sulphate or dilute sulphuric acid copious white precipitates, which are insoluble in nitric acid. Phosphates, carbonates, and the salts of most organic acids yield with barium chloride precipitates which are insoluble in water, but dissolve in nitric or hydrochloric acid.

Chloride of barium should be entirely soluble in water (absence of barium carbonate and sulphate), and the solution should not be colored or precipitated by ammonia or hydrosulphuric acid (absence of lead and other metals). When precipitated by an excess of sulphuric acid the filtrate should leave no fixed residue on evaporation (absence of alkalies), and should yield no precipitate with sodium carbonate (absence of calcium and other earths). Alcohol shaken with the powdered salt, then poured off and ignited, should not burn with a red flame (absence of strontium chloride).

6. Liquor barii chloridi.—Solution of chloride of barium, *E.;* Soluté de chlorure de baryum, *Fr.;* Chlorbarium-Lösung, *G.*—Dissolve barium chloride 1 troyounce in distilled water 3 fluidounces, *U. S.* 1870.

7. Barii bromidum.—Bromide of barium, *E.;* Bromure de baryum, *Fr.;* Brombarium, *G.* $BaBr_2.2H_2O$. Mol. weight 332.8.—It is obtained on dissolving barium carbonate in hydrobromic acid, and crystallizes in colorless rhombic plates, which dissolve in their own weight of cold water and are freely soluble in alcohol. The salt has a very disagreeable taste.

8. Barii iodidum.—Iodide of barium, *E.;* Iodure de baryum, *Fr.;* Jodbarium, *G.* $BaI_2.2H_2O$. Mol. weight 426.—It is conveniently made by boiling a solution of iodide of iron with excess of barium carbonate, filtering, and crystallizing. It forms large trans-

parent rhombic prisms which are very freely soluble in water and alcohol, and when heated melt and become anhydrous.

Physiological Action.—The soluble salts of barium are all supposed to possess closely analogous powers, but the sulphate, owing to its insolubility, is probably inert. Long ago Gmelin used this language: "The salts of barium are energetic poisons, having a special power of destroying the irritability of the voluntary muscles; they act upon the stomach as irritants, and also inflame the heart. The proper antidote for them is a soluble alkaline sulphate." Boehm's experiments, in which soluble barium salts were injected into the lymph-sacs of frogs, showed, as effects, mucous secretion from the skin, distension of the air-sacs, rigid extension of the limbs, convulsive movements under irritation, followed by relaxation and paralysis of the voluntary muscles first, and then of those of respiration; the abdomen was meanwhile tumid, and through its walls vigorous intestinal peristalsis was visible; the lungs were distended, and active irritation of the animal extorted from it a loud and unnatural cry. In mammals the injection of a strong solution of the salt into the veins immediately excites tonic and clonic convulsions, a discharge of urine and feces, and general paresis, or, if the dose has been excessive, death in convulsions may ensue. In the stomach the poison does not exhibit any effect for 15 or 20 minutes, when alvine evacuations take place, the abdomen is distended, and the peristaltic movements of the bowels are visible. In dogs profuse salivation occurs, with vomiting and prolonged straining. Gradually extreme muscular debility succeeds, and the pupils dilate, but perception does not appear to be extinct until death, which is attended with slight spasms. The action of barium salts upon the heart is essentially the same in frogs and mammals; it occasions a contraction of the heart and arteries, which is more or less prolonged according to the dose employed, and, as a consequence, augments the pressure of the arterial blood-column. If, however, the dose employed is excessive, the heart is paralyzed and not made rigid. Boehm concluded from his experiments that barium salts "either stimulate powerfully the whole nervous sympathetic system or have a special relation to unstriped muscular fibre."

We are not acquainted with any experiments upon man sufficient to illustrate the physiological action of these compounds, or which prove them to be tonic, diuretic, and diaphoretic, as they are said to be. It is true that Dr. F. Flint took "about 1 grain three times a day with a very marked stimulant effect" (*Practitioner*, xxiii. 40). It is certain that in an overdose chloride of barium may produce the symptoms common to the irritant poisons—abdominal pain, vomiting, purging, collapse with thready pulse, general muscular asthenia, coma, convulsions, and death. The most characteristic symptoms are labored respiration and bronchial effusion. After death the lesions in the stomach consist of vascular injection and extravasation, and even ulceration. The carbonate is said to have destroyed life in at least three cases. Of four persons who were poisoned by this compound, three suffered from weakness of the lower limbs; the fourth had paralysis of the legs and trunk, and death occurred on the second day. No lesions whatever were found in the stomach or bowels (Reineke, *Practitioner*, xxii. 49). In a case which ended in recovery the patient complained of dimness of sight, double vision, headache, tinnitus, and cramps, with occasional vomiting and purging. In another case the principal symptoms were numbness of the feet, cramps in the legs, and general coldness of the body (*Edinb. Med. Jour.*, xxviii. 651).

Medical Uses.—There is little in the summary above given of the action of the salts of barium to connect it with the therapeutic results which are said to have followed their administration in disease, unless, perhaps, it really have the power of "stimulating powerfully the whole nervous sympathetic system." Such an action might be admitted to explain the virtue attributed to it of curing *scrofula* of the glands. Hufeland claimed that in this affection its virtues "do not yield either to mercury or antimony;" which might very well be the case even if it were more injurious than useful. Yet a large number of writers might be cited who attribute to it a peculiar efficacy in scrofula. Among them, Phillips holds that as a local discutient it is not inferior to iodine, and that in cases where "the tallow-like complexion, the pale tongue, and the languid circulation, accompanied by irritability of the mucous surfaces, are present, its virtues are remarkably demonstrated." A later and a better authority, Lebert, declares that he has "never obtained the slightest advantage from its use" in glandular scrofula. And this experience, we apprehend, is more weighty than that of a multitude of less competent judges. In other forms of scrofula affecting the joints, eyes, etc. the evidence of its utility is, if possible, still less. Dr. F. Flint ascribes the apparent cure of an *aneurism* of the abdominal aorta to the administration of chloride of barium in doses of from $\frac{1}{5}$ to $\frac{2}{5}$ grain three times a day for nearly 5 months. This took place after the diet-and-rest cure had been tried for an equal period without benefit (*Practitioner*, xxiii. 37). The virtues attributed to natural mineral waters containing barium salts in the treatment of *cutaneous diseases* are no doubt more or less real, but that they are in any degree due to the minute proportion of those salts present in the waters is a groundless hypothesis. The dose may be stated at from ½ grain to 1 or 2 grains (Gm. 0.03–0.12) dissolved in a large quantity of water and taken after meals. Of the solution of chloride of barium the dose is about 5 drops (Gm. 0.30).

BEBERINÆ SULPHAS, *Br.*—SULPHATE OF BEBERINE.

Sulfate de bébéerine, Fr.; *Schwefelsaures Bebirin*, G.

Prepared from nectandra- or bebeern-bark.

Preparation.—Take of Bebeeru-bark in coarse powder 1 pound; Sulphuric Acid ½ fluidounce; Slaked Lime ¾ ounce or a sufficiency; Solution of Ammonia a sufficiency; Rectified Spirit 16 fluidounces or a sufficiency; Diluted Sulphuric Acid a sufficiency; Water 1 gallon; Distilled Water a sufficiency. Add the sulphuric acid to the water; pour upon the bebeeru-bark enough of this mixture to moisten it thoroughly; let it macerate for 24 hours; place it in a percolator and pass through it the remainder of the acidulated water. Concentrate the acid liquor to the bulk of 1 pint; cool, and add gradually the lime in the form of milk of lime, agitating well and taking care that the fluid still retains a distinct acid reaction. Let it rest for 2 hours; filter through calico; wash the precipitate with a little cold distilled water, and to the filtrate add solution of ammonia until the fluid has a faint ammoniacal odor. Collect the precipitate on a cloth, wash it twice with 10 ounces of cold water, squeeze it gently with the hand, and dry it by the heat of a water-bath. Pulverize the dry precipitate, put it into a flask with 6 ounces of the rectified spirit, boil, let it rest for a few minutes, and pour off the spirit. Treat the undissolved portion in a similar manner with fresh spirit until it is exhausted. Unite the spirituous solutions, add to them 4 ounces of distilled water, and distil so as to recover the greater part of the spirit. To the residue of the distillation add by degrees, and with constant stirring, diluted sulphuric acid till the fluid has a slight acid reaction. Evaporate the whole to complete dryness on the water-bath, pulverize the dry product, pour on it gradually 1 pint of cold distilled water, stirring diligently; filter through paper; evaporate the filtrate to the consistence of syrup, spread it in thin layers on flat porcelain or glass plates, and dry it at a heat not exceeding 140° F. Preserve the product in stoppered bottles.—*Br.*

The percolate obtained on treating bebeeru-bark with acidulated water contains, besides sulphate of beberine, beberic acid, which is almost completely removed by the lime. The filtrate, which is still acid, is treated with ammonia, whereby impure beberia is precipitated, together with some lime compounds. From this mixture alcohol takes up the alkaloid still contaminated with coloring matter, which is not removed by the subsequent treatment with sulphuric acid. But, after evaporating to dryness and redissolving in cold water, some foreign matters which are soluble in the acid solution remain on the filter.

Properties.—Thus prepared, sulphate of beberine (or *bibiria*) forms dark-brown, thin, translucent scales, yielding a brownish-yellow powder having a bitter taste and being completely soluble in water and in alcohol. The commercial salt yields with from 6 to 8 parts of water a clear solution, but on further dilution a precipitate is often occasioned, which J. Nesbit (1881) found to be due to a deficiency of sulphuric acid; on supplying this only a slight amount of oxidation-product remains undissolved. Dott (1881) found the scaly salt to contain about 15 per cent. of water, 7.8 per cent. of SO_3, and about 60 to 64 per cent. of mixed alkaloids, the remainder being extractive and coloring matter. Pure sulphate of beberine is yellowish-white. The officinal salt contains also the sulphate of *sipirine*, a second and brown alkaloid met with in the bark. Beberine was considered by Walz (1860) to be identical with buxine, the alkaloid of the common box; the statement was corroborated by Flückiger (1869), who established also the identity of pelosine with the two alkaloids. That solutions of the salts of these alkaloids are precipitated by certain acids and neutral salts has been repeatedly observed; Palm (1883) recommends the separation of beberine from the other alkaloids by precipitating its solution with sodium chloride. (See also NECTANDRA and PAREIRA BRAVA.)

Tests.—The officinal salt yields a white precipitate with chloride of barium, and with caustic soda a yellowish-white precipitate which is soluble in ether, and on evaporating the solvent is again left as a yellow translucent residue entirely soluble in dilute acids.

The salt is completely decomposed by heat, without leaving any fixed residue. These tests, in connection with the properties mentioned, are sufficient to prove the purity of the salt.

Physiological Action.—Administered hypodermically to frogs, it produces tetanic rigidity without exaggerated reflex excitability, in which respect it resembles quinine, caffeine, and theine, and differs from strychnine. Internally, it does not produce the headache, tinnitus, deafness, gastric irritation, etc. which quinine sometimes occasions, while it equals that alkaloid in its tonic influences upon the appetite and digestion.

Medical Uses.—Introduced as a substitute for quinine, it has not confirmed the estimate originally made of its efficacy: for although, like the greater number of vegetable bitters, it displays *anti-periodic* virtues, and like some of them also it will occasionally effect a cure of intermittent fever, yet on the whole its powers must be rated much lower than those of the cinchona salts. It has been found curative in some cases of periodical *headache* and *neuralgia* of the same type, and as a useful tonic in the general debility of pulmonary phthisis and of prolonged suppuration with *hectic fever*. In strumous *ophthalmia*, atonic *dyspepsia*, certain cases of *menorrhagia*, *leucorrhœa*, etc. it may be used as a substitute for quinine. The *dose* as a tonic is from 1 to 3 grains (Gm. 0.06–0.20); as an anti-periodic, from 5 to 10 grains (Gm. 0.30–0.60). It may be given, like sulphate of quinine, in a watery solution with an excess of aromatic sulphuric acid.

BELÆ FRUCTUS, *Br.*—BAEL-FRUIT.

Indian bael, *Bengal quince*, E.; *Bael*, *Coing du Bengale*, Fr.; *Belafrucht*, *Bengalische Quitte*, G.

The dried, half-ripe fruit of Ægle Marmelos, *Correa* (*Pharm. Jour.*, vol. x. p. 166, plate), s. Cratæva Marmelos, *Linné*, s. C. religiosa, *Ainslie*. Bentley and Trimen, *Med. Plants*, 55.

Nat. Ord.—Aurantiaceæ.

Origin.—The bael tree is a medium-sized thorny tree, with ternate leaves and large white flowers, indigenous to the Himalaya Mountains, but much cultivated throughout India.

Description.—The fruit is from 2 to 4 inches (5 to 10 Cm.) in diameter, more or less globular in shape, and resembles an orange of large size in appearance and internal arrangement, it being divided into about twelve cells, containing in the ripe state a pleasant-flavored, highly mucilaginous juice, while the rind is quite aromatic. As found in commerce, the fruit is mostly broken, a portion of the dried pulp and seeds still adhering to the fragments of the rind. The latter is smooth and of a brownish-gray color externally, about ⅛ inch (3 Mm.) thick, hard, and of a slightly astringent taste, destitute of aromatic properties. The exposed portion of the dried pulp is of a deep-orange, red-brown, or bright brownish-red color, whitish within, hard, of a mucilaginous scarcely acidulous taste, and encloses in each cell several oblong, flat seeds, which are woolly and very mucilaginous.

Constituents.—These have not been well ascertained. The rind contains mucilaginous and pectin compounds, but appears to be free from tannin, which, according to Collas (1856), is found in the ripe fruit to the amount of 5 per cent. The infusion of bael is scarcely affected by iron salts.

Substitution.—The fruit of Feronia elephantum, *Correa*, another aurantiaceous tree of India, is used there like bael. It is known under the name of *elephant-* or *wood-apple*, and differs from bael in being completely divided into five compartments.

Off. Prep.—Extractum belæ liquidum, *Br.*

Medical Action and Uses.—Bael is, and long has been, used in India, where the British practitioners ascribe to it astringent, aromatic, and demulcent qualities. It enjoys in that country great repute, especially in the treatment of some forms of bowel complaint. The pulp of the fresh fruit is used with sugar to make a draught (sherbet) which, according to Waring, "is not only astringent when *diarrhœa* exists, but possesses the singular property of being also aperient if the bowels are *costive*." The bark of the root and of the trunk of the tree is tonic and astringent; the expressed juice of the leaves "is commonly given in colds and incipient fevers when the patient complains of general dulness, pains in his limbs, and a sense of fulness in the stomach;" the young leaves are applied warm to the eyes in *ophthalmia;* and a decoction of the unripe fruit is prescribed in *diarrhœa* and *dysentery*. In chronic diarrhœa following typhoid fever Christison found it singularly efficient. He says: "It is an incomprehensible remedy, has neither aroma nor taste, and certainly no astringency," in the dried state. The liquid extract appears to be the most available preparation of bael. It is recommended to be given in doses of 1 to 2 fluidrachms (Gm. 4–8) (Tayrer, *Times and Gaz.*, June, 1878, pp. 611, 645; July, 1878, p. 86).

BELLADONNA, *U. S., Br., P. G.*—BELLADONNA.

Deadly nightshade, Dwale, E.; *Belladone, Morelle furieuse*, Fr.; *Tollkirsche, Wolfskirsche, Tollkraut, Belladonna*, G.

Atropa Belladonna, *Linné.* Bentley and Trimen, *Med. Plants*, 193.
Nat. Ord.—Solanaceæ, Atropeæ.

Officinal Parts.—1. BELLADONNÆ FOLIA, *U. S., Br.;* Folia (s. Herba) belladonnæ, *P. G.*—Belladonna-leaves, *E.;* Feuilles de belladone, *Fr.;* Belladonna-Blätter, *G.*

The leaves.

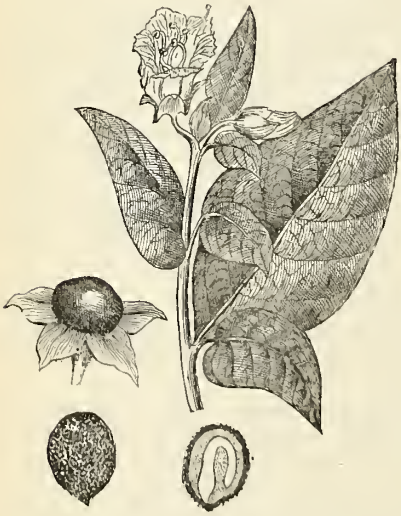
2. BELLADONNÆ RADIX, *U. S., Br.*—Belladonna-root, *E.;* Racine de belladone, *Fr.;* Belladonnawurzel, *G.*

The root.

Origin.—Belladonna is a nearly glabrous, herbaceous, perennial plant, attaining a height of from 4 to 6 feet (1.2 to 1.8 Mm.), and has dark-purple bell-shaped flowers and glossy purplish-black berries of the size of a cherry. It is found in the woods, chiefly in mountainous districts, of Central and Southern Europe, and as far east as Asia Minor, Caucasia, and Central Asia. It is cultivated in Europe and in this country to a certain extent.

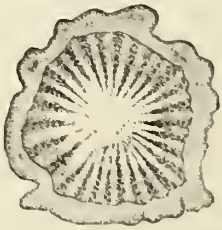
Description.—1. BELLADONNA-ROOT. As collected from plants several years old, the roots are a foot (30 Cm.) or more long, ½ inch to 1 inch (12 to 25 Mm.) thick, cylindrical above and gradually tapering, fleshy, and in the dry state with deep longitudinal wrinkles. The head is frequently crowned with the hollow bases of the overground stems; the bark is covered with a brownish-gray cork, or, after its removal, is of a light gray or grayish-white color externally and somewhat lighter internally. A fine blackish cambium-line separates the bark from the meditullium, in which the small yellow wood-bundles, with large vessels, are arranged in radiating wedges, separated by rather broad medullary rays; near the centre and in the young branches the wood-bundles are loosely scattered around a central ligneous cord, while in the old roots the woody tissue predominates considerably. When fresh the root has a disagreeable, heavy odor, which disappears on drying, leaving merely a faint earthy smell. The taste is not very marked, being at first sweetish, with a bitterish and somewhat acrid after-taste. The fracture of young roots is nearly smooth and mealy, of old roots woody and tough. Young branches, peeled and dried, have some resemblance to marshmallow-root. (See ALTHÆA.) Belladonna-root is best collected at or shortly after the flowering period; from old plants only soft root-branches should be preserved, but tough woody roots, which are sometimes 2 inches (5 Cm.) and more thick, should be rejected for pharmaceutical use. The former German Pharmacopœia directed the root to be kept not more than 1 year.

FIG. 38.



Atropa Belladonna, *Linné:* branch, fruit, seed, and section of seed, the last two magnified.

FIG. 39.



Belladonna-root: transverse section.

2. BELLADONNA-LEAVES.—The forking stem bears above numerous bright-green, broadly ovate or ovate-oblong leaves, with the margin entire, and arranged in unequal

pairs, one being about one-half the size of the other. They attain a length of 4 to 6 inches (10 to 15 Cm.; not over 20 Cm., *P. G.*), are about one-half as wide, are tapering toward the apex and narrowed at the base into the petiole, ½ to 1 inch (12 to 25 Mm.) in length. The leaves are entirely smooth, a slight downiness on the nerves beneath excepted. They lose about 85 per cent. and become thin and papyraceous in drying, the upper surface readily assuming a brownish tint, the lower becoming grayish-green; they show, particularly on the lower surface, a whitish granular appearance under the magnifying-glass. Circular holes, resulting from the separation of suberous warts, are frequently observed. The heavy odor of the fresh leaves disappears on drying almost completely, but it is somewhat restored by moisture; the taste is slightly saline, bitterish, and nauseous.

Admixtures.—The root of Medicago sativa, *Linné*, has been observed as an adulteration of belladonna-root; it resembles the latter, but branches of the crown are solid, the bark is thinner, and the meditullium is tough, woody to the centre, and traversed by numerous fine medullary rays. Leaves of digitalis, hyoscyamus, verbascum, and other plants, occasionally met with in carelessly-gathered belladonna, are easily distinguished by their characters, particularly the hairs. The leaves of Solanum nigrum, *Linné*, are smaller, with the margin repand-dentate. In some parts of Southern Europe the oblong-obovate leaves of Scopolia atropoides, *Schultes* (s. Hyoscyamus Scopolia, *Linné*), are said to be collected with belladonna. They are stated to possess the same medicinal properties.

Constituents.—The most important principle contained in both belladonna-root and herb is atropine, the complex nature and chemistry of which have been described above. (See ATROPINA.) Estimated by iodohydrargyrate of potassium, Lefort (1872) found young roots to contain 0.6, old roots 0.25, and dry leaves, both cultivated and wild-grown, collected in the flowering period, 0.44 per cent. of atropine. Buddel (1882) obtained from amylaceous belladonna-root from .41 to 1 per cent., and from non-amylaceous root between .143 and .625 per cent., of alkaloid. The alkaloids are probably combined with malic acid. Besides the usual vegetable constituents, albumen, gum, etc., the root contains *atrosin*, a red coloring principle found also in the berries, according to Hübschmann. Young roots contain a considerable amount of starch, which is present to a more limited extent in older and more woody roots, and, according to W. Merz, is almost entirely wanting during summer; the young roots are said to contain more starch in autumn than in spring. A comparative examination of air-dry tough and soft roots, made by E. M. Holmes (1882), gave—

	Moisture.	Ash, soluble.	Ash, insoluble in water.	Alcohol extract.	Water extract.	Mayer's test, proportion.
Woody roots,	7.94	3.43	4.60	22.53	15.96 p. ct.	6
Soft roots,	10.28	2.20	3.68	29.87	10.50 "	10

The herb contains asparagin, which sometimes crystallizes in the extract (Biltz, 1839). By dialysis Attfield (1862) obtained crystals of potassium nitrate and of an organic magnesium salt. Flückiger found the ash of dry leaves to amount to 14.5 per cent., and to consist mainly of calcium and alkaline carbonates.

Pharmaceutical Uses and Preparations.—Belladonna-root is used in making Atropia, *Br.;* Abstractum belladonnæ, Emplast. belladonnæ, Extract. bellad. fluid., *U. S.;* and Linim. belladonnæ, *Br.* The following preparations are made from the leaves: Extract. bellad. alcohol., *U. S.;* Ext. belladonnæ, *Br.;* Tinct. belladonnæ, *U. S. Br.*

Allied Plants.—ATROPA MANDRAGORA, *Linné*, s. Mandragora officinalis, *Miller*, s. M. vernalis, *Bertero*, and M. autumnalis, *Bertero*.—Mandrake. *E.;* Mandragore, *Fr.;* Alraunwurzel, *G.*—These acaulescent plants are indigenous to Southern Europe, where their roots are employed. They are 2 to 3 feet (60 to 90 Cm.) long, conical, sometimes forked, an inch (25 Mm.) or more thick; in the fresh state fleshy, whitish, and of a heavy narcotic odor; in the dry state wrinkled, externally brown, but internally whitish, showing a thick bark, and in the meditullium distant and narrow yellow wood-bundles. They have a sharp and bitter taste and a narcotic action. They are rarely met with in this country.

SCOPOLIA JAPONICA, *Maximowicz*, *Japanese belladonna*, has appeared in commerce, and was described by Holmes (1880). It is a nearly cylindrical oblique rhizome about 4 inches (10 Cm.) long and ½ inch (12 Mm.) thick, on the upper surface marked with circular slightly alternate stem-scars, and below, on the node, with one or more rows of root-scars; it is externally brown, internally pale-brown, horn-like in appearance and with numerous whitish dots; has a mousy and narcotic odor and a slight bitter taste. It contains an alkaloid which Langgaard (1881) found to belong to the atropine group.

Physiological Action.—*On Animals:* Birds and herbivorous animals eat the fruit of belladonna without injury, and the latter excrete its active principle with the urine. Yet in the latter animals, but not in birds, the application to the eye of belladonna, or of the urine of animals eating it, causes dilatation of the pupil. It has been suggested that the innocuousness of belladonna in the cases just referred to is due to the active principle being modified by the digestive action of the stomach, but the animals which cannot be poisoned by belladonna in the stomach are equally insusceptible to its action when it is introduced directly into the blood. Nevertheless, their pupils become dilated by belladonna. Birds, as stated, are an exception. This is one of the many examples which show the danger of concluding from the lower animals to man in regard to the uses of medicines, unless the mode of action in the two cases is first proved to be identical. When belladonna, in the form of an extract, is given to dogs or injected into their veins, they exhibit, along with dilated pupils, evidences of suffering, retching or vomiting, generally muscular debility, dulness of the senses, and increased frequency and force of the heart's action. Death appears to be produced by exhaustion, but only after very large doses. In no animal is there any degree of that delirious excitement which belladonna produces in man.

On Man: The first and simplest effect of belladonna in small doses is to dilate the pupil, whether it be applied locally (in which case its action may be confined to one eye) or when taken internally. It is remarkable that no notice appears to have been taken of this property of belladonna until Ray (in 1686) related that, having dressed an ulcer of the face with the leaves of the plant, he observed that the pupil became dilated, and that the same effect was reproduced on two other occasions (*Histor. plantar.*, i. 680). Recorded cases show that a solution of atropine instilled into the ear or a belladonna plaster applied to the side of the chest has produced dilatation of the corresponding pupil only. The continued use of small doses internally occasions also dryness of the throat and a pink efflorescence of the skin closely resembling that of scarlatina: still larger doses excite a peculiar delirium, which will be presently described. All of the characteristic phenomena have been occasioned by the application of belladonna plasters and liniments to the skin, especially when the cuticle was broken, and in an infant by the milk of a female who had taken a large dose of the drug. The following is a summary of the effects of belladonna upon the several physiological elements of the economy. *On the nervous system:* A sense of tightness or pain is felt in the forehead and eyes, with giddiness, confusion of thought, and noises in the ears. The sight is confused, objects are hazy or their character is mistaken. Often they appear to be much smaller than natural. Spectral illusions, generally of a pleasing character, are frequent, such as jewels, flashes of colored light, birds of brilliant plumage, and insects with enamelled wings. In other cases they have the hideous appearance of the phantasms of delirium tremens. Sometimes there is a total blindness of several days' duration, and even after all mental disorder has subsided. The mind is apt to be filled with extravagant ideas; there is often delirium, which is generally of a gay description, and which prevents sleep or disturbs it with fantastic dreams. Sometimes the patient is quite conscious of his illusion and delirium, but is without the power to control either of them. The latter may be characterized by the incessant repetition for hours of some habitual act or phrase; sometimes, though rarely, it is violent, maniacal, and attended with injury to one's self or the attendants; but, in general, poisonous doses of the drug give rise to active and, for the most part, joyous delirium. It is a powerful anæsthetic; in a case of poisoning by it ending in recovery there was almost a total loss of sensibility of the skin, lasting for several days. It has no direct soporific operation. *On the muscular system:* Belladonna in excessive dose renders the gait unsteady and staggering, producing numbness with trembling and jerking movements of the limbs; the patient unconsciously runs against objects in his way or avoids encountering imaginary ones; he is unable to co-ordinate his movements or to pick up small objects. The pupil is dilated, the eye bright, the voice husky, or deglutition, owing to dryness of the throat, is impossible; the bladder is paralyzed and the urine retained, or both this secretion and the feces may be passed involuntarily. The upper eyelid is apt to be paralyzed, and may remain so for months. *On the circulation and secretions:* Under the action of full doses of belladonna the pulse is at first slower and fuller, contrary to what takes place in the lower animals after the subcutaneous injection of atropine, but afterward becomes more frequent, as well as more feeble, until in fatal cases it grows thready and intermittent. During the active period of the operation the whole capillary circulation would seem to be congested, for the external mucous membranes are dry, the face is red and turgid, there is a sense of fulness in the head, with throbbing of the arteries, as if the blood were prevented from returning to the heart by a ligature around the neck. But the intracranial pressure does not appear to be increased in a like proportion (Jacobi). The general dryness of the skin and throat and larynx contrasts with the greatly augmented secretion of the kidneys during the active stage of belladonna-poisoning. This diuresis has been attributed to the fact that the active principle of the drug is excreted with the urine, and almost exclusively in this manner. Irritation of the scrotum sometimes exists in a high degree. Cases of fatal poisoning by belladonna are few in number. A lad of sixteen died from a drachm of the extract, and a woman of sixty-six after swallowing "a teaspoonful of belladonna liniment." A woman, having taken ½ ounce each of lin. belladonnæ and lin. aconiti (*Br. Phar.*), died in spasms within half an hour (*Edinb. Med. Jour.*, xxvii. 443). A man, having liquefied an ointment containing 2½ drachms (Gm. 10) of extract of belladonna, injected it into his bowel. He voided a portion of it, but the remainder caused the most marked symptoms of belladonna-poisoning. Recovery ensued without special treatment (*Bull. de thérap.*, ci. 239). A case of morphine-poisoning in an infant six weeks old is related by Dr. Chew (*Med. Record*, xix. 38). The first signs of reaction followed the administration of belladonna, and consisted in a bright scarlet flush of the skin. Children have a remarkable tolerance of belladonna. After death by belladonna or atropine the lungs and right side of the heart are engorged, the brain and meninges are congested, and the retina is hyperæmic, and a corresponding condition of the spinal cord has been observed.

Although it is impossible to present a clear and consistent rationale of the mode of action of belladonna in producing the phenomena that have been enumerated, it may be proper to state the most plausible views upon the subject. Like all other medicines which act directly through the nervous system, small and large doses of belladonna produce opposite effects, the former stimulating, the latter paralyzing it. The direct action of small doses upon the heart is to increase the vigor and the frequency of its contractions; but large doses render the pulse still more frequent, but more and more feeble and thready. Under moderate stimulant doses the number of visible capillary vessels is increased, owing, it is alleged, to the greater force with which the blood is propelled; but the individual vessels are said to undergo such a contraction (?) at the same time that the amount of blood in the part is diminished rather than increased. The continued use of such doses or the immediate administration of larger ones produces general dilatation of the capillary vascular system. Mr. T. W. Jones seeks to explain this effect by saying that constriction of the small arteries is the cause of the venous engorgement, and that the latter occasions the cerebral and muscular disturbance (*Amer. Jour. of Med. Sci.*, Apr. 1881, p. 362). This blood-stasis accounts for the dryness of the mouth and the redness of the skin, but it is not quite easy to explain by its means the absence of dryness of the external integument, nor the increased secretion of urine and bile, nor the greater facility of defecation, which are effects of medicinal doses of the medicine. The alleged hypnotic power of medicinal doses of belladonna may be referred to the diminution of blood which it occasions in the cerebral vessels; and in like manner the insomnia, hallucinations, blindness, etc. which large doses induce may be attributed to the hyperæmia which they cause in the brain. The anodyne and anæsthetic powers of belladonna appear to be inherent, and not the indirect result of changes in the blood-supply. On the other hand, the spinal symptoms, as shown after toxical doses by the suspension of mental control over movements and their co-ordination, seem to result from impaired sensibility and motility.

Medical Uses.—Belladonna is probably powerless to remove any sort of malignant *tumor*, but it very certainly does retard the growth and lessen the pain even of *cancers*, and promote the removal of some other tumors, especially the glandular, which are susceptible of absorption. It may be presumed to do this by lessening the blood-supply, and thereby restricting the nutrition of the morbid growth and its pressure upon the sensitive nerves. The virtues of belladonna in certain forms of *neuralgia* illustrate the folly of too rapidly generalizing. The relations of opium to pain of all descriptions are so nearly identical that it was naturally to be inferred that the same was true of belladonna; and yet there is only one form of uncomplicated pain, neuralgia, in which this medicine is of much service as a direct anodyne, and one variety of that form chiefly. It is a powerful remedy for neuralgia, but almost exclusively for neuralgia of the face and head. It is next most useful in intercostal neuralgia, then in visceral neuralgia, and least of all in sciatica. It should be given internally to the production of slight constitutional effects, while local applications of belladonna in ointment or liniment are made upon the sound or blistered skin, or atropine is hypodermically employed. The application of a belladonna plaster—or, still better, of a plaster of belladonna and conium—over the *heart* is of signal service in many cases of the pain which is usually felt near the apex and is associated with palpitation, depending upon functional oftener than upon organic disease, and which is probably neuralgic.

The physiological action of belladonna, as revealed by experiments, is far from pointing clearly to one of the most useful applications of the drug in *relaxing spasm*, which has long been well known as a clinical fact. Sometimes, doubtless, it is difficult to disengage from this symptom the often-associated element, pain, which by turn excites and is produced by spasm. This is evidently the case in spasm of the *sphincter ani* and of the *urethra*, and probably in spasm of the *gall-ducts*, the *ureters*, the *bladder*, the *intestines*, and the *uterus*. It is probably so in pain depending upon muscular spasm in *rheumatism* and in that caused by the irritation of wounded and inflamed *nerves*. But the consideration of other cases of spasm without pain shows that the direct antispasmodic power of the medicine is very great. It will not be pretended that spasm of the *os uteri* during labor is the effect of the pain which accompanies it, and yet belladonna overcomes the rigidity in question, probably in the same manner in which it may be overcome by venesection. It is said to control nocturnal *seminal emissions* depending upon an over-excited state of the genital organs, and not on their mere debility. It is alleged that the medicine relieves *jaundice* supposed to be caused by the presence of inspissated bile in the ducts, but not necessarily occasioning pain; strangulated *hernia* is said to have been cured by local applications of belladonna, as it also has by the internal use of the drug (*Boston Med. and Surg. Jour.*, Nov. 1882, p. 419), and also *phimosis* and *paraphimosis;* and its relaxing influence on the bowels has frequently been resorted to successfully in cases of *obstinate constipation*, and especially in *lead colic*. The purely antispasmodic operation of the medicine is still more clearly seen in *whooping cough*. It should not be used until the inflammatory stage of the disease has declined, and then in doses not exceeding, at first, the eighth of a grain twice a day. The dose should be gradually increased until the pupils exhibit its effects. In other *nervous coughs* it is equally available, especially in such as depend upon laryngeal irritation. In *spasmodic asthma* it is one of the most reliable remedies, provided it be given in doses sufficient to produce its characteristic operation. For the purpose the hypodermic injection of atropine is to be preferred, and when the paroxysm occurs regularly its approach may be prevented by this remedy. The inhalation of an atomized preparation of belladonna may also be used. It is not without utility in spasmodic and membranous *croup*, and even in *laryngismus stridulus*, by moderating the laryngeal spasm. The *nervous vomiting* of pregnancy may be palliated by the internal use of the drug or by rubbing a solution of the extract upon the epigastrium. In *tetanus* the medicine has occasionally produced a cure, and also in cases of poisoning by *strychnia*, and in others of *epilepsy*, especially in children. It forms a valuable addition to the bromides in cases of epilepsy that resist the use of the latter alone.

The supposed power of belladonna to limit the amount of blood in the spinal cord has been invoked with apparent advantage in the treatment of *epidemic meningitis*. As it was given along with ergot, to which the same operation is attributed, the share of the former medicine in the cure is difficult to determine. These two medicines were originally associated in the treatment of *paraplegia* due to myelitis, ergot being at first administered alone, after which belladonna was given internally and applied in a plaster to the spine. Subsequently, iodide of potassium was prescribed in addition to the other remedies. It is a question, What was the value of the elements time and rest in this method of treatment?

One of the most useful applications of belladonna is the treatment by it of *incontinence of urine*, an affection presenting neither evident spasm nor pain, but in which probably the former state exists. By blunting the organic sensibility of the neck of the bladder it allays the spasm of this part, and prevents a call of nature until a due amount of urine has accumulated. The power of belladonna in dilating the pupil is most valuable in permitting a thorough exploration of the interior of the *eye* by means of the ophthalmoscope or otherwise, in obviating the unnatural adhesions which are so apt to occur in *iritis*, and also in preventing or in remedying prolapse of the *iris*. It was first applied to facilitate the operation for *cataract* in 1795. It is probable that the medicine lessens the congestive process in the eye by diminishing the calibre of the blood-vessels and by lowering the sensibility of the retina to light. Both locally and internally it is one of the most efficient remedies for *photophobia*. Where the eye is concerned the action of belladonna may be obtained by smearing its extract, softened with water, around the orbit, but the use of atropine is both more cleanly and more efficient. The dryness of the skin produced by belladonna has been proved clinically to render it an efficient remedy for all forms of passive *perspiration*. The hectic sweats of phthisis, of profuse suppuration, of articular rheumatism, are all more or less under its control, and local and unilateral sweats have been arrested by its topical application. It is curious that in some cases the suspension of the cutaneous exhalation was followed by a compensatory diarrhœa. The requisite dose for checking perspiration is one that will produce a commencing dilatation of the pupil and a very slight dryness of the throat. A similar control over excessive *salivation* has been exerted by this medicine when the symptom in question followed hemiplegia. The control of belladonna over the *mammary secretion* has long been known, and liniments containing it have been used for drying up the milk or for diminishing it when excessive. It should be applied before inflammation has set in. It does not appear to be secreted with the milk. The stimulant action of belladonna upon the heart has been taken advantage of in *typhoid fever*. Under its use the pulse and temperature rather decline. Dr. Harley says: "My own impression is, that the stimulant action of belladonna on the heart is converted in the pyrexial state into a tonic, and, if not pushed too far, even a sedative, influence on the heart and blood-vessels generally; in other words, that it is a tonic and sedative to the sympathetic system generally. By this action the capillary circulation is accelerated, the contraction of the vessels promoted, and the arterial tension which attends congestion of the parenchymatous organs is relieved, and a load at once removed from the heart." There is reason to think that in some cases of cardiac *dropsy*, with feeble action of the heart through valvular obstruction or muscular degeneration, belladonna may be serviceable. In several instances also it appears to have rescued patients from fatal *collapse* (in endocarditis, diarrhœa, bronchitis) by sustaining the heart's action (Weber). The protective power of belladonna against the contagion of *scarlatina* has been both firmly maintained and vehemently denied. A careful examination of the evidence bearing upon the question has led us to the conclusion that so long as persons are under the influence of belladonna, as indicated by the state of the pupils, the throat, and the skin, the liability to contract scarlatina is very much diminished. Nor does there seem to be wanting a good reason why it should be so, since the mucous membrane of the throat and larynx is maintained by the drug in a condition unfavorable to absorbing the scarlatinous or any other morbid element that enters the body through these channels.

The *antagonism* of *belladonna* and *opium* has long been known and practically tested in cases of poisoning by the one or the other of those agents. Doubtless their antidotal action was suggested by their opposite actions upon the pupil. More recent observations have shown other points of opposition, thus: opium tends to produce coma, belladonna cerebral excitement; opium diminishes the internal and increases the cutaneous secretions, while belladonna increases the secretions of the gastro-intestinal tract and diminishes those of the skin; opium lessens the secretion of urine, but belladonna augments it; and, above all, opium exerts a depressing action upon the lungs and heart, but the functions of these organs are stimulated by belladonna. These opposite actions of the two medicines may surely be described by the single word antagonism, and neither experiments upon animals, however numerous, nor any amount of reasoning, however ingenious, can diminish its significance or its importance. Harley has shown, experimentally, that by removing the restraint due to partial collapse of the lungs, and by direct stimulation also, belladonna relieves the distended heart; and clinical observation demonstrates that this special stimulant operation is the very one that is needed to preserve life in opium-poisoning. Indeed, electricity, the cold dash, coffee, and other agents employed with success to combat the effects of opium can have no other mode of action. Every one who has witnessed the use of electricity or of flagellation in the successful treatment of opium-narcotism must have been convinced that these agents stimulate the lungs and heart, and so preserve life until the excess of the poison is eliminated or destroyed. It is evident that belladonna and its preparations can act in no other manner; and indeed clinical observation proves it, for unless the condition of the patient is such as to allow him to be impressed by the physiological antidote, it can do no good; and, on the other hand, unless the dose of the antidote is such as to attain, without exceeding, the due degree of stimulation, it may do serious harm. It results from experience that repeated and small doses of belladonna or of its alakaloid (from one-sixtieth to one-fortieth of a grain (Gm. 0.0010–0.0016) of the latter, hypodermically, is preferable) should be administered until the pulse and respiration acquire more force and the pupil begins to be dilated, but care must be taken not to substitute the narcotic action of belladonna for that of opium. By observing these rules a great many cases of opium-poisoning have terminated favorably which without treatment would probably have ended fatally.

Although poisoning by *physostigma* (Calabar bean) is uncommon, it should be known that belladonna (in the form of atropine) is the appropriate antidote for its effects. Its administration should be conducted upon the principles just set forth, and the guide for its dose and the frequency of its administration are to be found also in the dilating effect produced upon the contracted pupil.

Administration.—1 grain (Gm. 0.06) is the primary dose of the powder of belladonna, root or leaf. It should be gradually increased until the pupil begins to be affected. An infusion may be made with 20 grains (Gm. 1.30) of the leaves in half a pint of water, of which the dose is half a fluidounce every four or five hours. The tincture, fluid extract, and alcoholic extract, and atropine, are more frequently prescribed than belladonna in substance. For external use the ointment and plaster, and various liniments containing these preparations, are employed.

ATROPA MANDRAGORA, or mandrake, which has such a resemblance to A. belladonna as to call for some notice here, is chiefly interesting from its anæsthetic virtues. It was fully described in the first century of our era by Dioscorides, and after him by Pliny, and their descriptions were handed down by the Arabians to modern times. Of these writers, the first particularly mentions that wine of mandrake was administered to persons about to suffer amputation or the actual cautery. He speaks also of its juice being used in a suppository to induce sleep, and states that the fruit of the plant, and even the emanations from it, have the same effect. Indeed, he describes two species, but attributes the same qualities to them both. In 1848, Sylvester drew attention to the ancient uses of this plant as an anæsthetic. For many centuries, said Dr. Richardson (1873), Atropa mandragora was employed as a general anæsthetic, and the poets and historians, not less than the physicians, descanted on its potent efficacy. He experimented with a watery infusion preserved by alcohol. The effects produced in animals were dilatation of the pupils, paralysis of motion and sensation, excitement during the stage of recovery, or sleep and paralysis if the dose was too potent. Pigeons were affected by a very much smaller dose than rabbits. Death occurred by failure of the respiratory power from obstruction of the air-passages with accumulated secretions. The heart continued beating long after respiration had ceased. The muscles retained their electric excitability as much as an hour after death. In man, the tincture applied to the tongue produced a sensation of numbness lasting for several minutes, and an acid taste and dryness of several days' duration. In doses not sufficient to cause actual narcotism the symptoms induced were—desire for sleep, a sense of fulness in the vessels of the head, a peculiar enlarged and confused vision, an exaggeration of sounds, an inaction of the bowels, with white hard feces when the bowels were made to act, and a restless, nervous excitability closely akin to hysteria. The symptoms were not actually removed for 2 days, and left a lingering uneasiness and coldness still longer. These statements, when originally published, do not appear to have led to any further experiments with the drug, and we may repeat the remark of Dr. Francis Adams, made more than thirty years ago, that "we see no good reason why its well-regulated use might not be revived."

BENZINUM, *U. S.*—BENZIN.

Benzinum petrolei, P. G.; *Æther petrolei.—Petroleum benzin, Petroleum ether*, E.; *Benzine, Esprit (Naphté, Éther) de pétrole, Petroléine*, Fr.; *Petroleumbenzin, Petroläther, Benzin*, G.

Preparation.—The lower hydrocarbons present in American petroleum are separated from the heavier compounds by fractional distillation and from all the lightest hydrocarbons by fractional condensation. (See PETROLEUM.)

Purification.—The disagreeable odor of crude benzin is to a considerable extent removed by agitation with sulphuric acid. Fairthorne (1880) recommended quicklime for the purpose, which removes the peculiar sulphurous odor. Grazer (1883) obtained the best results with a mixture of solution of potassium bichromate and sulphuric acid. The adhering acid is removed by washing.

Properties.—Benzin is a transparent, colorless, diffusive liquid of a strong, characteristic odor slightly resembling that of petroleum, but much less disagreeable; neutral in reaction; insoluble in water, soluble in about 6 parts of alcohol, and readily so in ether, chloroform, benzol, and fixed and volatile oils. It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently. It has a sp. gr. from 0.670 to 0.675 (0.640 to 0.670, *P. G.*), and boils at 50° to 60° C. (122° to 140° F.) (55° to 75° C. =

131° to 167° F., *P. G.*). Benzin should be carefully kept in well-stopped bottles or cans, in a cool place, remote from lights or fire.—*U. S.*

Constituents.—*Pentane*, C_5H_{12}, boils at 38° C. (100.4° F.), *hexane*, C_6H_{14}, at 70° C. (158° F.). The benzin of the U. S. P. should therefore consist chiefly of the former, while that of P. G. consists mainly of hexane, with variable quantities of pentane and *heptane*, C_7H_{16}, the latter boiling at 98° C. (208.4° F.); this also agrees with the density, which is for pentane .60, for hexane .63, and for heptane .71.

Tests.—Benzin when evaporated upon the hand should leave no odor, and when evaporated in a warm dish should leave no residue (absence of heavy hydrocarbons). When boiled a few minutes with one-fourth its volume of spirit of ammonia and a few drops of test solution of nitrate of silver, the ammoniacal liquid should not turn brown (absence of pyrogenous products and sulphur compounds), and it should require 6 parts of officinal alcohol to dissolve it (difference from benzol). If 5 drops are added to a mixture of 40 drops of sulphuric acid with 10 drops of nitric acid in a test-tube, the liquid warmed and set aside for half an hour, and then diluted in a shallow dish with twice its volume of water, it should not have the bitter-almond-like odor of nitro-benzol (absence of benzol).—*U. S.* On agitating 2 parts of benzin with a cold mixture of 1 part of sulphuric acid and 4 parts of fuming nitric acid, the liquid should not become colored, and should not acquire a bitter-almond-like odor.—*P. G.* Benzol being much higher in price than benzin, an adulteration of the latter with the former is not likely to occur; but these tests are useful for distinguishing the two liquids. (See also BENZOLUM.)

Pharmaceutical Uses.—Benzin is directed in the preparation of Charta sinapis, *U. S.*, for depriving powdered mustard-seed of fat. It may be used for the extraction of fixed oils, and has been recommended by Dr. Wolff for the preparation of volatile oils. It is employed in the arts as a solvent for fats, for caoutchouc, and for certain resins.

Physiological Action and Medical Uses.—According to Husemann, the vapors of benzol are destructive to insects, but pigs tolerate very large doses of it; *e. g.* 3 or 4 drachms. According to Gabalda, the poisonous action of benzin differs from that of nitrobenzin only in degree. It produces confusion of the senses, vertigo, unconsciousness, convulsions, coma, or sometimes only a sort of intoxication, like that of alcohol. As much as 50 drops have been given to *trichina* patients without injury, but the continued use of the oil produces some of the effects just mentioned, and without mitigating the disease. It has been employed locally in the treatment of *scabies*, but, although it destroys the itch-insects, it does not affect their eggs. It has also been used in *herpes tonsurans*, *favus*, *sycosis*, etc. Like creasote and carbolic acid, it restrains fermentation in certain forms of *dyspepsia*. As a substitute for the emanations from gas-works it has been used by inhalation in *whooping cough*. The ordinary *dose* is from 10 to 15 drops (Gm. 0.60–1.00). It may be prescribed in emulsion or, preferably, in capsules.

BENZOIN.—SPICE-BUSH.

Wild allspice, *Fever-bush*, E.; *Laurier benzoin*, Fr.; *Benzoelorbeer*, G.

The bark and fruit of Benzoin odoriferum, *Nees*, s. Lindera (Laurus, *Linné*) Benzoin, *Meissner*.

Nat. Ord.—Lauraceæ.

Origin.—The spice-bush is a shrub about 10 to 15 feet (3 to 4.5 M.) high, common in damp woods of Canada and the United States. It has deciduous oblong-obovate, entire, and smooth leaves, and produces in March and April lateral clusters of four or five yellow inconspicuous flowers.

Description.—1. THE BARK is in thin quills or curved pieces, yellowish or pale-brown and smooth upon the inner surface, and blackish-brown, minutely dotted with corky warts, somewhat glossy and nearly smooth, upon the outer surface. It breaks with a short granular fracture, has an agreeable though not very strong odor, and an aromatic somewhat pungent and astringent taste. Older bark has a brown-gray or dark-ash color and more prominent corky warts.

2. THE FRUIT is an obovate or oblong drupe, with a circular depressed scar of the pedicel, almost $\frac{3}{8}$ inch (9 Mm.) long, red, after drying blackish and granular upon the surface, and contains a single large white seed, with plano-convex cotyledons and having an oily taste. The fragile integuments of the fruit have a spicy taste, and when bruised an agreeable odor.

Constituents.—The bark was analyzed by J. Morris Jones (1873); it contains some tannin, fat, starch, sugar, tasteless resin, and volatile oil, which, on being treated with oxidizing agents, develops the odor of bitter almonds, and belongs to the cinnamyl series. The air-dried bark yields 3 per cent. of ash. P. M. Gleim (1875) obtained from the berries, by treatment with petroleum benzin, 44 per cent. of a deep-red very aromatic oily liquid which is soluble in ether and chloroform and partly soluble in alcohol, glycerin, and oil of turpentine. The fresh berries yielded by distillation 5 per cent. of a colorless volatile oil having the specific gravity .87, and a fragrance somewhat like that of jessamine. A. W. Miller (1878) obtained 50 per cent. of greenish-brown oily and resinous constituents, and 1 per cent. of a thin light-green volatile oil having the specific gravity .850 and a warm aromatic taste, resembling that of allspice and prickly ash.

Medical Action and Uses.—The virtues of this plant, which depend upon its volatile oil, are those of a vascular stimulant and diaphoretic. As such it has been used in the forming stage of acute *pulmonary inflammations* and *rheumatism*, and in chronic forms of the latter affection. It has also been employed as a *vermifuge*. The bark has been used in *intermittent fever*. During the Revolutionary War the berries are said to have been employed as a substitute for allspice, and in the late Civil War a similar use was made of them in the Southern States. The oil has served as an ingredient of embrocations for rheumatism, *contusions*, and other local painful affections, and internally to relieve *flatulent colic*. It has also been applied in *scabies*. The bark and the berries are usually administered in decoction; the oil may be prescribed in alcoholic solution or suspended in water by magnesia.

BENZOINUM, *U. S., Br.*—BENZOIN.

Benzoe, P. G.; *Resina benzoe*, *Asa dulcis.*—*Gum benjamin*, E.; *Benjoin*, Fr.; *Benzoe*, G.

A balsamic resin obtained from Styrax Benzoin, *Dryander. Philos. Trans.*, vol. lxxvii. plate 12; Bentley and Trimen, *Med. Plants*, 169.

Nat. Ord.—Styraceæ.

Origin.—The tree yielding benzoin is of medium height, has a hard dense wood, large branches forming a beautiful crown, a handsome dark-green underneath white hairy foliage, and reddish or white flowers in axillary racemes. It is indigenous to Borneo, Java, and Sumatra, and probably also to Cochin China and Siam, though it is not unlikely that the benzoin coming from the latter country may be produced by a different species.

Collection.—The tree is cultivated in Sumatra to a considerable extent, but benzoin is also obtained from wild trees. When about six or seven years old the trunks are about as many inches in diameter, and incisions are then made through the bark, when a white liquid resin commences to exude slowly; when sufficiently hard this is scraped from the bark. During the first three years the resin contains a large number of white tears, and is then called by the Malays *head benzoin*. During the next seven or eight years the white tears decrease in number, and the product is termed *belly benzoin*. At the expiration of this time the exudation is considerably diminished, the tree cut down, and an inferior quality, called *foot benzoin*, scraped from the wood.

Siam benzoin is likewise collected from incisions, but the tree yielding it is not known.

Commerce.—At the ports of Sumatra benzoin is received in the form of cakes wrapped in matting, and after having been softened by heat is packed in chests and sent to Penang and Singapore, whence it finds its way into general commerce. In Siam benzoin is carried on bullocks' backs to the Menam River, and then shipped to Bangkok, whence it is exported to other countries. In the year 1866–67, 5827 pounds of benzoin were imported into the United States. In the recent statistical reports benzoin is enumerated with other resins and gum-resins.

Description.—Sumatra benzoin is met with in commerce usually in the form of large rectangular blocks, which consist of milk-white opaque tears, varying in size and frequently quite small, always agglutinated by a brown-gray resin. In the interior it is often porous, presents a mere mottled or variegated but no distinct, amygdaloid appearance. It has an agreeable odor, distinct from and weaker than that of Siam benzoin. The tears melt at 85° C. (185° F.), the grayish-brown portion at 95° C. (203° F.) (Pharmacographia). It is always mixed with fragments of bark, of which the inferior kinds almost exclusively consist.

Penang benzoin is usually identical with Sumatra benzoin, but occasionally it differs from it in color, and more so in odor, which then suggests that of storax.

Siam benzoin has mostly a similar appearance, the inferior varieties consisting mainly of a grayish-red resin, which upon a fresh fracture is brown-red, glossy, translucent, and mottled with lighter spots, but containing few or no tears. The better quality is distinctly amygdaloid in appearance, on account of the milk-white tears, which are up to ½ inch (12 Mm.) and more in diameter. The resin is often porous, and crystals of benzoic acid are observed in the cavities. In the finest amygdaloid variety the tears largely preponderate over the red-brown translucent resin, which is nearly entirely absent in the *benzoin in tears.* This variety is met with in separate or loosely-agglutinated, roundish, or flattened pieces, 1 or sometimes 2 inches (25 to 50 Mm.) in diameter, which are of a reddish-yellow color externally, internally white or striped, and melt at 75° C. (167° F.). The odor of Siam benzoin is pleasantly balsamic, somewhat like that of vanilla.

Impurities, consisting of fragments of wood, bark, etc., are present to a larger or smaller extent in all varieties of cake benzoin, and remain behind on treatment with alcohol. With the exception of these impurities, benzoin should dissolve in five times its weight of alcohol; this solution gives with water a milky liquid having an acid reaction.—*P. G.* The tincture of Siam benzoin has a distinct red color; that of the other varieties is more of a brown or yellowish-brown color; rendered milky by the addition of water, the peculiar fragrance of the different varieties is best perceived.

Constituents.—Benzoin contains several resins, a trace of volatile oil, and from 12 to 20 per cent. of benzoic acid. In addition to these, Siam benzoin contains vanillin, which was obtained by Rump (1878) from the mother-liquor of benzoic acid prepared by Scheele's process (see page 35) by agitating it with ether and evaporating. Kolbe and Lautemann (1860) found in Siam and Penang benzoin also cinnamic acid, and the same acid was observed in Sumatra benzoin by Aschoff (1861). The quantity of cinnamic acid varies considerably, and it is often altogether absent. The cause of its presence has not been ascertained. The white tears often contain less benzoic acid than the resin. This portion consists of about four resins, which dissolve partly in ether, but are alike, or nearly so, in their composition and behavior to alcohol, in which they are soluble, and to caustic potassa; by treating them with fused potassa, paraoxybenzoic acid, $C_7H_6O_3$, and protocatechuic acid are obtained, besides products of secondary decomposition.

Tests.—When benzoin is boiled with milk of lime the hot filtrate should not give off the odor of oil of bitter almond on the addition of test solution of permanganate of potassium (absence of cinnamic acid).—*U. S.* For determining the presence of cinnamic acid the tincture of benzoin may be precipitated by hot water, filtered from the resin, and the filtrate treated with a solution of potassium permanganate or chlorinated lime; or the benzoin may be triturated with peroxide of lead and the mixture boiled with water.

Off. Prep.—Acidum benzoicum, *Br.;* Adeps benzoinatus, *U. S.*, *Br.;* Tinct. benzoini, *U. S.;* Tinct. benzoini comp., *U. S.*, *Br.*

Physiological Action and Medical Uses.—The internal action of benzoin has been considered in connection with benzoic acid, upon whose presence the virtues of the balsam chiefly depend; but the resin and volatile oil which it also contains communicate to it other qualities which assimilate it with the resins in general. Like these, it is a general and local stimulant, tending to elimination by the mucous membranes. This fact accounts for its established reputation in the treatment of chronic *bronchitis*, chronic *diarrhœa*, and *dysentery.* In the first of these affections the compound tincture of benzoin, or Turlington's balsam, has long been famous, and no medicine of its class excels it. Locally, the tincture is a most excellent stimulant and protective for wounds. The *dose* is stated to be from 10 to 40 grains (Gm. 0.60–2.60), but benzoin is never administered in substance.

BENZOLUM.—Benzol.

Benzene, E.; *Benzole*, *Benzène*, Fr.; *Benzol*, *Benzen*, G.
Formula C_6H_6. Molecular weight 78.

Preparation.—Benzol is obtained by the dry distillation of benzoic acid mixed with excess of lime, and by agitating the oily distillate with potassa solution and rectifying. It is largely obtained from *coal-tar*, one of the secondary products of the coal-gas manufacture; on subjecting it to distillation, water and ammonia pass over, accompanied by a brown oily liquid (8 or 10 per cent. of the tar), known as *light oil*, because it floats on water. Subsequently *dead oil* is obtained as an oily liquid heavier than water, and containing aniline, quinoline, naphthalin, carbolic acid, etc.; the residue in the retort constitutes pitch, and is used in place of asphaltum. The light oil contains mainly *benzol*, *toluol* (C_7H_8), *xylol* (C_8H_{10}), and *isocumol* (C_9H_{12}), and after rectification to free it from some dead oil is known in commerce as *coal-naphtha*, which owes most of its disagreeable odor to volatile bases removable by agitation with dilute sulphuric acid. The hydrocarbons are separated from one another by repeated fractional distillation until liquids of a nearly constant boiling-point are obtained. The fraction boiling near 80° C. (176° F.) consists chiefly of benzol, that with the boiling-point 110° C. (230° F.) of toluol, that distilling near 140° C. (284° F.) of xylol, and the portion coming over near 170° C. (338° F.) of isocumol. The benzol may be further purified by exposing it to a low temperature and expressing the portion remaining liquid.

Properties.—At the ordinary temperature benzol is a thin, colorless, very inflammable liquid, of considerable refractive power and a strong odor of coal-gas: but when obtained from benzoic acid it has a peculiar aromatic odor and a sweetish aromatic taste. It has the density .899 at 0° C. (32° F.) and .878 at 15° C. (59° F.), congeals at the freezing-point of water, melts again at 5.5° C. (42° F.), and boils at 80.5° C. (177° F.). It is nearly insoluble in water, but readily soluble in 4 parts of alcohol, in methylic alcohol, ether, and acetone; it dissolves some phosphorus, sulphur, and iodine, and considerable quantities of fats, volatile oils, caoutchouc, gutta-percha, and some resins. W. Smith and G. W. Davis (1882) obtained a colorless crystalline compound with antimony trichloride, having the composition $3SbCl_3.2C_6H_6$, and on exposure becoming opaque and liquefying. The name *benzin* was formerly given and is still used to some extent for benzol, but is best discarded as a synonym for the latter.

Composition.—Benzol is the hydride of phenyl, HC_6H_5; the hydrate of the same radical, C_6H_5HO, is carbolic acid.

Tests.—To distinguish it readily from *petroleum benzin*, Pusch (1875) recommends iodine, which dissolves in the latter with a raspberry-red and in benzol with a violet-red color; the former color is so intense that a small admixture of benzin can be recognized by neutralizing the violet tint. Commercial benzol obtained from coal-tar always contains variable quantities of the hydrocarbons mentioned above; it should boil and evaporate completely between 80° and 85° C. (176° and 185° F.). Agitated with sulphuric acid, it should not acquire a dark color.

Pharmaceutical Uses.—Benzol is useful as a solvent for some alkaloids and the substances mentioned above, but is chiefly employed in the manufacture of NITROBENZOL and ANILINE (which see).

BERBERIS.—BARBERRY-BARK.

Cortex radicis berberidis.—Écorce de racine de berbéride (*épine-vinette, vinettier*), Fr.; *Berberitzen-* (*Saurach-, Sauerdorn-*) *Wurzelrinde*, G.

The bark of the root of Berberis vulgaris, *Linné*. Bentley and Trimen, *Med. Plants*, 16. *Nat. Ord.*—Berberidaceæ.

Origin.—The barberry is a shrub 6 to 8 feet (1.8 to 2.4 M.) high, with three-parted spines, fascicles of obovate-spatulate and bristly serrulate leaves, yellow flowers in pendulous racemes, and oblong one-celled scarlet berries of an acidulous taste. It is indigenous to Western Asia and the greater part of Europe, and has been naturalized in thickets and waste grounds in New England and other parts of North America. The bark of the root is the part mostly used in North America, while in Europe the entire root is usually employed.

Description.—The thick and branching root has a tough wood of a pale lemon-yellow color, distinctly porous from the rather large vessels, which are arranged in concentric circles and with plainly-visible medullary rays. The rather thin bark is found in small irregular pieces, is externally of a yellowish-gray, and upon the nearly smooth inner surface of an orange-yellow color; the corky layer is soft, and the deep-yellow bast-fibres are in tangential rows imbedded in a yellow parenchyma which is striate by medullary rays. The nearly inodorous bark has a strongly bitter taste, and imparts to the saliva a yellow color; its infusion does not yield a black precipitate with ferric salts.

Constituents.—According to the analysis of Polex (1836), barberry-bark contains berberine, oxyacanthine, some starch, and tannin producing dark-green precipitates with iron salts, besides the usual constituents of vegetables.

Berberine, or berberia, was first discovered by Chevallier and Pelletan (1826) in the bark of Xanthoxylum clavæ Herculis, *Linné*, and named *xanthopicrit;* its identity with berberine was proved by Perrins (1862). A. Buchner obtained it (1835) crystallized from barberry-root, believed it to possess acid properties, and named it berberin. It had been previously separated in an impure condition by Brandes (1825) and by Buchner (1830). G. Kemp (1841) noticed that it forms crystallizable compounds with various mineral and organic acids, but its alkaloidal nature was first proven by Fleitmann (1846). Since then it has been discovered in numerous plants of the orders Berberidaceæ, Ranunculaceæ, Menispermaceæ, etc. (See papers in *Am. Jour. of Pharm.*, 1863, pp. 97, 301, and 456.)

For the preparation of berberine Procter (1864) gives a process which is based upon those of Buchner and Fleitmann: The root of hydrastis is exhausted with boiling water, the decoction evaporated, the soft extract exhausted by strong alcohol, some water is added, most of the alcohol distilled off, and then an excess of sulphuric acid added, when, on cooling, sulphate of berberine crystallizes, requiring recrystallization from hot water for purification. Its solution in hot water is then decomposed by freshly-precipitated oxide of lead (caustic baryta, Fleitmann) and the filtrate allowed to crystallize. It forms fine yellow needles, which lose at 100° C. (212° F.) nearly 19.5 per cent. of water, fuse at 120° C. (248° F.), are insoluble in ether, petroleum benzin, and carbon disulphide, and dissolve slightly in cold water and benzol and more freely in alcohol and alkalies. Its composition is $C_{20}H_{17}NO_4$ (Perrins). By adding to its hot solution an excess of acid crystals of neutral or acid salts are obtained, which are usually of a bright or golden-yellow color, have a bitter taste, and are very slightly soluble in acidulated water. Berberine dissolves in strong sulphuric acid with a dingy olive-green, and in nitric acid with a dark brown-red, color. Solutions of its salts are precipitated greenish-brown by potassium ferrocyanide, and yellow by picric acid, phosmomolybdic acid, or chloride of gold, platinum, or mercury; the precipitates are mostly crystalline or crystallize readily; the phosphomolybdate dissolves in ammonia with a blue color. Dissolved in hot alcohol, the salts of berberine yield, with solution of iodine in potassium iodide, dark-green scales of a metallic lustre and appearing reddish-brown in transmitted light; if an excess of iodine be employed, the crystals are of a red-brown color in reflected light. This behavior is recommended by Perrins as a convenient test for this alkaloid. Hydrochlorate of berberine assumes with chlorine a blood-red color (Buchner). This behavior furnishes a delicate test, by means of which, according to Klunge (1875), berberine may be detected in over 200,000 parts of solution; brucine, which gives a similar color with chlorine, yields with acids colorless solutions. L. Henry ascertained (1859) that berberine and its salts are colored blood-red by bromine, and that after the deposition of hydrobromate the solution gives a black precipitate with ammonia. Fused with potassium hydrate, berberine is decomposed, yielding two acids, one of which is sublimable, and vapors having the odor of chinolin (Hlasiwetz and Gilm).

Oxyacanthine, $C_{32}H_{46}N_2O_{11}$, remains in the mother-liquor from which the berberine salt has been precipitated by an acid. To avoid confusion with principles in Cratægus Oxyacantha, Berzelius proposed to call it *berbine*, and Wacker suggested the name of *vinetine*. It is a white alkaloid, turning yellow in sunlight, nearly insoluble in water, and has a bitter taste and an alkaline reaction; it dissolves in 30 parts of cold and in 1 part of boiling alcohol, in 125 parts of cold and 4 parts of boiling ether, and is easily soluble in chloroform, benzol, fats, and volatile oils. It reduces iodic acid. Sulphuric acid colors it brown-red, the color changing on heating to bright-red and brown. Nitric acid imparts a yellow and, when heated, a purple color. Its salts give white precipitates with alkalies, soluble in excess, with alkali carbonates, potassium iodide, potassium ferrocyanide, potassium sulphocyanide, or mercuric chloride, and yellow precipitates with picric acid or potassium ferricyanide.

These alkaloids are also contained in the wood and, according to Lenssen (1870), in the flowers; the latter contain, in addition, volatile oil, and 3.57 per cent. of sugar and 6.62 per cent. of malic acid were found in the berries.

Allied Species.—In India the root-bark of Berberis aristata, *De Candolle*, B. asiatica, *Roxburgh*, and B. lycium, *Royle*, is employed as a tonic; it contains berberine in abundance.

Several species of Berberis, belonging to the section Mahonia, are indigenous to the Pacific coast of North America, growing as far north as Vancouver Island, and are known as *Oregon grape*. Berberis repens, *Lindley*, is about 8 or 10 inches (20 to 25 Cm.) high; B. aquifolium, *Pursh*, attains a height of 4 to 6 feet (1.2 to 1.8 M.), and B. nervosa, *Pursh*, of about 4 inches (10 Cm.). The rhizomes and roots of these low shrubs resemble each other closely, those of the first species being thinnest. Oregon grape-root varies in size from that of a quill to an inch or two (3 to 25 or 50 Mm.) in diameter, is more or less knotty and crooked, has externally a yellowish-brown color, and is internally of a brighter yellow; the bark is thin, the wood tough, yellow, striate with fine medullary rays, and encloses a distinct pith. The bark has a bitter taste, and as obtained from B. nervosa was found by P. Neppach (1870) to contain berberine.

Physiological Action.—This bark, or that of an allied species, has long been employed in India as a tonic and febrifuge. Its virtues appear to depend upon berberine, which has also been found in several other medicines used as bitter tonics, and which was administered hypodermically to rabbits by Falck and Guenste. But the effects produced were not uniform. In one experiment they observed depression, paralysis, convulsions, and resolution, followed by death; in a second, in addition to such symptoms, profuse salivation, hurried and shallow breathing, anæsthesia, etc., but the animal recovered; in a third case no sensible results were produced. Nearly 50 grains given to a dog in divided doses caused no definite effects, but a strong solution of muriate of berberine injected into the veins occasioned salivation, diarrhœa, convulsions, paralysis, and tremulousness, which last symptom continued for some time after the other phenomena had disappeared. The elaborate inferences drawn by Curci from his experiments have no apparent relation to those just stated (*Bull. de thérap.*, ci. 329). According to him, berberine, when locally applied, causes obstruction of the superficial vessels, and when injected subcutaneously it produces hyperæmia and œdema of the surrounding tissues, followed by their induration. Internally, it coagulates the mucus and tonifies the coats of the alimentary canal. Thrown into the blood-vessels, it occasions debility, languor, somnolence, coldness, and finally death in collapse. At first it quickens the pulse-rate and the arterial pressure, while it lowers the bodily temperature. It renders the alkaline urine of herbivorous animals acid, and is eliminated mainly by the kidneys. Under its prolonged action animals lose weight, and their mode of death is by gradual extinction, and neither its phenomena nor the appearances after death are characteristic. It seems to retard the decomposition of the blood, and especially the separation of its hæmoglobin, and causes an enlargement rather than a contraction of the spleen. It is evident that these qualities, unless perhaps its alleged action on the capillary circulation, in no degree explain the virtues which have been attributed to berberine. In man, doses of 15 or 20 grains have occasioned some diarrhœa with or without colic. Small doses, on the other hand, appeared to increase the appetite and confine the bowels.

Medical Uses.—Berberine is supposed to act as a stomachic tonic and to increase the secretion of bile. It has been given in atonic *dyspepsia*, and especially in that condition following cholera, in *diarrhœa* from the same cause, in infantile and tuberculous diarrhœa, etc. In a word, it seems to be adapted to such cases as are usually treated with calumba. It has also been used with alleged success in reducing the *spleen* enlarged by malarial poisoning. It may be given in doses of from 2 to 5 grains (Gm. 0.10–0.30), in pill or powder or in alcoholic solution. *Berberis aquifolium* is said to be used in the Western States as a tonic and febrifuge.

BETULA.—BIRCH.

Bouleau, Fr.; *Birke*, Gr.

The bark, leaves, and saccharine juice of different species of Betula.

Nat. Ord.—Betulaceæ.

Origin.—This genus comprises shrubs and trees which are indigenous to the northern hemisphere, have alternate simple and straight-veined leaves, drooping staminate catkins, and shorter cylindrical fertile catkins, producing broadly-winged nutlets. The young twigs and leaves of most species are pungently aromatic; the bark is more or less completely separable into thin concentric layers, and when wounded in the spring exudes a juice having a sweet and somewhat acidulous taste.

Description and Constituents.—BETULA ALBA, *Linné*, is a slender and graceful tree indigenous to Northern Asia, Europe, and America, in the latter continent as far south as Pennsylvania. There are several varieties, varying in height from 15 to 75 feet (4.5 to 22.5 M.). The bark of the branches is brownish and verrucose, of the trunk white, smooth, separating in thin sheets, and of an astringent somewhat bitterish taste. The leaves are triangular-deltoid, acuminate, doubly serrate, light-green, shining, and of an astringent taste; when young, glandular and pungent. The buds and young twigs yield by distillation ⅓ per cent. of a colorless *volatile oil* having a balsamic and pungent odor, and by the dry distillation of the wood and bark dark red-brown *birch-tar* or *daggett* is obtained, which has a strong and persistent odor of Russia leather, and yields on distillation brown-red *empyreumatic oil of birch*, known as *oleum rusci*. The bark contains also a camphoraceous body, *betulin*, $C_{36}H_{60}O_3$, which forms light, flocculent, crystalline, tasteless masses fusible at about 258° C. (496° F.), subliming when heated with care, and soluble in ether, volatile oils, hot alcohol, and alkalies. On oxidation one or more acids are obtained, and on dry distillation an oily body, which, according to Hausmann (1878), has the characteristic odor of Russia leather. The whitish powder covering the young shoots and leaves is *betulo-resinic acid*, $C_{36}H_{26}O_5$, which, according to Kosmann (1854), has a bitter taste in alcoholic solution and dissolves in sulphuric acid with a red color.

Betula papyracea, *Aiton*, the *canoe birch*, grows in Canada and the northern part of the United States, has ovate, heart-shaped, taper-pointed leaves, and a tough white bark splitting into thin papery layers, which are used by the Indians in making canoes.

Betula lenta, *Linné*, Sweet, black or cherry-birch. It is indigenous to Canada and the northern part of the United States, but grows in the mountains as far south as Georgia; has oblong heart-shaped and acuminate leaves, which are pubescent on the veins beneath, and a glossy brown bark, the outer layers of which are slightly laminate and the inner layers close and reddish-brown. The bark and leaves yield a volatile oil, which Procter (1843) found to be identical with oil of gaultheria, and which Kennedy showed (1882) is largely sold in place of the latter. Pettigrew (1883) found it to be pure methyl salicylate, and to have the spec. grav. 1.180 at 15° C., and the boiling-point to be constant at 218° C. (424.4° F.). It does not pre-exist in the plant, but is formed by the action of water and an unknown compound of the bark upon *gaultherin*. This principle is syrupy, colorless, soluble in alcohol and water, insoluble in ether, and when distilled with sulphuric or hydrochloric acid yields the volatile oil. The bark contains 3.3 per cent. of tannin (Bowman, 1869).

Medical Action and Uses.—White birch is a popular remedy in the north of Europe. The sap is held to be a purifier of the blood, and is in general use for the cure of scaly diseases of the *skin*, *rheumatic* and *gouty* disorders, chronic affections of the *bladder*, *scurvy*, and *intermittent fever*. The fresh leaves are used to form a bed in which rheumatic patients lie, and which excites profuse sweating. Reduced to a pulp and mixed with gunpowder and cream, the bark is thought to be a sovereign remedy for the *itch*. A similar pulp mixed with oil is reputed to be efficient in discussing *scrofulous* enlargements of the glands. The oil of birch is likewise employed to cure chronic *cutaneous eruptions*, and is taken internally for the relief of *gonorrhœa*. It is said to have a more unpleasant odor than kindred oils, and when used should be scented with oil of rosemary or lavender. The American species (sweet birch) also appears to possess stimulant qualities; the bark and leaves are sometimes used to prepare diaphoretic infusions.

BIDENS.—Spanish Needles.

The herb of Bidens bipinnata, *Linné*.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This annual smooth weed is indigenous to the United States, and attains a height of about 3 feet (90 Cm.). The stem is quadrangular; the leaves are opposite, broadly ovate in outline, bipinnately dissected, the divisions lanceolate, mostly wedge-shaped at the base; the flower-heads are small, on long peduncles, have a double involucre, three or four short, yellow, and dark-veined ray-florets, and slender quadrangular three- or four-awned akenes. The plant has a disagreeable odor when rubbed, and a herbaceous afterward acrid taste. Its constituents have not been investigated.

Allied Species.—Bidens tripartita, *Linné*—Chanvre aquatique, *F.*; Wasserhanf, *G.*—indigenous to Europe, has three-lobed serrate leaves, yellow tubular florets, and two-awned akenes. It was employed like the preceding. The same common names are applied in Europe to Bidens cernua, *Linné*, Burmarigold, *E.*, which is also indigenous to Canada and the United States south to Virginia; it is known by its lanceolate, serrate, somewhat connate leaves, its nodding flower-heads with or without pale-yellow rays, and its flat, retrorsely-barbed, two-awned akenes.

Medical Uses.—There appears to be nothing to be added to the statement long ago made respecting this plant, that its roots and seeds have a popular reputation as *emmenagogues* and as remedies for acute *laryngeal* and *bronchial* affections; whence it may be inferred to be a stimulant and, when suitably administered with hot water, a diaphoretic.

BISMUTHI CITRAS, *U. S., Br.*—CITRATE OF BISMUTH.

Bismuthum citricum, Citras bismuthicus.—Citrate de bismuth, Fr.; *Wismuthcitrat, Citronsaures Wismuthoxyd*, G.

Formula $BiC_6H_5O_7$. Molecular weight 399.

Preparation.—Subnitrate of Bismuth 10 parts; Citric Acid 7 parts; Distilled Water a sufficient quantity. Boil the subnitrate of bismuth and the citric acid with 40 parts of distilled water, until a drop of the mixture yields a clear solution with water of ammonia. Then add 500 parts of distilled water, allow the suspended matter to deposit, wash the precipitate (first by decantation, and afterward on a strainer) with distilled water until the washings are tasteless, and dry the residue at a gentle heat.—*U. S.*

This is the process of R. Rother, first proposed in 1876, and consists simply in the decomposition at the boiling temperature of the bismuth subnitrate by the citric acid, anhydrous bismuthous citrate being formed, which is nearly insoluble in water and in the diluted nitric acid produced at the same time. The decomposition is ascertained to be complete by means of ammonia, which will then yield a clear solution with a drop of the turbid mixture. The yield is about 13½ parts.

Properties and Tests.—Bismuth citrate is "a white, amorphous powder, permanent in the air, odorless and tasteless, insoluble in water or alcohol, but soluble in water of ammonia. When strongly heated the salt chars, and on ignition leaves a more or less blackened residue with a yellow surface, which is dissolved by warm nitric acid. This solution on being dropped into water occasions a white turbidity. The ammoniacal solution when treated with hydrosulphuric acid in excess yields a black precipitate. The filtrate, deprived by heat of the excess of hydrosulphuric acid and cooled, when boiled with lime-water produces a white precipitate; and when a portion of it is mixed with an equal volume of concentrated sulphuric acid and cooled, a brown or brownish-black zone should not appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate)."—*U. S.*

Off. Prep.—Bismuthi et ammonii citras, *U. S.*

BISMUTHI ET AMMONII CITRAS, *U. S., Br.*—CITRATE OF BISMUTH AND AMMONIUM.

Bismuthi ammonio-citras, Bismuthum citricum ammoniatum.—Citrate de bismuth ammoniacal, Fr.; *Wismuthammoncitrat, Citronsaures Wismuthammonium*, G.

Formula $(NH_4)_3C_6H_5O_7Bi)OH_3$. Molecular weight 504.

Preparation.—Citrate of Bismuth 10 parts; Water of Ammonia, Distilled Water, each a sufficient quantity. Mix the citrate of bismuth with 20 parts of distilled water to a smooth paste, and gradually add water of ammonia until the salt is dissolved and the liquid has a neutral or only faintly alkaline reaction. Then filter the solution, evaporate it to a syrupy consistence, and spread it on plates of glass, so that on drying the salt may be obtained in scales. Keep the product in small, well-stoppered vials, protected from light.—*U. S.*

Rother (1876) states that dry citrate of bismuth yields with ammonia-water a syrupy liquid and a hard white mass, the latter being unaffected by excess of ammonia, but dissolving on the application of a gentle heat; this solution crystallizes on cooling, and the crystals, after being dried on a water-bath, are again soluble in water, and may be regarded as a compound of triammonium citrate with bismuthous hydrate, having the formula given above. Since the Pharmacopœia makes no provision for supplying the ammonia lost during the concentration of the liquid, the salt will have a more or less variable composition, probably approaching that determined by N. Gray Bartlett (1865) for a salt prepared by a similar process—namely, $BiC_6H_5O_7.NH_4HO.2H_2O$ (molecular weight 470). The yield by Rother's process is nearly 12½ parts, and by the officinal process 11½ to 12 parts.

Properties.—Citrate of bismuth and ammonium is in "small, shining, pearly, or translucent scales, becoming opaque on exposure to air, odorless, having a slightly acidulous and metallic taste and a neutral or faintly alkaline reaction; very soluble in water and but sparingly soluble in alcohol. When strongly heated the salt melts, then chars, and finally leaves a more or less blackened residue with a yellow surface, which is dissolved by warm nitric acid. This solution, on being dropped into water, occasions a white turbidity. The aqueous solution of the salt, when boiled with solution of potassa, evolves vapor of ammonia, and when treated with hydrosulphuric acid yields a black precipitate. If the filtrate be deprived by heat of the excess of hydrosulphuric acid, and cooled, a portion of it, boiled with lime-water, produces a white precipitate. Another portion, after being mixed with an equal volume of concentrated sulphuric acid and cooled, should not produce a brown or brownish-black zone around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate)."—*U. S.* The dry salt slowly loses ammonia on keeping, thereby becoming partly insoluble in water; the cautious addition of a few drops of ammonia-water to such a turbid mixture will then usually make a perfect solution.

Action and Uses.—If the virtues of subcarbonate and subnitrate of bismuth depend upon the insolubility of these salts, as appears to be the case, then their soluble salts must act in quite a different manner; but of their special action we possess no evidence. The *dose* of the nitrate of bismuth and ammonia is said to be 2 or 3 grains (Gm. 0.10–0.20.)

BISMUTHI OXIDUM, *Br.*—OXIDE OF BISMUTH.

Bismuthum oxydatum, Oxydum bismuthicum.—Oxyde de bismuth, Fr.; *Wismuthoxyd*, G.
Formula Bi_2O_3. Molecular weight 468.

Preparation.—Take of Subnitrate of Bismuth 1 pound; solution of Soda 4 pints. Mix and boil for 5 minutes; then, having allowed the mixture to cool and the oxide to subside, decant the supernatant liquid, wash the precipitate thoroughly with distilled water, and finally dry the oxide by the heat of a water-bath.—*Br.*

In this process the subnitrate of bismuth is decomposed by the soda, nitrate of sodium and white bismuth hydroxide being formed, the former of which remains dissolved in the water; $2(BiNO_4.H_2O) + 2NaHO$ yields $2Bi(HO)_3$ (or $Bi_2O_3.3H_2O$) $+ 2NaNO_3$. On drying the precipitate without heat it loses water and leaves *bismuthyl-hydroxide*, $BiHO_2$; but at the temperature of boiling water the anhydrous oxide is left.

Properties.—Oxide of bismuth forms a dull-yellow more or less crystalline powder, which dissolves in mineral acids without effervescence, and these solutions are colorless and yield black precipitates with hydrosulphuric acid, and white ones by alkalies, alkaline carbonates, and much water, the precipitates being insoluble in an excess of the precipitants. When heated to incipient redness the oxide is not diminished in weight. At a higher temperature it fuses to a brown mass, which becomes yellow again on cooling. The oxides of lead and silver are likely to be present as impurities, and are detected by dissolving in nitric acid and testing as described under BISMUTHI SUBNITRAS.

Action and Uses.—Oxide of bismuth would appear to be nearly insoluble in the stomach; for in a woman with gastric cancer, to whom it was given, a mass of it weighing a pound was found in the stomach after her death, which must have remained there for at least 2 months (*Practitioner*, xxviii. 293). It has been used for the same purposes as the subcarbonate and the subnitrate, and has been particularly recommended, when mixed with powdered acacia and muriate of morphia, as a snuff in *post-nasal catarrh* and *ozœna.* It may be prescribed in doses of 3 grains (Gm. 0.20) and upwards.

BISMUTHI SUBCARBONAS, *U. S.*—SUBCARBONATE OF BISMUTH.

Bismuthi carbonas, Br.; *Bismuthum subcarbonicum, Subcarbonas bismuthicus.—Carbonate of bismuth*, E.; *Sous-carbonate de bismuth*, Fr.; *Wismuthsubcarbonat, Basisches kohlensaures Wismuthoxyd*, G.
Formula $(BiO)_2CO_3.H_2O$. Molecular weight 530.

Preparation.—Take of Purified Bismuth in small pieces 2 ounces; Nitric Acid 4 fluidounces; Carbonate of Ammonia 6 ounces; Distilled Water a sufficiency. Mix the nitric acid with 3 ounces of distilled water, and add the bismuth in successive portions. When the effervescence has ceased, apply for 10 minutes a heat approaching that of ebullition, and afterward decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to 2 fluidounces, and add this in small quantities at a time to a cold filtered solution of the carbonate of ammonia in 2 pints of distilled water, constantly stirring the mixture as it is formed. Collect the precipitate on a calico filter, and wash it with distilled water until the washings pass tasteless. Remove now as much of the adhering water as can be separated from the precipitate by slight pressure with the hands, and finally dry the product at a temperature not exceeding 150° F.—*Br.*

In this process a solution of bismuthous nitrate is first formed and concentrated by evaporation, when it is added to a cold solution of an alkaline carbonate. Most metallic bismuth contains some arsenic, which is also oxidized by the nitric acid, so that arsenate of bismuth is found in the solution. In order to remove nearly the whole of the arsenic, the nitric acid solution may be diluted with sufficient distilled water until it remains faintly milky after stirring; on being set aside for a day most of the arsenate will be found deposited as a white crystalline precipitate. The clear solution, still retaining a small proportion of arsenic, may be almost completely deprived of it by pouring it into an excess of ammonia-water, whereby soluble nitrate and arsenate of ammonium are formed, while bismuthous hydrate is precipitated; this may then be converted into subcarbonate by dissolving in sufficient nitric acid, pouring the liquid slowly and with constant stirring into a solution of sodium carbonate, draining the precipitate upon a strainer, and washing it with distilled water. This process was originally proposed by Dr. Squibb, and adopted in the U. S. P. 1870 with the following working quantities: Bismuth 2 troyounces is dissolved in a mixture of nitric acid 4½ troyounces and water 4 fluidounces; the solution is diluted with water 10 fluidounces; on the next day decanted and filtered, diluted with water 4 pints, and mixed with ammonia-water 5 fluidounces; the precipitate is drained, washed, and dissolved in nitric acid 4 troyounces; the solution is mixed with water 4 fluidounces, next day filtered and slowly poured into a cold solution of sodium carbonate 10 troyounces in water 12 fluidounces; the precipitate is collected on a strainer, drained, and washed until the washings pass tasteless. In following this process it is important that the dilution with water should be carried far enough until a turbidity is observed which does not disappear completely on stirring; this solution should be set aside for a sufficient length of time, as indicated; the acid solutions should be added slowly and with continual stirring to the alkaline solutions, in order to ensure the complete decomposition of the acid salt; and the washing should not be continued for too long a time, in order to avoid gradual decomposition of the subcarbonate into hydrate. If the final precipitation be effected at a boiling temperature, an anhydrous subcarbonate would be precipitated.

The final reaction is explained by the equation $2(Bi3NO_3) + 3Na_2CO_3H_2O = (BiO)_2CO_3.H_2O + 6NaNO_3 + 2CO_2$, showing that carbonic acid gas is given off.

Properties.—Bismuthous subcarbonate is a white or pale yellowish-white powder, permanent in the air, inodorous and tasteless, insoluble in water, alcohol, alkalies, and alkaline carbonates, but soluble with effervescence in nitric acid; at a red heat it is converted into yellow bismuthous oxide which is soluble in hydrochloric or nitric acid; and these solutions have the behavior described on page 326.

Tests.—"On dissolving 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200) a copious effervescence takes place, and no residue should be left (absence of insoluble foreign salts). On pouring this solution into 50 parts of water a white precipitate is produced, and on filtering and concentrating the filtrate to 6 parts a portion of this, mixed with five times its volume of diluted sulphuric acid, should not become cloudy (absence of lead). If another portion be precipitated with an excess of water of ammonia, the supernatant liquid should not exhibit a blue tint (copper). On diluting a third portion with 5 volumes of distilled water the filtrate should remain unaffected by test solution of nitrate of silver (chloride) or of nitrate of barium (sulphate); also by hydrochloric acid (silver). If the salt be boiled with acetic acid diluted with an equal volume of water, and the cold filtrate freed from bismuth by hydrosulphuric acid, the new filtrate should leave no fixed residue on evaporation (alkalies and alkaline earths). On boiling 1 Gm. of the salt with 10 Ccm. of solution of soda (sp. gr. 1.260), and holding a glass rod dipped in acetic acid over the test-tube, not more than a faint white cloud, but no heavy white fumes, should appear (only traces of ammonia). If the preceding mixture, after thorough boiling, be diluted with water to 50 Ccm. and filtered, the filtrate, when supersaturated with hydrochloric acid and treated with hydrosulphuric acid, should not deposit more than a trace of a precipitate, which should not have a yellow or orange color (only traces of antimony, arsenic, tin). On boiling 1 Gm. of the salt with 10 Ccm. of strong solution of soda, decanting the liquid from the precipitated oxide of bismuth into a long test-tube, and adding about 0.5 Gm. of aluminium wire cut into small pieces (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any color or tint to paper wet with test solution of nitrate of silver and kept over the mouth of the test-tube for half an hour (absence of more than traces of arsenic)."—*U. S.* On adding the powder to sulphuric acid, tinged blue with solution of indigo, the color of the latter is not discharged (absence of nitrate). Arsenic may be conveniently detected by the modifications of Fleitmann's test, described on page 28. When bismuth subcarbonate is heated to redness it gives off water and carbonic acid, and loses 9½ per cent. of its weight (*U. S.* 1870); anhydrous carbonate would lose 8.6 and the monohydrated 11.7 per cent. of weight.

Medical Action and Uses.—Introduced as a substitute for subnitrate of bismuth, this preparation was claimed to possess the advantages of greater solubility in the gastric juices, and therefore to be less likely than the subnitrate to confine the bowels and color the stools. But these effects should not be considered advantages, for they would unfit the salt more or less for being used in the class of cases in which the subnitrate has been found advantageous only because it is nearly insoluble. *Dose*, from 10 to 60 grains (Gm. 0.60–4.00), suspended in water.

BISMUTHI SUBNITRAS, *U. S., Br.*—Subnitrate of Bismuth.

Bismutum subnitricum, P. G.; *Bismuthum hydrico-nitricum, Magisterium bismuthi, Subazotas (s. Subnitras) bismuthicus.—Sous-azotate (Sous-nitrate) de bismuth*, Fr.; *Basisches Wismuthnitrat (salpetersaures Wismuthoxyd), Wismuthsubnitrat*, G.

Formula $BiONO_3.H_2O$. Molecular weight 306.

Preparation.—Take of Purified Bismuth in small pieces 2 ounces; Nitric Acid 4 fluidounces; Distilled Water a sufficiency. Mix the nitric acid with 3 ounces of distilled water, and add the bismuth in successive portions. When effervescence has ceased, apply for 10 minutes a heat approaching that of ebullition, and decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to 2 fluidounces, and pour it into half a gallon of distilled water. When the precipitate which forms has subsided, decant the supernatant liquid, add half a gallon of distilled water to the precipitate, stir them well together, and after 2 hours decant off the liquid, collect and drain the precipitate in a calico filter, press it with the hands, and dry it at a temperature not exceeding 150° F.—*Br.*

By dissolving the metal in nitric acid the latter is partly decomposed, nitrous acid vapors being evolved and water generated, while the bismuth dissolves, forming normal bismuthous nitrate; thus: $Bi_2 + 8HNO_3 = 2(Bi3NO_3) + 2NO + 4H_2O$. Other metals likely to be present are dissolved with the formation of nitrates, except arsenic, which is oxidized to arsenic acid. The bismuth having been previously purified, the solution practically should contain only bismuthous nitrate. The latter requires now to be converted into the subnitrate, which is accomplished by water. The most uniform results are obtained by adding the acid solution to a definite quantity of cold water; the decomposition taking place may be explained by the following equation: $6(Bi3NO_3) + 10H_2O = 5(BiONO_3.H_2O) + Bi3NO_3 + 10HNO_3$. The nitric acid which is liberated will retain a portion of normal bismuthous nitrate in solution. Ditte ascertained that water containing in each liter 83 Gm. of $N_2O_5 = 96.83$ Gm. of HNO_3 will dissolve both normal and basic nitrate, forming with the latter the normal salt, so that no decomposition will take place on the further addition of the acid liquid. But if the precipitate is left for too long a time in contact with the acid mother-liquor, an oxynitrate of the formula $4BiONO_3.BiH_3O_3.3H_2O$ is gradually formed; by precipitating the solution with water of about 50° C. (122° F.) an oxynitrate is obtained having the composition $5BiONO_3.BiH_3O_3.3H_2O$; and by washing the officinal or the above compounds for some time with water they are decomposed into still more basic salts of the formulas $3BiONO_3.BiH_3O_3.3H_2O$ and $3BiONO_3.2BiH_3O_3.H_2O$. It is obvious from the foregoing that even with the most careful manipulation the product obtained is not likely to be of a definite composition, but to consist of a mixture of the above two salts or of intermediate basic salts.

The U. S. P. 1870 used commercial bismuth, which was freed from the contaminating metals by a process analogous to that described for the subcarbonate; the diluted and filtered solution in nitric acid was first precipitated by pouring it into an excess of solution of sodium carbonate; the bismuthous carbonate was redissolved in sufficient nitric acid, diluted with water, filtered, and poured into a definite quantity of water, to which subsequently ammonia was added to *partly* neutralize the nitric acid, so as to precipitate also the greater part of the bismuth still held in solution.

The following is an outline of the process of the German Pharmacopœia: Heat bismuth 2 parts and sodium nitrate 1 part to dull redness in an iron dish, stirring constantly until the metal has been finely divided; when partly cooled add water 5 parts and soda solution 3 parts, boil, filter, and wash the finely-divided metal and oxides; after drying dissolve in hot nitric acid 8 parts, heat to near 90° C. (194° F.), filter through asbestos from the precipitated bismuth arsenate, evaporate to 6 parts, and crystallize; wash the crystals 1 part with a little dilute nitric acid, triturate with water 4 parts; pour this mixture into 21 parts of boiling water, decant the liquid, drain the precipitate, and wash it with an equal bulk of water. The object of this process is to obtain the salt absolutely free from arsenic, nearly the whole of which is removed as sodium arsenate in the first portion of the process, and the last traces by heating the acid liquid and crystallizing the normal nitrate, the crystals obtained under these conditions being free from this and other impurities.

The acid mother-liquor obtained in the above processes may be treated with an alkaline carbonate to recover the bismuth remaining in solution, and the deposits of bismuthous arsenate may be freed from the latter metal by boiling with excess of alkali, after which the undissolved portion may again be worked up for subnitrate.

With the view of obtaining the salt of definite composition, Lalieu (1878) proposed its preparation from the well-washed and still moist oxide obtained from 200 Gm. of the metal, by treating it with nitric acid equal to 48.5 Gm. of nitric anhydride, adding it in small quantities, and then heating until the mixture becomes limpid and white; after the addition of a little water the subnitrate is thrown upon a filter, washed with twice its bulk of water, expressed, and dried; the yield is 265 Gm.

Properties.—Subnitrate of bismuth is a heavy white powder in minute crystalline scales and of a somewhat satiny appearance. It is not altered on exposure to air or light, is inodorous, has a faintly acid taste, and when moistened on litmus-paper has a slight but decided acid reaction. It is insoluble in water and alcohol, but dissolves completely and without effervescence in mineral acids. "When heated to 120° C. (248° F.) it loses between 3 and 5 per cent. of moisture, and at a red heat it gives off yellowish-red vapors and leaves between 79 and 82 per cent. of yellow bismuthous oxide."—*P. G.* The formula given above requires 76.5 per cent. of Bi_2O_3. This difference may be due to loss of water by drying at too high a temperature, but is usually owing to changes in its composition occurring during its preparation under the circumstances described above. The loss by ignition of these non-officinal oxynitrates ranges between 16 and 20 per cent.

Tests.—Bismuth subnitrate should dissolve in nitric acid without effervescence (absence of carbonate), and without leaving any residue (absence of insoluble matters), and this solution should yield no precipitate with dilute sulphuric acid, with solution of silver nitrate, or with barium nitrate (absence of lead, chlorides, and sulphates). When mixed with sulphuric acid diluted with an equal bulk of water it dissolves, and the solution acquires a black color on the addition of a crystal of ferrous sulphate (presence of nitrate). On treating this solution with an excess of ammonia and filtering from the white precipitate, the filtrate should not have a blue color (absence of copper), and should not give a precipitate with hydrosulphuric acid (absence of zinc). The sulphuric acid solution on being diluted with water and completely precipitated by hydrosulphuric acid should yield a filtrate which on being evaporated to dryness should not leave any residue (absence of alkaline, earthy, and certain metallic salts). Bismuth subnitrate on being heated with an excess of soda solution should not evolve any ammonia, and it should be entirely free from arsenic, so that a small portion of it when treated by Fleitmann's test (see page 28) produces no stain upon filtering-paper moistened with solution of silver nitrate.

Off. Prep.—Bismuthi oxidum, Trochisci bismuthi, *Br.*

Other Bismuth Salts.—1. BISMUTHI NITRAS S. TERNITRATE. BISMUTHUM TRISNITRICUM.—Bismuth nitrate, Normal bismuth nitrate, *E.;* Azotate (nitrate) de bismuth neutre, *F.;* Wismuthnitrat, *G.* $Bi(NO_3)_3.5H_2O$. Mol. weight 586.—The manner in which this salt may be obtained free from arsenic has been described above. Normal bismuth nitrate crystallizes in large colorless prisms having a strongly acid taste, melting at about 80° C. (176° F.) in its water of crystallization, parting with a portion of its acid near 120° C. (248° F.), and with the whole of it at 260° C. (500° F.), leaving Bi_2O_3 behind. Water decomposes the salt, forming a basic nitrate. Mr. Balmanno Squire (1876) found the normal bismuth nitrate to be soluble in glycerin, and this solution, when recently made, is miscible with water without being precipitated. Mr. J. Williams observed that heat must be avoided in preparing the solution and after diluting it with water, and that potassa and soda cause in it a white precipitate, which is dissolved by an excess of the alkali, the alkaline solution being miscible with water, but not with alcohol. Mr. W. W. Moorhead (1877) proposed a *glycerite of nitrate of bismuth*, using 2 troyounces of the crystals to sufficient glycerin to make 8 fluidounces. The salt may thus be prescribed in a perfect solution, which may be diluted by the patient when using it.

2. BISMUTHI OXYCHLORIDUM.—Bismuth oxychloride, Bismuthyl chloride, *E.;* Oxychlorure de bismuth, *Fr.;* Wismuthoxychlorid, *G.* BiOCl. Mol. weight 261.4.—It is prepared by slowly pouring a solution of bismuth in nitric acid into a solution of sodium chloride. It is a white powder known as *pearl white*, and in France, like bismuth subni-

trate, as *blanc de fard*. When heated in closed vessels it turns yellow and melts without decomposition, but on being heated in the air chlorine is given off and bismuthous oxide left. The salt is insoluble in water, but readily soluble in acid. It has occasionally been sold as oxide of bismuth.

3. BISMUTHI PHOSPHAS. Phosphate of bismuth is prepared by dissolving 5 parts of the subnitrate in sufficient nitric acid, and pouring this solution slowly into a solution of 6 parts of sodium phosphate. It is a white powder, resembling the preceding salt.

4. BISMUTHI LACTAS. Lactate of bismuth is prepared by boiling 10 parts of the subnitrate with an excess of caustic soda, washing the oxide well with water, and while still moist mixing it with 9 parts of lactic acid; the mixture is digested, and dried in the water-bath.

5. BISMUTHI SALICYLAS. Salicylate of bismuth is best prepared, according to Dr. L. Wolff (1883), by dissolving bismuth nitrate in glycerin and precipitating with a concentrated solution of sodium salicylate. It forms a granular powder having a pinkish tint, and is without action on test-paper; when heated it is decomposed, giving off a phenic odor, free from nitrous acid vapors.

6. BISMUTHI TANNAS, Bismuthum tannicum, Tannas bismuthicus.—Tannate of bismuth, *E.;* Tannate de bismuth, *Fr.;* Wismuthtannat, *G.*—44 parts of crystallized bismuthous nitrate are dissolved in the least possible quantity of nitric acid, previously diluted with half its weight of water; the solution is poured into an excess of solution of soda, the precipitate well washed with water, until the washings cease to have an alkaline reaction, and the moist precipitate triturated with 20 parts of tannin diluted with water, strained through muslin, and dried with the aid of a moderate heat. This is Cap's process, proposed in 1860; in the first part of it bismuthous hydrate is formed from the nitrate by decomposing it with sodium hydrate; the precipitate is then directly combined with tannic acid, with which it should be left in contact for an hour or two before being washed and dried. It forms a light-yellow powder which is insoluble in water and alcohol, and is entirely tasteless. When thoroughly dried its composition represents 53 per cent. of bismuthous oxide and 47 of tannin.

7. BISMUTHI VALERIANAS, Bismuthum valerianicum, Valerianas bismuthicus.—Valerianate of bismuth, *E.;* Valérianate de bismuth, *Fr.;* Wismuthvalerianat, *G.*—A solution of bismuthous nitrate in the smallest quantity of nitric acid, previously diluted with half its weight of water, is precipitated by a rather concentrated solution of sodium valerianate; the precipitate is washed with water, to which some valerianic acid has been added, until the washings, on evaporation, leave no residue, and afterward dried. Or 50 parts of subnitrate of bismuth are digested for 4 hours with 150 parts of ammonia diluted with the same weight of water; the sediment, consisting of bismuth hydrate, is well washed with water, drained, transferred to a mortar, and well triturated with 15 parts of concentrated valerianic acid, 30 parts of alcohol being gradually added during the trituration. It is afterward collected upon a filter and dried at the ordinary temperature. Prepared by either process, it is a white amorphous powder having a decided odor of valerianic acid, insoluble in water and alcohol, soluble in nitric and in sulphuric acid; the latter solution does not acquire a black color on the addition of ferrous sulphate (absence of nitrate). Other impurities may be detected by the same tests as in the bismuth subnitrate.

Physiological Action.—There is no doubt that, practically, subnitrate of bismuth is insoluble in the gastro-intestinal juices. Long ago, it is true, Orfila detected its presence in the liver, the spleen, and the urine, and his statements have been confirmed and extended by recent observations. Nevertheless, the quantity absorbed is quite inconsiderable, and there is nothing to show what the action is, if any, of that portion. Pure subnitrate of bismuth appears to act upon the stomach and bowels simply by coating their mucous membrane with a virtually insoluble and at the same time perfectly unirritating substance, which protects it against the action of the contents of these viscera, and at the same time probably restrains their secretions and absorbs the excess of free acids present. It may also decompose the sulphuretted hydrogen in these cavities. There is no doubt that it may be taken in unlimited doses without occasioning any signs of irritation whatever. When, as sometimes has happened in experiments on animals and in clinical experience, the medicine has produced all the effects of a corrosive poison, an examination of the specimen used has shown it to be adulterated with arsenic, or rather that the arsenic which is naturally associated with the bismuth has not been completely separated from it in the manufacture, or else that the preparation used was the nitrate, and not the subnitrate, of bismuth. In the case of a child ten months old and suffering from diarrhœa about 400 grains of subnitrate of bismuth were administered in the course of 3 days. After the first week the child began to grow œdematous, the conjunctiva was injected, the tongue dry, and the pulse rapid. On chemical examination of the bismuth it was found to contain $\frac{24}{100}$ of 1 per cent. of arsenic acid, and the child had taken in all about $\frac{3}{5}$ gr. of this substance. On suspending the medicine the symptoms subsided (Underhill). It has also been shown that a minute proportion of oxide of lead may be found in subnitrate of bismuth. If so, its presence has never been betrayed by any special symptoms, notwithstanding the large doses habitually given of the salt. Patients using bismuth sometimes notice a peculiar alliaceous taste in the mouth, while a corresponding smell is exhaled by the breath. It has been attributed to the presence of tellurium, but there is no evidence to show that this metal would produce such an effect if it were present in bismuth preparations, which it is not. It has also been ascribed to the arsenic which they often do contain in a minute proportion. But not only does arsenic produce no such symptom in those who use it, but bismuth preparations arsenic free occasion this peculiar odor (Squibb). Pure subnitrate of bismuth occasions no morbid symptoms, but confines the bowels and blackens and deodorizes the feces. After death in persons who have been using it freely the gastric mucous membrane presents no peculiarities, but that of the small intestine is in parts bluish, and the colon and rectum are stained black by a reaction of the bismuth with the sulphurous compounds present.

Medical Uses.—Subnitrate of bismuth was originally employed to relieve certain chronic and painful affections of the stomach, which appear to have been *gastralgia* and *simple ulcer* of that organ. It is probable that the latter was the disease most commonly treated successfully, and that it was sometimes associated with neuralgia of the stomach. It is certain that pure gastralgia is not peculiarly benefited by bismuth, and that simple ulcer is signally improved by it. If the pain is greatest upon taking food, there is probably ulcer; if the paroxysms occur when the stomach is empty, they are probably neuralgic. Ulcerated *cancer* of the stomach is favorably influenced by subnitrate of bismuth, which, as in simple ulcer, forms a covering to the raw and irritable surface, and thereby lessens pain and vomiting. It is beneficial in cases of chronic *gastric catarrh* due to coarse food or excessive eating, and which are attended by a feverish condition, a coated tongue, and an enlargement of the papillæ. In almost every form of *diarrhœa* caused by irritation or ulceration of the intestinal coats this medicine is of the utmost service—in all cases, indeed, for which chalk has for a long time been employed. The premonitory diarrhœa of *cholera* is generally under its control when it is given in doses of not less than 30 or 40 grains, and the same is true of smaller doses in *cholera infantum*. There is no better agent for controlling the diarrhœa of *typhoid fever* when it becomes excessive at any period of the disease, but especially during its decline; and it is useful in *tuberculous diarrhœa*—provided that the doses of the medicine are large—and in all forms indeed of chronic diarrhœa and *chronic dysentery*. In *acute* as well as in chronic dysentery enemas composed of mucilage in which bismuth is suspended are very soothing to the inflamed and ulcerated bowel.

As a topical application subnitrate of bismuth is useful whenever a neutral protective and absorbent powder is required. Nothing is superior to it as an application to superficial abrasions and ulcerations, as in *intertrigo*, slight *burns*, confluent *variola*, *eczema*, *zona*, *fissures of the anus*, *chapped nipples*, *lips*, and *hands*, and *leucorrhœa*. In the last-named disease powdered bismuth on a roll of charpie should be introduced into the vagina through a speculum, and withdrawn after 6 or 8 hours. *Cancrum oris* following an epidemic of measles was found to improve under the use of subnitrate of bismuth better than after any other topical measures (Macguire, *Med. Record*, xxiii. 113), showing the advantage of a protective treatment. A similar result is stated to have attended this method in the management of recent wounds (Riedel, *Am. Jour. Med. Sci.*, July, 1883, p. 250). It is an efficient remedy for acute *coryza* when repeatedly and thoroughly snuffed into the nostrils. Its efficacy may be increased by associating with it morphia and powdered gum-arabic; *e. g.* muriate of morphia gr. j, powdered gum-arabic ʒj, subnitrate of bismuth ʒiij. In chronic coryza the following powder has been strongly recommended as a snuff: subnitrate of bismuth 4 parts, liquorice-powder 8 parts, iodide of sulphur 30 parts. In most of these affections the cure will be hastened by associating with the bismuth oxide of zinc in the proportion of about one-fourth. In some cases of scrofulous *ozæna* cures have been effected by forcibly snuffing the finely-powdered subnitrate into the nostrils and daily cleansing the passages by means of the douche. Sometimes it is topically applied suspended in water, which appears to be irrational; and sometimes in glycerin, which is less so, since the glycerin, if pure, tends to deprive the tissues of their moisture. The powdered salt is an efficient palliative of *fetid sweats* of the feet and other parts.

A modification of Böttger's test for *diabetic sugar* has been proposed by W. L. Dudley, as follows: "Dissolve subnitrate of bismuth in the least possible quantity of chemically pure nitric acid, and add to it an equal amount of acetic acid of ordinary strength; dilute to eight or ten times its volume, and filter if necessary. To the solution to be tested add sufficient sodium hydrate to render it strongly alkaline, then add a drop or two of the bismuth solution; heat to boiling, and continue the boiling for 20 or 30 seconds. If sugar is present, the white flocculent precipitate which is formed on the addition of the bismuth solution to the alkaline liquid will become gray or black" (*Amer. Chem. Jour.*, 1880). Loewe employs the following formula for the test solution: "Subnitrate of bismuth 15 Gm.; dissolve in pure glycerin 30 Gm.; solution of sodium hydrate (sp. gr. 1.34) 60 to 70 Ccm., dilute with water 150 to 160 Ccm.; heat to 212° F." (*Practitioner*, xxvi. 291).

The *dose* of subnitrate of bismuth varies from 3 to 4 grains (Gm. 0.20–0.25) in infantile cases to a teaspoonful for adults, but the average dose for adults may be stated at 10 grains (Gm. 0.60). It is best given with water alone and when the stomach is empty. Milk, soup, and similar liquids as vehicles tend to envelop the medicine, and to that extent neutralize its action.

Phosphate of bismuth has been proposed (by Tédenat) as superior to all the other bismuth compounds, because it is more insoluble than they are. It may be given in somewhat smaller doses than the subnitrate (*Bull de thérap*, xcviii. 427).

Salicylate of bismuth has been credited not only with moderating and curing, but even with aborting, *typhoid fever* (Huchard), but upon insufficient grounds. No doubt it moderates the diarrhœa and corrects the fetor of the stools in this disease, and if largely given may reduce the temperature and pulse-rate; but that it shortens the disease or lessens its mortality no proof exists.

Tannate of bismuth is astringent, and was at one timed used internally in *diarrhœa* and topically in *gonorrhœa*, *leucorrhœa*, *ophthalmia*, etc. It is now very seldom employed.

There is no sufficient reason for believing that valerianate of bismuth is of the least therapeutical value.

BISMUTHUM, *Br.*—Bismuth.

Bismuth, Fr.; *Wismuth*, G.

Symbol Bi. Atomicity trivalent and quinquivalent. Atomic weight 210.

Origin.—The supply of bismuth is chiefly derived from the mines in Saxony, where it exists in the metallic state associated with cobalt, nickel, and silver ores. It is likewise found oxidized as *bismuth ochre*, in combination with sulphur and with tellurium, and in gold ores. Deposits of bismuth ore have been discovered in Hungary, France, Cornwall, and other parts of Europe, in Texas, California, Mexico, Bolivia, and other parts of America, and in Australia. Bismuth appears to have been first recognized as a distinct metal by Basilius Valentinus in the fifteenth century, but was afterward frequently confounded with antimony, tin, and zinc until Pott (1739), and afterward Bergmann, Davy, and others, proved its distinct properties.

Preparation.—The metal is extracted by a simple process of smelting, advantage being taken of its low melting-point, and run into hot iron receiving-pots, where it congeals. The sulphide of bismuth requires to be roasted; it is thus converted into oxide, which is reduced to the metallic state by being heated with charcoal. The crude metal thus obtained contains variable quantities of arsenic, copper, iron, and other metals.

Purification.—Bismuthum purificatum, *Br.*—Purified bismuth. Take of Bismuth 10 ounces; Nitrate of Potash in powder 2 ounces. Put the bismuth and 1 ounce of the nitrate of potash into a crucible, and heat them to a temperature at which both the metal and the salt are fused. Continue the heat, constantly stirring the contents of the crucible for 15 minutes, or until the salt has solidified into a slag over the metal. Then remove the salt, add the remainder of the nitrate of potash to the bismuth in the crucible, and repeat the process as before. Finally, pour the bismuth, while fused, into a suitable mould, and allow it to cool.—*Br.* 1867. (For a similar process, in which sodium nitrate is used, see Bismuthi Subnitras.)

A method proposed by Mr. Méhu (1873) aims at the formation of an alloy with potassium by heating to redness a mixture of powdered crude bismuth, potassium carbonate, charcoal, and soap under a layer of well-washed charcoal; the metallic button obtained at the end of an hour is then fused in a capsule, for the purpose of oxidizing the potassium to potassa, which is accomplished when a yellow-brown layer of bismuthous oxide begins to form. It is claimed that arsenic and sulphur are completely removed by this process.

Properties.—Bismuth is a brilliant grayish-white metal with a distinct roseate tinge and a crystalline lamellate texture. When fused bismuth is cooled until a crust has formed, and the liquid portion is then poured out, the crucible will be found lined with rhombohedral crystals resembling cubes. Its specific gravity is 9.83, which is diminished by high pressure. It fuses at 268.3° C. (515° F.), and when congealing expands considerably, like water under similar circumstances, the density of the liquid metal being more than 3 per cent. greater than that of solid bismuth. It boils above 1100° C. (2012° F.), and may be distilled in a current of hydrogen. It is superficially tarnished at the ordinary temperature by exposure to the air, but at a red heat decomposes the vapor of water and burns in the air with a bluish flame to brown oxide, becoming yellow on cooling. It has the peculiar property of lowering the fusing-point of metals: an alloy of 2 parts of bismuth and 1 part each of lead and tin fuses at 93.75° C. (200.75° F.) It is but slightly attacked by boiling hydrochloric or dilute sulphuric acid; but nitric acid dissolves it readily, the solution on concentrating yielding crystals of bismuthous nitrate (see BISMUTHI SUBNITRAS); the mother-liquor or the original solution in nitric acid, suitably diluted with water and separated from the white precipitate of subnitrate, should not yield a white precipitate with sulphuric acid (lead), or a blue one with potassium ferrocyanide (iron), or with the same reagent a reddish-brown one (copper). The presence of arsenic is ascertained by adding sulphuric acid to the solution, evaporating it to complete dryness, and applying Marsh's or Fleitmann's test (see pages 27 and 28). Silver, which is occasionally present, will be indicated by the white precipitate which takes place in the nitric acid solution, previously diluted with water as much as possible, on the addition of hydrochloric acid. The fetid breath following the administration of bismuth preparations has been attributed by C. Ekin (1876) to the presence of some tellurium; but from observations made by Dr. Squibb (1882) this appears to be doubtful, or at least not the sole cause.

The *salts of bismuth* are colorless, except those formed with a colored acid or acidulous radical. The nitrate, sulphate, and chloride dissolve in a small quantity of acidulated water, but are decomposed by a large quantity of water, with the formation of insoluble basic salts. The solutions of bismuth salts yield with hydrosulphuric acid a black precipitate insoluble in sulphydrate of ammonium, with alkalies white precipitates insoluble in an excess, and with zinc, cadmium, or copper a dark-gray spongy mass consisting of metallic bismuth. The solutions give with potassium iodide a yellowish-brown precipitate, becoming red on the addition of water; this coloring being so intense that a minute quantity of bismuth may be detected in lead if the acetate is precipitated by an excess of potassium iodide and the mixture heated to boiling; on cooling, the golden-yellow color of the lead iodide will be tinged crimson, orange, or brown, according to the proportion of bismuth present (Field and Abel, 1877).

Off. Prep.—Bismuthi subcarbonas Bismuthi subnitras, *Br.*

BISTORTA.—BISTORT.

Snakeweed, E.; *Bistorte*, *Couleuvrine*, Fr.; *Wiessenknöterich*, *Natterwurz*, G.

The rhizome of Polygonum Bistorta, *Linné.* Woodville, t. 232; Bentley and Trimen, *Med. Plants*, 212.

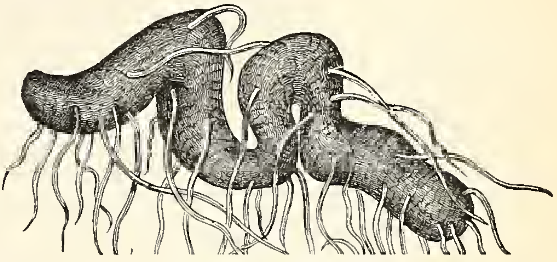
Nat. Ord.—Polygonaceæ.

Origin.—Snakeweed is an herbaceous perennial which grows in swampy meadows throughout Asia north from the Himalayas, in the greater portion of Europe, in Canada, and in the mountainous regions of the Western United States from Colorado northward. Its simple stems bear alternate ovate leaves with long and striate sheaths, and a terminal cylindrical dense racemose spike of rose-colored flowers. The young shoots and leaves are used for greens in the north of England and in subarctic countries, and the roasted rhizome is eaten in Siberia and Iceland.

Description.—The rhizome, which is collected in spring or autumn, is bent twice upon itself, is flattish on one side, rounded upon the other, transversely furrowed or annulated from the leaf-scars, and marked with the scars of the rootlets. As found in commerce, its total length is about 2 inches (5 Cm.); it is about ½ inch (12 Mm.) broad, about ¼ inch (6 Mm.) thick, and of a firm texture, though fleshy and somewhat spongy when fresh. Externally it is blackish-brown, internally reddish or brownish-red, and shows upon the transverse section a moderately thick bark, a large central pith, and a circle of very small whitish wood-bundles. It is inodorous and has a strongly astringent taste.

Constituents.—Bistort contains much starch and tannin. Bowman (1869) found the latter to amount to 21 per cent. The rhizome is also said to contain gallic acid. *Extract of bistort*, prepared with diluted alcohol, is occasionally employed; the yield is about 12 per cent.

Fig. 40.



Bistorta: natural size.

Allied Plants.—The herbs of most species of this genus have a slight astringent and more or less saline or acidulous taste, and have been occasionally employed as mild astringents. Pol. Persicaria, *Linné*, the *spotted knotweed* or *lady's thumb*, has the lanceolate leaves usually marked near the middle with a brown semilunar or triangular spot. Pol. amphibium, *Linné*, or *water-knotweed*, grows in ponds, swamps, and in damp sandy soil, is variable in appearance, and has the rose-red flowers in dense spikes. Pol. hydropiperoides, *Michaux*, or *mild water-pepper*, has narrow lanceolate leaves and slender spikes of whitish flowers. Pol. aviculare, *Linné*, known as *knot-grass*, *birdweed*, or *goose-grass*, is occasionally erect, but usually has the slender branches prostrate or ascending, and bears two to four inconspicuous greenish and reddish flowers in the axils of the small leaves.

The following, which are decidedly acrid, have elliptic or lanceolate pellucid-punctate leaves and more or less interrupted linear spikes of greenish and reddish flowers: Pol. Hydropiper, *Linné*, known as *water-pepper* or *smartweed*, has the leaves often dark-spotted and the akenes of a dull brown, flattish or obtusely triangular; Pol. acre, *Kunth*, has larger green leaves and acutely triangular glossy akenes. Dr. C. J. Rademaker (1871) isolated from water-pepper *polygonic acid*, upon which the medicinal properties mainly depend; it is green, crystallizable, soluble in alcohol, ether, and chloroform, almost insoluble in water, soluble in alkalies with a yellow color, and is precipitated by basic lead acetate, mercurous nitrate, and mercuric chloride.

Pol. acre and Pol. hydropiperoides are American plants; the remaining species are common in both hemispheres.

Medical Action and Uses.—In Europe this medicine is used for all the purposes of a simple and mild astringent, both internally and externally; *i. e.* in *diarrhœa*, passive *hæmorrhages*, *leucorrhœa*, relaxation of the *throat*, *anus*, *vagina*, etc. It may be prescribed in powder, decoction, or extract. The decoction is prepared with an ounce (Gm. 32) of bruised bistort to a pint of water. *Dose*, a tablespoonful every 2 hours.

BOLDUS.—Boldo.

Boldo, Fr., G.

The leaves of Peumus Boldus, *Molina*, s. Ruizia (Peumus, *Persoon*, Boldoa, *C. Gay*) fragrans, *Ruiz and Pavon.* Bentley and Trimen, *Med. Plants*, 217.

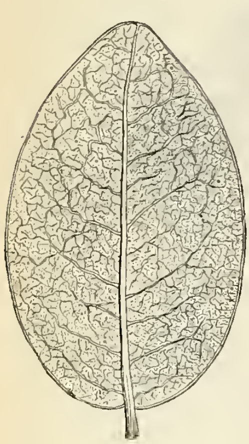
Nat. Ord.—Monimiaceæ.

Origin.—Boldo- or boldu-leaves are derived from a tall evergreen diœcious shrub which is a native of Chili, and is there frequently cultivated in gardens. It has lax cymes of sweet-scented, apetalous, greenish-yellow flowers, the pistillate ones producing about three yellowish drupes of the size of a pea and containing a single albuminous seed. The bark is used in tanning and the wood is esteemed for charcoal-making.

Description.—The leaves are opposite, on short petioles, coriaceous, about 2 inches (5 Cm.) long, broadly oval or oval-oblong, very obtuse at the apex, entire or somewhat undulate on the margin, rough on both sides, glossy above and pale and hairy beneath. The dried leaves are often reddish-brown, and have a fragrant odor and a refreshing aromatic pungent taste.

Constituents.—Claude Verne (1875) obtained from the leaves 2 per cent. of volatile oil, which after rectification is yellow, colored hyacinth-red by sulphuric acid, violet by nitric acid, red by potassa, and is decolorized by hydrochloric acid; it is freely soluble in alcohol, commences to boil at 185° C. (365° F.), and contains no aldehyd. Boldo-leaves also contain about $\frac{1}{10}$ per cent. of the alkaloid *boldine*, discovered by Bourgoin and Verne (1873); it is best extracted with acetic acid, imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, benzol, and caustic alkalies, and is colored red by nitric and sulphuric acids. Besides some tannin and aromatic resinous compounds the other constituents do not possess any medicinal importance.

Fig. 41.



Boldo-leaf, natural size.

Pharmaceutical Uses.—Verne has proposed a *tincture of boldo*, made with 20 parts of the leaves and 100 parts of 60 per cent. alcohol; *wine of boldo*, made with 3 parts of the leaves and 100 of Madeira wine; an *aqueous* and an *alcoholic extract of boldo*, the latter prepared by evaporating the tincture.

Allied Plants.—Atherosperma moschata, *Labillardière*, an Australian tree, known there as *sassafras tree*, has in all parts an odor resembling somewhat that of nutmeg; the bark, which is used as an antiscorbutic and tonic, contains tannin and the bitter alkaloid *atherospermine*, which is a white amorphous powder readily soluble in alcohol and chloroform, but dissolving sparingly in ether; its colorless solution in sulphuric acid becomes green with potassium chromate (Zeyer, 1861). The allied South American genera, Citrosma and Laurellia, are highly aromatic. The bark of these trees is used for tanning.

Physiological Action.—Like all plants which contain an essential oil, boldo in moderate doses is an active stimulant of the nervous and circulatory systems. In the experiments which have been made with it some of the effects produced are referable to the alcoholic vehicle. Thus, when it is said that 15 grains of the extract, dissolved in 14 Ccm. of alcohol, were injected into a dog and the dose renewed at the end of an hour, when the animal could not stand on his legs and was sleepy, and his temperature had fallen a degree or two, it is evident that of these effects the greater part were due to the alcohol. The judgment is not essentially different when 30 grains of alcoholic extract of boldo were injected dissolved in 8 Ccm. of alcohol. It is confirmed when we find that among the symptoms following the administration of the volatile oil to a large dog not one refers to the nervous system, but chiefly to the urine, which acquired a strong smell; to the stomach, which was disturbed by vomiting; and to the bowels, which were affected with diarrhœa. In man even the tincture is represented not to have produced cerebral or spinal phenomena, but only a glow in the mouth, fauces, and stomach, and some quickening of the pulse; and the oil, in the dose of 30 or 40 Cg., in capsules, caused some burning at the epigastrium, nausea, and eructation, which, as well as the smell of the urine, lasted for not less than 12 hours. In still larger doses only a higher degree occurred of the same phenomena, with the addition of diarrhœa. It is therefore an error to say, as has been done, that oil of boldo is a diffusible stimulant, resembling oil of turpentine in its action. Experiments upon himself by Verne (1882) showed that boldo affects neither the circulation, the temperature, nor the secretion of urine, but that it augments the discharge of urea (*Bull. de thér.*, cii. 286).

Medical Uses.—Boldo has been recommended, in alcoholic or vinous solution, for *anæmia*, *dyspepsia*, and *general debility*, and the oil has been proposed for the relief of *catarrh*, especially of the urino-genital organs. The tincture has been prescribed in doses of 5 to 15 drops (Gm. 0.30–1.00). It does not appear to have commended itself to general use.

ATHEROSPERMIA MOSCHATA. According to Graves (*Lancet*, Feb. 1, 1862, p. 134), under the name of "native sassafras" it has long been used by the early settlers and Bushmen of Australia for making a sort of diet-drink in *rheumatic* and secondary *syphilitic* affections. He used it in his own person in *chronic bronchitis*, and in less than 24 hours his pulse fell from 120 to 80, and the expectoration from being excessive and difficult became moderate and easy. Other physicians employed it with equal advantage, and subsequently administered the oil in drop-doses as a sedative of excessive and irregular action of the heart. A decoction made with an ounce of the bark to a pint of water and boiled for 10 or 15 minutes was administered every 3 or 4 hours in doses of an ounce or two.

BOLUS.—Bole.

Bol, Fr.; *Bolus*, G.

Description.—This term is applied to certain native silicates of aluminium, which are soft and unctuous to the touch, readily adhere to the moist tongue, and are easily scraped with the knife; they break with a conchoidal fracture, are insoluble in water, with which they gradually form a pasty mass, do not effervesce with acids, and for medicinal use are powdered and elutriated with water. They contain alumina and silica in the approximate proportion of 3 to 5. According to color they have been distinguished as—

Bolus alba, *P. G.*, known also as *Argilla* and *terra alba;* it is of a white color, and contains small quantities of magnesia and traces of iron.

Bolus armena, s. rubra, Argilla ferruginea, or *Armenian bole*, was formerly brought from Armenia, but is at present obtained in different parts of Europe. Its brown-red color is due to the presence of a considerable proportion of ferric oxide. *Terra lemnia*, formerly employed, differed from it merely in being of a yellowish color and containing less iron. After having been formed into flattish circular pieces and impressed with a seal these boles constituted the *terræ sigillatæ* which were formerly in high repute.

Creta rubra, Rubrica fabrilis, *red chalk* or *reddle*, is firmer than the preceding, contains more iron, and is used for marking on wood and stone.

Medical Action and Uses.—Bole was very generally used in Greek and Roman medicine, and in Europe until a quite recent date, in numberless cases requiring astringent and absorbent medicines. Of internal affections for which it was employed may be mentioned *menorrhagia*, *hæmoptysis*, *chronic bronchitis*, *diarrhœa*, and *dysentery*. Topically, it was applied in *leucorrhœa*, *prolapsus ani*, *sore nipples*, *aphthæ*, *intertrigo*, *burns*, *ulcers*, *erysipelas*, etc. The small proportion of iron contained in it may have increased its efficacy. *Dose*, 5 to 10 grains (Gm. 0.30–0.60).

BORAGO.—Borage.

Bourrache, Fr.; *Borasch*, *Boretsch*, G.

Borago officinalis, *Linné.*

Nat. Ord.—Boraginaceæ.

Description.—Borage is an erect hispid annual indigenous to the Levant, but naturalized in Southern and Middle Europe and frequently cultivated in gardens. It has a white fleshy root and an erect branching stem 1 or 2 feet (.3–.6 M.) high. The leaves are oval or obovate, alternate—the lower ones petiolate, entire, or wavy on the margin, the upper side and the veins beneath with stiff hairs. The flowers are in terminal racemes with ovate bracts, have a five-parted calyx, and a sky-blue or reddish corolla, which is rotate, closed in the throat by five emarginate appendages, and has five stamens. The fruit consists of four brownish-black ovate roughish nutlets, which are excavated at the base. The fresh plant has a slight cucumber-like odor and a saline taste. The herb is used as a salad and occasionally employed in medicine; the root and flowers have likewise been used.

Constituents.—Borage has been analyzed by Lampadius and Braconnot, who found considerable mucilage, a little resin, and potassium and calcium combined with organic and mineral acids. Braconnot obtained from the inspissated juice 30 per cent. of salts; Waltl (1829) from the dry herb 2 to 3 per cent. of potassium nitrate.

Allied Plants.—Cynoglossum officinale, *Linné.*—Hound's tongue, *E.;* Langue de chien, *Fr.;* Hundszunge, *G.*—A biennial European plant naturalized in North America. The stem is 2 feet (.6 M.) high; the leaves are hairy, elliptic, and petiolate, the upper ones lanceolate, sessile, and somewhat clasping; the flowers are brownish-red and have a short, white tube; the ovate nutlets are covered with short, hooked prickles. The fresh plant has a disagreeable odor; the taste is mucilaginous and slightly bitter.

Pulmonaria officinalis, *Linné.*—Lungwort, *E.;* Pulmonaire, *Fr.;* Lungenkraut, *G.*—A perennial European plant with a simple hairy stem and rough hairy entire leaves, often marked with white spots, and with reddish or purple nodding flowers. The radical leaves are ovate-cordate, pointed, and petiolate; the stem-leaves are spatulate or ovate, the upper ones sessile. The herb is inodorous, and has a mucilaginous somewhat astringent taste.

Mertensia (Pulmonaria, *Linné*) virginica, *De Candolle.*—Virginia lungwort, Cowslip, *E.*—It grows from New York westward, and southward to Texas, is a smooth herb 1 or 2 feet (.3 or .6 M.) high, and has obovate-oblong or elliptical sessile leaves, the lower ones narrowed into a petiole, and corymbose racemes of flowers, with a purple-blue or white corolla about an inch (25 Mm.) in length and four times as long as the calyx.

Echium vulgare, *Linné.*—Viper's bugloss, Blueweed, *E.:* Vipérine, *Fr.;* Natterkopf, *G.*—It is a common European perennial, and is naturalized in North America. It is rough-hairy, about 2 feet (.6 M.) high, and has linear-lanceolate leaves and showy blue flowers in axillary clusters, forming an elongated terminal raceme. It has very little odor and a mucilaginous taste. Both the herb and the long, nearly simple, brown, and internally white fleshy root have been employed.

Medical Action and Uses.—The virtues of borage, which are chiefly those of an emollient and protective, it owes to the mucilage it contains, while its saline elements render it somewhat diuretic when its infusion is freely used. In France especially it is much employed in acute *febrile* affections and in *pulmonary catarrhs.* The infusion is made with from 1 to 3 drachms (Gm. 4–12) in a pint of water. A decoction made from the whole plant and a fomentation prepared with the flowers are used in local inflammations.

Cynoglossum in a fresh state gives off an exhalation which has produced acro-narcotic effects, and the leaves are a popular remedy for superficial *burns, bruises, abrasions*, etc., and for glandular and other local swellings. *Pulmonaria* is a lenitive and expectorant, and its dried leaves are somewhat astringent. It is extensively used in France as an ingredient of tisanes for coughs in various pulmonary affections. Its name is, indeed, derived from such uses of the plant. *Mertensia* has similar properties, and *Echium vulgare* is, at the same time, diuretic by means of its potassium and other salts.

BRAYERA, *U. S.*—BRAYERA.

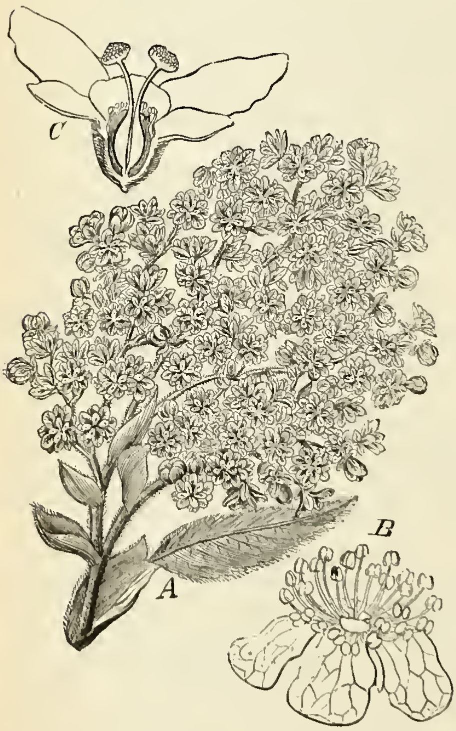
Kooso, Cusso, Br.; *Flores koso*, P. G.—*Kousso, Kusso*, E.; *Cousso, Kousso*, Fr.; *Koso, Kusso, Cusso*, G.

The female inflorescence (flowers and tops, *Br.*) of Brayera anthelmintica, *Kunth*, s. Banksia abyssinica, *Bruce*, s. Hagenia abyssinica, *Willdenow.* Bentley and Trimen, *Med. Plants*, 102.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—This is a handsome tree, attaining a height of 40 to 60 feet (12 to 18 M.); it produces an abundance of large oddly pinnate leaves, at the base with a sheath formed by the large adnate stipules; the inflorescence is abundant, axillary, unisexual, and paniculate. The tree, which flowers in October and November, is indigenous to the table-land and mountainous districts of Abyssinia, and is generally planted near towns and villages.

Fig. 42.



Brayera anthelmintica, *Kunth: A*, lowest branch of panicle, ⅔ size; *B*, staminate flower: *C*, section of pistillate flower; magn. 4 diameters.

Description.—The panicles are about 12 inches (30 Cm.) long, much branched; axis and branches zigzag, hairy, and glandular, each branch supported by a ciliate sheathing bract; flowers very numerous, ¼ to ⅓ inch (6 to 8 Mm.) broad, each with two large roundish membranous-veined bracts at the base, which are green in the staminate flowers, but become purplish-red in the pistillate flowers; calyx shortly stalked, top-shaped, hairy, and with ten membranous and veined segments arranged in two alternating whorls. The sepals of the outer whorl of the male flowers are greenish-yellow, small, and nearly linear; but in the female flowers they are finally about ⅖ inch (10 Mm.) long, and much larger than the inner row of sepals, and when fully developed are obovate and of a red color. The five linear petals are inconspicuous and much shorter than the inner sepals, with which they alternate. Stamens between fifteen and thirty, very small and shrivelled in the female flowers, equalling the petals in the male flowers, inserted in the contracted throat of the calyx. Carpels two, or occasionally three, distinct, enclosed in the calyx-tube; styles projecting from the tube; fruit a small membranous akene, pointed by the persistent short base of the style, and containing a straight fleshy embryo with two plano-convex cotyledons.

The female inflorescence being most frequently collected, the commercial article should have a pale brownish-red hue, and is often distinguished as *red kousso.* It is collected before the fruit has ripened, and either the entire inflorescence is dried loosely, or before quite dry a number of panicles are formed into cylindrical rolls, measuring about 10 to 20 inches (25 to 50 Cm.) in length, weighing about 4 to 8 ounces (120 to 240 Gm.), and tied by split culms of Cyperus articulatus; the loose panicles are usually much broken. The male inflorescence has in the dry state a light greenish-brown color, and is sometimes known as *kousso-esels*. The odor of both varieties is not strong, but pleasant and tea-like; the taste is gradually developed, mucilaginous, bitterish, acrid, and disagreeable.

The drug reaches commerce mostly by way of Aden and Bombay, or partly through Egypt to Southern Europe. It should be kept in a dark and dry place. "For medicinal use the drug should be freed from the stalks."—*P. G.*

Constituents.—According to Wittstein (1840), kousso contains as principal constituents 6.25 per cent. of a bitter acrid resin and 24.4 per cent. of tannin, consisting of two kinds; he also obtained 15.71 per cent. of ashes and some tasteless resin, besides the common constituents, chlorophyll, wax, sugar, and gum. The acrid resin appears to be the medicinally active principle, and has been variously called *brayerin*, *kwosein*, *koussin*, and *kosin*. As prepared by Dr. C. Bedall (1872) by Pavesi's process, it was found to be an efficient tænifuge. Kousso is repeatedly treated with alcohol to which slaked lime has been added; the residue is boiled with water, the different liquids mixed, filtered, and distilled, and the remaining liquid treated with acetic acid, which separates about 3 per cent. of koussin as a white flocculent precipitate, becoming denser and resin-like, and on drying yellowish or at a higher temperature brown; in larger quantities it has a peculiar odor of Russian leather, a persistent bitter and acrid taste, and is of a distinct crystalline appearance when viewed under the microscope. Dr. E. Merck has subsequently further purified it, probably by crystallizing it from boiling alcohol. Flückiger and E. Bury (1874) describe it as forming yellow rhombic crystals, which are readily soluble in benzol, bisulphide of carbon, chloroform, and ether, less freely in glacial acetic acid, sparingly in cold alcohol, and are insoluble in water; alkalies dissolve it readily, and acids precipitate it again; it fuses at 142° C. (287.6° F.), and congeals to a transparent yellow mass, which when touched with a trace of alcohol is converted into stellate tufts of crystals; its composition is $C_{31}H_{38}O_{10}$, and it is probably an ether of isobutyric acid. Prof. Buchheim found this *pure kosin* to be very inferior in its anthelmintic action.

By distillation with water, kousso yields traces of valerianic and acetic acids and a little solid volatile oil having the odor of the drug.

Off Prep.—Extract. brayeræ fluid., Infus. brayeræ (cusso, *Br.*), *U. S.*

Medical Action and Uses.—Kousso has been employed from time immemorial in Abyssinia for the expulsion of tape-worms, which there prevail extensively. But it is stated by Johnson that the operation of it is so severe that it often produces miscarriages, and even death, in pregnant women. In Europe it is said sometimes to have occasioned severe colic, but generally its operation is not distressing, and consists only of slight nausea, followed by feculent and then by liquid stools. According to Arena, these differences depend upon an alteration which the resin undergoes by time. Of all the remedies for tape-worm (Tænia solium, T. bothriocephalus) none is more efficient or certain, provided that the flowers are fresh, but they deteriorate rapidly. The parasite is generally discharged dead.

The Abyssinian mode of using it is thus described: An infusion is made with water or beer, or the flowers are mixed with honey to the amount of from 4 to 6 drachms (Gm. 16–24), and the whole is taken in the morning, fasting, and no food is eaten during the day. Generally, the worm is discharged in the course of 24 hours without purging, pain, or colic. This description by Aubert and by Engleman contradicts the one given above. In Europe and in this country an infusion is prepared with 2 drachms (Gm. 8) of the powdered drug in 4 fluidounces (Gm. 128) of boiling water, which, when cold, is drunk without having been strained. Kraus recommends 25 Gm. (ʒvi) in lemonade on an empty stomach, and followed an hour later by castor oil. As its taste and smell are disagreeable, resembling somewhat those of senna tea, it has been proposed to administer the powder in granules made with sugar and swallowed with some aromatic infusion. The following mode of preparing the dose has been recommended: Treat by displacement ½ ounce of kousso in powder with 6 drachms of boiling castor oil and 1½ ounces of boiling water. Express the liquid, and make an emulsion with it and the yelk of egg; add 40 drops of sulphuric ether, sweeten, and flavor with oil of anise. This emulsion should be taken, fasting, at one dose. In all cases the patient should fast the day before using the medicine.

BROMAL.—Bromal Hydrate.

Hydrate de bromal, F.; *Bromalhydrat*, G.
Formula $C_2HBr_3O.H_2O$. Molecular weight 298.4.

Preparation.—Bromal was discovered by Löwig (1832), and is obtained by leaving 1 part of ether or absolute alcohol and 3 parts of bromine in contact for several days, and distilling off about three-fourths, the distillate consisting of hydrobromic acid and various brominated compounds; the residue, dissolved in water, yields crystals of bromal hydrate, which require purification with sulphuric acid, rectification over lime, and recombination with water. Schäffer (1871) obtained better results, and with less bromine, by passing the latter in the gaseous state into alcohol, distilling, and collecting the portion coming over between 165° and 180° C. (329° and 356° F.), consisting chiefly of bromal and *bromoform*, which are separated by fractional distillation, the latter boiling at 152° C. (305.6° F.).

Properties.—Bromal is a colorless oily liquid boiling at about 172° C. (342° F.) and remaining liquid at $-20°$ C. ($-4°$ F.); it has a peculiar penetrating odor and a pungent burning taste; its vapors are irritating to the eyes. On exposure to a moist atmosphere it is converted into a white crystalline mass of *bromal hydrate*, which is obtained in larger transparent crystals from its solution in water; the hydrate has the odor and taste of bromal, fuses at 53.5° C. (128.3° F.), and when distilled is decomposed into water and bromal. The *alcoholate* fuses at 44° C. (111.2° F.), is slightly soluble in water, and decomposes by heat. Solution of potassa or soda decomposes bromal and its hydrate, forming formiate and bromoform, the latter having a sweet taste and an agreeable aromatic odor.

Tests for Purity.—A mixture of bromal hydrate and strong sulphuric acid separates oily bromal, but is not colored brown. The solution of bromal hydrate in distilled water is clear, and yields no precipitate with nitrate of silver.

Physiological Action and Medical Uses.—Bromal hydrate is a powerful and almost caustic irritant; applied to the skin in an ointment, it occasions redness and swelling, with subcutaneous infiltration, and therefore should not be used hypodermically. Unless greatly diluted it cannot be taken internally, and even then it soon gives rise to burning in the throat, vomiting, and diarrhœa. It has been tried in *epilepsy* ineffectually, and there is no reason why it should be used at all as a medicine.

BROMINII CHLORIDUM.—Chloride of Bromine.

Chlorure de brôme, Fr.; *Chlorbrom*, G.

Preparation.—According to Balard, chlorine gas is conducted into bromine, and the vapors given off are condensed by the aid of a refrigerating mixture.

Properties.—It is a reddish-yellow, thin, and very volatile liquid, which is soluble in water and yields a hydrate fusible at 7° C. (44.6° F.). On treating the solution with potassa, chloride and bromate of potassium are formed; its composition is probably $BrCl_5$.

Physiological Action and Surgical Uses.—This powerful caustic has been chiefly known as the principal ingredient of Landolfi's paste, which about 1854 attracted considerable attention, in Germany especially, for the treatment of *cancer* and other recurrent growths. The man and his method were subjected to a critical examination, with the result of condemning the former as a charlatan and the latter as more mischievous than useful.

BROMUM, *U. S., Br., P. G.*—Bromine.

Brominium, U. S. 1870.—*Brôme*, Fr.; *Brom*, G.
Symbol Br. Atomicity univalent. Atomic weight 79.8.

A liquid non-metallic element obtained from sea-water and from some saline springs.

Origin and Preparation.—Bromine was discovered by Balard (1826) in the mother-liquor obtained in the preparation of common salt from the water of the Mediterranean; he also investigated its chemical properties, and proved its close analogy to chlorine and iodine. Bromine does not exist in the free state, but is found widely distributed in nature, the bromides usually accompanying chlorides. It is more particularly found in sea-water, in the waters of Kreuznach, Kissingen, and other mineral springs, but is now obtained in considerable quantities from the mother-liquors of many salt-works in the United States and at Stassfurth, Germany. These mother-liquors, which have been freed by crystallization as much as possible from other salts, chlorides and sulphates, contain the bromine, usually in combination with magnesium or calcium. These compounds are decomposed either by heating their solution with black oxide of manganese and hydrochloric acid, or by warming it to between 45° and 50° C. (113° and 122° F.) while chlorine gas is being passed into it; the bromides are at once decomposed; $MgBr_2 + Cl_2$ forms $MgCl_2 + Br_2$. The bromine volatilizes, and is condensed under a small quantity of water, which is contained in a deep Woulf's bottle kept cool by water, while that portion of bromine which escapes condensation is conducted into a solution of caustic potassa contained in an open bottle; this solution, when it has nearly lost its alkaline reaction, is subsequently utilized for the preparation of potassium bromide. The mother-liquors, as obtained in Western Pennsylvania and West Virginia, yield about ½ per cent. of bromine, or the brine about 1 pound of bromine to 13 bushels of salt. The production of the Ohio and Kanawha valleys amounts to about 130,000 pounds of bromine annually, in addition to which from 800 to 1000 pounds are manufactured in Pennsylvania (S. S. Garrigues, 1873). According to Wellcome (1877), about 1000 pounds are daily manufactured in the United States.; W. J. M. Gordon (1883) gives the annual production in this country at between 450,000 and 500,000 pounds.

Properties.—It is a brownish-red mobile and very volatile liquid, exhaling at the ordinary temperature deep orange-red vapors, which are highly irritating to the eyes and lungs, and on being conducted into a flame impart to it a green color. Its odor, which is suggestive of chlorine and iodine, is suffocating and disagreeable, hence its name (from *βρῶμος*, a stench). It boils at 63° C. (145.4° F.) (Pierre); Balard and others gave the boiling-point as low as 47° C. (117° F.). At 15° C. (59° F.) its specific gravity is 2.99, and at the freezing-point of water 3.187. It congeals at about — 25° C. (— 12° F.), at the same time increasing its volume about 6 per cent. It destroys cork, wood, etc., bleaches litmus and other coloring principles, and alters or destroys most odorous organic compounds. It dissolves in 33 parts of water at 15° C. (59° F.), and in less of alcohol and ether; the brown-red, or if diluted brown-yellow, solutions are bleached rapidly in the sunlight, hydrobromic acid being formed. Bromide of potassium increases the solubility of bromine in water. Carbon disulphide, benzol, and chloroform dissolve bromine freely with an orange-red color, and, like ether, take it up from the aqueous solution on being agitated with the latter. When in contact with water at a low temperature, bromine forms a deep-red hydrate, $Br_2.10H_2O$, crystallizing in octahedrons or in scales, which at 15° C. (59° F.) are decomposed into bromine and water. Bromine and its solutions color starch-paste brown-yellow.

Impurities.—Iodine does not now often form an impurity of bromine, but chlorine is frequently present, and causes a lowering of the boiling-point. Bromide of carbon is occasionally present in crude bromine, and may be removed by careful rectification, its boiling-boint being considerably higher than that of bromine.

Tests.—Bromine should completely volatilize by exposure to air or to heat (absence of salts, etc.). "If 3 Gm. of bromine be mixed with 30 Ccm. of water, and enough water of ammonia to render the solution colorless, the liquid then digested with carbonate of barium, filtered, evaporated to dryness, and the residue gently ignited, the latter should be soluble in absolute alcohol without leaving more than 0.26 Gm. of residue (absence of more than 3 per cent. of chlorine). If an aqueous solution of bromine be poured upon reduced iron and shaken with the latter until it has become nearly colorless, then filtered, mixed with gelatinized starch, and a few drops of bromine solution be now carefully poured on top, not more than a very faint blue zone should appear at the line of contact of the two liquids (limit of iodine)."—*U. S.* If an aqueous solution of bromine be agitated with an excess of powdered iron, the greenish liquid on the addition of a little ferric chloride and chloroform should not impart a violet color to the latter (absence of iodine).—*P. G.*

Pharmaceutical Uses.—In the manufacture of most of the medicinal bromine compounds free bromine is or may be employed; it is directed for Ammonii bromidum and Potassii bromidum, *Br.*

Bromine blocks for disinfecting purposes have been recommended by Frank (1882), and consist of a porous mass formed by incinerating a mixture of diatomaceous earth with crude tartar or with calcium saccharate; cut into cubes of 45 Ccm., these weigh about 30 Gm. and absorb 100 Gm. of bromine, which is very gradually given off on exposure.

Physiological Action.—When dogs are confined in an atmosphere of bromine vapor they suffer a profuse secretion from the eyes, nostrils, and fauces, with cough, hoarseness, and dyspnœa. It is a corrosive irritant of the stomach, producing vomiting, pain, diarrhœa, and death by exhaustion. On dissection the mucous membrane of the stomach and bowels is found softened. Applied to the shaven hide, bromine acts as a caustic and produces gangrenous sores. As it is extremely volatile, care must be taken not to allow its vapors to reach the eyes, nostrils, or mouth.

Medical Uses.—Formerly, bromine was employed in the class of cases in which the use of iodine has become general—viz. glandular and other forms of *scrofula*, chronic diseases of the *skin*, constitutional *syphilis*, chronic enlargement of the internal *lymphatic* and *mesenteric glands*, the *liver*, *spleen*, *ovaries*, *uterus*, etc.—but in all of these uses it has been superseded by iodine. During the Civil War of the United States it was extensively used in the treatment of *hospital gangrene*, according to the method of Dr. Goldsmith, which consisted essentially of cleansing the wound as far as possible of gangrenous tissue, and then applying pure bromine by means of a cotton or lint swab attached to a long wooden handle. Lint moistened with a weak solution of bromine in water was then laid on, covered with oiled silk or other impermeable tissue, and secured with a bandage. After a few hours a poultice was substituted, under which the eschar separated, leaving a healthy wound. The operation was severe, and the patient while undergoing it was etherized. *Cancer* of different forms and of various external organs has been treated by tissue injections of a strong solution of bromine in alcohol, 1 part to 3; but owing either to its inefficiency or its painfulness the method does not appear to have been generally adopted. A weaker solution (1 part in 8) has been used with some advantage as a local application to the skin for the purpose of allaying *pain*.

Recently the topical use of bromine has been revived in the treatment of *diphtheria*. Hiller claims almost uniform success from pencilling the affected parts of the fauces with a solution of equal parts of bromine and bromide of potassium (Gm. 0.5–0.10 = gr. 8–12) in Gm. 200 = f℥vi of water. He also employs inhalations of bromine from a solution of 10 grains each of the two agents in from 10 to 15 ounces of water (*Centralblatt f. d. ges. Therap.*, i. 341).

BRYONIA, *U. S.*—BRYONIA.

Bryony, E.; *Couleuvrée*, F.; *Zaunrübe*, *Gichtrübe*, G.

The root of Bryonia alba, *Linné*, and Br. dioica, *Linné*.

Nat. Ord.—Cucurbitaceæ.

Origin.—Both plants are climbing monœcious and diœcious perennials and indigenous to Europe, Br. alba being more frequent in the northern, and Br. dioica in the southern section of that continent. They have rough, cordate, five-lobed, and toothed alternate leaves, and cymes of four to six small greenish-yellow flowers. Br. alba has black, Br. dioica red, globular berries, which are ¼ inch (6 Mm.) in diameter; hence the names *black* and *red bryony*. The root is collected in spring, and on drying loses from 85 to 88 per cent. in weight.

Description.—The roots are 18 inches to 2 feet (45 to 60 Cm.) long and 2 to 4 inches (5 to 10 Cm.) thick, nearly simple, in the fresh state fleshy and somewhat lactescent. Both are externally pale grayish-brown, transversely wrinkled, the root of Br. alba with numerous transversely elongated suberous warts or ridges. Internally they are white, have a thin bark, a brown cambium line, broad medullary rays, and numerous small narrow wood-bundles arranged between the medullary rays in radiating lines, and concentrically in circles separated by rather broad circles of parenchyma. This latter tissue shrinks considerably in drying, and, the root being usually dried in transverse slices, these show an irregular radiating and concentric arrangement from the projecting wood-rays. Dried bryony-root is inodorous and has a disagreeable bitter taste.

Constituents.—The bitter principle *bryonin* appears to have been first obtained pure by Walz (1859), though Schwerdtfeger had previously separated pearly crystals of a bitter and acrid taste, which, however, contained nitrogen. The aqueous solution of the alcoholic extract is precipitated by subacetate of lead, the filtrate treated with sulphuretted hydrogen, neutralized with soda, and precipitated by tannin; this precipitate is dissolved in alcohol, the solution treated with lime, the filtrate decolorized with animal charcoal, evaporated, and washed with ether. Bryonin forms a white powder having the composition $C_{48}H_{80}O_{19}$, of an intensely bitter taste, insoluble in ether and soluble in water and alcohol. When boiled with dilute sulphuric acid, bryonin is split into glucose and amorphous *bryoretin* and *hydrobryoretin*, the former of which is soluble, and the latter insoluble in ether. Bryony-root contains also starch, gum, sugar, albumen, waxy and fatty matter, malates and other salts.

Off. Prep.—Tincture bryoniæ, *U. S.*

Allied Plants.—Bryonia americana, *Lamarck*, and Br. africana, *Thunberg*, are employed in their native countries like European bryony. The former species is indigenous to the West Indies, the latter to Southern Africa.

Br. epigæa, *Rottl.*, of India has a mucilaginous and slightly bitter root, which is used by the natives as an alterative in syphilis and as a remedy in snake-bites.

Tayuya-root of Brazil, which has been recently recommended as a remedy for syphilis and scrofula, is said to come from a species of Bryonia.

Physiological Action.—The powder, introduced into a wound in a dog's leg, caused the animal's death in 24 hours, with symptoms of great depression, the wound suppurating. Conveyed into the stomach of a similar animal and the œsophagus being tied, death occurred after about the same interval, and the mucous membrane of the stomach and rectum was found inflamed. The fresh plant applied to the skin produces vesication. Taken accidentally by man, it has occasioned profuse watery stools, violent colic and vomiting, collapse, and death.

Medical Uses.—In the Hippocratic writings bryonia-root prepared with wine was recommended for tetanus, prolapsus of the rectum, and uterine ulcers. Dioscorides in addition speaks of the young sprouts as purgative and diuretic, and of the root applied in poultices, etc. for the cure of various cutaneous eruptions, abscesses, etc. One species, the black, was especially recommended in affections of the spleen and kidneys and as a remedy for epilepsy. Later ancient writers speak of it as an emmenagogue and abortifacient and as a remedy for the bites of venomous animals and insects. In modern medicine it has been principally employed as a hydragogue cathartic in *dropsy* in the same manner as jalap. In certain cases of *epilepsy* depending upon intestinal worms it has effected a cure. It has been used in chronic intermittent fever with enlargement of the *spleen*, and in chronic *bronchitis* with serous effusion in the air-tubes. It has also been recommended in the catarrhal stage of *whooping cough*. Externally, it has been employed as a rubefacient or vesicant in cases of *hydrarthrosis*, chronic articular and muscular *rheumatism*, and *glandular* engorgements. Slices of the fresh root have been applied behind the ears of children as a substitute for suppressed eruptions during dentition, and the juice has been used topically in *scabies*.

The *dose* of the powder is from 10 to 60 grains (Gm. 0.60–4.00). An infusion made with 2 drachms of the root in 8 fluidounces of water may be prescribed in doses of 2 fluidounces.

Tayuya-root has been sufficiently tested in Europe to prove that it is a very feeble remedy for *syphilis* and *scrofula*. In a few cases only did it seem to be useful in superficial and glandular forms of either disease, and then only when reinforced by other medicines or a severe regimen.

BUCHU, *U. S.*—Buchu-Leaves.

Buchu folia, Br.; *Folia bucco*, *Folia diosmæ*, *s. barosmæ.*—*Feuilles de bucco* (*booko*, *buchu*), Fr.; *Buckublätter*, *Buccoblätter*, G.

The leaves of—1. Barosma betulina, *Bartling;* 2. Barosma crenulata, *Hooker;* 3. Barosma serratifolia, *Willdenow*, s. Diosma serratifolia, *Curtis.* Bentley and Trimen, *Med. Plants*, plates 45, 46, 48.

Nat. Ord.—Rutaceæ.

Origin.—The three plants are shrubs attaining a height of several feet; the short-stalked or nearly sessile leaves are opposite or subalternate; the flowers, which are handsome, have the calyx deeply five-lobed; the five petals white or pinkish, longer than the calyx, and glandular punctate on the back, and the five hypogynous stamens alternating with the petals. The fruit consists of five carpels, which are united by the inner margin, are dehiscent above by their ventral suture, and contain each one smooth, glossy, and black seed. The shrubs are indigenous to the southern portion of Africa, more particularly to various parts of Cape Colony.

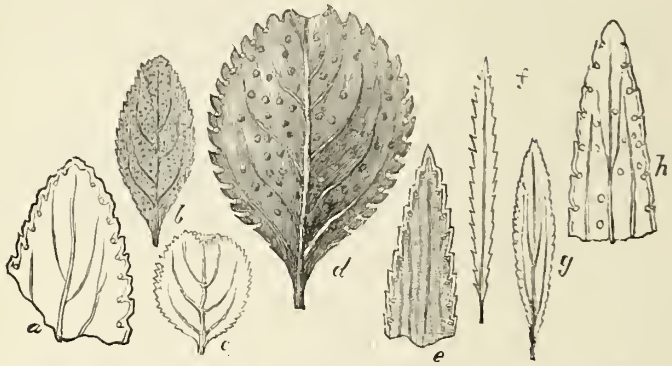
Much uncertainty has prevailed in relation to the diagnosis of the two first-named species, due to the great variation of the leaves. At the present time the following synonyms appear to be generally admitted:

1. Barosma betulina, *Bartl.;* Diosma betulina, *Thunb.;* D. crenata, *D. C.*, *Lindl.*, and

others; 2. B. crenulata, *Hook.*; B. crenata, *Kunze*; D. crenata, *Lin.*; D. crenulata, *Lin.*; D. odorata, *D. C.*; D. latifolia, *Lodd.*

Description.—The leaves of the first species constitute most of the so-called *short buchu* of the market; they are ½ to ¾ of an inch (12 to 19 Mm.) long, obovate or rhomboid-obovate, cuneate below, usually obtuse, and with the apex recurved; margin sharply serrate, each serrature containing a gland; base almost entire; texture cartilaginous.

Fig. 43.



Buchu-leaves: *a*, *b*, Barosma crenata, *Kze.*; *c*, *d*, Bar. betulina, *Bartl.*; *g*, *h*, Bar. serratifolia, *Willd.*; *e*, *f*, Empleurum serrulatum, *Ait.*—*b*, *c*, *f*, *g*, natural size.

The second species likewise contributes to the short buchu, the larger leaves being occasionally held as an *intermediate* variety between the short and the long. The leaves vary between ¾ and 1¼ inches (19 and 31 Mm.) in length, and between oval and ovate or obovate in shape, obtuse above, margin serrulate or crenate, each crenature with a gland.

The leaves of the third species differ materially in shape from the preceding: they constitute the *long buchu* of our commerce, are rather thinner than the two preceding kinds, 1 to 1½ inches (25 to 38 Mm.) long, linear-lanceolate in outline, tapering toward both ends, obtuse, margin serrulate, with a gland in each serrature, midrib prominent, with four lateral veins running nearly parallel to the margin.

Buchu-leaves are smooth, have a dull-green color, are paler on the lower surface; and have numerous large oil-cells, which render the leaves pellucid-punctate when held up to the light; they have a strong peculiar odor and a bitterish and aromatic taste. Prof. Flückiger (1873) has observed a layer of colorless cells between the epidermis of the upper side and the green tissue, which cells yield a large quantity of mucilage to water.

The leaves of Barosma Eckloniana, *Berg*, seem to be occasionally imported; they are nearly an inch long, oval, rounded at the base, strongly crenate, and grow from pubescent shoots (*Pharmacographia*).

Constituents.—The leaves of the first species yield from ½ per cent. (Flückiger, 1880) to 1.21 (Bedford, 1863) or 1.63 (Flückiger and Hanbury, 1874) per cent., those of the third species 0.66 per cent., of volatile oil (Bedford). The two oils agree with each other in sensible properties, and probably also in composition. In odor they resemble peppermint; exposed to a low temperature, they separate *barosma camphor* or *diosphenol*, a stearopten which, after recrystallization from alcohol, is in colorless needles which fuse at 83° C. (181.4° F.), sublime at the heat of a steam-bath, and boil at 233° C. (451.4° F.), but cannot be distilled without partial decomposition. Pure diosphenol has a slightly aromatic odor and a peculiar taste; its composition is $C_{14}H_{22}O_3$. Its alcoholic solution is colored dingy black-green by ferric chloride; its solution in alkalies is precipitated by carbonic acid. It is probably this camphor which was described by Landerer (1844) as *diosmin*, and observed in a tincture of buchu three years old. The diosmin of Brandes was an extract-like body of a bitterish taste. Prof. Wayne (1876) obtained salicylic acid from the distillate of a lot of buchu-leaves; recent investigations having failed to detect this acid, its presence may probably be accounted for by an accidental admixture of the leaves. Buchu-leaves possibly contain a body similar to rutin (Flückiger). Besides the constituents mentioned, resinous, gummy, albuminous, and coloring matters and saline compounds have been observed. B. crenulata yields 4 to 5.4 per cent. of ash; B. betulina, 4.4 to 4.7 per cent.; and B. serratifolia, 5 to 5.5 per cent, (H. W. Jones, 1879).

Impurities and Substitutions.—The short buchu is sometimes mixed with the flowers and the non-aromatic capsules, which must be separated. The long buchu is usually cleaner, but is occasionally mixed with or replaced by the leaves of Empleurum serrulatum, *Aiton*, nat. ord. Rutaceæ, indigenous to Southern Africa; they are 1 to 3 inches (25 to 75 Mm.) long, have a narrow linear shape, a serrulate margin, and an acute glandless apex; their odor is different from buchu. From other leaves buchu is readily distinguished by the characters given above.

Off. Prep.—Extr. buchu fluid., *U. S.;* Infusum buchu, Tinct. buchu, *Br.*

Physiological Action and Medical Uses.—Buchu excites a sense of warmth in the stomach, which diffuses itself over the whole body. It quickens the appetite and digestion, and favors the secretion of urine, giving it a pecular aromatic smell. Large doses excite vomiting and purging. The Hottentots, from whom a knowledge of this medicine was derived, employed an ointment made from it as a vulnerary, and a vinous tincture as a remedy for various disorders of the stomach and the urinary organs. It is chiefly in the last-named affections that it used—viz. *chronic pyelitis*, *cystitis*, and *urethritis*. It is most commonly, perhaps, resorted to as a remedy for *catarrh of the bladder* caused by an extension of urethral irritation, but catarrh of the whole urinary passage is favorably influenced by it, as well as vesical tenesmus and atony of the bladder when they are attendant symptoms. Like other bitter plants containing a volatile oil, it may sometimes be useful in *feeble digestion* with flatulence. It may be administered in substance (gr. xx–gr. xxx, Gm. 1.30–2.00), or in the infusion or fluid extract. The former is prepared with an ounce of buchu to a pint of boiling water. *Dose*, 1 or 2 fluidounces (Gm. 32–64). An infusion made with buchu and the analogous plant, uva ursi, is generally preferable to one containing either alone: ℞. Buchu, uvæ ursi, āā ℥j–℥iv (Gm. 4–16); hot water Oj. Digest for half an hour in a covered vessel and strain. *Dose*, from ½ fluidounce to 2 fluidounces three times a day.

CACTUS.—Cactus.

Cactier, Fr.; *Kaktus*, *Fackeldistel*, G.

Nat. Ord.—Cactaceæ.

Description.—Of the numerous species of these American plants which are more or less medicinally employed in their native country the following has recently attracted attention:

Cactus (Cereus, *Miller*) grandiflorus, *Linné*.—Night-blooming cereus, *E.;* Cierge à grandes fleurs, *Fr.;* Königin der Nacht, *G.*—It is indigenous to tropical America, and frequently cultivated for ornament. The stem is weak, branching, fleshy, green, and five- or six-angled, the angles being beset with clusters of five or six short radiating spines. The numerous imbricate calyx-lobes are linear, acute, brownish, the inner ones yellow. The lanceolate petals are of a white color. The flowers, which open in the evening and wither by the following morning, are very fragrant and produce an orange-colored, internally white, berry of the size of an egg. The fleshy branches, with the flowers, are imported preserved by alcohol. The juice has an acrid taste. The plant has not been analyzed.

Allied Plants.—Cactus (Cereus, *De Candolle*) fimbriatus, *Lamarck.*—The stem is erect, eight- to ten-angled, with clustered spines, and bears rose-colored flowers and red fruits. The juice is acrid; the berries are acidulous.

Cactus (Cereus, *De Candolle*) paniculatus. *Lamarck.*—It is tall, tree-like, with a quadrangular stem and numerous crenate and spiny branches. The large yellowish berries have a sweet and acidulous taste.

Cactus (Cereus, *Miller*) flagelliformis, *Linné.*—Stem and branches are weak, thin, several feet long, ten-angled, warty, spiny, and bear red flowers and small woolly berries. The acidulous juice is reputed to be anthelmintic. It contains, according to L. A. Buchner (1836). acid calcium malate, potassium acetate, albumen, mucilage, etc.

Opuntia vulgaris, *Miller*, s. Cactus Opuntia, *Linné.*—Prickly pear, *E.;* Figue de Barbarie, *Fr.;* Indische Feige. *G.*—It is indigenous to the West Indies and near the coast of North America northward to Massachusetts. The branches are broadly obovate, green, fleshy, bristly, and have small appressed subulate leaves, yellow flowers, and red bristly berries with an acidulous sweet pulp.

Mammillaria simplex, *Haworth*. s. Cactus mammillaris, *Linné.*—The stem is simple, obovate-oblong, about 8 inches (20 Cm.) high, mammilar-tuberculate, spiny, and produces small white flowers and bright-red berries.

Melocactus communis, *Link et Otto*, s. Cactus Melocactus, *Linné*.—The stem is subglobular, about sixteen-furrowed, the ridges beset with clustered brown spines, flowers and berries red.

The succulent stems of the last-named three species and of many others are bruised and employed as discutient applications. The red-juiced berries when eaten are stated to color the urine red.

Medical Action and Uses.—Long ago the cactus- (grandiflorus) juice was known to be extremely acrid, producing vesicles and pustules on the skin, and internally vomiting, colic, and bloody stools. In substance and in tincture it was employed as a vermifuge (Richter, *Arzneimittellehre*, ii. 290). In 1868 it was stated that the tincture of this plant had been used advantageously by Rubini in functional *palpitation of the heart* (*Med. Record*, iii. 299); in 1879, Dr. N. S. Davis confirmed the earlier statement (*Phila. Med. Times*, x. 26); and in 1883, Dr. Byrd reported that it palliated the abnormal action and the pain in rheumatic disorders of the heart, and was even beneficial to the rheumatism itself (*ibid.*, xii. 811). It was used as a fluid extract and in doses of 10 or 12 drops. Dr. Cullen claims for the medicine even more remarkable powers in "functional heart disease" with "lips and fingers almost stagnant with blood," and in which he had tried without success "the usual remedies, digitalis and bromide of potassium" (*Therapeutic Gaz.*, Dec. 1882). On the other hand, Dr. O'Hara finds the medicine peculiarly efficacious in removing the effects of degenerative lesions of the heart, including dropsy, angina, etc. (*Med. News*, xliii. 526). It is evident that more precise information is needed to determine the virtues of Cactus grandiflorus.

CADMII IODIDUM, *Br. 1867.*—Iodide of Cadmium.

Cadmium iodatum, *Iodidum cadmicum*.—*Iodure de cadmium*, Fr.; *Jodcadmium*, *Kadmiumjodür*, G.

Formula CdI_2. Molecular weight 365.

Preparation.—This salt is generally prepared by digesting an excess of metallic cadmium with iodine and water until a colorless solution is obtained, which is filtered and evaporated. It may also be obtained by dissolving 20 parts of potassium iodide and 15 parts of cadmium sulphate in water, evaporating the solution to dryness, exhausting the residue with warm absolute alcohol, and filtering and crystallizing (A. Vogel, 1863).

By the first process a direct combination of the metal and iodine is effected, while in the second process a mutual decomposition of the two salts takes place, with the formation of cadmium iodide and potassium sulphate. The latter, being insoluble in alcohol, remains upon the filter: $CdSO_4 + 2KI$ yields $CdI_2 + K_2SO_4$.

Properties and Tests.—Iodide of cadmium exists in white, flat, micaceous crystals of a pearly lustre, inodorous, of a nauseous metallic taste, permanent in the air, soluble in alcohol, and at the ordinary temperature in a little more than its own weight of water. Heated at about 310° C. (600° F.), it forms an amber-colored liquid, and at a dull red heat is decomposed, vapors of iodine being given off. The aqueous solution, which reddens litmus, yields with sulphuretted hydrogen a yellow precipitate of CdS, which is insoluble in sulphydrate of ammonium (difference from arsenic), and the filtrate from this precipitate is not affected by ammonia, sulphydrate or carbonate of ammonium (absence of the metals of the zinc group and of the earths and alkaline earths), and after applying these tests leaves no residue when evaporated to dryness and ignited (absence of alkalies). The presence of heavy metals would be indicated by the brown or blackish discoloration in the yellow color of the precipitated sulphide. Ammonia would be detected by the odor given off on the addition of an excess of potassa solution. Most other cadmium salts differ considerably from the iodide in appearance. Their possible presence, however, may be inferred by applying the following test of the British Pharmacopœia: "10 grains dissolved in water, and nitrate of silver added in excess, give a precipitate which, when washed with water and afterward with half an ounce of solution of ammonia, and dried, weighs 12.5 grains." Any deviation from this weight indicates the presence of foreign salts.

Off. Prep.—Unguentum cadmii iodidi, *Br.* 1867.

Medical Action and Uses.—According to Garrod, it has the same action and may be employed in the same cases as yellow iodide of lead, particularly in *scrofulous* enlargement of the *glands* and chronic skin diseases. It does not stain the skin. An ointment may be used containing 60 grains of the salt to 1 ounce of lard (Gm. 4 to Gm. 32).

CADMII SULPHAS, *U. S. 1870.*—Sulphate of Cadmium.

Cadmium sulfuricum, Sulfas cadmicus.—Sulfate de cadmium, Fr.; *Schwefelsaures Cadmiumoxyd, Kadmiumsulfat,* G.

Formula $3CdSO_4.8H_2O$. Molecular weight 767.4.

Preparation.—This salt is readily prepared by dissolving 2 parts of metallic cadmium in 2 parts of sulphuric acid which has been diluted with 10 or 12 parts of water and mixed with 1 or 1¼ parts of nitric acid. Cadmium dissolves slowly in diluted sulphuric acid, with the liberation of hydrogen, but in the presence of nitric acid it is readily dissolved, with the evolution of nitric oxide, according to the equation $3Cd_2 + 6H_2SO_4 + 4HNO_3 = 6CdSO_4 + 8H_2O + 4NO$. Sufficient heat will be generated to cause the reaction to proceed briskly. When it slackens heat is applied, and the whole evaporated to dryness to expel excess of acid; the residue is dissolved in three times its weight of water, the solution filtered, evaporated to one-half, and set aside to crystallize. The crystals are collected upon a filter and dried at a moderate heat. The mother-liquor may be made to yield more crystals by further evaporation. From the last portions the cadmium may be obtained by precipitation with zinc.

Properties and Tests.—Sulphate of cadmium crystallizes in colorless rhombic prisms, which effloresce somewhat in the air, have an astringent and strongly metallic taste, and change the color of blue litmus-paper to red. It dissolves at 23° C. (73.4° F.) in 1.6 parts of water, is somewhat more soluble in hot water, and is insoluble in alcohol; at 100° C. (212° F.) it loses 11.8 per cent. (5 molecules) of water, and the remainder when heated to redness; at a full red heat one half of the acid is also expelled. Its purity may be ascertained by precipitating the solution of 10 grains of the salt with dilute potassa solution, and after washing the precipitate igniting it; it should weigh 5 grains; or, 10 grains of cadmium sulphate dissolved in water, and barium nitrate added in excess, yield a precipitate which after washing and heating should weigh 9.1 grains.

Medical Action and Uses.—Sulphate of cadmium is astringent and irritant. like sulphate of zinc, but is much more powerful. A grain taken internally has occasioned profuse salivation, vomiting, colic, diarrhœa, and tenesmus. Injected subcutaneously, it has caused giddiness, retarded pulse and respiration, fainting, and sometimes spasms. In doses of from ½ grain to 1 grain hypodermically, or of from 6 to 10 grains internally, it is fatal to rabbits. In continued small doses it occasions in these animals indigestion, emaciation, subcutaneous hæmorrhages, and fatty degeneration of the heart and liver, with inflammation of the kidneys. It has been chiefly used in *conjunctivitis*, ulcers and opacities of the *cornea*, *otorrhœa*, and *gleet*, in solutions containing from 1 to 8 grains (Gm. 0.06–0.50) of the salt in 2 ounces of water. *Bromide of cadmium*, although not used in medicine, is employed by photographers, and is sometimes found in commerce labelled bromide of ammonium. In a published case two ladies, misled by this error, took a small but uncertain dose of the former salt. It occasioned violent vomiting and a severe burning pain in the throat, œsophagus, and stomach, followed by purging and collapse. No cerebral symptoms were present. For several days both patients were confined to bed and their stomachs continued irritable (Wheeler, *Boston Med. and Surg. Jour.*, Oct. 1876, p. 434).

CADMIUM.—Cadmium.

Cadmium, Fr., G.; *Kadmium*, G.

Symbol Cd. Atomicity bivalent. Atomic weight 111.8.

Origin and Preparation.—This metal is found near Bishopstown, Scotland, in the form of sulphide as the mineral Greenockite, but it is more frequently present in small quantities in some kinds of calamine, blende, and other zinc ores. It was discovered by Stromeyer and Hermann in 1817. Cadmium being more volatile than zinc, it is contained in the first portions obtained on the distillation of the latter metal, and its presence is indicated by the appearance of a brown flame (the so-called "brown blaze") before the greenish-white flame of burning zinc is noticed. To obtain cadmium, the zinc, or the zinc oxide containing it, is dissolved in dilute sulphuric or muriatic acid, and the cadmium precipitated by metallic zinc; or, the acid solution is treated with sulphuretted hydrogen to precipitate the cadmium as yellow sulphide, which is used as a pigment under the name of *cadmia;* the sulphide is dissolved in strong hydrochloric acid, the solution precipitated by an excess of ammonium carbonate to remove copper and traces of zinc, and the washed and dried precipitate mixed with lampblack and distilled.

Properties.—Cadmium is a malleable and ductile metal having the color of tin, and like the latter it emits a crackling sound when bent. It crystallizes readily in octahedrons, is superficially tarnished on exposure to the atmosphere, becomes brittle at 82° C. (180° F.), fuses near 315° C. (592° F.) (B. Wood, 1862), and volatilizes, according to Becquerel (1863), at 720° C. (1319° F.), and according to Deville and Troost at 860° C. (1580° F.) Its density varies between 8.60 and 8.69; its vapor is dark-yellow, has a nauseous taste and burns with a dark-red flame to brown oxide. In the presence of acids cadmium slowly decomposes water, hydrogen being given off; but nitric acid dissolves the metal readily. The salts of cadmium are mostly white; those soluble in water have an acid reaction and a disagreeable metallic taste. Their solutions, treated with sulphuretted hydrogen or ammonium sulphydrate, afford orange-yellow precipitates of CdS, which is insoluble in an excess of the precipitate and in dilute acids and alkalies. Caustic alkalies produce white precipitates of CdH_2O_2, which is soluble in ammonia, but not in potassa or soda. The soluble carbonates, phosphates, and oxalates, and ferrocyanide of potassium, produce white precipitates.

Tests.—The impurities likely to be present in metallic cadmium are mainly zinc and copper, the former of which is recognized by precipitating the solution in nitric acid with sulphuretted hydrogen, when the filtrate from the bright orange-yellow precipitate will yield a white precipitate on the addition of ammonia and ammonium sulphydrate. When the solution in nitric acid is precipitated by slight excess of ammonium carbonate the filtrate will have a blue color if copper be present.

Off. Prep.—Cadmii iodidum, *Br.;* Cadmii sulphas.

CAFFEA.—COFFEE.

Semen Coffeæ.—Café, Fr.; *Kaffee*, G.

The fruit of Coffea arabica, *Linné.* Bentley and Trimen, *Med. Plants*, 144.

Nat. Ord.—Rubiaceæ, Coffeineæ.

Origin.—Coffee is indigenous to tropical Africa, more particularly to Abyssinia; possibly also to Southern Arabia, but this is denied by some authors. It grows wild in Central Africa and on the coast of Mozambique, and was introduced into Java near the close of the seventeenth century, and into the West Indies and South America during the eighteenth century. At present it is very extensively cultivated in most tropical and subtropical countries. The Liberian coffee-plant is a distinct species, C. liberica, *Hiern* (1877), which seems to be less subject to disease, and has been successfully introduced in the East Indies. The seeds of several other species of Coffea are used in their native countries, but do not appear to be of commercial importance.

In its wild state the coffee tree attains a height of from 20 to 30 feet (6 to 9 M.), and has somewhat the aspect of a cherry tree, but its bark is whitish and furrowed and its numerous branches are opposite. In cultivation it is trimmed down to the height of about 6 feet (1.8 M.). The smooth evergreen leaves are ovate-oblong, rather acuminate, 4 to 6 inches (10 to 15 Cm.) long, 1½ to 2 inches (37 to 50 Mm.) wide, dark-green and glossy above, paler beneath, and somewhat glandular near the midrib. Flowers in clusters of three to five or seven, with a small five-lobed calyx, a white tubular five-lobed corolla, five stamens, and one pistil with a bifid style. The fruit is an oval, deep-purple, two-seeded drupe, the parchment-like endocarp enclosing two plano-convex seeds, which are placed together by their flat sides and constitute the raw coffee of commerce. The Liberian coffee-plant has the corolla six- to nine-lobed and the fruit globular.

When the berries are ripe they are gathered and freed from the pericarp and scanty pulp by suitable apparatus and washing; the seeds are then dried, and subsequently freed from the parchment-like testa by passing them between wooden rollers and by winnowing. The seeds constitute one-third the weight of the ripe berries.

The use of coffee as a beverage appears to have spread from Abyssinia first to Arabia early in the fifteenth century, to Constantinople in 1554, and to France and England after 1640. Until the beginning of the eighteenth century the supply was exclusively obtained from Arabia, where, in the district of Yemen, the plant is cultivated and yields the small seeds so highly valued as Mocha coffee. The East Indian coffees consist usually of the largest seeds; West Indian and South American coffees are generally intermediate between the two varieties previously named.

Description.—The seeds are oval, longitudinally grooved upon the flat side, usually almost completely deprived of the parchment-like, finely-wrinkled testa, fragments of which remain in the groove and sometimes upon the back. The horny albumen is of the shape of the seed, according to the variety of a yellowish, brownish, bluish, or greenish tint, and is folded, or rather rolled up, whereby the groove is produced. The embryo is situated under the convex side near one end, is slightly curved, and occupies about one-fourth the length of the seed. Raw coffee has a very faint odor and a sweetish, slightly astringent, and bitterish taste. The commercial varieties vary considerably in flavor, in size, and in the shade of color. On keeping, coffee loses during the first year about 8 per cent. in weight, principally moisture; during the second, 5 per cent., and during the third year 2 per cent., the flavor being at the same time greatly improved.

Constituents.—The sweetish pulp of the pericarp contains several sugars, of which Boussingault (1881) found 2.37 per cent. cane-sugar, 8.73 per cent. invert-sugar, and 2.21 per cent. mannit. According to Payen's analysis (1849), coffee contains 13 per cent. of fat, 15.5 of glucose, dextrin, and an undetermined vegetable acid, 10 of vegetable casein, 5 of chlorogenate of caffeine and potassium, 3 of nitrogenized principle, 0.8 of caffeine, 0.001 of solid volatile oil, 0.002 of liquid aromatic principle soluble in water, 6.7 of ash, and 12 of moisture, the remainder being cellulose. The fat consists of palmitin and olein. The acids contained in coffee have been the subject of repeated investigations. These render it probable that, besides a little citric acid, the principal one is *caffeo-tannic acid*, which, according to Rochleder, is Payen's *chlorogenic acid;* its precipitate with gelatin is soluble in the tannin solution; tartar emetic does not precipitate it, but it yields with lead salts and baryta solution yellow precipitates. Vlaanderen and Mulder (1858) separated this principle under the name of *caffeic acid*, and regard the other acids of coffee (*caffeanic*, *cœrulic*, and *caffeelic*) as products of oxidation; and they believe the various colors of raw coffee to be due to mixtures of these derivatives. They consider chlorogenic as a mixture of their caffeic and cœrulic acids; Rochleder's *viridinic acid* (1848) may be a similar mixture. The *caffeic acid* of Hlasiwetz (1867) is obtained by continued boiling of caffeo-tannin with excess of potassa solution and separation by sulphuric acid. When pure it has the composition $C_9H_8O_4$, is in straw-yellow crystals, forms mostly yellow-colored salts, and, like the amorphous gum-like caffeo-tannin, yields with fusing potassa protocatechuic acid, $C_7H_6O_4$. By dry distillation pyrocatechin is obtained. Zwenger and Siebert (1861) obtained from Java coffee 0.3 per cent. of kinic acid, which is most likely the coffeic acid of Stenhouse, obtained (1854) from coffee-leaves, and which readily yielded kinone when treated with manganic deutoxide and sulphuric acid. (For a description of *Caffeine* see below.)

The roasting of coffee, which is best accomplished at a temperature of about 250° C. (482° F.), renders the seeds pulverizable, and at the same time gives them a more agreeable taste and enables them to yield more of their constituents to water. The coffee thus acquires a chestnut-brown color and loses about 18 per cent. of its weight. The generation of gaseous compounds ruptures the cells, and a peculiar and agreeable aroma is produced, probably through the decomposition of the fat and tannin. But Payen's (as well as Rochleder's) investigations failed to point out the principle to which the changes are due. Very probably they depend upon the decomposition of several of the organic compounds, and unquestionably upon the production of a pyrogenated volatile oil, to which the grateful aroma is due. Caffeine does not partake of these changes, except that it is slowly volatilized at the temperature stated; hence the roasting of coffee ought to be effected in closed vessels. Bernheimer (1880) found nearly one-half of the products of roasting to consist of palmitic acid, the remainder being acetic acid, carbonic acid, probably acetone, hydroquinone, pyrrol, methylamine, .18 to .28 per cent. caffeine, and .04 or .05 *coffeol*, $C_8H_{10}O_2$, to which the aroma of coffee is due; it is an oil boiling at 195° C. (383° F.), and is probably a methylether of saligenin.

Coffee yields 4 to 5 per cent. of ash—Mocha coffee as much as 7.84 per cent.—consisting chiefly of carbonates and phosphates of potassium, sodium, magnesium, and calcium, the earth salts amounting to one-seventh or one-sixth of the weight.

Adulterations.—Coffee-seeds are not subject to adulteration, except that inferior qualities are mixed with or sold for the better varieties, and that the brown, yellow, or discolored seeds are occasionally artificially colored with indigo, Prussian blue, and other substances. These pigments usually adhere merely superficially, and may be removed by washing with water. Ground coffee is frequently adulterated with roasted amylaceous seeds and bitter roots, chiefly chicory, and occasionally dandelion. Roasted coffee yields with cold water a brownish-yellow infusion, while that of the adulterants is dark-brown or red-brown. F. M. Rimmington (1880) suggested the following process for the detection of adulterations: the coffee is boiled with water and a little sodium carbonate, then washed with water and macerated in a weak solution of chlorinated lime for 2 or 3 hours, when the ground coffee will form a dark stratum and the ground chicory a nearly white layer; the microscope will reveal other admixtures.

The husks of coffee have been to some extent used under the name of *sultan coffee* and *sacca coffee;* they are said to improve the flavor of coffee, but, according to Peckolt, contain only .082 per cent. of caffeine. The roasted flattish ovate seeds of Cassia occidentalis, *Linné*, are used in the tropics as a substitute for coffee under the name of *negro coffee* or *Mogdad coffee*, and have been met with as an adulteration in Europe; they do not contain caffeine, and are best detected by the microscope. Mogdad coffee yields 4 to 5 per cent. of ash; roasted chicory, 10 to 11 per cent.; roasted rye and wheat, 2 to 3 per cent.

CAFFEINA, *U. S.*, *Br.;* COFFEINUM, THEINUM, *P. G.*—Caffeine, caffeia, theine, guaranine, *E.;* caféine, théine, *Fr.;* Koffeïn, Kaffeïn, Theïn, *G.* Formula $C_8H_{10}N_4O_2.H_2O$. Mol. weight 212.—This, the most important constituent of coffee, is obtained by precipitating the decoction of coffee with acetate of lead, removing the excess of lead from the filtrate by sulphuretted hydrogen, neutralizing by ammonia, evaporating, and recrystallizing (Garot). Prof. E. S. Wayne (1875) recommended the following process, which has been found very serviceable: 2 parts of powdered coffee or tea are boiled with 3 parts of levigated litharge and sufficient water; the acids combine with the lead; the nearly colorless filtrate is freed from lead by sulphydric acid, and on concentration will yield most of the alkaloid in colorless crystals; the yellowish mother-liquor requires to be treated with animal charcoal, when the remainder of the alkaloid is likewise obtained colorless. Good coffee yields between 0.8 and 1.0 per cent., coffee-leaves .3 per cent., maté or Paraguay tea and Chinese tea between 1.1 and 1.25, kolanuts 2.13, and guarana about 5 per cent. of caffeine. Caffeine crystallizes in colorless or white, flexible, silky needles or thin long prisms, which are inodorous, of a faintly-bitter taste, fusible, and sublimable without decomposition. It is soluble in 75 parts (*U. S.*), 80 parts (*P. G.*), of water, and in 35 parts (*U. S.*), about 50 parts (*P. G.*), of alcohol at 15° C. (59° F.); in 160 parts of absolute alcohol; in about 6 parts (*U. S.*), 9 parts (*P. G.*), of chloroform; in 9.5 parts (*U. S.*), 2 parts (*P. G.*), of boiling water. It is soluble in about 500 parts of ether, slightly soluble in carbon disulphide, and dissolves freely in boiling alcohol. These solutions have a neutral reaction to test-paper. Benzol, chloroform, or amyl alcohol, when repeatedly agitated with its solution in acidulated water, dissolves the whole of the caffeine (Dragendorff). Crystallized from alcohol or ether, it is anhydrous; crystallized from water, it contains 8.5 per cent. (1 molecule) of water, with which it parts at above 100° C. (212° F.); when heated to above 180° C. (356° F.) it sublimes without leaving any residue. The anhydrous crystals have the composition $C_8H_{10}N_4O_2$, and contain 28.8 per cent of nitrogen. Caffeine, moistened with strong nitric acid or dissolved in chlorine-water and evaporated at the heat of a water-bath, leaves a reddish-yellow residue, which becomes purple by ammonia from the formation of *murexoin* (Schwarzenbach). Concentrated aqueous solutions of caffeine give with silver nitrate a white granular, crystalline precipitate; with mercuric chloride, long needles soluble in hydrochloric acid; with palladium chloride, yellow scales; with picric acid, no precipitate; the alkaloid dissolves in sulphuric and in nitric acid, and the solution remains colorless for several hours (Dragendorff). Caffeinæ citras, *Br.*, is citric acid 1 p., water 2 p., caffeine 1 p., evaporated.

Caffeine is *methyl-theobromine*, and may be formed by heating theobromine-silver with methyl iodide in sealed tubes. According to Mulder and Günther, it dissolves more or less readily in solutions of citric, tartaric, oxalic, and acetic acids, and on cooling caffeine crystallizes. Hager, and afterward Haaxman (1877), ascertained that commercial *citrate* and *valerianate of caffeine* consist merely of the alkaloid with some acid adhering. Lloyd (1881) and Biedermann (1882) showed that caffeine salts with organic acids may be obtained from chloroform, and that they are easily decomposed by water. Tanret (1882) regards the solutions of caffeine in sodium benzoate, cinnamate, and salicylate as definite compounds suitable for hypodermic use; these solutions may be made so as to contain in each Ccm. (15 minims) 0.20 Gm. (3 grains) of caffeine, and with sodium salicylate 0.30 Gm. (4½ grains). The salts with mineral acids have an acid reaction to test-paper, and are decomposed by water or alcohol. Their concentrated solutions yield with hydrargyro-potassium iodide a precipitate which soon crystallizes in needles. Similar precipitates obtained with other alkaloids remain amorphous (Delffs, 1854). Diluted acidulated solutions of caffeine are not precipitated by Mayer's reagent (Dragendorff).

When caffeine is heated with alcoholic potassa or with solution of barium hydrate, water is assimilated, carbonate of barium is precipitated, methylamine and a little ammonia are given off; and from the residue Strecker obtained (1861) a strong and uncrystallizable base, *caffeidine*, $C_7H_{12}N_4O$, which is easily soluble in water and alcohol, but to a slight degree in ether. The decomposition takes place mainly according to the equation $C_8H_{10}N_4O_2 + H_2O = C_7H_{12}N_4O + CO_2$. O. Schultzen (1867) and F. Rosengarten (1871) proved that by prolonged boiling a further decomposition takes place, affecting chiefly the caffeidine, and resulting in the production of sarkosine, formic acid, methylamine, and ammonia; thus: $C_8H_{10}N_4O_2 + 6H_2O = C_3H_7NO_2 + CH_2O_2 + 2CH_3H_2N + NH_3 + 2CO_2$.

Allied Drugs.—SEMEN (NUCES) COLÆ.—Cola-nut, Guru-nut, *E.;* Noix de cola, Noix de gourou, Café du Soudan, *Fr.;* Kolanuss, *G.*—The tree, Cola (Sterculia, *Beauvois*) acuminata, *R. Brown*, (nat. ord. Sterculiaceæ), is indigenous to tropical Africa, and is also found in tropical America; the yellow flowers produce five follicles, each containing one seed. The latter in the fresh state are brown externally and purplish- or violet-colored internally; after drying, reddish or brown, somewhat mottled on the surface. They are about an inch (25 Mm.) long, oblong-ovate, flattish on one side, and have a slight nutmeg-like odor and a mild somewhat aromatic taste; in the fresh state they are bitter. Daniell showed the presence of caffeine, and Attfield (1865) obtained 2.13 per cent. of this alkaloid, besides 1.5 fat and volatile oil, 42.5 starch, 10.7 sugar and gum, 6.3 protein compounds, and 3.2 ash. Heckel and Schlagdenhauffen (1882) obtained similar results, and found also .023 theobromine and 1.62 tannin. The seeds are said to be used for clearing muddy water.

Physiological Action.—*On Animals:* In the last century coffee and tea used in experiments upon frogs were known to produce in these animals paralysis of the hind legs. More recently similar experiments with caffeine upon a great variety of animals—including dogs, rabbits, cats, birds, and fish—showed that this substance is fatal to them by producing, first of all, spasm, and then paralysis. 1 grain of it thrown into the veins of a small dog was sufficient to destroy its life, but in a large animal of the same species even 30 grains produced only salivation, muscular rigidity, exhaustion, hurried breathing, and defecation. In all the experiments with full doses hyperæsthesia was apparently manifested, with exaggerated reflex irritability at first, and afterward still more decidedly, the heart and pulse at first beating more frequently, but gradually settling down to their normal rate or even lower. In most cases, and however the caffeine was introduced, increased defecation or diarrhœa occurred. The muscular rigidity it causes is followed by complete resolution, which, however, is not paralysis, since direct irritation of the limbs revives the rigid contraction. Indeed, it is eminently the property of caffeine to increase reflex excitability until it is extinguished by the approach of death. As an examination of the spinal cord does not exhibit any uniform condition after death from this substance, and especially no marked degree of hyperæmia, it has been doubted whether the muscular spasms are of spinal origin alone, or are partly due to the state of the blood-vessels in the muscles themselves. It seems probable that both actions concur.

On Man: Since coffee was introduced into Arabia from Africa in the fifteenth century, numerous opinions have been expressed of its salutary and of its mischievous effects. The consequences of an abuse of tea were declared to be similar to that of coffee long before chemistry had demonstrated the identity of theine with caffeine. Among their evil effects were enumerated the following: indigestion, acidity, heart-burn, watchfulness, tremors, debility, irritability of disposition, and dejection of spirits. By some persons both tea and coffee were accused of producing paralysis. Most of these effects are more likely to follow the habitual use of tea than of coffee, perhaps because, as a general rule, more of the former than of the latter is consumed; and the spinal symptoms, such as painful muscular tension and cramp and persistent wakefulness, are more apt to be produced by tea. In experiments undertaken with a number of selected healthy persons the operation of caffeine has been found to vary exceedingly; by the same dose some were scarcely at all affected, while others suffered from palpitation of the heart, a full, frequent, or irregular pulse, irritable bladder and difficulty of urination, trembling limbs, headache, roaring in the ears, flashes before the eyes, sleeplessness, phantasms, a sort of intoxication, and even delirium when a very large dose was taken, and a subsequent unfitness for bodily or mental labor. To illustrate the toxical effects of coffee the following examples may suffice: 50 minutes after taking a drachm of citrate of caffeine a burning sensation of the throat was complained of, and giddiness, with vomiting, purging, and abdominal pain. General paresis with tremor ensued, followed by collapse, but the mind remained clear (Routh, *Practitioner*, xxxi. 48). Fort took an infusion of 8 ounces of coffee in a quart of water in the course of a day. The pulse rose to 114, sleep was impossible, muscular spasms occurred all over the body, and were very painful in the extremities, chest, and throat. The tongue was dry, there was nausea with frequent liquid stools, and the pulse ranged from 110 to 114, and was intermittent. The next day there were headache and anorexia (*Bull. de thérap.*, civ. 350). These effects, which may be called poisonous, illustrate the danger of exceeding due moderation in the use of coffee, for they show that it may, if immoderately consumed, tend to develop a morbid condition of the nervous system which must render it peculiarly liable to disease, although in a much less degree than opium or alcohol. Indeed, the excessive use of coffee is much more injurious to the spinal than to the cerebral functions. In its primary operation it agrees with those stimulants in exciting muscular and mental activity as well as cheerfulness, and in its after effects it does not tend to produce narcotism or stupor, but only that unsteadiness of the mind, and still more of the spinal functions, which denotes exhaustion. The experiments of Dr. Mary P. Jacobi in a case of exposed brain led her to a corresponding conclusion—viz. that under the influence of coffee "the amount of blood circulating in the brain is smaller, but it is brought to the nerve-tissues under increased pressure; hence assimilation of nutritive material should be increased in rapidity if lessened in quantity." It agrees with tobacco, with Chinese and Paraguay teas, and with various other dietetic stimulants used by different nations, in the main features of its action. It results from some carefully conducted experiments that caffeine is diuretic in the sense of increasing the secretion of water by the kidneys, but that it diminishes all the solid constituents of the urine except the fixed salts; that the proportion of carbonic acid in the expired air declines under its use, and that its ultimate tendency is to diminish rather than increase the frequency, volume, and force of the pulse after its primary and transient stimulant impression has subsided. Its diuretic action is more prompt and less complete and durable than that of digitalis. Its final effect, in other words, is to lessen the amount of blood that is supplied to all the organs, and thereby their functional activity. This effect appears to be due to a contraction of the whole capillary system, in consequence of which the venous side of the circulation becomes distended with blood. To this mode of action may be referred the engorgement of the portal circulation which the immoderate use of coffee tends to produce, and which is shown by the formation of hæmorrhoids and chronic enlargement of the liver. Possibly to this cause also may be attributed the dyspnœa and hurried breathing which some persons experience after an excessive use of coffee, and the coolness of the hands and feet which is more usual.

The moderation of tissue-waste which, it has been said, is an effect of coffee, as of other articles having the same general action and used by different nations, is illustrated by various well-established facts. The inhabitants of Central Africa, the native country of coffee, in their predatory excursions are said to subsist entirely upon a mixture of coffee and butter, which is prepared in masses of the size of a billiard-ball, one of which will keep a man in strength and spirits during a day's fatigue. Jomand says: "120 Gm. (4 oz.) of powdered coffee and 3 liters (8 pints) of an infusion made with 200 Gm. (6½ oz.) of different kinds of coffee enabled me to live for 5 consecutive days without lessening my ordinary occupations, and to use more, and more prolonged, muscular exercise than I was accustomed to, without any other physical injury than a slight degree of fatigue and a little loss of flesh." The Belgian coal-miners live and work efficiently upon a ration of solid food much less than that of the French miners, and yet perform more labor than the latter. The only difference in the quality of their food consists in the Belgians receiving a ration of coffee, and to this is attributed their superior endurance. Such facts show that Böcker was in error when he alleged that coffee assists digestion only by hurrying forward the alimentary mass and preventing assimilation, and also when he concluded that they only who live to eat, and not those who eat to live, should use coffee with their meals. This is a notable instance of scientific error.

It may seem, at first sight, irrational that a substance which restricts tissue-waste should be used for the very purpose of quickening certain functions, and especially those of the brain. The mental exhilaration, physical activity, and wakefulness it causes explain the fondness for it which has been shown by so many men of science, poets, scholars, and others devoted to thinking. It has indeed been called "the intellectual beverage." But all these occupations involve increased functional activity, and therefore increased waste of tissue, in the brain and spinal marrow—the very action which coffee is said to restrain. To reconcile these apparent incongruities it has been maintained that coffee does not act primarily as a cerebral stimulant, but only secondarily by removing the vascular plenitude occasioned by prolonged study, by a full meal, and especially by alcohol, opium, or other agents which directly tend to load the brain with blood—that if taken on an empty stomach it does not quicken the functions of the brain.

but, on the contrary, renders it dull and inapt for steady thought, creates general debility and nervousness, and frequently causes hæmicrania. During digestion, however, the case is different, particularly if a full and stimulating meal has been taken: the mind grows dull and sluggish, a tendency to sleep arises, and everything indicates an increased amount of blood in the brain. In like manner, prolonged mental labor produces cerebral plenitude and drowsiness. It is this condition, apparently, which coffee corrects by contracting the blood-vessels and relieving the brain of its oppressive load of blood. The habit of taking coffee at breakfast and after dinner is explained by the stimulant action (whether direct or indirect) which it exerts not only upon the nervous system generally, but especially upon the stomach and bowels; there can be no doubt that it quickens gastric digestion and relieves the sense of plenitude in the stomach, stimulates the secretion of bile, and by augmenting the peristaltic action of the intestine promotes defecation. It is quite as certain that, used to excess, it paralyzes the digestive function in all its steps, and leads to further disorders, of which the chief are congestion of the liver, constipation, and hæmorrhoids. Whether these effects are to be ascribed to a power in coffee to produce contraction of the capillary blood-vessels may be uncertain, but their reality is beyond doubt. To such an operation has also been ascribed an anaphrodisiac action of coffee which is alleged by Willis, Linnæus, and by numerous French writers, one of whom cites a Persian tale to the same effect. It would be singular if such were the case, when, as is well known, the consumption of coffee is greatest by the very nations most notorious for sexual excesses. It is not, however, without interest to remember that the use of coffee is universal and excessive in France, and that the smallness of the families of that country is quite exceptional.

Uses.—The mode in which coffee assists digestion has been described, and the popular use made of it to prevent or to relieve *indigestion;* but it is useful not only in those forms of the affection which are associated with exhaustion or debility, and which result from previous excesses in eating and drinking or depend upon weakness due to sedentary habits, acute disease, old age, etc. Other forms of gastro-intestinal atony may be associated on the one hand with *constipation*, or on the other with *diarrhœa*, and in either case pure strong coffee in small quantities will often afford relief. In constipation the coffee should be taken early in the morning before the first meal. Partly with a view to promote digestion coffee has been much used during *convalescence* from acute diseases; but in this condition, and also in acute febrile diseases of a *typhoid type*, it had long been employed with advantage before the present rationale of its operation was understood, according to which it restrains tissue-change, and thus becomes a conservator of force. It, indeed, may take the place of alcohol in the adynamic conditions for which that stimulant is prescribed, or may be associated or exhibited alternately with it. It has been found that in *typhus* fever coffee increases the elimination of urea, and in so far purifies the blood without increasing the destructive metamorphosis of tissue, and that it lessens coma and low delirium, which it probably does by contracting the capillaries of the brain. In this and all other typhoidal conditions it appears to act immediately as a stimulant of the heart as well as a conservator of force. It has an advantage over alcohol in that it stimulates and sustains, as well as cheers, without inebriating. Coffee, and also caffeine, have been used in the treatment of *intermittent fever*, and have cured it, as almost everything else has done, occasionally. The power of coffee to prevent and to moderate *alcoholic intoxication* is well known; one may drink more wine while taking coffee than without this association, and actual intoxication is often arrested by a cup of strong coffee. These effects tend to confirm what has been said above of the action of coffee on the brain. *Delirium tremens* is an indirect effect of alcohol, and comes on, it may be, days after intoxication has ceased, and involves an opposite state of the brain—one of anæmia, not of congestion. In this affection coffee is only an adjuvant; what good it does is through its primary stimulant impression upon the nervous system and the stomach, and by its limiting the waste which the exorbitant excitement and muscular effort attendant upon the disease entail. For these purposes it should be given in small and repeated doses. In *opium-narcotism* the condition is much the same as in acute alcoholic intoxication, and in it coffee is equally efficient in preventing coma and its consequences. Experiments upon animals have also shown that coffee and tea are direct physiological antidotes to morphia. Coffee should be given in the manner just recommended, and by the rectum as well as by the mouth, but not to the neglect of other stimulants of the nervous system, such as flagellation and electricity. "Fluid extract of coffee," and also "strong coffee," have been used hypodermically in cases of opium-poisoning. According to Litti, coffee is an antidote to *strychnia* in rabbits (*Med. Record*, xxviii. 264). The stimulant action of strong coffee sometimes prevails against obstinate *hiccup*. The utility of coffee in *spasmodic asthma* has long been established. A competent authority in regard to this disease (Salter) says: "I should think, from my own experience, that coffee relieves asthma in two-thirds of the cases in which it is tried. The relief is very unequal, often merely temporary, and sometimes very slight; sometimes it is complete and permanent." It should be given in a very strong and hot infusion, either an hour in advance of the paroxysm if it occurs periodically, or as soon as the first symptoms are felt. Its mode of action is not accurately known. It must be borne in mind, however, that the attack usually comes on at night, and especially during sleep—that is to say, at a time when all convulsive diseases except hysteria are most apt to break out—and that the action of coffee is directly opposed to sleep; that the paroxysm may be relieved either by stimulants or by sedatives (belladonna, lobelia); and therefore it seems probable that the cure of the attack depends upon the removal of the congestion of the nervous centre which was its immediate cause. A similar mode of action probably explains certain cases in which *chordee* and also *dysury* were terminated by the same means. Some forms of *nervous headache* are apt to be relieved by coffee, by tea, and, as recent observations have shown, by Paraguay tea. It would seem that the most appropriate cases are those in which the face is flushed and other signs exist of cerebral congestion; those, on the other hand, in which the face is pale and the pain appears to be simply neuralgic, and not congestive, are thought to be aggravated by the medicine. Caffeine in two-grain doses is sometimes used, but a well-prepared infusion of coffee is preferable. It has long been known that certain strangulated *hernias* have been reduced under the influence of coffee after the failure of the taxis. In many the reduction was spontaneous, in others easy. They were cases in which the protrusion was recent, and when there was no sign of gangrene or of inflammation in the hernial tumor. The mode of action may be inferred, from what was said above, to be, that coffee excites contraction of the intestinal muscles, by which the gas contained in the loop is expelled, and contraction of the blood-vessels, by which the serous transudation is diminished. In favorable cases these two agencies suffice to lessen the bulk of the tumor and permit its reduction. Desprès has used strong coffee with decided benefit in uterine *hæmorrhage* occurring after delivery and also in the form of *metrorrhagia* (*Bull. de thérap.*, xcvi. 201).

In 1725, Zwenger recommended coffee as a remedy for dropsy (*Bull. de thér.*, ciii. 146). It has been stated above that caffeine is a diuretic. Clinically, it has been proved by Gubler and others to act very promptly in this manner, and to reduce the pulse-rate simultaneously. These effects are ascribed to a direct action upon the nerves of the kidney. In several cases of cardiac *dropsy* "citrate of caffeine" in the dose of 3 grains three times a day promptly produced copious diuresis, even when digitalis had failed or ceased to have any effect (Shapter). The cases most benefited are those in which cardiac irregularity exists as an effect of muscular debility rather than of valvular obstruction. Leech, who found it useful as a diuretic in *cardiac dropsy*, judged that it exerted a direct action upon the kidneys, causing the elimination of water (*Practitioner*, vols. xxiv., xxv.); and Brakenridge, localizing its action still further, pronounced it to be "a stimulant of the renal glandular epithelium, and very slightly, if at all, a vascular diuretic" (*Edinburgh Med. Jour.*, xxvii. 4. 100). That coffee and caffeine are primary and direct stimulants of the whole nervous system seems proved by daily experience, and that their effects are comparable, not to those of digitalis, but rather to the action of alcohol. Unlike digitalis, which affects only certain involuntary muscles, caffeine, like alcohol, stimulates the entire muscular and vascular system. It has been repeatedly said that caffeine and digitalis cannot be substituted therapeutically for one another—that the former acts where the latter ceases to act; and the explanation of this fact resides in their very dissimilar mode of action. When digitalis fails, it is because the heart is either positively or relatively incompetent to propel the blood, and the medicine has no power of strengthening except by tonically contracting it; but coffee or caffeine stimulates the nervous centres which are the source of the heart's power, and temporarily restores the regularity and efficiency of its function, and so permits the removal of the dropsies, etc. which immediately threaten the extinction of life. Cases illustrating this singular rescue from imminent death have been published by Milliken (*Phila. Med. Times*, xii. 344), Brakenridge, Huchard, and others. The explanation affords a satisfactory reason for the failure of caffeine in dropsy that is not due to cardiac disease. (Compare Lépine, Huchard, Dujardin-Beaumetz, *Centralblatt f. Therapie*, i. 229.) Caffeine, and also strong coffee, have been found useful in atonic *diarrhœa*, "in melancholia, in the brain disorders of over-workers, in the sleeplessness and depression of spirits of drunkards, in asthenic mania" (Shapter, *Times and Gaz.*, July, 1881, p. 33), and as a means of curing the *opium* and the *alcohol habit.* It is probable that the use of coffee in the southern and of alcohol in the northern countries of Europe shows that the one is better adapted to a dry and the other to a damp climate, and also that an intellectual stimulant is more grateful to the excitable nature of Southern, and one that blunts perception to the cooler temperament of Northern, races.

The *dose* of caffeine may be said to range from ¼ grain to 2 or 3 grains (Gm. 0.016–0.200) in powder, mixed with sugar. Huchard maintains that the ordinary doses are too small. He begins with 5 or even 10 grains during a day, and then gradually increases the dose until 15 grains, or even two or three times that quantity, are taken in the same space of time. If, like coffee, it sometimes causes uncertainty of sight and gait, nausea, headache, palpitation, etc., the dose must be lessened. Owing to its imperfect solubility it should not be prescribed in pill. The most convenient mode of administrating caffeine hypodermically is that proposed by Tanret, who has published the following formula: ℞. Benzoate of sodium Gm. 3.60; Caffeine Gm. 3; Distilled Water q. s. to make 10 Ccm. Of this solution each Ccm. contains 30 Cg. (5 grains) of caffeine (*Med. Record*, xxiii. 440).

The so-called *valerianate of caffeine* appears in some cases to have been of service in the treatment of *hysterical vomiting* and of *whooping cough.* In the latter disease it was given twice a day in doses of about half a grain (Gm. 0.03) to children of two years and upward.

The Kola or Gourou nut, derived from an African plant, is said to contain a larger proportion of caffeine than the best coffee, besides an appreciable quantity of theobroma and a special form of tannin. It is used by the natives for various diseases of the bowels and liver, and also as a tonic (*Edinb. Med. Jour.*, xxviii. 644).

CAHINCA.—Cahinca-Root.

Radix caincæ, s. cainanæ.—Cainça, Fr.; *Caincawurzel*, G.

The root of Chiococca racemosa, *Jacquin.*

Nat. Ord.—Rubiaceæ, Coffeineæ.

Origin.—The plant is a native of Southern Florida, the West Indies, Central America, and a portion of South America. It is a shrub with opposite shining, oval, ovate-oblong, or elliptic leaves, racemes of fragrant yellowish flowers, and small white berries with flattish ovate seeds.

Description.—The woody root exists in pieces 3 to 6 inches (7 to 15 Cm.) long, about $\frac{1}{12}$ to ¼ inch (2 to 6 Mm.) thick, more or less bent, externally blackish- or grayish-brown, finely wrinkled longitudinally, with narrow transverse corky ridges and fissures, with a thin brown bark of a resinous lustre internally, and with a whitish wood. It is usually mixed with portions of the lower stem, which are ½ to 1 inch (12 to 25 Mm.) thick, and have deep longitudinal furrows, with intervening rounded often very prominent ridges, produced by separated wood-bundles which have not been developed into separate branches; the porous wood encloses a thin pith and is radiate by medullary rays. The bark has a nauseous, bitter, and acrid taste.

The roots of Chiococca densifolia, *Martius*, and Ch. anguifuga, *Martius*, are of a reddish-brown color, often transversely fissured, and destitute of longitudinal ridges. The shrubs are indigenous to Brazil, and are known there as *cainana* or *caninana.*

Constituents.—The most important constituent of cahinca-root is *cahincin* or *cahincic acid*, which, according to Rochleder (1867), has the composition $C_{40}H_{64}O_{18}$. It exists in the root partly free and partly as a calcium salt (François, Pelletier, and Caventou, 1829), forms white, silky, very bitter needles, is soluble in about 600 parts of cold water and ether, and crystallizes from its solution in hot alcohol. When boiled with hydrochloric acid it is split into sugar and *cahincetin*, $C_{22}H_{34}O_3$, the alcoholic solution of which gelatinizes on the addition of water. Fused together with hydrate of potassium, cahincetin yields butyric acid and *cahincigenin*, $C_{14}H_{24}O_2$. Rochleder and Hlasiwetz (1851) regard the tannin of cahinca-root as being identical with *caffeo-tannic acid.*

Medical Action and Uses.—When first introduced into American and European medicine cahinca was reputed to be an efficient diuretic, as well as a tonic and laxative. There is no doubt of its diuretic virtues in *dropsy*, independent of acute renal disease. But it is now very rarely employed. It is best administered in a decoction made with 2 drachms (Gm. 8) of the root to a pint of water, or an electuary may be formed with powdered gum and syrup containing about 15 grains (Gm. 1) of the powdered root.

CALAMUS, *U. S.*—Calamus.

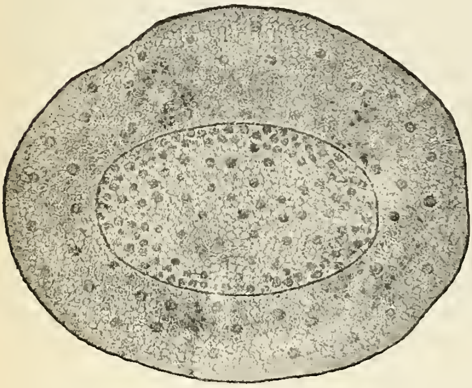
Rhizoma calami, P. G.; *Radix calami aromatici*, *Radix acori*.—*Sweet flag*, E.; *Acore vrai*, *Acore odorant*, Fr.; *Kalmuswurzel*, G.

The rhizome of Acorus Calamus, *Linné.* Woodville, *Med. Bot.* 248; Bentley and Trimen, *Med. Plants*, 279.

Nat. Ord.—Araceæ, Acoroideæ.

Origin.—An herbaceous perennial, with leaves resembling those of the flag (iris), and green triangular flowering stems terminating with a cylindrical spadix of small sessile flowers, and a long two-edged bract resembling the leaves. The plant is indigenous to North America and Northern Asia, but has spread throughout Central Asia to India, and throughout Europe to the Pyrenees. In Burmah and Ceylon it is cultivated. It grows in the muddy margins of streams and swamps.

Fig. 44.



Transverse section of rhizome of Calamus; magnified three diameters.

Description.—The rhizome grows to the length of several feet, is horizontal, subcylindrical, about ¾ inch (2 Cm.) in diameter; reddish-brown, longitudinally wrinkled, distinctly annulate from the transverse and obliquely-directed leaf-scars, which are crowded near the over-ground stems; in other parts ⅜ to ½ inch (9 to 12 Mm.) or more distant, and some of them fringed by projecting wood-bundles; the lower surface of the rhizome shows the circular root-scars arranged in a wavy single or sometimes double line, branching alternately to the right and left. It has a spongy texture, due to numerous air-passages, and breaks with a short corky fracture, showing a white or pale reddish-white color internally. Upon the transverse section a fine darker line (nucleus sheath) separates an elliptical central portion from an outer layer, the latter being in width about one-fifth the diameter of the rhizome. The wood-bundles are irregularly scattered, most numerous within the nucleus sheath; the oil-cells, which become more conspicuous on being moistened by an alkali, are likewise scattered and more numerous in the outer portion.

Calamus has an agreeable aromatic odor, which is best preserved by keeping the rhizome unpeeled, as directed by the present Pharmacopœia. Peeled calamus when fresh is white, but turns pinkish on drying, and is less aromatic and bitter than the unpeeled. It should be collected early in spring, and deprived of the far less aromatic and bitter rootlets, which are 4 to 6 inches (10 to 15 Cm.) long, unbranched, but near the tip beset with soft thin fibres. On drying it loses from 70 to 75 per cent. in weight. It is not subject to adulteration, and cannot easily be confounded with other rhizomes.

Constituents.—The rootlets contain little of the volatile oil; the rhizome yields from 1½ to 2 per cent.; Bartels obtained from the fresh-peeled rhizome ¼ per cent., Martius 1 per cent. from the peelings. The yellowish or brown-yellow oil (Oleum calami, *P. G.*) has an agreeable odor, turns red-brown by ferric chloride, and contains, according to A. Kurbatow (1873), a hydrocarbon, $C_{10}H_{16}$, of a terebinthinate odor, boiling at 159° C. (318.2° F.), and yielding with chlorine a crystalline mass which melts at 65° C. (149° F.). The portion boiling at a higher temperature is of a deep-blue color, and not of a constant boiling-point. Faust (1867) named the bitter principle *acorin.* It was obtained from the concentrated decoction by precipitating it successively with alcohol and acetate and subacetate of lead, removing the lead by sulphuretted hydrogen, neutralizing with soda, and agitating with ether, which leaves it as a soft brown-yellowish mass, soluble in ether and alcohol, having a faint alkaline reaction, and being precipitated from its solution in hydrochloric acid by tannin, phospho-molybdate of sodium, and iodo-hydrargyrate of potassium. It contains nitrogen, and when boiled with dilute sulphuric acid or baryta-water yields sugar and a resin-like body. Flückiger obtained a small quantity of crystals from its tannin precipitate by treatment with lead oxide and chloroform. Trommsdorff obtained from the fresh drug 1.6 of starch, 5.5 of gum, 2.3 per cent. of soft resin, and 21 per cent. of cellulose.

Off. Prep.—Extract. calami fluidum, *U. S.*

TINCTURA CALAMI. Digest 1 part of bruised calamus with 5 parts of alcohol spec. grav. .892 for 8 days; express and filter. It has a brownish-yellow color.—*P. G.*

EXTRACTUM CALAMI. Bruised calamus is exhausted by digestion with a mixture of 3 parts of water and 2 parts of alcohol, and the filtered tincture evaporated to the consistence of a thick extract.—*P. G.*

Physiological Action and Medical Uses.—Calamus excites a sense of warmth in the stomach, promotes the appetite, and improves the digestion. It is said to quicken the pulse and increase the secretion of urine and perspiration. In excessive doses it may cause headache. It is added to bitter tonic infusions in atonic *dyspepsia* and other disorders producing abdominal flatulence. It may be used for the relief of flatulent *colic* and as a very mild stimulant in some cases of the *typhoid condition.* It is often eaten prepared with sugar as a conserve, and it may be habitually chewed to relieve slight dyspeptic disorder. An infusion made with an ounce (Gm. 32) of calamus and a pint of hot water may be prescribed in the dose of a wine-glassful.

CALCII BROMIDUM, *U. S.*—BROMIDE OF CALCIUM.

Calcium bromatum.—*Bromure de calcium*, Fr.; *Bromcalcium*, *Calciumbromid*, G.

Formula $CaBr_2$. Molecular weight 199.6.

Preparation.—Bromide of calcium is readily prepared by dissolving pure calcium carbonate in hydrobromic acid and evaporating the solution. Bödeker has used a method which was described by Faust (1867), and is based upon the decomposition of bromide of sulphur, SBr_6, by lime, whereby bromide and sulphate of calcium are formed; $SBr_6 + 4CaH_2O_2$ yields $3CaBr_2 + CaSO_4 + 4H_2O$. 20 parts of sulphur are dissolved in 240 parts of bromine (300 parts are required by calculation), and the solution added to thin milk of lime, which contains 140 parts of pure lime. After the mixture has become colorless the liquid is filtered, treated with carbonic acid gas, and heated, to remove excess of lime; the filtrate is concentrated, mixed with twice its bulk of alcohol to precipitate calcium sulphate, is again filtered, and evaporated.

Properties.—Thus obtained, bromide of calcium is a whitish, granular, or pulverulent, neutral, deliquescent salt having a pungent bitter and saline taste. It is freely soluble in alcohol (1 part, *U. S.*) and water, the latter solution yielding with difficulty colorless needles. According to Kremers (1857, 1858), 1 part of the salt dissolves at 0° C. (32° F.) in .80 parts, at 20° C. (68° F.) in .70 parts, at 40° C. (104° F.) in .47 parts, and at the boiling-point 105° C. (221° F.) in .32 parts of water, and solutions having at 19.5° C. (67° F.) the specific gravity

	1.044	1.089	1.139	1.194	1.252	1.315	1.385	1.461	1.594	1.641	
contain	5	10	15	20	25	30	35	40	45	50	per cent. $CaBr_2$.

The salt melts at a red heat, giving off bromine; treated with strong sulphuric acid, hydrobromic acid is evolved, afterward bromine and sulphurous acid gas. The aqueous solution yields with ammonium oxalate a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid; with nitrate of silver, a curdy precipitate insoluble in nitric acid and in diluted ammonia-water; and with a few drops of chlorine-water liberates bromine, which dissolves in carbon disulphide with a yellow or brown-yellow color free from violet tint.

The solution left in contact with lime forms an oxybromide of calcium, which has a strong alkaline reaction, and on evaporation is left behind as a very white salt.

Tests.—The neutral reaction of the salt and its ready solubility in water and alcohol exclude most impurities. "If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (absence of bromate and nitrate). If 1 Gm. of the salt be dissolved in 10 Ccm. of water, some gelatinized starch added, and then a few drops of chlorine-water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (iodide). On adding to 1 Gm. of the salt dissolved in 20 Ccm. of water 5 or 6 drops of test solution of nitrate of barium no immediate cloudiness or precipitate should make its appearance (sulphate). If a portion of the salt be precipitated with an excess of nitrate of silver, the washed precipitate for some time shaken with a cold saturated solution of carbonate of ammonium, and the decanted and filtered liquid supersaturated with nitric acid, not more than a faint cloudiness, insufficient to produce a precipitate, should appear (limit of chloride). On adding to the aqueous solution, first, chloride of ammonium, then test solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test solution of phosphate of sodium (limit of magnesium). 1 Gm. of the dry salt when completely precipitated by nitrate of silver yields, if perfectly pure, 1.878 Gm. of dry bromide of silver."—*U. S.*

Medical Action and Uses.—In 1871 this salt was stated by Dr. Hammond to produce the characteristic effects of the bromides more promptly than the analogous compounds, and also to induce sleep where they failed to do so. He regarded it as peculiarly appropriate for relieving the *insomnia* caused by mental labor or excitement, and the exhausted and irritable states of the nervous system met with in *hysterical* women, and accompanied by headache, vertigo, insomnia, and extreme mental excitability. He also found that it cured *epilepsy* in very young infants when bromide of potassium failed. The best mode of administering it is said to be according to the following formula: ℞. Calcii bromid. ℥j; Syrupi calcis lactophos. f℥iv.—M. S.—A teaspoonful three times a day in a little water in epileptic cases. As a hypnotic for adults the dose is from 20 to 30 grains (Gm. 1.30 to 2.00).

It has been objected to this as well as to the other bromine salts that their sedative action is due not to the bromine they contain, but to their alkaline or earthy bases. This strange notion is sufficiently condemned by the fact that uncombined bromohydric acid produces the same effects as its salts.

Iodobromide of calcium is reported to have maintained in quiescence the distressing symptoms of a case of *exophthalmic goitre*, and at last reduced the thyroid gland to its natural size.

CALCII CARBONAS PRÆCIPITATUS, *U. S.*—PRECIPITATED CARBONATE OF CALCIUM.

Calcii carbonas præcipitata, Br.; *Calcium carbonicum præcipitatum*, P. G.; *Calcaria carbonica præcipitata*, *Carbonas calcicus præcipitatus*, *Creta præcipitata.—Precipitated carbonate of lime*, E.; *Carbonate de chaux précipité*, *Craie précipitée*. Fr.; *Calciumkarbonat*, *Präcipitirter kohlensaurer Kalk*, G.

Formula $CaCO_3$. Molecular weight 100.

Preparation.—Take of Chloride of Calcium 5 ounces; Carbonate of Soda 13 ounces; boiling Distilled Water a sufficiency. Dissolve the chloride of calcium and carbonate of soda each in 2 pints of the water; mix the two solutions and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling distilled water until the washings cease to give a precipitate with nitrate of silver, and dry the product at the temperature of 100° C. (212° F.).—*Br.*

In this process a mutual decomposition of calcium chloride and sodium carbonate takes place, resulting in the formation of sodium chloride, which remains in solution, and calcium carbonate, which precipitates. The decomposition is illustrated by the equation $CaCl_2 + Na_2CO_3 = 2NaCl + CaCO_3$. The precipitate retains, even after prolonged washing, a small portion of sodium salt; made with ammonium carbonate, it is much more readily freed from the latter by washing. If carbonate of calcium is precipitated in the cold, it is flocculent and quite voluminous, and with difficulty deprived of the mother-liquor by washing; hence it is advisable to heat the solutions before mixing them.

Properties.—Thus prepared, it is a white, impalpable, inodorous, and tasteless powder consisting of microscopic rhombohedric crystals, but entirely free from grittiness. It has the specific gravity 2.72, is without action upon moistened test-paper, and is not altered in the air, but above 400° C. (752° F.) begins to evolve carbonic acid gas, and at a red heat is entirely converted into calcium oxide. The salt is completely insoluble in water and alcohol, but dissolves without residue in dilute hydrochloric, nitric, or acetic acid, carbonic acid gas being copiously given off. Such solutions, if necessary neutralized with ammonia, yield with oxalate of ammonium a white precipitate of oxalate of calcium, which is insoluble in acetic acid, but dissolves in hydrochloric acid.

Tests.—"On adding to the solution in acetic acid first, chloride of ammonium, then test solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test solution of phosphate of sodium (limit of magnesium). A solution of the salt in hydrochloric acid, freed from carbonic acid gas by heat, should not be rendered turbid when supersaturated with water of ammonia (absence of aluminium, iron, or phosphate)."—*U. S.* This ammoniacal liquid on being heated and precipitated by ammonium carbonate should yield a filtrate which, on being evaporated to dryness and ignited, should leave not more than a trace of residue (magnesium and sodium salt).

A substitution of calcium sulphate for the carbonate, wholly or partly, has been occasionally observed; this will not readily dissolve in diluted hydrochloric acid, with little or no effervescence; boiled with distilled water and allowed to cool, then filtered, a liquid will be obtained giving a white precipitate with barium chloride.

Off. Prep.—Trochisci bismuthi, *Br.*

Medical Action and Uses.—Chalk is astringent and antacid. In the form of prepared chalk it is much used as a dusting powder by females who have a coarse and greasy skin, and also to promote the healing of slight *abrasions*, *burns*, and *scalds*, certain cutaneous eruptions, etc. It is used in an ointment as a dressing for *ulcers* with flabby granulations and a profuse discharge. It is administered internally to check *diarrhœa*, especially when due to cold and accompanied with acidity, as indicated by sour eructations or breath, colic, flatulence, and acid and greenish discharges. If there is any reason to suppose that the alimentary canal contains undigested food, a mild laxative (magnesia) should first be given. Chalk is generally prescribed to relieve diarrhœa in the form of the officinal chalk mixture, with the addition of an astringent, as tincture of catechu, of kino, etc., and a few drops of laudanum. There is no better medicine in the incipient stages of epidemic *cholera*. The *dose* of prepared chalk is from 5 to 60 grains (Gm. 0.30–4.00) or more, suspended in thin mucilage.

CALCII CHLORIDUM, *U. S.*, *Br.*—CHLORIDE OF CALCIUM.

Calcium chloratum, *Calcaria muriatica*, *Chloridum calcicum*.—*Chlorure de calcium*, Fr.; *Chlorcalcium*, *Calciumchlorid*, G.

Formula $CaCl_2$. Molecular weight 110.8.

Chloride of calcium deprived of its water by fusion at a low red heat. It should be preserved in a well-stopped bottle.

Preparation.—This compound is a by-product in many chemical processes, among others in that for solution of ammonia. It may be formed by neutralizing hydrochloric acid with marble or other calcium carbonate; $CaCO_3 + 2HCl$ yields $CaCl_2 + CO_2 + H_2O$. Iron being usually contained in these native carbonates, it is removed by digesting the solution with chlorinated lime and slaked lime, by which the iron is first converted into ferric chloride and then precipitated as ferric hydrate. The filtrate, which will be found to have an alkaline reaction, is neutralized with hydrochloric acid, evaporated, and dried at a temperature of 200° C. (392° F.). The direction of the U. S. P. to heat to low redness is an unnecessary complication, since the whole of the water of crystallization is expelled at 200° C.; the Br. P. directs the salt to be dried at 204.5° C. (400° F.), and regards its composition to be $CaCl_2.2H_2O$ (mol. weight 146.8).

Properties.—Calcium chloride is in white, dry, but very deliquescent inodorous masses, and has a hot, saline, and bitterish sharp taste. The U. S. Pharmacopœia describes it as colorless, slightly translucent, hard, and friable masses, in which condition it is obtained by heating the salt to fusion at a red heat. Since in driving off the last portions of water a small quantity of chlorine is expelled as hydrochloric acid, the anhydrous salt has usually a faint alkaline reaction, which is increased at a red heat. According to Kremers (1858), 1 part of the anhydrous salt dissolves at 10° C. (50° F.) in 1.58 parts, at 15° C. (59° F.) in 1.46 parts, at 20° C. (68° F.) in 1.35 parts, at 40° C. (104° F.) in .83 part, at 60° C. (140° F.) in .72 part of water; the solution, saturated at 15° C. (59° F.), has the specific gravity 1.41104. The concentrated solutions, exposed to a low temperature, deposit transparent crystals of the salt containing $6H_2O$, and these melt in the neighborhood of 30° C. (86° F.); when evaporated to dryness at a temperature not exceeding 150° C. (302° F.) a crystalline powder, $CaCl_2.2H_2O$, is obtained, which on being mixed with two-thirds its weight of snow produces a temperature of −45° C. (−49° F.). The anhydrous salt dissolves in about 8 parts of cold absolute alcohol, and at 78.3° C. (174° F.) in 1.43 parts; it is more freely soluble in alcohol containing water. These solutions are precipitated by an excess of ether, and on concentration and cooling yield soft white crystals of calcium chloride, combined with alcohol ($2C_2H_6O$) or with alcohol and water. The aqueous solution yields with ammonium oxalate a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid, and with silver nitrate a white precipitate readily soluble in ammonia and reprecipitated by nitric acid.

Tests.—"The dilute aqueous solution should not be precipitated by water of ammonia (aluminium, iron, etc.), nor by test solution of chloride of barium (sulphate). On adding to the aqueous solution, first, chloride of ammonium, then test solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test solution of phosphate of sodium (limit of magnesium)."—*U. S.* The aqueous solution should not be precipitated by lime-water (absence of soluble carbonate), by solution of calcium sulphate (absence of barium), or by hydrosulphuric acid, neither before nor after the addition of ammonia (absence of metals).

Pharmaceutical Uses.—Chloride of calcium is used for the drying of gases and certain liquids and in the preparation of various calcium salts. For the latter purpose it is directed only in the process for Calc. carbonas præcipitata.

Liquor calcii chloridi, *Br.*—Dissolve calcium chloride 88 grains in distilled water 1 ounce. Spec. grav. 1.145.

Physiological Action and Medical Uses.—Chloride of calcium is an active irritant, and in excessive doses may occasion gastro-intestinal inflammation. In medicinal doses it is supposed to have a special action upon the glandular system, increasing secretion, removing infarctions, etc. It has been used very successfully to reduce *scrofulous* swellings of the external lymphatic glands, of the mesenteric glands, etc., and in strumous *diseases of the skin*, particularly *lupus*. In the latter cases it should be associated with iodine, applied locally. It is also said to exhibit peculiar virtues in the *dyspeptic* disorders to which scrofulous children are subject, and which are popularly supposed to be of verminous origin, such as restless sleep, capricious appetite, irregular stools, foul breath, and enlarged tonsils. (For full details see W. Begbie, *Works*, Sydenham Soc. ed., p. 307.) Physicians of authority have affirmed its curative power in cases of *uterine* and *ovarian tumors*. The only tumors which contract under this or any other medicinal treatment are the so-called muscular tumors, which may be reduced by the loss of their liquid constituents. The use of the medicine is not unattended with risk. If persisted in for a length of time it is apt, according to Wells, to bring about calcareous degeneration of the arteries generally. Whatever action it may possess in arresting the growth of fibroids probably depends upon this property. *Dose*, from 10 to 20 grains (Gm. 0.60–1.30), taken in milk or dissolved in a large quantity of water. The old "solution of muriate of lime" (*Ph. Edin.*) contained 8 ounces of the crystallized salt in 12 fluidounces of water. *Dose* for an adult, from 20 to 50 minims, in water or milk. A syrup has been prepared which contains 5 ounces of the crystallized salt in 12 fluidounces of the excipient. *Dose*, a teaspoonful.

CALCII HYPOPHOSPHIS, *U. S.*, *Br.*—Hypophosphite of Calcium.

Calcis hypophosphis, Br. Add.; *Calcium hypophosphorosum*, *Calcaria hypophosphorosa*, *Hypophosphis calcicus*.—*Hypophosphite of lime*, E.; *Hypophosphite de chaux*, Fr.; *Calcium-hypophosphit*, *Unterphosphorigsaurer Kalk*, G.

Formula $Ca2PH_2O_2$ or $CaH_4(PO_2)_2$. Molecular weight 170.

Preparation.—Hypophosphite of calcium is obtained by heating phosphorus with milk of lime, inflammable phosphoretted hydrogen being given off—namely, $3(Ca2HO) + 6H_2O + 4P_2$ yields $3(Ca2PH_2O_2) + 2PH_3$. Procter (1858) uses a deep boiler, in which a uniform milk is made with 4 pounds of burned lime and 5 gallons of water; 1 pound of phosphorus is added, and the whole boiled, boiling water being added from time to time to preserve the measure, until the phosphorus has been all oxidized and the strong odor of phosphoretted hydrogen has disappeared. The mixture is filtered, the residue washed with water, the mixed filtrates evaporated to 6 pints, filtered from the hydrate and carbonate of calcium, and again evaporated and crystallized or granulated. Nearly half the phosphorus is oxidized to phosphoric acid, probably by the decomposition of water, since the escaping gas contains free hydrogen (Wurtz) and remains with the excess of lime as calcium phosphate. E. Scheffer (1858) succeeded in avoiding much of this loss by using phosphorus which had been previously burned under water by passing atmospheric air into it, whereby it assumed a spongy appearance. It unites then with the lime even at the ordinary temperature, but more readily at 55° C. (about 130° F.), and very little spontaneously inflammable gas is generated. The salt is prepared on the large scale by adding granulated phosphorus to milk of lime and exposing the mixture to the air, and agitating frequently until the phosphorus has disappeared. A small portion of phosphoretted hydrogen is evolved (Gmelin-Kraut's *Chemie*). It is well to precipitate the dissolved lime by passing carbonic acid gas through the warm filtrate and by filtering again. The observation previously made by Wurtz, that hypophosphites boiled with an excess of alkali are decomposed into hydrogen and phosphite or phosphate, has been recently confirmed by W. F. Short (1882) for the calcium salt prepared by boiling with excess of lime.

Properties.—Hypophosphite of calcium crystallizes in transparent, thin, flexible scales composed of flat monoclinic prisms, but is usually met with as a white crystalline powder with a pearly lustre, of a neutral or slightly alkaline reaction, inodorous, and of a bitter, nauseous taste. In the dry state it is permanent in the air, but when dissolved in water it is gradually oxidized to calcium phosphate. Heated to redness in a retort, it decrepitates, evolves water, spontaneously inflammable phosphoretted hydrogen, and a little phosphorus, and leaves nearly 80 per cent. of a reddish residue containing a little amorphous phosphorus and calcium pyrophosphate. The salt dissolves in 6 parts (6.8 parts, *U. S.*) of cold and in a slightly less amount of boiling water; it is insoluble in strong and but slightly soluble in dilute alcohol (H. Rose). The solution yields white precipitates with silver nitrate and with mercuric chloride, both turning dark when heated, from a reduction to the metallic state. Metallic gold is precipitated from the chloride, and the soluble copper salts yield, with the solution, particularly on heating, metallic copper. Oxalate of ammonium produces in the solution a white precipitate which is insoluble in acetic acid, but dissolves in hydrochloric acid.

Tests.—Its complete solubility in water proves the absence of phosphate and carbonate of calcium. The solution should not be precipitated by lead acetate (absence of soluble phosphate, etc.) or by acidulated barium chloride (absence of sulphate). It should give a blue precipitate with ammonium molybdate, the precipitate appearing green if phosphate is present from the admixture with yellow phosphomolybdate. "On adding to the aqueous solution, first, chloride of ammonium, then test solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test solution of phosphate of sodium (limit of magnesium)."—*U. S.*

Off Prep.—Syrupus hypophosphitum, *U. S.*

Pharmaceutical Uses.—SYRUPUS CALCII HYPOPHOSPHITIS. Hypophosphite of Calcium 1 ounce; Water 9½ fluidounces; Sugar 12 ounces; Essence of Vanilla ½ fluidounce. Dissolve and mix (Procter).

Medical Action and Uses.—On theoretical grounds the combinations of phosphorus with lime have been supposed to possess a power of stimulating and regenerating the nervous system and those tissues which contain phosphorus and lime. The experiments of Perl (*Virchow's Archiv*, lxxiv. 54) led him to conclude that the soluble salts of lime are in a slight degree absorbable, and therefore capable to that extent of acting therapeutically when the normal lime compounds of the body are deficient. According to Dysart, the lacto-phosphate is the only salt of lime that is readily appropriated by the economy (*Practitioner*, xxii. 375). These views have led to the use of the lime salts in *anæmia*, *scrofula*, *caries*, *tuberculosis*, and other cachectic conditions; in *chlorosis* and *menorrhagia*; in *fractures* uniting slowly or imperfectly; in *rickets* and in *Pott's disease*; and in various chronic *profluvia* connected with a feeble and often strumous state of the system. The claims of these preparations, independently of other and more efficient medicines (iron, cod-liver oil) and hygienic influences, consist largely of assertion without evidence, and are too slender to be seriously entertained. Nevertheless, as the preparations of lime in question are innocuous, there is no reason why the degree of benefit they confer, however slight, should not be taken advantage of in the various cachexiæ mentioned. *Dose*, 5 or 6 grains (Gm. 0.30–0.40) or more, at meal-times. The syrup of the hypophosphate of calcium may be used in doses of a fluidrachm (Gm. 4).

CALCII IODAS.—IODATE OF CALCIUM.

Iodate de chaux, Fr.; *Jodsaurer Kalk*, G.

Formula $Ca2IO_3.6H_2O$. Molecular weight 497.2.

Preparation.—The following process was proposed by W. Flight (1864): An alcoholic solution of iodine is gradually mixed with an excess of a filtered aqueous solution of chlorinated lime, care being taken to prevent the increase of temperature, so that the formation of chloride of iodine shall not be permitted. The chlorinated lime oxidizes the iodine, iodate of calcium being precipitated, while chloride of calcium and hydrochloric acid remain in solution; $5CaCl_2O_2 + 2I_2 + 2H_2O$ yields $2CaI_2O_6 + 3CaCl_2 + 4HCl$. Reichardt (1874) directs the use of iodine with an excess of chlorinated lime diffused in water. After decolorization the mixture is slightly acidulated with hydrochloric acid, heated to boiling, and the filtered solution crystallized.

Properties.—Iodate of calcium crystallizes from water in flat, colorless, shining needles, which are slowly efflorescent on exposure, require at 15° C. (59° F.) about 300 parts of water for solution, and are nearly insoluble in alcohol. The aqueous solution yields a white precipitate with oxalate of ammonium, and liberates iodine on the addition of sulphurous acid.

CALCII IODIDUM.—Iodide of Calcium.

Calcium iodatum.—Iodure de calcium, Fr.; *Jodcalcium, Calciumjodid*, G.
Formula CaI_2. Molecular weight 293.2.

Preparation.—The salt is obtained on dissolving slaked lime in hydriodic acid and evaporating; or, 3 parts of iodine are digested with sufficient iron and water until a green solution of ferrous iodide is obtained. The liquid is filtered and mixed with 1 part of iodine, and after this has been dissolved it is boiled with milk of lime prepared with 1 part of burnt lime, until the iron has been precipitated; the liquid is then filtered and evaporated.

Properties.—Iodide of calcium is a white salt which crystallizes with difficulty in pearly scales. It is freely soluble in alcohol and water, and is very deliquescent. 100 parts of water dissolve at 0° C. (32° F.) 192, at 20° C. (68° F.) 204, and at 92° C. (197.6° F.) 435 parts of the salt. On exposure to the air the solution is partly decomposed, carbonate of calcium being precipitated. The solution yields a white precipitate with oxalate of ammonium, and a bright red one with corrosive sublimate.

Tests.—On mixing the solution with sulphurous acid and sulphate of copper in excess and heating the mixture, a grayish precipitate of cuprous iodide is produced, and the filtrate yields no precipitate on the addition of nitrate of silver (absence of chloride and bromide).

Medical Action and Uses.—Experiments seem to show that this salt arrests putrefactive fermentation, deodorizes fecal matter, and acts as an irritant upon the living tissues. Given internally, in doses of from 1 to 3 grains (Gm. 0.06–0.20) three times a day, it is alleged to arrest *erysipelas*, diminish and deodorize *suppurative discharges*, and promote the cure of *scrofulous ulceration*. These statements call for confirmation, and even more so its claims to extraordinary efficacy in pulmonary *phthisis*.

CALCII PHOSPHAS PRÆCIPITATUS, *U. S.*—Precipitated Phosphate of Calcium.

Calcii phosphas, Br.; *Calcium phosphoricum*, P. G.; *Calcaria phosphorica. Phosphas calcicus præcipitatus.—Precipitated phosphate of lime*, E.; *Phosphate de chaux hydraté*, Fr.; *Calciumphosphat, Phosphorsaure Kalkerde*, G.
Formula Ca_32PO_4. Molecular weight 310.

Preparation.—Take of Bone-ash 4 ounces; Hydrochloric Acid 6 fluidounces; Water 2 pints; Solution of Ammonia 12 fluidounces or a sufficiency; Distilled water a sufficiency. Digest the bone-ash in the hydrochloric acid, diluted with a pint of water, until it is dissolved; boil for a few minutes; filter; add the remainder of the water, and afterward the solution of ammonia, until the mixture acquires an alkaline reaction; and, having collected the precipitate on a calico filter, wash it with boiling distilled water as long as the liquid which passes through occasions a precipitate when dropped into solution of nitrate of silver acidulated with nitric acid. Dry the washed product at a temperature not exceeding 100° C. (212° F.).—*Br.*

The process of the U. S. P. 1370 was identical with the above. By dissolving the bone-earth in hydrochloric acid, acid calcium phosphate, $CaH_4 2PO_4$, and calcium chloride, $CaCl_2$, are formed; on the addition of ammonia the result is ammonium chloride, water, and tricalcium phosphate, the latter of which precipitates; $CaH_4 2PO_4 + 2CaCl_2 + 4NH_4HO$ yields $4NH_4Cl + 4H_2O + Ca_3 2PO_4$. The ammonium chloride is removed by washing with water. If the precipitation is effected in the cold the calcium phosphate is very voluminous and the washing is quite difficult. The calcium phosphate of the German Pharmacopœia is prepared by precipitating a solution of calcium chloride with sodium phosphate, has the composition $CaHPO_4.2H_2O$, is more readily soluble than the above salt, and when heated to redness loses 26 per cent. of water.

Properties and Tests.—This preparation is often called *bone phosphate* to distinguish it from other calcium phosphates; it forms a light white, amorphous, permanent powder, which at a strong red heat melts without decomposition, and on cooling yields a porcelain-like mass. When fused with sodium carbonate or digested with a solution of this salt, it is partly decomposed, with the formation of calcium carbonate. It is insoluble in water and other simple solvents; but it is somewhat soluble in solutions of sodium chloride and other neutral alkali salts. Continued boiling with water induces decomposition, with the formation of basic phosphate, $Ca_5(PO_4)_3OH$, and of hydrophosphate, $CaHPO_4$. Calcium phosphate dissolves without effervescence in dilute hydrochloric acid (absence of carbonate); also in dilute nitric and acetic acids, and even in carbonic acid water. The acetic acid solution, which is best obtained by adding to the nitric acid solution an excess of sodium acetate (a white precipitate indicates ferric phosphate), yields a white precipitate with ammonium oxalate (presence of calcium), a white one with ferric chloride, and a yellow one with ammonio-nitrate of silver (presence of phosphate). The solution of 10 Gm. of the phosphate in hydrochloric acid yields with ammonia a white precipitate insoluble in boiling solution of potassa (alumina would be dissolved), and when washed and dried weighs 10 Gm. The phosphate contains small quantities of ammonio-phosphate of magnesium and calcium fluoride, derived from the bones.

Calcium phosphoricum crudum, *P. G.*, is a white or grayish-white powder which dissolves almost completely in dilute hydrochloric acid, with slight effervescence. It is probably *bone-ash.*

Off. Prep.—Pulvis antimonialis, *U. S.*, *Br.;* Syrupus calcii lactophosphatis, *U. S.*

Pharmaceutical Uses.—Syrupus calcii phosphatis. 1 troyounce of phosphate of calcium dissolved with sufficient hydrochloric (or preferably phosphoric) acid, avoiding excess of acid, and sufficient syrup to make 1 pint (Wiegand, 1854). The syrups of chlorhydrophosphate and of acid phosphate of calcium, as used in France, are little more than one-fourth the strength of the preceding.

Syrupus calcii lactophosphatis. The French formula (1877) is as follows: 12.5 Gm. of calcium phosphate are dissolved in sufficient (about 14 Gm.) of concentrated lactic acid and 340 Gm. of water; 630 Gm. of sugar are dissolved in the liquid, and 10 Gm. of essence of lemon added. In the United States 4 drachms of calcium phosphate and sufficient lactic acid have been used for making 1 pint of syrup.

Medical Action and Uses.—If this compound and its preparations possess medicinal virtues, they are chiefly those of the hypophosphite of lime, which is treated of elsewhere. They have been used with reputed advantage in *mollities ossium*, and also to promote the consolidation of *fractures* in which the formation of callus is slow or imperfect. The *dose* of the phosphate is from 10 to 30 grains (Gm. 0.60–1.60), and may conveniently be given in carbonic acid water.

CALCII SULPHAS.—Sulphate of Calcium.

Gypsum, E.; *Sulfate de chaux*, *Gypse*, Fr.; *Calciumsulfat*, *Schwefelsaurer Kalk*, *Gyps*, G.
Formula $CaSO_4.2H_2O$. Molecular weight 172.

Origin.—This compound is met with in nature in the form of transparent prisms known as *selenite*, and in semi-opaque or opaque masses which are called *alabaster* and *gypsum*. On adding sulphuric acid or a sulphate to a solution of a calcium salt the same compound is precipitated.

Properties.—Sulphate of calcium is white, crystalline or amorphous, insoluble in alcohol, soluble in about 380 parts of cold water and in 450 parts of boiling water: an aqueous solution, saturated at the ordinary temperature, becomes turbid on being heated to boiling. When heated to between 100° and 200° C. (212° and 392° F.) the salt becomes anhydrous. The nearly anhydrous salt is Calcii sulphas, *Br.*

Calcii sulphas ustus, s. Calcium sulfuricum ustum, *P. G.*—Plaster of Paris, *E.;* Plâtre, *Fr.;* Gebrannter Gyps, *G.*—It is obtained from native gypsum in the manner indicated above, and after grinding constitutes a white amorphous powder, which when made into a paste with water combines with it and solidifies in a few minutes, at the same time slightly expanding in volume. Gypsum which has been dehydrated at 400° C. (752° F.) or at a higher temperature is *overburnt*, and does not exhibit the property of rapidly recombining with water. Plaster of Paris should be preserved in well-closed vessels, to prevent the gradual absorption of moisture from the atmosphere.

Surgical Uses.—Plaster of Paris is used for making casts of deformities and surgical injuries, and as one of the articles adapted for applying the so-called immovable apparatus intended to retain broken bones in a fixed position. "A roller of coarse, soft muslin must have dry plaster of Paris thoroughly rubbed into its meshes; some cold water is then to be poured upon either end of it, so as to moisten it through. A dry roller having been previously applied to the limb, the wetted plaster bandage must be smoothly rolled upon it, the surgeon taking care that no reverses are made. . . . . It hardens in the course of a few minutes, and as it dries forms a solid, hard, and light casing to the limb. It has the advantage over the starch apparatus of being lighter, and especially of drying and hardening quickly" (Erichsen). Some surgeons recommend "crinoline," and others "cheese-cloth," in preference to muslin as a material for the bandages, on account of the larger meshes of their web; and it is suggested to impregnate the fabric with the powdered plaster of Paris by passing it through a box containing this substance. To render the plaster less brittle it is sometimes mixed with mucilage, which, however, causes it to dry more slowly. The bandage may be converted into a jacket by cutting it, when dry, down the middle of the front and finishing the edges with eyelet-holes and lacings. (See *Med. Record*, xvi. 487.)

This bandage has been regarded as peculiarly suited to the treatment of simple, compound, and comminuted *fractures* of the limbs and ribs, and of Pott's *disease of the spine*. It is regarded by surgeons as the best form of immovable apparatus, provided that it be judiciously and skilfully applied; but some object that, owing to the concealment of the seat of injury, cures with shortening, deformity, etc. are more common with the use of the immovable than with other apparatus. In treating angular curvature of the spine the patient is partially suspended by the head and shoulders, or is lying prone in a canvas hammock, while the bandage is applied. (For further information compare *Med. Record*, xxi. 11; *Med. Chir. Trans.*, lxiv. 295.)

CALCII SULPHIS.—Sulphite of Calcium.

Sulfite de chaux, Fr.; *Schwefligsaurer Kalk*, G.

Formula $CaSO_3.2H_2O$. Molecular weight 156.

Preparation.—4 parts of slaked lime are intimately mixed with 1 part of water; the mixture is spread out in thin layers, and sulphurous acid gas passed into the vessel or chamber as long as it is absorbed; or, the gas is passed into milk of lime and the resulting precipitate dried.

Properties.—Sulphite of calcium is a white powder requiring 800 parts of cold water for solution; it dissolves readily in aqueous sulphurous acid, and crystallizes from this solution in hexagonal prisms. It has a slight sulphurous taste, and on exposure is gradually converted into sulphate of calcium.

Medical Action and Uses.—The local action of this sulphite appears to be very slight, since when administered to dogs in very large doses it does not occasion any signs of gastro-intestinal irritation. This fact is referable, in part at least, to the great insolubility of the compound. It appears to be absorbed and excreted without change in the urine. It limits *fermentation* and *putrefaction* in the digestive organs, like other compounds of sulphurous and hyposulphurous acids (see Acidum Sulphurosum), and may be applied externally for the same purposes and to stimulate indolent *ulcers*, etc. The very large quantities which are considered necessary for securing its effects render its internal administration as difficult as it is indeed superfluous, considering the number of soluble sulphites and hyposulphites available.

CALENDULA, *U. S.*—Calendula.

Marigold, E.; *Souci*, *Fleur de tous les mois*, Fr.; *Ringelblume*, *Todtenblume*, G.

The fresh flowering herb of Calendula officinalis, *Linné*.

Nat. Ord.—Compositæ, Cynareæ.

Description.—The garden marigold is an annual plant, a native of Southern Europe and the Levant, and is frequently cultivated for ornament. It has a spreading somewhat angular and roughish-hairy stem a foot or two (.3 to .6 M.) high, and alternate, sessile, rather fleshy, hairy, and entire or few-toothed leaves, of which the lower ones are spatulate or obovate, and the upper ones varying between oblanceolate and lance-oblong. The flower-heads are terminal, about 2 inches (5 Cm.) broad, have a flattish, hemispherical involucre, with two rows of nearly equal linear-lanceolate scales, and a flat receptacle without chaff. The ray-florets are in one or several rows, pistillate, strap-shaped, about ¾ inch (19 Mm.) long, ⅛ inch (3 Mm.) wide, veined, three-toothed at the apex, and vary in color from light-yellow to orange. The numerous disk-florets are tubular, five-cleft, yellow, staminate, and barren. The akenes are strongly incurved or coiled, and more or less muricate, those of the outer row distinctly winged, those of the inner rows with slight or no wings. The fresh plant has a rather strong and heavy somewhat narcotic odor and a bitter somewhat saline taste. After drying, the plant has but little odor and a weaker taste.

The dried ray-florets, and occasionally also the flower-heads, are sometimes found in commerce; they have the characters described above. On exposure to the sunlight the yellow color of the florets is changed to a whitish tint.

Substitution.—In 1867 we called attention to the fact that the flower-heads of Tagetes erecta, *Linné*, were sold as calendula, and we believe that much of the *fluid extract of calendula* at present in the market is really obtained from the species named and from Tag. patula, *Linné*. These two plants are indigenous to Mexico and tropical America, but are often cultivated under the names of *French* or *African marigold*. They have pinnatifid leaves and showy flowers, with the scales of the involucre united to form a tube, the receptacle naked, and the ray-florets broadly ligulate, toothed, light or deep orange-colored, sometimes (T. patula) striped with red; the akenes are flattish, slender, and crowned with a few chaffy or awned scales.

Composition.—Calendula was analyzed by Geiger (1818), who, besides the usual constituents of herbs, found in it an amorphous bitter principle and *calendulin*, which is yellowish, tasteless, insoluble in ether, soluble in alcohol, and swelling with water into a transparent jelly.

Pharmaceutical Uses.—Tinct. calendula, *U. S.*, is prepared from the powdered herb; the direction to use the calendula *fresh* must evidently be interpreted to mean that the carefully-dried flowering herb is to be kept not longer than for 1 year. The florets of marigold form an ingredient of some fumigating-powders, being added on account of their bright color. *Fluid extract of calendula* may be prepared according to the formula for Extr. calumbæ fluidum.

Medical Action and Uses.—The leaves and the unexpanded flowers were at one time supposed to possess stimulant and resolutive virtues, and were used in congestions of the *liver*, *jaundice*, *amenorrhœa*, *scrofula*, and even in *typhoid* febrile states. Both internally and externally marigold was employed in the treatment of *cancer*, and was thought to dispose cancerous ulcers to heal. A solution of the extract and a decoction of the herb were employed for this purpose. A saturated tincture of the flowers is said to promote the cure of *contusions*, *wounds*, and simple *ulcers*. A tincture of calendula has (1881) been recommended in suppurative *otitis*, but as it was mixed with boracic acid, which was alone competent to the cure, the efficacy of the tincture may be doubted (*New York Med. Record*, xx. 729). The extract is alleged to have been very efficient in allaying chronic *vomiting*, as well as for the purposes above enumerated. It was given in doses of 2 grains (Gm. 0.10) several times a day.

CALLITRICHE.—Water-Starwort.

Callitriche verna, *Linné*.

Nat. Ord.—Callitrichaceæ.

Description.—The plant is a native of Europe, and of North America from Pennsylvania and New Jersey northward. It grows in stagnant waters and sluggish rivulets, has a stem 1 or 2 feet (.3 to .6 M.) long, radiating at the nodes, and nearly sessile, obovate, entire, and three-nerved floating leaves, which are crowded in a tuft and about $\frac{1}{3}$ inch (8 Mm.) long; the submerged leaves are longer and linear, the flowers monœcious and inconspicuous.

A closely-allied species, Call. heterophylla, *Pursh*, which is common in the Southern United States, has broadly spatulate and petiolate floating leaves, and is used for the same purposes as the Northern water-starwort.

Medical Action and Uses.—Water-starwort is esteemed in the Southern States as a diuretic in *dropsy*, and is administered in the form of a tincture or in spirits saturated with the plant. In decoction it is given to horses to promote diuresis.

CALUMBA, *U. S.*—Calumba.

Calumbæ radix, Br.; *Radix colombo*, P. G.; *Radix columbo.*—*Colombo*, *Columbo*, E.; *Colombo*, Fr.; *Kolombowurzel*, G.

The root of Jateorrhiza Calumba, *Miers*, s. Cocculus palmatus, *Wallich*. *Bot. Mag.*, 2970, 2971; Bentley and Trimen, *Med. Plants*, 13.

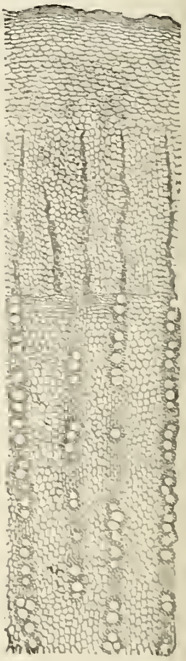
Nat. Ord.—Menispermaceæ.

Origin.—Besides the plant named above, Jateorrhiza palmata, *Miers*, s. Cocculus palmatus, *De Candolle*, has been named as the source of the drug. The distinctive characters, supposed to depend upon the shape of the basal lobes of the leaves and the presence or absence of hairs in the male inflorescence, were proven by Hanbury to be unimportant and to exist on the same stem; hence he suppressed the name of a supposed species, retaining that of J. palmata. Bentley agrees with these views, but retains the name of J. Calumba. The name is derived from *kalumb*, the African name of the root.

The plant is indigenous to the forests of Mozambique, in the southern portion of Eastern Africa, quite abundant along the lower Zambesi River, and cultivated in some African and East Indian islands. It is a hairy perennial climber, which reaches the summits of lofty trees, has large nearly orbicular, cordate, and palmately-lobed leaves, and diœcious flowers. It grows from a short, thick, and irregular rhizome, and this gives off numerous fusiform roots, which are the portion collected during the dry season, cut into transverse slices, and dried in the shade.

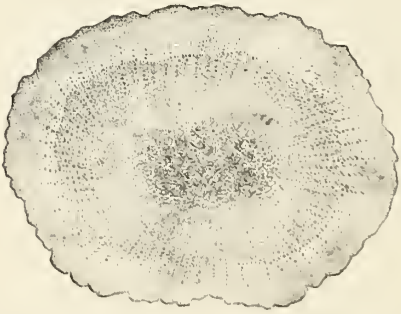
Description.—Columbo-root exists in commerce in nearly circular disks, having a diameter of 1 to 2½ inches (25 to 63 Mm.), and a thickness of about ¼ to ½ inch (6 to 12 Mm.). From the considerable shrinking of the parenchyma the central portion is quite depressed, but the meditullium shows two or three circles of projecting and radiating vascular bundles, and upon a fresh section the dark-colored cambium line becomes plainly discernible, together with the numerous radiating dark-colored and narrow bast-wedges. The fresh section is of a light or grayish-yellow color, more yellowish-brown in the outer bark, which externally shows a gray-brown cork. The root breaks very readily in all directions with a short and mealy fracture; its odor is slight, more prominent and characteristic on powdering or moistening; the taste is slightly aromatic, persistently bitter, and at the same time mucilaginous. As imported it is often more or less worm-eaten.

Fig. 46.



Calumba: trans. section through the outer portion; mag. 25 diam.

Fig. 45.



Calumba: transverse section, natural size.

Colombo-root enters commerce directly from Zanzibar or through Bombay and other Indian ports. 38,115 pounds were received in the United States in 1882; during the preceding year only 8336 pounds.

Constituents.—Columbo-root has been analyzed by Planche, Wittstock, Buchner, Lebourdais, and Boedeker. *Columbin* was obtained by Wittstock (1830) by evaporating the ethereal tincture of the root. Boedeker (1849) prefers to obtain it by shaking the turbid aqueous solution of the alcoholic extract with ether. It forms colorless, inodorous, and very bitter prisms and needles, and is soluble in alkalies and hot alcohol, and in acetic acid, less so in cold alcohol and ether, and nearly insoluble in water. Boedeker found the yellow color of the cell-walls due to *berberine*, which exists probably in combination with the straw-yellow bitter *columbic acid*; the latter is almost insoluble in cold water, sparingly soluble in cold ether, freely in alkalies and alcohol; the last two principles are probably formed from the first. Columbin is $C_{42}H_{44}O_{14}$; the addition of ammonia, NH_3, may result in the formation of berberine, $C_{20}H_{17}NO_4$, columbic acid, $C_{22}H_{24}O_7$, and $3H_2O$. Buchner (1831) found in columbo-root also 35 per cent. of starch, 17 of pectin, 4.7 of gum, 5 of yellow resin, and a little wax. The root yields about 6 per cent. of ash.

Substitutions.—The roots of bryonia and of Frasera Walteri, which have been occasionally sold as columbo, have scarcely any resemblance to it, and are readily distinguished by their color and by the absence of the dark cambium zone and radiating lines.

Off. Prep.—Extractum calumbæ, *Br.;* Extr. calumbæ fluid., *U. S.;* Infus. calumbæ, Mistura ferri aromatica, *Br.;* Tinct. calumbæ, *U. S.*, *Br.*

Medical Action and Uses.—Columbo is a pure stimulant stomachic tonic, increasing the appetite and improving the digestion. It does not constipate. In India it has long been used in the treatment of *diarrhœa*, *cholera morbus*, and *dysentery*, and in Europe it has been found an efficient remedy for the *vomiting* and *purging* incident to teething, for atonic *dyspepsia*, the vomiting of pregnancy, etc. Its special mode of action appears to depend chiefly upon its constituent berberine (see BERBERIS), although the associated columbin, which is intensely bitter, probably enhances the tonic power of the medicine. In order to preserve the infusion it may be prepared as follows: Take 1 ounce of powdered columbo, ½ ounce of powdered orange-peel, 2 ounces of brandy, and 14 ounces of water. Macerate for 12 hours and filter. Or it may be prepared more quickly by displacement. If a laxative operation is desired, rhubarb may be added to the materials. The dose of columbo in powder is from 10 to 30 grains (Gm. 0.60–2.00). In this form it may be associated with carbonate of iron and a little ginger or orange-peel. The simple infusion, which is no longer officinal, is made with half a troyounce of columbo to a pint of water. *Dose*, 1 or 2 fluidounces (Gm. 32–64).

CALX, *U. S.*, *Br.*—LIME.

Calcaria usta, P. G.; *Calcii oxidum*, *Calcaria*, *Calx viva*, *Calx usta*, *Oxydum calcicum*. —*Burned lime*, E.; *Chaux*, *Chaux vive*, Fr.; *Kalk*, *Aetzkalk*, *Gebrannter Kalk*, G.

Formula CaO. Molecular weight 56.

Lime recently prepared by calcination and preserved in well-closed vessels in a dry place.

Preparation.—Lime is an alkaline earth which is obtained by calcining native carbonate of calcium, such as chalk, limestone, or marble, by which carbonic acid gas is given off, oxide of calcium remaining behind; $CaCO_3$ is decomposed into $CO_2 + CaO$. Prepared on the large scale from native carbonates, it contains also the impurities naturally existing therein, such as magnesia, ferric oxide, alkaline salts, silica, and clay. If the latter is present in sufficient quantity, it will slake feebly or not at all, and is then called *poor* or *over-burnt*. To obtain pure lime, pure calcium carbonate should be employed, and if the calcining has been done in a crucible the resulting mass should be moistened with water and again calcined to expel the carbonic acid gas completely. The same effect is produced on the large scale by constructing the lime-kiln in such a manner that the products of combustion pass over the limestone.

CALCII HYDRAS, *Br.;* Calcaria hydrica.—Slaked lime, Calcium hydrate, *E.;* Chaux éteinte, Chaux hydratée, *Fr.;* Kalkhydrat, Gelöschter Kalk, *G.*—Formula CaH_2O_2. Molecular weight 74.

The British Pharmacopœia gives the following directions for preparing it: Take of Lime 2 pounds; Distilled Water 1 pint (Imperial). Place the lime in a metal pot, pour the water upon it, and when the vapor ceases to be disengaged cover the pot with its lid and set it aside to cool. When the temperature has fallen to that of the atmosphere, put the slaked lime on an iron wire sieve and by gentle agitation cause the fine powder to pass through the sieve, rejecting what is left. Put the powder into a well-stopped bottle and keep it excluded as much as possible from the air. Slaked lime should be recently prepared.

Properties.—Burnt lime is in hard white or grayish-white, porous masses of the specific gravity 3.1 to 3.2. It is fusible with difficulty only before the oxyhydrogen blowpipe, giving off a splendid red light, but is not otherwise altered. It is inodorous, and has an alkaline reaction and a caustic, burning taste. When mixed with about one-half its weight of water it absorbs the latter, the air being at the same time expelled from the pores with a hissing noise; it then becomes heated and is converted into slaked lime, particles of this being mechanically carried up by the vapors; moistened with a small quantity of water, lime becomes luminous in the dark. At 15° C. (59° F.) it requires about 750 parts of water for solution, but at 100° C. (212° F.) over 1300 parts are necessary; hence a solution of lime saturated in the cold becomes turbid on being heated. Exposed to the air, it absorbs water and carbonic acid and is converted into hydrate and carbonate of calcium.

Slaked lime forms a soft white powder of spec. grav. 2.08 and of a strong alkaline taste and reaction. It does not part with its water at 100° C. (212° F.), and becomes completely anhydrous only at a dull red heat, without melting previously. On exposure to the air it is converted into calcium carbonate. When lime is slaked, or slaked lime is mixed with sufficient water to form a thin magma, the mixture is called *milk of lime*.

Tests.—"Lime mixed with water to a thin milk should be dissolved by nitric acid with but little effervescence (limit of carbonate), and without leaving more than a slight residue of insoluble matter. Distilled water agitated with slaked lime should give the reactions mentioned under Liquor Calcis."—*U. S.*

Salts.—Slaked lime decomposes most of the alkaline and metallic salts by combining with their acids and forming *calcium salts*, which are colorless unless the acid be colored, have a neutral reaction upon test-paper, and impart to the flame of the blowpipe a yellowish-red color. Lime salts soluble in water are not precipitated by ammonia, but yield white precipitates with carbonate, phosphate, and oxalate of ammonium, and with sulphuric acid, the latter precipitate being soluble in a large quantity of water, and the former ones in acetic acid, with the exception of the oxalate. Those salts which are insoluble in water are dissolved by dilute hydrochloric acid, and this solution is not disturbed (that of calcium oxalate excepted) when solution of sodium acetate is added in excess; but if to this liquid a solution of ammonium oxalate is added, all the calcium will be precipitated as calcium oxalate.

Pharmaceutical Uses.—On account of its affinity for water, lime is employed in preparing absolute alcohol and strong ether; its affinity for acids renders it useful in the preparation of alkalies (ammonia, potassa, soda), alkaloids (quinine, strychnine, etc.), and certain organic acids and allied compounds (santonin). It is employed in preparing precipitated sulphur, in the manufacture of chlorinated lime and potassium chlorate, and in many other chemical processes. Liquor calcis, *U. S.*, *Br.*, is a solution of it in water, and Potassa cum calce, *U. S.*, contains it as one of its active constituents.

Physiological Action and Medical Uses.—Owing to its strong affinity for organic elements, unslaked lime causes the decomposition of organized matter, and thus favors the solution of the animal and vegetable constituents of soils. With albumen it forms a horny mass. In like manner it is employed to arrest putrefactive fermentation in cesspools, sewers, slaughter-houses, dissecting-rooms, etc. It is used by tanners to remove the hair and cuticle from hides. It has a less affinity for water than the alkalies, and is therefore a less energetic caustic, but in forming a hydrate it evolves a large amount of heat, so that when taken internally in large doses it inflames the mucous membrane of the throat, œsophagus, etc., and even causes ulceration and gangrene of these organs and of the stomach, and death. As a caustic, quicklime has been employed from time immemorial, and was usually mixed with sulphuret of arsenic in the treatment of indolent and unhealthy *ulcers* and for removing superfluous *hair* from the skin. Quicklime may also be used to destroy *nævi* and to establish *issues*, for which purposes a fragment of freshly-prepared lime should be laid upon the skin protected by adhesive plaster with a proper opening in it, and moistened with a few drops of water. The heat produced is estimated at 350° F., and so rapidly destroys the organization of the skin that the lime ought to be removed before it is entirely exhausted in order to prevent too deep an eschar. Mixed with wood-ashes, it has been employed in the treatment of *favus*, and in an ointment containing 1 part of lime to 20 or 30 of lard for the cure of *psoriasis* and indolent *ulcers*.

CALX CHLORATA, *U. S.*—Chlorinated Lime.

Calx chlorinata, Br., U. S. 1870; *Calcaria chlorata*, P. G.; *Chloris calcicus*, *Chloruretum calcis*, *Calcii hypochloris*.—*Chloride of lime*, *Hypochlorite of calcium*, *Bleaching-powder*, E.; *Chlorure de chaux*, *Poudre de Tennant ou de Knox*, Fr.; *Chlorkalk*, *Bleichkalk*, G.

A compound resulting from the action of chlorine upon hydrate of calcium, and containing at least 25 per cent. *U. S.* (30 per cent. *Br.*, 20 per cent. *P. G.*) of available chlorine. Chloride of lime should be preserved in well-closed vessels in a cool and dry place.

Preparation and Composition.—Chlorinated lime was first prepared on an extensive scale by C. Tennant and Knox of Glasgow in 1799, and is manufactured in essentially the same manner at the present time, the improvements introduced at various times consisting in perfecting the apparatus and the production of chlorine. Well-slaked lime, free from dampness, is rubbed through a sieve, and the powder thus obtained is spread upon shelves which are placed in several tiers in boxes or chambers, into which dry chlorine gas is conducted from the top as long as it is absorbed, care being taken to regulate the current of gas in such a manner that the temperature within the chambers does not rise higher than 25° C. (77° F.), in order to avoid the formation of calcium chlorate. According to Lunge (1881), in the presence in the calcium hydrate of an excess of about 4 per cent. of moisture, and at a temperature of about 40° C. (104° F.), a product containing 43 per cent. of available chlorine may be obtained.

The oldest view concerning the composition of chlorinated lime admits of a direct combination and the formation of $CaOCl_2$, and since the whole amount of slaked lime cannot be thus converted, a portion of it was supposed to form a double compound with it, having the composition $2(CaOCl_2.H_2O) + CaH_2O_2$. But it is now generally admitted that a decomposition takes place, the precise nature of which is, however, by no means fully established. It has been assumed that the reaction occurs between two molecules each of calcium hydrate and chlorine. $2CaH_2O_2 + 2Cl_2$ may form $CaCl_2 + Ca2ClO + 2H_2O$; that is, calcium chloride, calcium hypochlorite, and water, which have been by some supposed to be merely mixed together; but since alcohol does not dissolve one-half of the chlorine as $CaCl_2$, others have regarded them to be combined, forming $CaCl_2.Ca2ClO.2H_2O$. Schorlemmer (1873) adopted the view previously suggested by Odling, that chlorinated lime is calcium hypochlorite, in which 1ClO is replaced by Cl; that its formula is therefore $Ca(ClO)Cl$, and that with water this compound yields calcium hypochlorite and chloride. If either of the above be the true composition of chlorinated lime, it should contain about 49 per cent. of available chlorine, while in fact it contains much less. This deficiency has been ascribed to various causes, but mainly to the difficulty or impossibility of exactly forming calcium hydrate without excess or deficiency of water, both of which causes act injuriously; the formation of some calcium chlorate under certain circumstances likewise accounts for a part of the loss. Fresenius and F. Rose (1861) regarded dry chlorinated lime as a compound of calcium hypochlorite and oxychloride with $4H_2O$, formed according to the equation $4CaH_2O_2 + 2Cl_2 = Ca2ClO.Ca_3O_2Cl_2.4H_2O$, and that this compound is decomposed by water into hypochlorite, chloride, and hydroxide of calcium. C. Stahlschmidt (1876) expressed the view that chlorinated lime may be considered as a calcium hydrate in which 1 atom of hydrogen is replaced by Cl, and that its formation is explained by the equation $3CaH_2O_2 + 2Cl_2 = 2CaHClO_2.CaCl_2.2H_2O$, which requires an amount of active chlorine equal to nearly 39 per cent. of the product, which result may be attained in practice. In certain cases, however, nearly 43 per cent. of chlorine has been reached, and this is accounted for by the presence of some moisture, by which the above chlorohydrate of calcium, as it may be called, is decomposed into hypochlorite and hydrate of calcium, $CaCl_2O_2 + CaH_2O_2$, the latter of which, with more chlorine, yielding again chlorohydrate; but to complete the conversion into hypochlorite (and chloride) of calcium a much larger amount of water seems to be necessary than could be retained by dry chlorinated lime. That aqueous solutions of chlorinated lime contain calcium hypochlorite was proven by Kingzett, who obtained this salt from concentrated solutions of the former placed in a freezing mixture or evaporated in a vacuum over sulphuric acid. Schorlemmer, Lunge, and others have shown that with nitric or sulphuric acid carefully added, avoiding excess, a distillate containing hypochlorous acid is obtained; that carbonic acid liberates in the solution hypochlorous acid; and that, after exhausting chlorinated lime with little water, the subsequent solutions contain calcium and chlorine uniformly in the proportion required by the formula $Ca(ClO)Cl$.

Properties.—Chlorinated lime is a white or whitish powder or in friable lumps, dry or but slightly damp, with a feeble odor of chlorine and a disagreeable bitter and saline taste. Under various circumstances it may undergo decomposition on keeping, either with the evolution of oxygen or by conversion into a mixture of chloride and chlorate of calcium. On exposure to the air it absorbs and combines with carbonic acid and becomes moist. It has an alkaline reaction, but finally bleaches test-paper. It is partly soluble in water and in alcohol, wholly soluble in dilute hydrochloric acid (not more than a trifling residue of insoluble matter should be left, *U. S.*), with the evolution of chlorine and the production of calcium chloride; $2Ca(ClO)Cl$ or $Ca2ClO.CaCl_2 + 4HCl$ yields $2Cl_2 + 2CaCl_2 + 2H_2O$. If chlorinated lime contains a larger percentage of calcium chloride than is indicated by one of the above formulas, its chlorine will not be liberated, and is therefore not *available chlorine* for bleaching purposes. The same decomposition is effected by an excess of all acids except carbonic, which liberates hypochlorous acid. The solution in diluted acetic acid shows the presence of lime by yielding with ammonium oxalate a white precipitate soluble in hydrochloric acid. The aqueous solution, mixed with binoxide of manganese, mercuric, ferric, and other oxides, evolves oxygen (Mitscherlich), and if ammonium sulphate be added nitrogen is given off (Calvert, 1870). The solution in the presence of carbonic or other acid rapidly destroys vegetable colors, and this property finds extensive application in the arts. Distilled with alcohol, wood-spirit, some volatile oils, etc., chlorinated lime generates chloroform, and when it is mixed with certain organic substances in the dry state a gradual decomposition and development of heat take place, and may result at last in an explosion. The spontaneous explosions of chlorinated lime which are on record may probably be referred to such a cause.

Tests.—The solution of chlorinated lime in diluted hydrochloric acid may be tested for impurities in the same manner as a solution of calcium carbonate. The most important determination, however, is that of the amount of available or active chlorine present, and depends upon its oxidizing power. The methods in use are oxidation of arsenious oxide or of ferrous sulphate or of sodium hyposulphite, in the last case preceded by the liberation of iodine. The process adopted is as follows: "If 0.71 Gm. of chlorinated lime be mixed with a solution of 1.25 Gm. of iodide of potassium in 120 Ccm. of water, and 9 Gm. of hydrochloric acid be then added, the red-brown liquid should require for complete decoloration not less than 50 Ccm. of the volumetric solution of hyposulphite of sodium, corresponding to not less than 25 per cent. of chlorine."—*U. S.* "10 grains, mixed with 30 grains of potassium iodide and dissolved in 8 fluidounces of water, produce, when acidulated with 2 fluidrachms of hydrochloric acid, a reddish solution which requires for the discharge of its color at least 934 grain-measures of the volumetric solution of hyposulphite of sodium, corresponding to not less than 33 per cent. of chlorine." —*Br.* "If 0.5 Gm. of chlorinated lime be triturated with 100 Ccm. of water, and to this liquid be added 2 Gm. of potassium iodide, 20 drops of hydrochloric acid, and a little starch solution, the mixture should require for decoloration at least 28.5 Ccm. of decinormal solution of sodium hyposulphite, corresponding to not less than 20 (20.18) per cent. of chlorine."—*P. G.* In the first part of these processes iodine is liberated from the potassium salt, thus causing the red color of the solution or a blue color in the presence of starch; the addition of the hyposulphite causes the formation of tetrathionate and iodide of sodium, the red or blue color disappearing as soon as all the free iodine has been converted into the latter salt. By a slight modification the test may be used to ascertain the true percentage of available chlorine.

Pharmaceutical Uses and Preparations.—Chlorinated lime is largely employed in the arts for bleaching purposes; it is used in preparing chloroform and Liquor sodæ chlorinatæ, *U. S.;* as Vapor chlori, *Br.*, it is used in the moist condition; and Liquor calcis chloratæ, *Br.*, is a solution of it in water.

Fumigatio chlori, P. G. 1872. For *stronger* fumigation use a mixture of table-salt and black oxide of manganese, each 1 part, and sulphuric acid 2 parts, previously diluted with 1 part of water. The *milder* fumigation is made of chlorinated lime mixed with water to a soft mass, vinegar being afterward added.

Physiological Action and Medical Uses.—The action of chlorinated lime resembles that of chlorine, with a superadded causticity derived from the lime in its composition. In moderate doses it appears sometimes to act as an irritant of the stomach and bowels, and if the quantity taken be large it produces heat in these organs, nausea, vomiting, and diarrhœa. If used in a mouth-wash it removes acid, bitter, or metallic tastes. Externally, it is an active irritant, and is sometimes moderately caustic. It dries suppurating surfaces and prevents gangrenous ulceration.

In solution of the strength of 20 or more grains (Gm. 1.30) to the ounce of water it has been regarded as a useful stimulant in purulent *ophthalmia*. This solution on lint is efficacious in *frost-bite* and also as an injection in *gonorrhœa*. In various forms of *ulceration of the mouth*, scorbutic, gangrenous, or arising merely from debility, chlorinated lime promotes cicatrization, and is useful for this affection in scarlatina. Indolent and specific ulcers of other parts, and *burns*, are favorably modified by its use. It may be included among the means of curing *itch* when applied on cloths in a solution containing from $\frac{1}{60}$ to $\frac{1}{40}$ part of chlorinated lime. But care must be taken lest it irritate the skin unduly.

In *typhus fever* it is thought to moisten and cleanse the tongue, allay delirium, and revive the functions of the skin. It tends to reduce excessive mucous secretions, and has been used with marked advantage in the treatment of *phthisis* and *chronic bronchitis* with profuse purulent expectoration. When this is fetid the action of the medicine is peculiarly efficient; and it may be prescribed in atomized inhalations as well as by the stomach. It has been used with success in the treatment of *scrofulous glands*, both internally and in an ointment. Even in some cases of enlarged mesenteric glands its action has appeared to be salutary.

As a *disinfectant* chlorinated lime has been employed under a great variety of circumstances to suspend the decomposition of organic matter and neutralize the resulting foul effluvia. Besides being used for this purpose in privies, close-stools, dissecting-rooms, sewers, etc., it has proved to be very efficacious in correcting the *foul odors* connected with putrefaction in the living body, as in cases of *retained placenta* or uterine clots, *cancer of the uterus* and of other parts, *ozæna*, *mercurial salivation*, *foul breath* due to the decomposition of glandular secretions in the fauces, the fetor exhaled by the *armpits*, *feet*, etc. A false analogy led to its use for preventing contagion by the sick and by infected fomites, but there is no reason to believe that its influence exceeded that of the various measures of purification which were associated with it. Chlorinated lime decomposes hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid, and may therefore be used as a chemical *antidote* to these poisons. Persons *poisoned* by privy and by sewer gases have been restored by holding a cloth wet with a solution of this substance before the nostrils. A similar expedient has been used to protect persons in an atmosphere saturated with *sulphuretted hydrogen*.

The *dose* of chlorinated lime is from 1 to 5 grains (Gm. 0.06–0.30) in solution. From 10 to 60 grains (Gm. 0.50–4.00), dissolved in from 4 to 8 ounces of water and filtered, may be given in 24 hours. As a mouth-wash 1 part dissolved in 100 of water may be used. For external use the most energetic form of the preparation is that of a semi-fluid paste; the feeblest, to be at all useful, may contain 1 drachm (Gm. 4) of chlorinated lime in 8 ounces of water. An ointment for dry atonic ulcers may be made with equal parts of this preparation and lard; for enlarged glands, etc. the proportion of 1 drachm (Gm. 4) to an ounce of lard is sufficient.

CALX SULPHURATA, *U. S., Br.*—SULPHURATED LIME.

Calcaria sulfurata, *Hepar sulphuris calcareum*, *Hepar calcis.*—*Sulfure de chaux*, Fr.; *Kalkschwefelleber*, G.

A mixture consisting chiefly of sulphide and sulphate of calcium (CaS and $CaSO_4$).

This preparation has been erroneously called *calcii sulphidum*, s. *calcium sulfuratum*, and is usually dispensed when sulphide of calcium is prescribed.

Preparation.—Lime, in very fine powder, 100 parts; Precipitated Sulphur 90 parts. Mix the lime and sulphur intimately, pack the mixture with gentle pressure in a crucible so as to nearly fill it, and, having luted down the cover, expose the crucible for 1 hour to a low red heat by means of a charcoal fire so arranged that the upper part of the crucible shall be heated first. Then remove the crucible, allow it to cool, rub its contents to powder, and at once transfer them to small glass-stoppered vials.—*U. S.*

This is one of the formulas which have long been in use for the preparation of sulphurated lime, and in which the proportion of sulphur varied from 1 to 3 parts for 2 parts of lime. The proportions adopted by the Pharmacopœia are those of Hager, who gives the formula $3CaS + CaSO_4$ for the product. But to obtain such a mixture the sulphur is used largely in excess, for the reaction is assumed to take place as follows: $4CaO + 2S_2 = 3CaS + CaSO_4$, or between 224 parts of lime and 128 parts of sulphur, or 100 of lime and little more than 57 of sulphur, so that more than one-third of the sulphur used is in excess, and is either present simply as an admixture, or, more likely, different salts are mixed with calcium sulphides, for a polysulphuret is not attainable by fusion.

The following is the process of *Br.:* Calcium sulphate (nearly anhydrous) 7 oz., wood-charcoal 1 oz., both in fine powder; mix thoroughly; heat to redness in an earthen crucible until the black color has disappeared; cool and at once place the whitish residue in a stoppered bottle.

Properties.—Sulphurated lime is "a grayish-white or yellowish-white powder, gradually altered by exposure to air, exhaling a faint odor of hydrosulphuric acid, having an offensive alkaline taste and an alkaline reaction, very slightly soluble in water and insoluble in alcohol. On dissolving sulphurated lime with the aid of acetic acid, hydrosulphuric acid is abundantly given off and a white precipitate (sulphate of calcium) is thrown down. The filtrate yields, with test solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid."—*U. S.*

Tests.—"If 1 Gm. of sulphurated lime be gradually added to a boiling solution of 1.25 Gm. of sulphate of copper in 50 Ccm. of water, the mixture digested on a water-bath for 15 minutes and filtered when cold, no color should be imparted to the filtrate by 1 drop of test solution of ferricyanide of potassium (presence of at least 36 per cent. of real sulphide of calcium)."—*U. S.* This test requires the mixture to have the composition $CaS + CaSO_4$, the combining weight being 208.

Allied Compounds.—CALCII SULPHIDUM, S. SULPHURETUM, S. SULFURATUM.—Calcium sulphide, *E.;* Sulfure de calcium, *Fr.;* Schwefelcalcium, *G.* Formula CaS. Mol. weight 72.—Nearly pure calcium sulphide is obtained by intimately mixing 12 parts of powdered gypsum with 3 or 4 parts of lampblack or powdered charcoal, and heating the mixture in a covered crucible as long as gas is given off. The charcoal, combining with the oxygen of the calcium sulphate, escapes as carbonic oxide or carbonic acid, and leaves calcium sulphide, CaS, having a grayish, yellowish, or reddish color from impurities naturally present. It is inodorous, has an alkaline and a sulphurous taste, dissolves completely in 500 parts of water, and is gradually decomposed by water into hydrate and sulphydrate of calcium.

CALCII OXYSULPHURETUM, known in France as *sulfure de calcium* or *foie de soufre calcaire.* Mix sulphur 100 parts; slaked lime 300 parts; water 500 parts; boil, stirring frequently, until a portion when dropped on a cold slab will solidify; then pour out on a marble slab, and when cold keep the mass in well-stopped bottles.—*F. Cod.* It has a gray or greenish-gray color, and is a variable mixture of oxysulphuret and hyposulphite or sulphate of calcium.

A solution known in France as *sulfure de chaux liquide* is made by boiling for an hour 2 parts of lime previously slaked, 5 of sublimed sulphur, and 20 of water, water being added to preserve the original amount; the filtrate has the density 1.16.

A soft mass, containing *sulphydrate of calcium,* CaH_2S_2, and used as a depilatory, is prepared from 2 parts of slaked lime and 3 of water by passing into the mixture hydrosulphuric acid as long as it is absorbed. The mass, known as *Martin's depilatory,* has a strong sulphurous odor, and on standing separates into two portions, which are to be mixed when used; if properly prepared, an application for 8 or 10 minutes is sufficient for removing the hair.

PHOSPHORESCENT POWDER OR PAINT. Calcined oyster-shells or cuttlefish-bone 100 parts; caustic lime 100 parts; calcined sodium chloride 25 parts; mix and thoroughly incorporate from 20 to 25 per cent. (about 55 parts) of sulphur and from 3 to 7 per cent. (about 8 to 18 parts) of sulphide of calcium, barium, strontium, or magnesium; the luminosity may be increased by adding incinerated marine algæ. The powder is rendered adhesive by means of varnish, collodion, etc. After exposure to the sunlight it will be luminous in the dark. A similar compound is *Canton's phosphorus* (1768), prepared from burnt oyster-shell 2 parts and sulphur 1 part.

Medical Action and Uses.—Sulphurated lime acts as irritant and corrosive, and is seldom, if ever, used internally. It is decomposed in the stomach, liberating sulphuretted hydrogen gas. The *dose* of it internally is variously stated to be from $\frac{1}{10}$ to $\frac{1}{2}$ grain (Gm. 0.006–0.003) and from 3 to 6 grains (Gm. 0.20–0.40). Externally, it is sometimes employed, in baths containing from 1 to 4 ounces (Gm. 32–128) of the salt, in the treatment of *itch* and certain obstinate scaly *diseases of the skin.* (See SULPHUR.) It has also been used in an ointment (1 to 10 parts in 15 parts of lard) for similar purposes, and as an ingredient of depilatory preparations.

Calcium sulphide has been used, like potassium sulphide, in local and general baths for chronic diseases of the *skin,* chronic *rheumatism,* etc., and internally for chronic *bronchitis,* etc. It was given internally in doses of one-tenth of a grain, gradually increased to a grain (Gm. 0.004–0.060), in the treatment of *acne,* and with alleged success. But as milk of sulphur and other topical applications, as well as other internal treatment, were employed at the same time, the share of the sulphide in the result may have been, and probably was, very small.

In 1869, Dr. Ringer claimed for the sulphides generally, but especially for this preparation, the power of arresting suppuration (*Therapeutics,* p. 48), directing 1 grain of calcium sulphide to be dissolved in half a pint of water, and a teaspoonful of the solution to be taken every hour. Thus, to one-sixty-fourth of a grain of this compound, so administered, was ascribed the cure of scrofulous and tuberculous abscesses. After years of oblivion this method was revived by Dr. F. N. Otis (*New York Med. Jour.,* May, 1880), who claimed for it the power of arresting the suppuration of *buboes, furuncles,* and other *abscesses;* and a case was published in which the cure was attributed to it of a gastro-pulmonary fistula (*Phila. Med. Times,* xi. 73). Ultimately, a much more moderate estimate of the virtues of this preparation was furnished in a report to the Therapeutical Society of New York. It concluded "that in many cases of suppurative affections, ranging from the small pustules of acne to extensive suppurating surfaces, an appreciable, and often a very marked, benefit is derived from the use of calcium sulphide. . . . . At the same time, its action is not uniform, and in many apparently favorable cases it will fail entirely. It is somewhat prone to irritate the stomach." One-tenth of a grain every 2 hours, it is stated, is the full dose, although some patients will bear a grain three or four times a day. "It will occasionally produce headache and more or less eructation of sulphuretted hydrogen" (*Amer. Jour. Med. Sci.,* July, 1882, p. 268). The almost total silence of recent therapeutical works regarding this preparation seems to prove that the statements above made have not appeared convincing to the medical profession.

CAMBOGIA, *U. S., Br.*—GAMBOGE.

Gambogia, U. S. 1870; *Gutti*, P. G.; *Gummi-resina* (*Gummi*) *guttæ*, *s. gutti*, *Gutta gamba. Cambodia.*—*Gutte*, *Gomme-gutte*, Fr.; *Gummigutt*, *Gutti*, G.

A gum-resin obtained from Garcinia Hanburii, *Hooker filius*. Bentley and Trimen, *Med. Plants*, 33.

Nat. Ord.—Guttiferæ (Cluciaceæ).

Origin.—A medium-sized tree with glossy laurel-like leaves and small yellow diœcious flowers, the pistillate ones being on short pedicles. It was formerly regarded merely as a variety (pedicellata) of Garc. Morella, *Desrousseaux* (s. G. pictoria, *Roxburgh;* G. Gutta, *Wight;* G. cambogioides, *Royle;* Hebradendron cambogioides, *Graham*), and is indigenous to Siam, Cambodia, and Cochin China. Flückiger and Hanbury observed that the yellow milk-juice is secreted in unbranched ducts, which are principally located in the middle bark, and to a less extent in the dotted vessels of the alburnum, in the pith, leaves, flowers, and fruit. Gamboge is obtained by incisions made into the bark, the latex being collected in the joint of a bamboo, occasionally also in other vessels, where it is allowed to harden.

Description.—Gamboge is in cylindrical, either solid or hollow, straight or bent, sticks, 6 to 8 inches (15 to 20 Cm.) long and 1 to 2 inches (25 to 50 Mm.) in diameter, called "pipes;" the surface is striated longitudinally from impressions of the bamboo, and occasionally contains some splinters of it. Gamboge breaks easily with a flattish conchoidal, smooth fracture, of a deep orange-red tint and of a waxy, somewhat resinous lustre; thin splinters are slightly translucent. It yields a bright-yellow powder, and on being triturated with water a uniform bright-yellow emulsion is readily obtained. This emulsion forms with ammonia-water a clear deep-red afterward brown solution, the liquid becoming colorless on the addition of acids, the yellow resin being precipitated. Gamboge is inodorous, but the dust is sternutatory, and it has a disagreeable acrid taste. Inferior qualities of pipe gamboge are of a brown or gray tint, harder, of a dull earthy or irregular fracture, and less inclined to produce a uniform emulsion.

Cake gamboge has been collected in flat vessels, and is met with in irregular lumps, which otherwise resemble pipe gamboge, but are more liable to be adulterated.

Constituents.—Aside from accidental impurities, like cellular tissue, gamboge contains about 4 per cent. of moisture, the remainder being resin, and 16 to 20 per cent. of gummy matter, which is not identical with gum-arabic. The resin is called *cambogic acid*, is soluble in alcohol, ether, and with a deep-red color in dilute alkalies, and from the latter solution is precipitated unaltered by acids; its solutions yield a yellow precipitate with lead acetate, and brown ones with iron and copper salts. By fusing it with caustic potassa, Hlasiwetz and Barth (1866) observed the disengagement of vapors having the odor of lemon and melissa, and found in the residue, besides acetic and volatile fatty acids, also *phloroglucin* and *pyrotartaric* and two other acids. Gamboge is free from starch, and if adulterated with it an emulsion made with hot water will turn green by solution of iodine, or it may be recognized in the residue left after treatment with alcohol and cold water.

Off. Prep.—Pilulæ catharticæ comp., *U. S.;* Cambogiæ comp., *Br.*

Physiological Action.—Experiments upon animals with gamboge do not render its operation clear. It produces few symptoms of local irritation, but little evidence of pain, fever, nervous motor derangement, or coma, and not uniformly either vomiting or purging. In man, applied to the raw skin, it acts as an irritant. Internally, in small doses, it appears to increase the glandular secretions, but in large doses causes colic and tenesmus. But there is no evidence of its increasing the secretion of bile. In doses of 3 or 4 grains (Gm. 0.20–0.25) it occasions liquid stools, with little or no colic. Rutherford's experiments led him to conclude that gamboge is not a cholagogue, although it violently irritates not only the duodenum, but the whole of the small intestine. He remarks that colchicum, which is equally irritant, is decidedly cholagogue, and infers, therefore, that duodenal irritation alone is not sufficient to increase the excretion of bile. The purgative virtue of gamboge appears to reside in its resinous element. When given in small and repeated doses it is said to cause diuresis. There is no evidence of its having ever produced fatal effects.

Medical Uses.—Gamboge is seldom employed unless associated with other purgatives. It is reputed to be well adapted for relieving such congested states of the *liver* as arise from malarial causes. In these cases it is usually associated with calomel. As a *hydragogue*, acting by the kidneys as well as the bowels, its merits appear to be well established. For this purpose it should be given in small and repeated doses, such as a grain (Gm. 0.06) every hour, dissolved in sweetened water. It is often associated with jalap and with bitartrate of potassium. Its want of taste fits it for use by children. It is sometimes employed as a *vermifuge*, and is then usually prescribed with vermicide medicines.

Gamboge is administered in substance, in the average *dose* of from 1 to 5 grains (Gm. 0.06–0.30). It is most efficient when mixed with water and sugar. A convenient formula is the following: ℞. Gamboge gr. x; Carbonate of potassium ʒj; Cinnamon-water f℥ij. —Mix. S.—30 drops three times a day in water.

CAMPHORA, *U. S., Br., P. G.*—CAMPHOR.

Camphre, Fr.; *Kampfer*, *Campher*, G.

Formula $C_{10}H_{16}O$. Molecular weight 152.

A stearopten or concrete volatile oil obtained from the wood of Cinnamomum Camphora. *F. Nees et Ebermaier*, s. Camphora officinarum, *C. Bauhin*, s. Laurus Camphora, *Linné*, and purified by sublimation. Woodv., *Med. Bot.*, plate 155; Bentley and Trimen, *Med. Plants*, 222.

Nat. Ord.—Lauraceæ.

Origin.—The camphor laurel is a handsome tree 25 to 30 feet (7.5 to 9 M.) high, with thin reddish or yellowish branches, and alternate evergreen, smooth, and shining leaves, which are glaucous beneath. The flowers are small, yellowish, in pedunculate axillary cymes, and produce oblong-globular dark-purple berries about $\frac{1}{3}$ inch (8 Mm.) long and containing a single seed. It is indigenous to Eastern and South-eastern Asia from Cochin China north through China, and in Japan and Formosa. It grows very readily in tropical and subtropical countries, and is cultivated in Italy as an ornamental tree. All parts of the tree have a camphoraceous odor and taste, but the camphor is obtained from the root, trunk, and branches by chipping the wood, and either boiling it with water in an iron vessel which is covered with a rude earthen or wooden head lined on the inside with straw, in which the camphor condenses, or as in Formosa, where the chips are merely exposed to the vapor of water, which is boiled in a wooden trough, lined on the outside with clay, earthen pots, ten in number, serving as the heads of the rude still. The camphor is scraped out from time to time, placed in suitable vats to drain off much of the adhering oil, and then packed. Camphor appears to have been used as a medicine in Europe in the twelfth century. The kind first known was Dryobalanops camphor, which is now seen only as a curiosity outside of Southern Asia.

Commerce.—*Japan* or *tub camphor*, formerly also called Dutch camphor, is imported in tubs containing about 125 pounds, covered by matting and surrounded by another tub. It is in white granular masses, usually with a reddish tint and dry to the touch. *Formosa* or *Chinese camphor*, generally imported in lead-lined chests, is occasionally as handsome in appearance as the preceding, but frequently is in smaller granules, darker, sometimes even blackish in color, or damp from adhering oil or moisture. Crude camphor dissolves completely in alcohol, with the exception of from 1 to 5 or 6 per cent. of foreign matters, sand, etc. In the fiscal year 1866–67, 432,075 pounds of crude and 30,526 pounds of refined camphor passed through the custom-houses of the United States. Since 1876 very little refined camphor has been imported, it varying between 208 pounds in 1877 and 11 pounds in 1882, while in the same period the importation of crude camphor fluctuated between 986,292 pounds in 1879 and 2,542,830 pounds in 1880.

Refining.—This was formerly done exclusively in Europe, but it has for some years been successfully carried on in the United States. It is stated that the apparatuses used in Europe are still the old-fashioned *bombaloes*, large somewhat depressed glass globes with a short neck and an aperture through which the watery vapors find egress; some charcoal or lime is introduced with the crude camphor into the vessels, which are placed in a sand-bath, and this is rapidly heated, first to expel the water, after which the sand is lowered and the heat gradually increased to between 200° and 205° C. (392° and 401° F.); after the camphor has sublimed and condensed at the top the vessels must be broken in order to recover the purified camphor. Similar subliming-vessels are in use in the United States, but they are so arranged that they can be taken apart and used over again, and provision has even been made by a firm in Philadelphia to recover the volatile oil contained in the camphor. The operation requires a careful regulation of the heat for subliming and judicious provision for cooling the top, so as to obtain the camphor in solid crystalline cakes. Another Philadelphia firm sublimes the crude camphor slowly from retorts and condenses the vapors in a large chamber, whereby the camphor is obtained in a fine crystalline powder, which is afterward, by hydraulic pressure, formed into solid cakes, thus lessening the surface of exposure and the rapidity of evaporation.

Properties.—Refined camphor forms orbicular slightly convex cakes, with a circular hole in the centre, corresponding to the aperture of the subliming-vessel. It is white, translucent, crystalline in texture, fissured in the interior, tough, and not pulverizable, except after moistening it with alcohol, ether, chloroform, or a volatile oil. It evaporates slowly at the ordinary temperature, and condenses in partly-filled bottles in the form of glossy hexagonal plates or prisms. Various contrivances have been suggested to keep camphor in the powdered condition, such as precipitation by water in the presence of magnesia, trituration with a fixed oil, glycerin, or sugar; but the most satisfactory method appears to be that proposed by J. C. Lowd (1871), of condensing the hot camphor vapors in a large chamber. When kept in a cool place the powder thus obtained, which is sometimes called *flowers of camphor*, may be preserved for some years, and even if it should cake together may readily be reduced to the pulverulent condition.

Camphor fuses at 175° C. (347° F.), boils at 205° C. (401° F.), sublimes without leaving any residue, and when ignited burns with a luminous sooty flame; its specific gravity at 15° C. (59° F.) is 0.990 to 0.995. It is sparingly soluble in water (see AQUA CAMPHORÆ), dissolves at 15° C. (59° F.) in 0.7 parts of alcohol, and is freely soluble in ethers, chloroform, glacial acetic acid, wood-spirit, acetone, carbon disulphide, benzol, benzin, and volatile and fixed oils; its solutions in alcohol and ether increase the solubility of corrosive sublimate, and the presence of this salt renders camphor more soluble in these liquids. (See HYDRARG. CHLOR. CORROS.) Camphor dissolves by trituration in 10 parts of milk, and the solution may be diluted with water without causing precipitation. When rubbed together with powdered chloral or resins the mixtures gradually become soft or liquid, and in the fused state resins dissolve a considerable proportion of camphor. It has a peculiar penetrating odor and an aromatic somewhat cooling taste. The odor of camphor is destroyed by Tolu balsam, asafetida, and similar umbelliferous resins. Thrown upon water, camphor shows a peculiar rotating motion, which is probably caused by its rather rapid evaporation and slow solubility. It turns polarized light to the right.

Its composition is represented by the formula $C_{10}H_{16}O$. When distilled with chloride of zinc or phosphoric anhydride it is gradually converted into cymol, $C_{10}H_{14}$, and by oxidation with nitric acid into *camphoric acid*, $C_{10}H_{16}O_4$, and finally into *camphoronic acid*, $C_9H_{12}O_5$. Schwanert's *camphresinic acid* (1863) is a mixture of these two. By the action of hypochlorous acid on camphor Wheeler (1868) obtained several chlorine substitution-products, and by acting upon these with alcoholic solution of potassa *oxycamphor*, $C_{10}H_{16}O_2$, is formed, which crystallizes in needles, has the odor and taste of camphor, and sublimes without change, but melts at 137° C. (278.5° F.). Camphor combines and forms also substitution-compounds with iodine and bromine.

Other Camphors and Camphor Oils.—The crystallizing stearoptens of volatile oils are sometimes designated as camphors.

OLEUM CAMPHORÆ, U. S. 1870.—Oil of camphor, Camphor oil of Formosa, *E.;* Huile volatile de camphre, *Fr.;* Flüchtiges Kampferöl, *G.*—The oil is obtained in the preparation of crude camphor, and a portion also in refining this product. It is a dark wine-yellow or yellowish-brown liquid, having a camphor-like odor and taste and the specific gravity .940. At a low temperature it deposits a considerable quantity of camphor in the form of crystals, and at about 180° C. (356° F.) it begins to boil. It turns the plane of polarized light to the right. By careful fractional distillation a considerable portion of camphor is left in the retort, but cannot be completely removed by this means. The liquid distillate has, according to Martins, the odor of camphor and cajeput, and, according to Mulder, is a solution of laurel camphor, $C_{10}H_{16}O$, in a hydrocarbon of the composition $C_{10}H_{16}$; the latter, according to Lallemand (1859), resembles oil of lemon in its chemical behavior.

SUMATRA, s. BORNEO CAMPHOR, OR BARUS CAMPHOR, is found in fissures of the wood of Dryobalanops Camphora, *Colebrook* (D. aromatica, *Gaertner*). Nat. Ord. Dipterocarpaceæ. Its odor is somewhat different from that of ordinary camphor; its crystals are slightly heavier than water, and but sparingly volatilized at ordinary temperatures. It is *borneol* or *camphyl alcohol*, $C_{10}H_{18}O$, and by treatment with nitric acid it is converted into ordinary camphor. The stately tree yielding this drug is indigenous to Sumatra and Borneo, and requires cutting down to obtain the camphor, which in the East is sold at a high price, and therefore never enters commerce at large. This camphor is dextrogyre.

CAMPHOR OIL OF BORNEO is obtained from the same tree by tapping or felling it. It is a rather viscid brown-yellow or reddish oil, which is a solution of resin and a little borneol in a hydrocarbon, $C_{10}H_{16}$; the latter has a terebinthinate odor, and is identical with the hydrocarbon of oil of valerian; hence the names *borneene* and *valerene*. Lallemand (1859) could not obtain borneol, but isolated two terpenes boiling respectively at 180° and 255° C. (356° and 491° F.). The crude oil is dextrogyre, begins to boil at about 175° C. (347° F.), and deposits little or no camphor when placed in a freezing mixture. It is rarely, if ever, met with in commerce.

NGAI CAMPHOR is obtained in Burmah and China by the distillation of Blumea balsamifera. *De Candolle;* Nat. Ord. Compositæ—a tall weed of South-eastern Asia, and commands there a higher price than ordinary camphor. It has the composition of the Borneo camphor, $C_{10}H_{18}O$, but turns polarized light to the left, and yields with nitric acid a camphor having the composition of ordinary camphor, but levogyre in optical behavior. It was examined in 1874 by Hanbury, Plowman, and Flückiger.

Pharmaceutical Uses and Preparations.—Camphor is used in preparing monobromated camphor, and is a constituent of the following officinal preparations: Aqua camphoræ, *U. S.*, *Br.;* Linim. aconiti, Linim. belladonnæ, *Br.;* Linim. camphoræ, *U. S.*, *Br.;* Linim. camphoræ comp., Linim. chloroformi, Linim. hydrargyri, Linim. iodi, Linim. opii, *Br.;* Linim. saponis, Linim. sinapis comp., *U. S.*, *Br.;* Linim. terebinthinæ, Linim. terebinth. comp.; *Br.;* Mistura chloroformi, *U. S.;* Spiritus camphoræ, Tinct. opii camphorata (camph. comp.), *U. S.*, *Br.;* Ung. hydrarg. comp., Ung. plumbi subacet., *Br.*

VINUM CAMPHORATUM, *P. G.*—Wine of camphor, *E.;* Vin camphré, *Fr.;* Kampferwein, *G.*—Dissolve camphor 1 part in alcohol 1 part, and add gradually and with agitation mucilage of acacia 3 parts and white wine 45 parts. It is a whitish, turbid liquid, which requires to be well shaken when dispensed.—*P. G.*

CAMPHORA CARBOLISATA, S. PHENOLATA.—Camphorated phenol, Phenol-camphor, *E.;* Camphre phenolé, *Fr.;* Phenolkampfer, *G.*—Camphor 2 parts; carbolic acid 1 part; allow to liquefy (Bufalini, 1875). Camphor 100 parts, carbolic acid 36 parts, alcohol 4 parts; dissolve (Hager). A colorless or oily liquid having the odor of camphor, soluble in fixed oils, alcohol, and ether, nearly insoluble in water and glycerin.

CAMPHORA SALICYLATA.—Salicylated camphor, *E.;* Camphre salicylé, *Fr.;* Salicylirter Kampfer, *G.*—Camphor 84 parts, salicylic acid 65 parts; heat in a water-bath to 90° C. (194° F.) until liquefied (Prota Giurleo, 1881). A colorless oily liquid, solidifying to an opaque crystalline mass, becoming unctuous on being triturated; slightly soluble in water and glycerin, more soluble in fats and volatile oils, and crystallizing from hot benzol.

Physiological Action.—*On Vegetables and Animals:* Camphor at first stimulates, but ultimately kills, plants, causing them to fade and wither. It does not appear to prevent the germination of seeds. It destroys insects; in birds it produces an excited intoxication, followed by stupor and convulsions; in frogs it manifests, in small doses, a depressing influence upon reflex motility and a stimulant action upon the heart; but in large doses it paralyzes that organ. Given in full doses and by the mouth to dogs, it occasions general excitement, with signs of gastric distress, which are followed by tremor, lowering of temperature, convulsions, and death. It appears to increase the arterial blood-pressure. After death the stomach is found injected and the venous system and the heart are distended with dark blood.

On Man: The local action of camphor upon the living tissues is that of a stimulant and irritant. A piece of it held in the mouth irritates, and may even ulcerate, the lining membrane; the same effect is produced in the stomach. Internally, its action varies with the dose. In large doses it causes a burning pain at the pit of the stomach, diminished frequency and force of the pulse, followed by its intermission, by giddiness, dimness of vision, muscular debility, paleness and coolness of the skin, with a cyanotic hue in grave cases, spasms and rigidity of the muscles, and general convulsions. These phenomena, which show that camphor in large doses is a direct and powerful sedative, are followed by a reaction in which there is more or less excitement and fever. In no instance does camphor seem to have directly caused the death of a healthy person. An ounce of camphorated oil induced sleep at first, then violent delirium, vomiting, labored breathing, and a pulse of 104, but of good strength (*Lancet*, Jan. 1880). A drachm each of camphor and hydrate of chloral, taken together, caused speedy unconsciousness, coldness, and flaccidity of the limbs, a slow and feeble pulse, and a narcotism that did not cease for 4 days, followed by a mental confusion that continued for 9 or 10 days (Simmons). In smaller but still excessive doses it produces a peculiar intoxication, with delirium, in which great mental vivacity and muscular activity are displayed—a condition compared to that which is apt to be produced by champagne wine; but these effects are transient, and are followed by depression, pallor, coldness, profuse sweating, and dysuria. In medicinal doses (gr. ij to gr. xv = Gm. 0.12 to 1.0) camphor stimulates the nervous and vascular systems, and through them all the functions; the pulse becomes stronger and more frequent, the skin grows warmer and moister, and there is a consciousness of more or less exhilaration. Such effects are of short duration, and are not succeeded by exhaustion or depression. Small doses appear to irritate the genital organs, but full medicinal doses allay morbid excitement in them. It appears, then, that camphor stimulates in small and depresses in large doses, and that its operation is very transient—almost as much so as that of alcohol, which in some other respects it resembles. According to physiological experimenters, the spinal cord is not influenced by camphor, for convulsions do not occur after the separation of the medulla oblongata from the medulla spinalis. Owing to the rapid disappearance of the smell of camphor from the urine and feces of animals poisoned by it, it is held that the drug is decomposed in the organism.

Medical Uses.—The ancients do not appear to have used camphor in febrile affections, but in the eighteenth century it acquired a reputation in the treatment of *typhoid conditions* which it has never lost. It was held to be less heating than ammonia, less stupefying than opium, and, along with the latter, to act as a powerful sudorific. It was considered—and is, in fact—an appropriate remedy for the condition which includes exhaustion, stupor, and nervous derangement, shown by muscular trembling and subsultus and low delirium, the phenomena belonging to the malignant or typhoid state in which the nervous system tends to collapse because the blood has become impure. In this condition stimulants sustain nervous power until the depuration and reorganization of the blood are accomplished; and camphor in small and repeated doses has the advantage, over some other appropriate remedies, of inducing no injurious secondary effects. The typhoid state, it should be remembered, may be an incident of inflammatory affections as well as of idiopathic fevers. A French army surgeon claims that in the treatment of an epidemic of typhoid fever marked by unusual ataxia he was very successful after he began the administration of enemas containing 8 grains of crystallized carbolic acid, 15 grains of camphor, 1 ounce of alcohol, and about 6 ounces of water (*Bull. de thérap.*, ciii. p. 465). The share of the carbolic acid in the alleged result may well be disregarded. In *spasmodic diseases* camphor has been largely employed in whooping cough, chorea, and even epilepsy, but its power in these affections is of very subordinate importance. In minor disorders of this class, such as nervous *headache*, nervous *palpitation*, *hiccup*, spasmodic *dysphagia*, etc., camphor in small and repeated doses shows the same power as other nervous stimulants. In small doses, or even as a topical application, it seems to afford marked relief in that distressing occipital headache which arises from severe and prolonged mental strain. In full sedative doses it has proved an antidote to *strychnia*. The Arabians and their followers in Europe were familiar with the power of camphor in large doses to repress *sexual excitement*, and they, as well as nearly all successful imitators of them, prescribed from 20 to 60 grains a day. The doses of 2 or 3 grains sometimes directed for this purpose are worse than useless. They are perhaps more efficient in certain cases of genital excitement produced by local irritation—by cantharides, for example. It is usual to incorporate powdered camphor with blistering plasters to prevent *strangury*, but the evidence of the efficiency of this expedient is not very strong. A poultice saturated with camphor and applied to the perineum will relieve this symptom, and also prevent *chordee*. In some cases of *mania* large doses of camphor have proved efficient, particularly in the puerperal form; it very probably would be more eligible than the excessive doses of opiates which are sometimes employed. It is stated that equal parts of chloral hydrate and camphor form a much more powerful sedative and soporific than a like dose of either substance alone (Simmons, *Amer. Jour. of Med. Sci.*, Jan. 1880, p. 89). Camphor has been employed to expel *lumbricoid worms*, and by enema to destroy *ascarides* of the rectum. It has been resorted to internally and locally with good effect in hospital *gangrene*. *Ulcers* that are slow to heal, owing to a depressed state of the system, are benefited by camphor in powder; the same may be said of specific ulcers of the genitals. Camphor dissolved in ether or chloroform, or even alcohol, and applied on cotton within the cavity of a carious tooth, mitigates *toothache* materially. This is one of the most ancient uses of the medicine. Snuffed into the nostrils, camphor, like other local irritants, will sometimes arrest a forming *coryza*. In an ointment or liniment it forms one of the best cures for *scabies*, and is said to prevent the maturation of *variolous* pustules.

Camphor may be administered in substance in the pilular form when the dose is small, but larger doses are best given in emulsion, which should be flavored with the extract or the syrup of liquorice. As a stimulant the *dose* is from 1 to 5 grains (Gm. 0.06–0.30), repeated every 3 or 4 hours in mild cases, but in low fevers it should be from 10 to 20 grains (Gm. 0.60–1.20), and repeated according to the indications. In maniacal nervous excitement not less than 20 grains (Gm. 1.30) should be given, and repeated as often as may be required. In cases of *poisoning* by camphor, alcohol may be administered in small and repeated doses.

Carbolized camphor is prepared as follows: Carbolic Acid 9 Gm.; Camphor 25 Gm.; Alcohol 1 Gm. Mix, and add Olive Oil 35 Gm. It has been applied with a brush to the false membranes of *diphtheria*, and is stated to have caused a rapid subsidence of the inflammatory swelling and a removal of the exudation (*Bull. de thérap.* xciv. 18; xcviii. 529).

Salicylated camphor is a mixture of equal parts of salicylic acid and camphor, with the addition of a few drops of alcohol, which should be mixed with from 10 to 20 parts of vaseline. By the addition of paraffin this ointment can be made into suppositories. It is stated to exhibit remarkable healing powers when applied to phagedenic and atonic *ulcers*, especially those of a syphilitic nature (*Bull. de thérap.*, xcvii. 143).

Wine of camphor is used for the same purposes as spirit of camphor.

CAMPHORA MONOBROMATA, *U. S.*—Monobromated Camphor.

Bromated camphor, E.; *Camphre monobromé*, Fr.; *Monobromkamfher*, G.
Formula $C_{10}H_{15}BrO_2$. Molecular weight 230.8.

Preparation.—Laurent obtained (1840) bibromide of camphor, $C_{10}H_{16}OBr_2$, by uniting bromine with camphor, and stated that on distillation it afforded bromine, camphor, a little hydrobromic acid, and a bromated oil. Swarts (1861) heated camphor bibromide in sealed tubes and obtained monobromated camphor. W. H. Perkin (1865) subjected the oily bromide of Laurent to distillation, and found the distillate, collected above 265° C. (509° F.) after crystallization from alcohol, to be monobromated camphor. We have found (1872) the following process to give satisfactory results: Break 13 ounces of camphor into small pieces; put these into a quart retort, first filling the neck; raise the latter somewhat, and then introduce through the tubulure, by means of a funnel-tube, 4 ounces of bromine, washing the last down with 20 or 30 minims of alcohol. A brisk reaction will commence in about 15 or 20 minutes; after it has subsided and the retort has become cool introduce 8 to 9 ounces of bromine in four portions, waiting after each addition until the reaction has ceased. The addition of alcohol is not requisite, but facilitates the reaction, and the bromine may be added in larger quantities if provision be made for condensing the vaporized bromine and returning it to the retort. This is now slowly heated to about 132° C. (270° F.), allowed to cool, the contents dissolved in warm petroleum benzin, the solution allowed to crystallize, and the crystals purified by recrystallization from hot alcohol or petroleum benzin. On evaporating the mixed mother-liquors an oily mass is obtained, which, heated to 260° C. (500° F.), becomes black, and contains monobromated camphor, to be obtained by recrystallization as before. Gault (1874) heats at first in a water-bath, crystallizes from strong alcohol, and heats the oily mass contained in the mother-liquor to not over 220° C. (428° F.). A similar process is recommended by Dubois, who states that by confining the heat to 100° C. no by-products of any consequence are formed. J. U. Lloyd (1875) recommends the camphor bibromide to be heated with water in a retort placed in a sand-bath, and the product to be crystallized from alcohol. T. C. Linthicum (1876) considers the reaction very unsatisfactory at 100° C.

In the above processes bibromide of camphor, $C_{10}H_{16}OBr_2$, is first formed, and this, on being heated, is decomposed into hydrobromic acid, HBr, and monobromated camphor, $C_{10}H_{15}BrO$, the latter representing a molecule of camphor in which 1 atom of hydrogen is replaced by 1 of bromine. During the operation one-half of the bromine used is given off as hydrobromic acid, and may be collected in water or combined with a base.

Properties.—Monobromated camphor crystallizes from alcohol in thin white or colorless prisms and needles, and from petroleum benzin in long flat prisms or glossy scales. It has a weak but persistent camphoraceous odor, a mild camphoraceous taste, and a neutral reaction. It is permanent in the air and not affected by direct sunlight. It is insoluble in water, slightly soluble in glycerin, freely soluble in alcohol, ether, chloroform, fixed oils, and in less than its own weight of hot petroleum benzin, from which solution the greater part crystallizes on cooling. It melts at 76° C. (168.8° F.), and evaporates slowly with the vapors of boiling water, condensing in fine white interlaced needles; at 274° C. (525° F.) it boils and volatilizes completely, with partial decomposition. It dissolves without decomposition in cold sulphuric acid, and is again precipitated by water. When boiled with nitrate of silver and nitric acid it is decomposed, and yields

81.2 per cent. of bromide of silver. Heated with zinc chloride to near 160° C. (320° F.), it yields a hydrocarbon, C_8H_{16}, and liquid thymol, $C_{10}H_{14}O$ (Schiff, 1880).

Pharmaceutical Uses.—If a liquid preparation is desired, monobromated camphor is conveniently given in the form of emulsion, after dissolving it in six or eight times its weight of expressed oil of almond or other bland oil. Monday (1877) proposed an *elixir of monobromated camphor* containing 1 per cent. by weight of the latter, by dissolving with the aid of a gentle heat 3 Gm. of it in a mixture composed of 120 Gm. of 90 per cent. alcohol, 80 Gm. of water, and 100 Gm. of glycerin.

Physiological Action.—From a number of experiments upon animals Bourneville drew the following conclusions: 1. Monobromated camphor diminishes the number of the heart-beats and contracts the blood-vessels of the ears and eyelids. 2. It renders the inspirations less frequent. 3. It lowers the temperature steadily, and in fatal cases until death; in those animals which recover the temperature rises to its original point, but more slowly than it fell. 4. It is unquestionably hypnotic, and seems to act chiefly upon the brain. 5. It does not appear to induce tolerance, and cats and guinea-pigs lose flesh rapidly while using it. But Trasbot reports that, experimenting upon dogs, he never observed in them either somnolence or the lowering of the pulse or temperature. On the contrary, in doses varying from 7 to 15 grains (Gm. 0.40–90) this preparation induced convulsions identical with those caused by strychnia. Again, Valenti y Vivo inferred from his experiments that it may be considered an antidote to strychnia, although it must be freely exhibited for this purpose. The experiments of Mr. Lawson upon man tend to confirm the conclusions of Bourneville in regard to its influence upon the pulse and temperature, both of which were depressed under the action of the compound, but in doses of 10 grains it did not show any soporific influence. In his subsequent trials of the medicine he found that its great liability to produce gastric irritation, and the excitability and wasting following thereon, formed a strong objection to its use.

Medical Uses.—Monobromated camphor has been used with alleged advantage in *epilepsy*, not only in the convulsive form of the disease, but in epilepsia minor, and in cases of epileptic delirium in females. But, according to Dr. Gowers, it in his hands produced no good results. It has appeared to arrest *convulsions* depending upon dentition. In several cases of inveterate *chorea* and of *paralysis agitans* it is reported to have mitigated the convulsive movements in a notable degree, and to have controlled the excitement of *hysteria* and also of *delirium tremens*. In *insomnia* connected with cerebral hyperæmia or with heart lesions it has proved beneficial, and *palpitation* of the heart due to either cause has been relieved by it. The same is true of its use in *headache* occasioned by over-stimulation of the brain by mental excitement. It has also palliated *nervous cough* and nocturnal *incontinence of urine*, relieved anal and vesical *tenesmus*, especially when this symptom depended upon nervous irritability and not upon substantial disease of the affected organs, and it has also subdued *priapism*. It will be observed that all of these affections are such as are apt to be benefited by the alkaline bromides; and it is more than probable that a solution of one of them in camphor-water, if not in simple watery solution, would answer the same purpose. After a sufficient trial of the preparation, Dr. Lawson concluded (*Practitioner*, xiv. 262) that its insolubility and the gastric derangement it causes render it ineligible as a medicine, and that its therapeutic value does not entitle it to rank with the other soporific and calmative medicines which are analogous to it. It has usually been administered in sugar-coated pills, and in doses of from 2 to 5 grains (Gm. 0.10–0.30), repeated several times a day or oftener. Its insolubility and unpleasant taste and smell render any other liquid vehicle than oil inappropriate for its administration. A formula for an elixir is given above.

CANELLÆ CORTEX, *Br.*—Canella Bark.

Canella, U. S., 1870.—*Cannelle blanche*, Fr.; *Weisser Zimmt*, *Weisser Canel*, G.

The bark of Canella alba, *Murray*, s. Winterania Canella, *Linné*, s. Canella Winterana, *Gaertner*. Woodville, *Med. Bot.* 237; Bentley and Trimen, *Med. Plants*, 26.

Nat. Ord.—Canellaceæ.

Origin.—The *white wood* or *wild cinnamon* tree is indigenous to many of the West Indian islands and the southern section of Florida. It grows to about 40 feet (12 M.), has evergreen, blunt, lanceolate leaves, pale violet-colored, highly aromatic flowers in terminal corymbs, and bluish-black subglobular berries, about $\frac{3}{8}$ inch (1 Cm.) long, and containing two to four angular and roundish reniform seeds. The silver-gray corky layer of the bark is mostly removed by beating, and subsequent cutting before the bark is collected. The drug became first known in Europe in 1605.

Description.—The bark is in quills or half quills varying in length from a few inches to 2 or 3 feet (.6 or .9 M.), and in diameter from ¼ to 1½ inches (6 to 38 Cm.). The external surface is of a pale yellowish-red color, with transversely elongated scars of the suberous warts, and occasionally with fragments of the gray corky layer and with whitish patches of the inner bark laid bare by the removal of the reddish layer; inner surface white, finely striate; fracture short, white, with numerous bright orange-yellow dots of resin-cells. The odor is agreeably aromatic, cinnamon-like; the taste aromatic, somewhat bitter, and biting.

Substitutions.—The bark of Cinnamodendron corticosum, *Miers* (Bentley and Trimen, *Med. Plants*, 27), a small tree of the same natural order as the preceding, is indigenous to Jamaica, and is there employed like Canella alba. It has oblong-lanceolate, acute leaves and red flowers in axillary clusters of two to four. The bark is of a ferruginous gray-brown, darker upon the outer surface, spotted by scars of the nearly circular suberous warts, smooth and finely striate upon the inner surface, and agreeing in odor and pungent taste nearly with the preceding. Both barks have been frequently sold as Winter's bark. Cinnamodendron macranthum, *Baillon*, of Porto Rico, yields a similar bark.

Constituents.—The analyses of Henry (1821) and of Petroz and Robinet (1822) proved the existence of volatile oil, resin, bitter principle, mucilage, starch, albumen, and salts. The *canellin* of the last-named chemists is identical with mannit, according to Meyer and Von Reiche (1843), who obtained 8 per cent. of it, and separated from the volatile oil eugenol, an oil having the odor of cajuput, and another fraction not further examined. From 0.5 to 0.94 per cent. of volatile oil and about 6 per cent. of ash, consisting mainly of calcium carbonate, have been obtained from the bark. The bitter principle has not yet been isolated. The cinnamodendron-bark has probably similar constituents, but contains in addition some tannin, which is not present in Canella alba.

Off. Prep.—Vinum rhei, *U. S.*, *Br.*

Medical Action and Uses.—Canella is tonic and stimulant, and may be employed to relieve simple gastric debility. It is seldom used alone, but rather along with bitter tonics and with purgatives that tend to debilitate, as scammony and jalap, or that have a local action which it is designed to increase, as in the case of aloes when given for *uterine disorders*. The *dose* in powder is from 10 to 40 grains (Gm. 0.60–2.50).

CANNABIS, *U. S., Br., P. G.*—CANNABIS.

Hemp, E.; *Chanvre*, Fr.; *Hanf*, G.

Cannabis sativa, *Linné*. Bentley and Trimen, *Med. Plants*, 231.

Nat. Ord.—Urticaceæ, Cannabineæ.

Officinal Kinds.—1. CANNABIS AMERICANA, *U. S.*—American cannabis, American hemp, *E.*; Chanvre américain, *Fr.*; Amerikanischer Hanf, *G.*—Cannabis sativa, grown in the Southern United States, and collected while flowering.

2. CANNABIS INDICA, *U. S.*, *Br.*; Herba cannabis Indicæ, *P. G.*—Indian cannabis, Indian hemp, *E.*; Chanvre indien, *Fr.*; Indischer Hanf, *G.*—The flowering tops of the female plant of Cannabis sativa, grown in the East Indies.

Origin.—The hemp-plant is indigenous to Asia, from India north to Western China and the Caspian Sea; it grows likewise in tropical Africa. Having been cultivated from a very early period for its textile bast-fibres and its oily fruit, the cultivation has extended to most civilized countries. The plant grows spontaneously in Europe and North America, and has been naturalized in some parts of Brazil. It is an annual, with an angular roughish stem, 4 to 8 and even 10 feet (1.2, 2.4, and 3 M.) high, with opposite or the upper ones alternate petiolate and digitate leaves, composed of five to nine lanceolate or linear-lanceolate, acute, and serrate leaflets, and with diœcious flowers. The Indian plant has the lower leaves alternate, the stem is more branched, and the bast-fibres are coarser; but the characters vary and are not sufficiently important to constitute it a distinct species. The plant richest in resin grows at an altitude of 6000 to 8000 feet (1800 to 2400 M.).

Description.—The American hemp consists usually of the barren plant, which has the characters given above; the staminate flowers are in loose pedunculate, axillary panicles crowded near the summit, and composed of clusters of pedicillate greenish flowers having a deeply five-cleft perianth. The fertile plant has the pistillate flowers single or in pairs, sessile, bracteate, and with slender protruding stigmas, the inflorescence forming erect, short, and compact spikes. The odor of the dry plant is heavy, the taste bitter and somewhat acrid.

The Indian hemp found in the market is that known in India as *gunjah* or *ganja*, and in London and elsewhere as *guaza;* as collected, it consists of the tops of branches, which are 2 to 3 inches (50 to 75 Mm.) long, compressed, of a brownish-green color, with few leaves, a large number of female flowers, and some ripe or nearly ripe fruits, the whole more or less agglutinated by resin, but nevertheless quite brittle; odor narcotic, not unpleasant; taste bitter and slightly acrid. In the bazaars it is also seen in bundles, which are composed of the upper branches, 2 to 3 feet (.6 to .9 M.) long, several inches in diameter, and showing more or less of the resinous exudation.

Another form is used in India under the name of *bhang* or *siddhi*, the *hashish* of the Arabs, which consists of leaves and small stalks coarsely broken and mixed with few fruits; it is smoked with or without tobacco, and is chiefly employed in the preparation of various electuaries and beverages. The resin is collected in India in a very primitive manner and impure condition, and is known as *charas* or *churrus.* It is either the dusty powder obtained on storing the dry plant, or by rubbing the fresh tops between the hands and scraping off the adhering resin, or by removing it from the leather garments of men who run through the hemp-fields brushing against the plants. The plants grown at an altitude of from 6000 to 8000 feet are stated to produce this resin, while those grown in the plains yield little or none.

FRUCTUS CANNABIS.—Hempseed, *E.;* Semences de chanvre, Chénevis, *Fr.;* Hanfsamen, *G.*—It is an akene about ⅛ inch (3 Mm.) long, ovate, somewhat flattened, and somewhat two-edged; the pericarp is thin, hard, smooth, greenish or brownish, delicately veined, and contains a single greenish seed, the embryo of which has the radicle bent upon one of the cotyledons. The fruit is inodorous, and has an unpleasant, sweetish, and oily taste. By trituration with water it yields an emulsion.

Constituents.—G. Martius (1856) obtained from this plant, besides gum and sugar, nitrate of potassium and other salts and resinous matter; dried at 100° C. (212° F.), the herb yielded 18 per cent. of ash containing silica and phosphates as the main constituents. European hemp had been previously examined by Schlesinger and Bohlig (1840); both found considerable malic acid, and the latter 0.3 per cent. of a yellow aromatic oil having faintly narcotic properties. Personne (1857) claimed the volatile oil obtained from Indian hemp to be the sole active principle; he separated it into liquid *cannabene*, $C_{18}H_{20}$, and solid *cannabene hydride*, $C_{18}H_{22}$. According to Bohlig, the essential oil contains oxygen. After rectification over sodium it was found by L. Valente (1881) to have the spec. grav. .9292 at 0° C., to boil at 256° to 258° C. (493° and 496.4° F.), to be readily soluble in alcohol, and to be violently acted upon by bromine. The *hashiscin* of Gastinel is merely the alcoholic extract of gunjah deprived of the principles soluble in water. The *cannabin* of T. and H. Smith (1846) is much purer; it is obtained by exhausting the gunjah with water and solution of sodium carbonate, then washing the residue with water, drying, exhausting with alcohol, treating the tincture with milk of lime, precipitating the lime with sulphuric acid, treating the filtrate with animal charcoal, filtering, concentrating, and precipitating by water; it constitutes a brown amorphous resin which burns without leaving any ash. Procter (1864) observed that the resin is converted by hot nitric acid into an orange-red substance resembling gamboge, and Bolas and Francis (1871) obtained from this residue *oxycannabin*, $C_{20}H_{20}N_2O_7$, which crystallizes from methylic alcohol in large prisms. Preobraschensky (1876) claimed to have obtained *nicotine* from Bucharian hashish and from gunjah. Siebold and Bradbury (1881) failed, like other investigators, to obtain nicotine, but isolated from 10 pounds of gunjah about 2 grains of a volatile alkaloid, *cannabinine*, which forms a varnish-like mass of a coniine-like but less nauseous odor, sparingly soluble in water, and in this solution yielding with chlorine-water a white turbidity. Matthew Hay (1883) showed that Cannabis indica contains several alkaloids; the sulphate of one of these is soluble in alcohol. The alkaloid itself is easily soluble in water and in alcohol, more slowly soluble in chloroform and ether, and from the latter solution obtainable in needles. It does not show the color-reactions of strychnine, but resembles it in its physiological effects; hence the name *tetanocannabine* is proposed for it.

The analysis of Bucholz, and the later one by Anderson (1855), failed to find in hempseed any other constituents than those common to oily seeds. The small quantity of resin has not been further examined; the protein compounds amount to 22 or 24 per cent. and the fixed oil to about 30 per cent. Berjot (1860) obtained 28. Cloëz (1865)

31.5, and Münch (1866) 35.5 per cent. of oil. *Oil of hempseed* is a drying oil, and has a greenish- or brownish-yellow color, a peculiar odor, and a mild taste; it is readily soluble in boiling alcohol, and when heated with one-fifth of its measure of soda solution spec. grav. 1.34 it acquires a yellowish-brown color and a thick consistence.

Off. Prep.—Extract. cannabis Indicæ fluid., *U. S.;* Ext. cannabis Indicæ, Tinct. cannabis (cannab. Indic.), *U. S.*, *Br.*

EXTRACTUM CANNABIS AMERICANA, Extract of American hemp. An alcoholic tincture of American cannabis evaporated to the consistence of an extract, *U. S. P.* 1870.

CANNABINE TANNATE, for which no formula has been published, is a yellowish-brown permanent powder, insoluble in water and ether, slightly soluble in alcohol, of a not unpleasant odor, and of a bitterish astringent taste; it is stated to be the tannate of a glucoside.

Physiological Action.—The action of American hemp is identical in kind with that of the East Indian species, but its activity appears to be less. Like some other narcotics, Indian hemp when given by the stomach to carnivorous animals produces its characteristic effects, but graminivorous animals and fish exhibit only vacillating movements and a dull aspect. Upon man its action varies with the individual's temperament and tendencies. Some it inspires with pugnacity, others it inclines to dreamy contemplation, to motiveless merriment, or to maudlin sensibility; some it makes unnaturally active and restless, and plunges others in a drowsy stupor; but more than any other agent, not even excepting belladonna, it perverts the natural perception of objects and their normal condition and relations. Time, distance, and sound are especially apt to form the subjects of the hallucinations caused by this drug. As in dreams, the events of days or weeks may be compressed into an actual period of a few minutes, objects near at hand may seem to form a limitless perspective, and whispered tones may have the reverberation of thunder. These and an infinite variety of fantastic pictures are evoked by smoking the drug, as it is generally employed in Asia, associated with opium. During its influence the physical condition of the experimenter exhibits changes in acceleration of the pulse, warmth of skin, restless muscular movements, more or less insensibility to touch and pain, and sometimes impaired power of locomotion, the limbs feeling as if weighted with lead. In one reported case a diffused vesicular eruption was attributed to this medicine (Hyde). It does not increase, but, on the contrary, impairs, the venereal propensity and power. The habitual use of cannabis in excessive doses causes the face to become bloated, the eyes injected, and the limbs weak and tremulous; the mind grows imbecile, and ultimately death by marasmus is apt to occur. Acute poisoning by large doses is marked by various and dissimilar symptoms in different cases. In some there is loss of consciousness, with collapse or stupor, insensible pupils, a pale, clammy, and insensible skin, extreme debility, and a small, feeble pulse. In others a cataleptic condition, spasms, or convulsions occur, and in all there is marked anæsthesia. The last-named effect led to the use of cannabis by the Chinese in certain surgical operations.

Medical Uses.—The effects of cannabis as just described would not suggest its employment in *tetanus*, and yet in the traumatic variety of a disease notoriously of fatal issue its virtues have been demonstrated by physicians entirely competent to test them. In India it has been successfully employed by causing the patient to smoke *gunja*, or else the dried leaves of cannabis, almost continuously. It is of comparatively little use in *neuralgia*, *rheumatism*, *epilepsy*, or *chorea*. In a case of chorea following concussion of the spine it seemed to promote the cure (Siegfried, *Hygien. and Med. Rep. U. S. Navy*, 1879). Its anæsthetic virtues are shown by its allaying the intense itching of *eczema*, so as to permit the patient to sleep; it is said to have been used with advantage to diminish *hallucinations* of sight and hearing in certain forms of *insanity* and in *delirium tremens;* but in such sensorial aberrations its action is by no means uniform. It is alleged that extract of cannabis used habitually in the dose of one-third of a grain twice a day will prevent or greatly mitigate recurrent *headache*, or *migraine*. During the attacks the dose should be increased to half a grain (Gm. 0.03) or more. It seems to be peculiarly efficient in various conditions of the brain involving a positive or relative anæmia of that organ, such as *delirium* and *sleeplessness after fever*, *softening of the brain*, *thickening of the meninges*, *obstinate nervous vomiting*, etc. Fronmüller alleges that "tannate of cannabin" is a reliable hypnotic in the dose of from 2 to 10 grains, but this statement is not confirmed by Ewald, Leyden, and others. Cannabis appears capable, directly or indirectly, of causing uterine contraction, as in many cases of *uterine hæmorrhage;* and it is also said to provoke this act during *labor* with as much energy as ergot, but its effects are less persistent. The *dose* of extract of cannabis is from ½ grain to 2 grains (Gm.

0.03–0.12), but since the preparation is often quite inert, none should be used medicinally that has not previously been tested. Lemon-juice tends to neutralize its effects. Tobacco and coffee are said to increase and prolong the action of the drug.

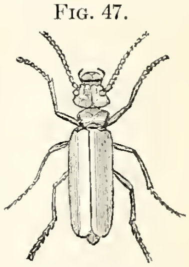
CANTHARIS, *U. S., Br.*—CANTHARIDES.

Cantharides, P. G.; *Muscæ Hispanicæ.—Spanish flies*, E.; *Cantharides*, Fr.; *Spanische Fliegen*, *Canthariden*, *Kanthariden*, G.

Cantharis vesicatoria, *De Geer* (*Hist. des Insectes*), s. Lytta vesicatoria, *Fabricius*, s. Meloe vesicatorius, *Linné*. The beetle collected chiefly in Hungary and Southern Russia. Class Insecta; Order Coleoptera—Beetles.

Description.—The so-called Spanish fly is indigenous to Southern and Central Europe, and is found eastward as far as Western Asia; it frequents chiefly trees and shrubs of the Oleaceæ and Caprifoliaceæ, such as the ash, lilac, elder, and honeysuckle. The beetle is from ½ inch to 1⅕ inch (12 to 30 Mm.) long and ⅕ to ⅓ inch (5 to 8 Mm.) broad, flattish-cylindrical in shape, of a shining brass or copper-green color above and below, and finely punctate above. Head subcordate, with a longitudinal furrow; eyes two, lateral; antennæ filiform, of eleven joints, the lowest three green, the upper black; thorax of the same width as the head, longitudinally channelled; wing-cases covering the body, with two fine longitudinal ridges; wings ample, membranous, brownish-transparent; tarsi of the hinder legs with four, and of the others with five, joints; claws bifid. Cantharides have a strong and disagreeable odor, and yield a brown-gray powder intermixed with green shining particles.

FIG. 47.



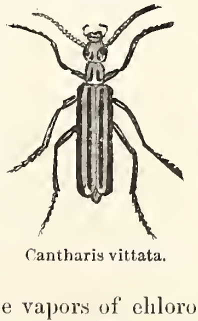
Cantharis vesicatoria.

Collection and Commerce.—Cantharides are collected early in the morning by spreading cloths under the trees and shrubs, which are then shaken or beaten with poles; the insects are plunged into hot water, afterward spread out and dried. A better method for killing them is by means of a little chloroform, ether, oil of turpentine, or carbon disulphide after enclosing them in a tight vessel. They are collected for exportation in Spain, Italy, Hungary, and Southern Russia, and packed in boxes and casks. Those coming from Russia are of a copper color, larger than those of Western Europe, and are most esteemed. 6000 pounds of cantharides were imported in the year 1867, and 5000 pounds in 1879, but the importation usually reaches 14,000 to 19,000 pounds per annum, including Chinese blistering-beetles.

Allied Species.—Several of the American species allied to the Spanish flies have been found to possess efficient vesicating properties, and among these may be mentioned: *Cantharis vittata*, or potato-fly, which has a black thorax and wing-cases, with three yellow stripes upon the former, and the latter margined with yellow and with a yellow stripe down the middle; *C. cinerea*, black, closely punctured, and covered with ash-gray hairs; *C. marginata*, elytra black, with the margin ash-colored; *C. atrata*, only about ½ inch long, uniformly black. Attention has also been called among others to *C. Nuttalli*, which resembles the Spanish fly, but has golden-purple wing-cases striped with green; it is very abundant in Kansas and Colorado. (An interesting paper, treating of many of the North American blistering-beetles and of the development of Meloe, by Mr. W. Saunders, may be found in the *Proceedings of the American Pharmaceutical Association*, 1876, p. 505.)

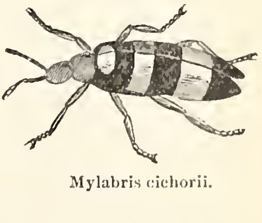
MYLABRIS CICHORII, *Fabricius*, and M. PHALERATA, *Pallas*, two vesicating insects indigenous to Eastern and Southern Asia and to some parts of Africa, have recently been imported as *Chinese blistering-flies;* the insects are black, with two orange-colored bands and two spots of the same color upon the wing-cases. They yield a blackish-gray powder destitute of the green glossy particles observable in powdered cantharides, and are quite efficient as a vesicant. The East Indian Lytta Gigas, *Fabricius*, which is longer than cantharides and of a purplish-blue color, has likewise been occasionally met with in commerce.

FIG. 48.



Cantharis vittata.

FIG. 49.



Mylabris cichorii.

Preservation.—All blistering-beetles should be kept in a well-dried condition and in close vessels, protected by a little camphor, ether, chloroform, or oil of turpentine against the attacks of mites and of small beetles and their larvæ. W. E. Saunders (1883) finds the vapors of chloroform to afford better protection than camphor. The blistering principle resides mainly in the soft parts of can-idea which has been sometimes advanced, that they increase in strength when thus attacked, is erroneous.

Adulterations.—Cantharides are occasionally mixed with beetles of a similar color which have been collected with them, but evidently not for fraudulent purposes. The shape and color of the insects prevent them from being adulterated. But powdered cantharides are said to be sometimes ground together with euphorbium. Adulterations are best recognized by determining the amount of cantharidin by the modifications of Procter's process mentioned below, sometimes also by the amount of ash. "When incinerated, cantharides should yield not over 8 per cent. of ash."—*P. G.*

Constituents.—Robiquet's analysis (1810) indicated the presence of cantharidin, free acetic and uric acids, fatty matters (stearin, palmitin, and olein, according to Goessmann), yellow viscid matter soluble in water and alcohol, a yellow substance soluble in ether and alcohol, black extractive, and magnesium and calcium phosphates. E. Dietrich (1883) found also notable quantities of formic acid. Pocklington (1873) regards the green coloring matter as chlorophyll. *Cantharidin*, $C_{10}H_{12}O_4$, is most readily obtained by Procter's process (1851), as modified by Mortreux (1864) and Fumouze (1867): this method consists simply in exhausting the powder with chloroform, evaporating spontaneously, and freeing the residuary crystals from fat and coloring matter by washing them with bisulphide of carbon. Galippe (1875) recommends the substitution of acetic ether for the chloroform. Beguin gives preference to the same menstruum, and believes that the solvents mentioned completely extract the cantharidin, and that therefore it cannot be contained in the beetles partly in combination, as was stated by Bluhm (1865), Rennard (1871), and others. But Dragendorff (1867, 1872) showed that the yield of cantharidin may be increased by treating the powder first with an alkali, and supersaturating afterward with hydrochloric acid before exhausting the cantharidin; and E. Dietrich (1880) found it of advantage to subject the alkaline liquid to dialysis. The experiments of R. Wolff (1877), made with Lytta aspersa of South America, indicate that ammonium compounds may be present and gradually increase in quantity through the agency of moisture and the magnesium salts of the beetles, whereby sparingly soluble compounds are formed; all of which, as far as examined, are decomposed by acetic ether, with the liberation of cantharidin; hence the larger yield when old cantharides are treated with this menstruum. The amount of cantharidin found by different authors in cantharides varies between 0.17 and 0.57. Boiraux and Léger (1875) obtained as much as 1 per cent. by using hot coal-oil (boiling between 80° and 120° C.). W. R. Warner (1856) obtained from C. vittata 0.40, L. Fahnestock (1879) from the same species by Dragendorff's method 1.3 per cent.; R. Wolff from Lytta aspersa 0.85, Prestat (1876) from Mylabris interrupta of Algiers 0.858, Maisch (1872) by Fumouze's process from Chinese beetles 1.016 per cent., and L. Fahnestock (1879) 1.25 per cent. from the same lot of beetles after they had been kept for six years, and with the use of Dragendorff's process; Warner obtained only 0.43 per cent. That cantharidin is with difficulty obtained pure from old cantharides was also shown by Fahnestock (1879). According to Nentwich (1871), full-grown cantharides only are vesicating.

Cantharidin crystallizes in colorless prisms and scales, and is soluble in alcohol, methylic alcohol, ether, chloroform, acetic ether, glacial acetic acid, and fixed and volatile oils, but insoluble in carbon disulphide and in petroleum benzin. Dietrich considers formic acid the best solvent, and states that cantharidin dissolved in this acid may be distilled. It is rendered soluble in water through the yellow viscid matter in cantharides (Robiquet), which we find to be partly precipitated by basic lead acetate and mercuric chloride. But, according to Rennard, hot and cold water dissolves nearly $\frac{1}{3}$ and $\frac{1}{5}$ per cent. of cantharidin, and this vaporizes when distilled with water, more particularly with the first portions—with chloroform even at 60° C., and in the dry state at and above 85° C. (185° F.). When dry it fuses near 210° C. (410° F.), and sublimes more freely at that temperature, condensing again in glossy prisms or needles. It unites with bases after assimilating H_2O, forming salts, *cantharidic acid* having the composition $C_{10}H_{14}O_5$, but on being decomposed by an acid cantharidin is again separated (Dragendorff, 1867). Krafft (1877) gives the formula $C_{20}H_{24}O_8$ to cantharidin, and states that the latter, heated with hydriodic acid spec. grav. 1.8, is gradually converted into the monobasic *cantharic acid*, which has the same composition, is crystalline, soluble in 120 parts of cold and 12 of boiling water, sparingly soluble in ether, and not vesicating when its glycerin solution is applied to the skin.

Off. Prep.—Acetum cantharidis, *Br.*; Ceratum (emplastrum) cantharidis, Charta cantharidis (epispastica), *U. S.*, *Br.*; Ceratum extr. canthar., Collodium cum cantharide, *U. S.;* Emplast. picis cum cantharide (calefaciens), *U. S.*, *Br.;* Linim. cantharidis, *U. S.;* Liquor epispasticus, *Br.;* Tinctura cantharidis, *U. S.*, *Br.;* Unguentum cantharidis, *Br.*

Other Insects.—Only two insects are now officinal in the U. S. and British Pharmacopœias, Cantharis and Coccus. Some European pharmacopœias recognize also the *red ant*, Formica rufa, *Linné*, which belongs to the order Formicidæ, and is used in preparing a spirit (see ACIDUM FORMICICUM) and a tincture. The latter, *tinctura formicarum*, is made by digesting 2 parts of fresh and bruised ants in 3 parts of alcohol, and has a brown color.

Recently an insect of the order Orthoptera has been recommended—BLATTA (PERIPLANETA, *Burmeister*) ORIENTALIS, *Linné;* Cockroach, *E.;* Bête noir, Panetière, Cafard, *Fr.;* Schabe, *G.*—It is a native of Asia, but now found in most parts of the civilized world. It is dark-brown, about 1 inch (25 Mm.) long, has a flat broad body, the extremity of which is furnished with two conical appendages; the antennæ are long and filiform, the legs thin but strong, and the wings lie straight on the back, covering the greater part of the body of the male, but being quite short in the female. The cockroach is nocturnal in its habits and has a disagreeable sickening odor. Bogomolow (1876) announced the isolation of the active principle *antihydropin* in a crystalline form, but has not published the process for obtaining it.

Physiological Action.—*On Animals:* Cantharides given to dogs in large doses cause vomiting, debility, dilated pupils, pain, bloody urine and feces, coldness, convulsions, and death. In doses not fatal irritation of the sexual organs is manifested. Injected into the veins, the symptoms are essentially the same. Half a grain of cantharidin used in this manner killed a dog in half an hour, and one-seventh of a grain destroyed a cat in the same time. After death from cantharides vascular injection of the intestine, the kidneys, and the bladder is found.

On Man: Internally, if the quantity be large, cantharides occasion a burning heat in the throat, stomach, and bowels, cause nausea and vomiting, often of blood, and produce fibrinous and sometimes bloody stools, griping, and tenderness of the abdomen. With such symptoms death may take place. If there is time for the absorption of the cantharidin, there is also strangury, with burning pain in the kidneys and bladder; the urine may at first be increased, but soon grows scanty, albuminous, or bloody; the local irritation is apt to occasion erection of the penis; sometimes, though rarely, erotic excitement and seminal emissions occur, and in the female genito-urinary excitation, which may induce abortion. Gangrene sometimes attacks the genitals. It is said that venereal excitement is more apt to follow the action of cantharides in substance than that of cantharidin, and the difference is ascribed to an essential oil which the former contains, and which gives them their characteristic nauseous and pungent odor. The general symptoms of cantharidal poisoning consist of a frequent and small pulse, hurried breathing, vascular injection of the face, heat of skin, thirst, pain in the head, delirium, trembling, tetanic spasm, and coma. The smallest fatal dose of cantharides on record is 24 grains, but the patient was a pregnant female, who aborted. An ounce of the tincture has been fatal to a boy of seventeen. Cantharidin does not appear to stimulate so energetically when taken internally; indeed, some Italian writers declare it to be a direct and powerful sedative of the nervous and circulatory systems. Several cases of poisoning by cantharidal collodion are recorded. In one case 15 drops of the preparation were taken by a woman who suffered chiefly from pain, strangury, and albuminous urine (*Phila. Med. Times*, iv. 312). In another case a man swallowed about 8 ounces of strong alcohol and half an ounce of sulphuric ether holding in solution half an ounce of cantharidal collodion. About 4 hours afterward he began to pass urine, and during the following 6 or 7 hours he discharged nearly 2 quarts; then it became scanty, glutinous, and bloody. He had severe pain over the kidneys, and also in the course of one ureter, and in the bladder. The urine was scalding, and there was a burning pain in the abdomen. The pulse gradually became small and the hands and feet cool, and death occurred in 35 hours (*Boston Med. and Surg. Jour.*, Jan. 1880, p. 108). After death from cantharides the gastro-intestinal and urinary mucous membranes are congested, bloody, inflamed (with exudation), or gangrenous. The kidneys are sometimes enlarged and engorged, and offer the signs of parenchymatous and desquamative nephritis, but chiefly of the latter (Eliaschoff, *Virchow's Archiv.*, xciv. 323; Aufrecht, *Pathologische Mittheil.*, ii. 32); the bladder contains blood, while its lining membrane is red, and presents blebs, pseudo-membranes, and sometimes ulcers. Applied to the skin in cerates, ointments, etc., or as cantharidin, this agent produces a stinging and burning pain, with redness, followed by vesication. The serum contained in the elevated cuticle is pale-yellow, alkaline, and albuminous; the chorion is pale-red, and its papillæ are prominent, or, if the action has been energetic, the chorion is highly inflamed and may be coated with a fibrinous layer. When a blister is very large and long applied, it is apt to produce strangury, and the urine is then covered with an albuminous pellicle. It may also cause general nervous excitement and fever, inflammation of the lymphatics and their glands, or a diffuse erythema, and even gangrene of delicate parts or of such as are weakened by blood diseases. Hence a blistering plaster of large size should rarely be kept upon the skin until complete vesication occurs. Cantharidin does not appear to cause toxical effects as readily as cantharides.

Medical Uses.—*Internally:* Cantharides in the form of the tincture have been given in low forms of *fever*, and in cases of exhaustion from protracted *hectic*, with alleged advantage, but there is nothing to render this method eligible. The same is true in regard to *dropsy* and chronic *bronchitis.* In scaly *diseases of the skin* they have been found very useful, and should not be forgotten when arsenic and the application of tar, etc. have failed. In various forms of *debility of the bladder*, such as produce incontinence of urine in children and old men, and in the latter *dysury*, this medicine has been often efficient. Sometimes, indeed, when directly injected into the urethra, long-standing *gleets* have been cured by it, and also by its internal administration. In chronic *vesical catarrh* it deserves more confidence than it is apt to receive. *Diabetes insipidus* has been arrested by it. In all of these cases, except the last, it acts by producing a substitutive irritation. Before the pathological conditions which produce *dropsy* were recognized, a certain number of cases of this affection were recorded as having been cured by cantharides. Richter restricted the use of the medicine to cases distinguished by a torpid state of the system; Ferriar applied it to the cure of scarlatinous dropsy; and it was recommended by Lieutaud and by Blackwall (Stillé, *Therapeutics*, 4th ed., ii. 427). More recently Grainger Stewart (1871) mentioned the tincture of cantharides as a good stimulant diuretic in the later stages of the inflammatory form of Bright's disease; but Dickinson (1868) spoke of it unfavorably. E. Wagner (1882) referred to it, along with sabina, as possibly dilating the renal capillaries. In 1884, Dr. Bruen claimed that the tincture of cantharides acts favorably in chronic catarrhal nephritis combined with some interstitial process and associated with more or less cardiac hypertrophy, especially when given along with digitalis. He also stated that in several cases of *cardiac dropsy* "it very constantly increased the urinary secretion, forming a valuable adjuvant to digitalis" (*Phila. Med. Times*, xiv. 275). It has usually been held that digitalis is not adapted to the treatment of cardiac hypertrophy, except when it is associated with predominant dilatation. Its irritant action upon the pelvic organs is illustrated by its use in *amenorrhœa* depending upon atonic conditions, and in passive *seminal emissions* of the same nature.

Externally, the uses of cantharides, especially in blisters, are very numerous. They are employed—1st, to stimulate the whole or a particular part of the system; 2d, to promote the absorption or prevent the accumulation of inflammatory exudations; 3d, to recall suppressed discharges; 4th, to act as a depletory; 5th, to promote the cure of internal diseases by counter-irritation of the skin. Their direct remedial influence by stimulation is seen in cures of indolent *ulcers*, *fistulæ*, and several inveterate diseases of the skin, as *lepra*, *psoriasis*, and *lupus*, and even of certain acute ones, as *zona* and *erysipelas.* Blisters have been used with striking effect to prevent the increase and hasten the cure of *boils* and *carbuncles*, by applying them so as to cover the whole indurated spot and allowing them to vesicate fully. To be successful this method must be employed early. Liniments containing tincture of cantharides are among the best means of curing *alopecia.* The revulsive operation of blisters is the one most usually invoked, and, on the whole, the most useful. Wherever there is a local tendency to congestion the timely and due application of a blister modifies and may arrest it; thus it may prevent serious *congestion of the brain*, or its increase if already existing, or its consequences through effusion if this have occurred, by depleting the neighboring skin, and probably by a reflex action upon the vaso-motor nerves. These consequences include *paralysis* and other effects of *congestion*, *hæmorrhage*, and allied conditions of the brain and spinal cord. Evidently, vesication should not be made in their acutest stage, and its benefits are relatively small when the state has become chronic; in the former it over-stimulates, in the latter its stimulation is useless. Many cases of *dropsy of the brain* have been palliated by blistering the scalp; many of *general dropsy* by blisters cautiously applied to the legs; many also of *hydrocele*, of *hydrarthrosis*, and, most of all, of *chronic pleurisy*, in which no medical means are more efficient than a succession of large blisters. A similar action is no doubt exerted by blisters when applied along the under surface of the penis for *gleet* and to the sacrum for *leucorrhœa*, to prevent *abortion*, to relieve *dysmenorrhœa*, and to hinder the suppuration of deep-seated *buboes* and other glandular inflammations. In the last-mentioned cases, if the inflamed organ is very superficial or the action of the blister is deep, suppuration will be hastened. *Abscesses* of various sorts may be conveniently evacuated by blistering, and especially cold abscesses, if the skin over them is already thin.

The action of blisters in *fevers* is probably both stimulant and revulsive, and to a certain extent depletory. The clinical facts of the matter are simply these: that blisters, especially on the nape of the neck, are generally useful in *typhus* and *typhoid* fevers, whether the condition be one of excitement or of coma or denote a tendency to the one or the other state. They are not equally beneficial under analogous conditions in scarlatina or variola, or during acute inflammations of the lungs, heart, or bowels. Their stimulant action is the one most frequently sought—*i. e.* when the symptoms are moderately comatose—in which case the vesicant should not remain applied longer than from 2 to 4 hours, its fuller effect being secured by a dressing of simple ointment or a poultice. In cases of profound stupor a more sustained operation is necessary. When coma is due to an *apoplectic* condition, whether hæmorrhagic or only congestive, the active depletory operation is to be secured by a more prolonged application of the blister, and, if necessary, to the scalp as well as to the back of the neck. In such cases also the discharge should be maintained by means of stimulant dressings. In all forms of inflammation of the *eyes* blisters are invaluable as revulsives, applied to the nuchæ, behind the ear, or on the forehead. The utility of blisters in *acute* inflammation of the pleura and of the lungs (*pleurisy* and *pneumonia*) depends upon their being applied long enough only to vesicate superficially and so as to cover a large portion of the affected lung. Smaller blisters may relieve a stitch in the side, but will not so distinctly influence the progress of the inflammation within, as denoted by a diminution of the cough, oppression, and fever. Small blisters are of essential use in those limited pleurisies which occur during chronic phthisis, and they should not be disregarded in analogous pneumonias. In *pericarditis* blisters should never be omitted; they allay pain, probably limit the effusion, and certainly promote its absorption. The revulsive action of blisters is also a precious resource in the treatment of *phlegmasia alba*, of *phlebitis*, and especially of *chronic fluxes of the bowels*. Nothing is more efficient in the last than a succession of large and superficial blisters. The treatment of acute articular *rheumatism* by blisters applied upon the affected joints has been attended with a large degree of success, but it is doubtful whether the benefit is due so much to a revulsive or counter-irritant operation as to the alkalinity of the secretions induced by blistering. As the use of alkalies internally and locally usually cures acute articular rheumatism, it does not seem worth while to employ a remedy which accomplishes no more than they, while it inflicts much pain. In cases of retrocedent rheumatism or gout it has been advised to blister the joints last affected, but less severe revulsives are doubtless as useful. Of all the local methods of treating *neuralgia*, that by blisters is the most efficient. It consists in applying small blisters over the superficial portions of the affected nerves, especially where they emerge from bony or tendinous openings or distribute their terminal branches to the skin. The vesication should be slight when the nerves are superficial, energetic when the trunks lie deep. The nerves of the head, face, and chest require the former method—the sciatic nerve the latter. In cases suitable for superficial vesication the operation should be repeated as often as the skin heals if the pain continues to return; when the nerves lie deep, the discharge from the blistered surface should be constantly maintained until the cure is perfect. *Spinal irritation*, so called, is most frequently a true neuralgia, but is sometimes also a constant aching of the muscles along the spine, produced by nervous exhaustion. It may be relieved by superficial blistering, and by other local stimulants, including electricity, provided a suitable regimen by rest and nutritious food are at the same time employed. The revulsive action of blisters is also employed in *convulsive disorders* for the purpose of reducing the morbid irritability of the cerebro-spinal centres. It has long been used upon the spine in *tetanus*, and with unequivocal advantage, and in all diseases attended with tetanoid rigidity or convulsions. Its advantages are hardly inferior in all cases of *paralysis* that depend upon congestion or inflammation of the spinal cord or its membranes. It is notably a valuable element of the treatment in *epidemic meningitis* when the phenomena dependent upon nervous disorder exceed those which depend upon alterations of the blood. The blisters should cover the occiput and extend along the spine to the end of the cervical vertebræ at least, and should vesicate thoroughly. *Spasms* of particular muscles are often moderated by blistering the affected part, as in *scrivener's spasm*, and the nutrition of *wasting muscles* after rheumatism, injuries, etc. is generally improved by a course of blistering. *Vomiting* is often arrested by blistering the epigastrium.

A blister should, in general, be applied as near as possible to the part which it is intended to benefit. It is usually undesirable to allow it to remain upon the skin until vesication has been accomplished. *Usually from 3 to 6 hours, or until vesication commences, will be long enough.* It will act more promptly if the part has first been cleansed with warm water and soap and bathed with vinegar. Fever renders the action of blisters more rapid, and coldness and nervous insensibility of the skin retard it. They act more promptly when the skin is delicate, hence more so in children and females than in other persons; consequently, especial care should be used to prevent their excessive action in such patients, either by diluting the blistering cerate or by interposing a piece of tissue-paper or fine muslin between the plaster and the skin. If it is desired to heal a blister soon, the raised cuticle should be cut freely, so as to evacuate the serum, and a dressing of carded cotton applied and secured with a roller. If it is intended to maintain the discharge, the cuticle should be removed, and a dressing, first of simple cerate, and within 24 hours one of basilicon ointment, applied. Under such stimulation the discharge grows purulent, and may be maintained by savine cerate or mezereon ointment. As a general rule, blisters should be very cautiously employed in old and in young persons; in the former they act slowly and often leave intractable sores; in the very young they are prone to excite excessive reaction and occasion gangrene. During epidemics of diphtheria blisters are very apt to become covered with false membrane; during other epidemics they are likely to be attacked with erysipelas or with gangrene, or to be followed by abscesses or by an eruption of boils. To prevent the strangury which plasters of cantharides frequently cause, the most usual method is to sprinkle the surface of the plaster with finely-powdered camphor or to brush it over with tincture of camphor. The efficacy of this method is very doubtful. It has been alleged that if the plaster be sprinkled with bicarbonate of sodium mixed with coarsely-powdered cantharides, the apprehended effect will not take place. For internal administration the tincture is the only preparation of cantharides which it is prudent to use.

Poisoning by cantharides recently taken should be treated by a vegetable emetic, with copious draughts of warm water, and afterward by the free use of mucilaginous or albuminous liquids. But chloroform and the fixed oils, which dissolve the active principle of cantharides, should not be administered. General warm baths and emollient cataplasms on the abdomen should be used, and opiate enemata.

Blatta orientalis, or common cockroach, was anciently employed in medicine. An oily decoction of these insects was used to cure warts, scaly eruptions, indolent ulcers, contusions, boils, etc. Internally, they were given along with resin for the relief of dyspnœa (Pliny). Quite recently (1878) in Russia they have been employed in *albuminuria*. They are said to diminish the quantity of albumen, increase the perspiration and urine, remove the attendant dropsy, and neither to impair the digestion nor irritate the kidneys. In other forms of dropsy they are reported to have exhibited remarkable diuretic powers. More recent statements of the use of this agent in Russia appear to confirm the belief in its diuretic powers in dropsy (*Med. Record.*, xvii. 682). But Paul, having fully tested it clinically, concluded that it has no medicinal effect whatever (*Bull. de thérap.*, xcvi. 429, 473). Stanislas Martin endeavored to discern in the insect the cause of the virtues attributed to it, but he could extract from it only a stinking fat (*Bull de thérap.*, xcii. 168). The daily dose was from 4 to 5 grains (Gm. 0.25–0.30) of the powder obtained from the dried insect.

Ænas afer, a coleopterous insect that abounds in Spain, is claimed to possess over cantharides the following advantages: it is cheaper; it acts without appreciable pain; it is equally powerful, and does not irritate the urinary organs (*British Med. Jour.*, May 20, 1882).

Red ants were formerly used medicinally. A large number of them, enclosed in a linen bag, were infused in boiling water, which, with the bag, was then added to local or general baths in the treatment of chronic gout and rheumatism. The affected foot or hand was sometimes subjected for several hours to the action of the ants by being thrust into their hills. Internally, a tincture of domestic manufacture was given, and which was made by the prolonged infusion of a large amount of ants in an equal quantity of brandy. An officinal *spiritus formicarum* was formerly in common use, and is retained in the last edition of the German Pharmacopœia (1883). It was given internally, in doses of from 20 to 50 drops, in nervous and paralytic affections, and also applied by friction. An oil made by macerating living ants in almond oil was used for similar external purposes.

CAPSICUM, *U. S.*—CAPSICUM.

Capsici fructus, Br.; *Fructus capsici*, P. G.; *Piper Hispanicum.*—*Capsicum-fruit, Cayenne pepper, African pepper, Pod pepper*, E.; *Capsique, Piment des jardins, Piment rouge, Poivre de Cayenne*, Fr.; *Spanischer Pfeffer, Schotenpfeffer*, G.

The dried fruit of Capsicum fastigiatum, *Blume.* Woodville, t. 80; Bentley and Trimen, *Med. Plants*, 188, 189.

Nat. Ord.—Solanaceæ.

Origin.—Several species have long since been cultivated in tropical countries, and since the early part of the sixteenth century also in Europe; they are supposed to be indigenous to South and Central America, and to have been introduced into the East Indies by the Portuguese; also in Africa. The plants of this genus are herbaceous or shrubby, have the leaves alternate or on the flowering branches sometimes opposite, petiolate, entire or wavy-margined, and produce from the forks of the branches from one to three pedunculate flowers with a rotate, five-lobed, yellowish, whitish, or reddish corolla, and yielding an incompletely two- or three-celled berry containing numerous flat seeds. In the course of time many varieties have been produced through cultivation. The average annual importation into the United States during seven years ending 1882 was 81,977 pounds of the fruit and 13,295 pounds of powdered capsicum, the highest being of the former 353,683 pounds in 1876, and of the latter 25,352 pounds in 1881.

Description.—C. FASTIGIATUM, *Bl.*, is a small shrub bearing in each fork two or three fruits which are $\frac{1}{2}$ to $\frac{3}{4}$ inch (12 to 18 Mm.) long, about $\frac{1}{5}$ inch (5 Mm.) thick, of a conical-oblong shape, supported by a flattish cup-shaped five-toothed calyx, bright-scarlet in color; become shrivelled on drying, and consist then of a thin, translucent, and fragile pericarp enclosing two cells containing, attached to the thick central placenta, numerous flat, reniform, yellowish seeds, which are about $\frac{1}{8}$ inch (3 Mm.) in diameter and have a semicircular embryo enclosed in a fleshy albumen. The odor of the fruit is peculiar, its taste extremely hot and biting. This kind is known in commerce as *African* or *bird pepper*, and in Great Britain as *chillies* and *Guinea pepper.* It is the only kind permitted by the British and the U. S. Pharmacopœia.

C. FRUTESCENS, *Linné.* has a similar fruit, which is ovate-oblong, $\frac{1}{3}$ to $\frac{1}{2}$ inch (8 to 12 Mm.) long and $\frac{1}{8}$ or $\frac{1}{6}$ inch (3 or 4 Mm.) thick.

C. ANNUUM, *Linné*, is an herbaceous annual, and is extensively cultivated in the temperate zone. The fruit grows singly in the forks of the stem, is much larger than the preceding, and varies in shape between straight or curved, conical, erect, or pendulous, and more or less globular; it attains a length of 2 to 4 inches (5 to 10 Cm.), a thickness of 1 to $1\frac{1}{2}$ inches (25 to 38 Mm.), is sometimes yellow, but generally red, and after drying brownish; otherwise it resembles the preceding. The fruit is known in England as *pod pepper*, but also sold as *chillies*, and is the kind recognized by the German Pharmacopœia.

C. LONGUM, *Fingerhuth*, C. grossum, *Willdenow*, C. cordiforme, *Miller*, and other nominal species, are now usually regarded as varieties. Some cultivated varieties, like much of the *paprika* used in Hungary, were shown by H. B. Brady (1880) to be almost destitute of pungency.

The fruits of C. cerasiforme, *Willdenow*, of the size and shape of a cherry, and of C. chlorocladum, *De Candolle*, small and oblong, are occasionally, though not often, met with.

The outer layer of the pericarp of capsicum-fruit consists of several rows of tangentially elongated cells with irregularly thickened walls, and containing the granular red or yellow coloring matter. This is followed by a thicker layer of thin-walled parenchyma and thin spiral vessel, and by the inner membrane, consisting of a single row of flat irregularly thick-walled cells.

Powdered capsicum is of a dark orange-red color, is very sternutatory and irritating, and, particularly when prepared from the second species, is not unfrequently attacked by insects.

Constituents.—Since the analysis made (1816) by Bucholz and Braconnot the name of *capsicin* has been given to various liquid or soft preparations, all of which were more or less impure, though containing the fiery principle, which at last was isolated by J. C. Thresh (1876), who found it to be a crystallizable body which has been called *capsaicin*, is with difficulty obtained pure, and, according to Dr. Buri, has the composition $C_9H_{14}O_2$. It is present in small quantities only, and intimately associated with a red fatty matter which consists chiefly of palmitic acid. Buchheim's *capsicol* (1873) is a red oily liquid containing the active principle, which may be isolated by treating the oleoresin prepared with ether or benzin with weak potassa solution, passing carbonic acid gas through the watery liquid, and purifying the precipitate by recrystallization. Capsaicin is colorless, melts at 59° C. (138.2° F.), volatilizes at 115° C. (239° F.) with extremely irritating vapors, and dissolves in alcohol, fixed oils, ether, amylic alcohol, benzol, and alkalies, but slowly in turpentine, carbon bisulphide, and petroleum. It yields crystalline compounds with barium, calcium, and mercury, and when oxidized with nitric acid produces an oily body, oxalic and succinic acids, and another crystalline acid whose nature has not been determined. The red coloring matter of capsicum is but slightly soluble in boiling alcohol, but dissolves readily in oils, sulphide of carbon, petroleum, amylic alcohol, ether, and chloroform. Felletár (1868) isolated from capsicum a volatile alkaloid which has the odor of coniine, but was found to differ from this alkaloid by Dragendorff (1871) in the different shape of the crystals of its hydrochlorate, and from lobeline in not being colored by Fröhde's reagent. The odor of capsicum is in part due to a volatile oil consisting chiefly of stearopten and having a parsley-like odor; from 100 pounds of capsicum Flückiger obtained only .02 Gm. (*Pharmacographia*).

Off Prep.—Extract. capsici fluid., Oleoresina capsici, *U. S.;* Tinctura capsici, *U. S.*, *Br.*

INFUSUM CAPSICI.—Infusion of capsicum, *E.;* Tisane de capsique, *Fr.;* Spanischpfeffer-Aufguss, *G.*—Macerate for 2 hours capsicum 240 grains in boiling water a pint, and strain.—*U. S.* 1870.

Physiological Action.—Capsicum is an irritant and a local stimulant. Applied to the skin, it causes redness, and if continuously applied may ultimately produce vesication. In proper quantities it excites a grateful warmth in the throat and stomach and quickens the appetite and digestion. It tends to prevent the flatulence occasioned by vegetable food, and for this purpose is largely used as a condiment in hot climates. In large doses it causes a general glow, with thirst, but does not raise the temperature or accelerate the pulse. If too lavishly used, it sometimes brings on torpor of the digestive functions, but often it seems not to be injurious. These conclusions have been fully sustained by the experiments of Högyes on man and animals (1878), which show that capsicum and capsicol produce only a local and transient irritation of the skin and mucous membrane, and that when used as a condiment cayenne pepper acts chiefly by stimulating the salivary and gastric glands and promoting the peristaltic action of the alimentary canal.

Medical Uses.—Capsicum is of use by enabling feeble stomachs to digest food, as is shown by its efficacy in atonic *dyspepsia*. Freely taken, it is said to cure *hæmorrhoids*, as black pepper and still other stimulants are known to do. It perhaps sometimes cures *intermittent fever*, and in obstinate cases is a good stimulant to conjoin with quinia. Chéron attributes to capsicum the power of controlling *menorrhagia*. In common with other agents of the same nature it tends to prevent or to relieve *sea-sickness*. In *delirium tremens* it is beneficial by enabling the patient to retain and digest food; indeed, we have seldom in this disease found it necessary to employ other internal remedies than a strong soup well seasoned with red pepper. As a local stimulant it is particularly efficient in *tonsillitis*. The simple form may sometimes be arrested in its first stage by a capsicum gargle; and in the sore throat of *scarlet fever* and in *diphtheria* no application is so efficient as a strong gargle or wash made with this substance.

The *dose* of powdered capsicum is from 5 to 10 grains (Gm. 0.30–0.60). An infusion is made by adding 40 grains (Gm. 2.50) of capsicum to half a pint of boiling water: of this a tablespoonful may be given at a dose. An infusion used with remarkable success in an epidemic of *angina maligna* (diphtheria?) is thus described: Take 2 tablespoonfuls of red pepper and the same quantity of fine salt; beat them into a paste, and add half a pint of very sharp vinegar. Of this the dose for an adult is said to be a tablespoonful every hour. It is excessively acrimonious, but it is alleged to hasten the separation of the false membranes and sloughs from the fauces. A plaster made of Burgundy pitch (or the officinal capsicum plaster), with which powdered capsicum or its oleoresin has been incorporated, is a very efficient stimulant in cases of chronic *lumbago* and other forms of muscular *rheumatism*, *neuralgia*, etc. Analogous to this is an "extract of red pepper" mixed with resin plaster and spread upon paper. These preparations excite a sense of warmth in the skin, and redden but do not vesicate it.

CARBO ANIMALIS, *U. S.*, *Br.*—ANIMAL CHARCOAL.

Carbo ossium, *Ebur ustum*, *Spodium*.—*Boneblack*, *Ivory black*, E.; *Charbon animal*, *Noir d'os*, Fr.; *Thierkohle*, *Knochenkohle*, *Beinschwarz*, G.

Charcoal prepared from bone.

Preparation.—Boneblack of commerce is obtained by roasting bones deprived of fat in iron cylinders until vapors cease to be given off, when charcoal is left intimately mixed with about ten times its weight of the inorganic constituents of bones, and containing a little nitrogen, probably as nitrogen carburet. The volatile products of this dry distillation are various gases, an ammoniacal aqueous liquid called *bone-spirit*, and a blackish-brown tar called *bone-oil*.

CARBO ANIMALIS PURIFICATUS, *U. S.*, *Br.*—Purified animal charcoal, *E.*; Charbon animal purifié, *Fr.*; Gereinigte Knochenkohle, *G.*

Animal Charcoal, in No. 60 powder, 2 parts; Hydrochloric Acid 3 parts; Water a sufficient quantity. Pour the hydrochloric acid, previously mixed with 15 parts of water, upon the animal charcoal, and digest the mixture on a water-bath for 24 hours, occasionally stirring. Pour off the supernatant liquid and digest the undissolved portion with 15 parts of water for 2 hours. Transfer the mixture to a strainer, and when the liquid portion has run off wash the residue with water until the washings cease to be affected by test solution of nitrate of silver. Dry the product, heat it to dull redness in a closely-covered crucible, and when cool keep it in well-stopped bottles.—*U. S.*

The process of the British Pharmacopœia is very similar to that given above, 16 ounces of boneblack, 10 fluid-ounces of hydrochloric acid, and 20 fluidounces of water being used.

Carbo carnis, or meat charcoal, is prepared by cutting 3 parts of veal, freed from fat, in small pieces, mixing it with 1 part of small bones, and roasting in a covered vessel until inflammable vapors cease to escape; the residue when cold is powdered.

Properties.—Boneblack, like purified animal charcoal, is a dull black, rather dense, inodorous, and nearly tasteless mass, which for uses in the arts is either granulated or powdered. It is entirely insoluble in all simple solvents; the purified animal charcoal also in hydrochloric acid, which dissolves a portion of the boneblack. The compounds removed in its purification are the inorganic constituents of the bones, and consist mainly of calcium phosphate, with some calcium carbonate and magnesium compounds. When ignited with free access of air, boneblack leaves a white ash, amounting to at least 86 per cent. of the original weight, which should be completely soluble in hydrochloric acid with the aid of heat. It has the remarkable property of removing organic coloring matters from their neutral or somewhat acid solutions, and is employed for that purpose in the refining of sugar and in many chemical operations, for many of which its previous purification is requisite to avoid contamination with earthy matters which would be dissolved by the organic acids.

Tincture of litmus diluted with twenty times its bulk of water, agitated with purified animal charcoal and thrown upon the filter, passes through colorless.—*Br.* When ignited at a high temperature with a little red oxide of mercury and free access of air, purified animal charcoal leaves at most only a trace of residue.—*U. S.*, *Br.* If 1 part of it be digested with 2 parts of hydrochloric acid and 6 parts of water, no effervescence should take place (absence of carbonates), and the filtrate should not yield a precipitate on being supersaturated with ammonia (absence of earthy phosphates); boneblack yields a voluminous white or whitish precipitate. The clear ammoniacal liquid or filtrate should not be precipitated by solution of barium chloride or test mixture of magnesium (absence of alkali sulphate and phosphate), and on being evaporated to dryness and ignited should leave no fixed residue (absence of potassium and sodium salts).

Purified animal charcoal removes from their aqueous solutions tannin, alkaloids, bitter principles, basic lead and other metallic salts, iodine, lime, etc.—a property which it shares more or less with boneblack, and which was first observed by Figuier (1810). This property is due to the finely-divided state of the carbon and the surface attraction resulting therefrom, and may be imparted to wood charcoal if, previous to charring, the vegetable substances are intimately mixed with flint, lime, or other earthy matters; a mixture of 10 parts of pipe-clay, 50 parts of finely-powdered coal, and 2 of tar yields, after carbonization, a charcoal possessing excellent decolorizing properties, depending in part upon the presence of alumina. By reheating purified animal charcoal with potassium carbonate its decolorizing power, which was impaired by the treatment with acid, is greatly increased, and similar active charcoals are obtained from blood, horn, leather, etc. by mixing them with the salt mentioned, carbonizing the mixtures, and exhausting the residues with water.

The value of animal charcoal as a decolorizer is best ascertained by treating known weights of it with diluted solutions of indigo or litmus, and ascertaining the bulk which may be completely decolorized by slow percolation. Corenwinder (1853) proposed treatment of the charcoal with diluted solutions of lime and sugar, and determining by titration the amount of lime remaining in solution. The decolorizing property, however, does not appear to be strictly proportional to the lime- or salt-absorbing power of animal charcoal. When the decolorizing power of the charcoal has been exhausted it cannot be restored by heating to redness, because a dense charcoal, resulting from the absorbed substances, will then be deposited in the pores; but if allowed to ferment this substance will be destroyed, and by washing the charcoal with water, drying, and igniting it becomes again a good decolorizer. Pelouze (1854) proposed to effect the revivification of spent animal charcoal by treating it with caustic alkalies or alkaline carbonates; according to Renner (1862), the process is a tedious one. Placing the decolorizing power of bone-black = 1, Bussy ascertained that of purified animal charcoal to be = 1.6; purified animal charcoal ignited with potassium carbonate = 20; blood ignited with potassium (or calcium) carbonate = 20; glue ignited with potassium carbonate = 15.5.

Composition.—Animal charcoal consists of amorphous carbon intimately mixed with the inorganic compounds of bone (see Os), chiefly phosphate and carbonate of calcium, which are partly or wholly removed in purification with hydrochloric acid.

Pharmaceutical Uses.—The chief use of animal charcoal is for decolorizing the aqueous or alcoholic solutions of organic principles; the *purified* animal charcoal should alone be employed.

CARBO LIGNI, *U. S.*, *Br.*—CHARCOAL.

Carbo ligni pulveratus, P. G.; *Carbo præparatus*, *Carbo e ligno*, *Carbo vegetabilis*.—*Wood charcoal*, E.; *Charbon végétal*, Fr.; *Holzkohle*, *Präparirte Kohle*, G.

Charcoal prepared from soft wood.

Preparation.—Wood heated to about 300° C. (572° F.) leaves charcoal as a residue. On a large scale this is effected in iron cylinders (see Acidum Aceticum Pyrolignosum), in closed chambers of brick, or by the method of pile-burning, in which the heat developed by the combustion of a portion of the wood effects the charring of the rest. Two, and sometimes three, stacks of billets of wood of even length are piled up around some stakes driven into the ground until a flattish cone of from 30 to 70 feet in diameter has been formed, which is covered by sod and earth, openings being left near the base for the escape of the water which is at first expelled. After the heap has been kindled in the centre the top opening is closed, and when the wood has become perfectly dry the open space at the base is likewise closed and the pile left to smoulder for several weeks. The charcoal is finally withdrawn and extinguished by water, dry sand, or charcoal-dust. The yield varies with the kind and dryness of the wood. Karsten found that a wood which lost at 100° C. 57 per cent. and at 150° C. (302° F.) an additional 10 per cent. of its weight, would yield only 14 per cent. of charcoal, while the same wood dried yielded 25 per cent. The difference is explained by the formation of carburetted hydrogen on the passing of aqueous vapors over red-hot charcoal, and the same cause accounts for the smaller yield in the dry distillation of wood when the cylinders are rapidly heated, so that the wood near the iron is charred while the pieces in the centre still contain water.

Properties.—Charcoal has the shape and shows the texture of the wood from which it was obtained; it is black, inodorous, tasteless, very porous and brittle, insoluble and infusible. Alcohol in which charcoal has been digested should not become colored, and on evaporation should leave no residue. When charcoal is heated in the air it is converted into carbonic oxide or dioxide, but it should not burn with flame (absence of organic compounds). Ordinary wood charcoal is usually incompletely carbonized, and requires to be again ignited in nearly-closed vessels until it ceases to give off inflammable vapors, and to be reduced to a uniform, fine, non-gritty, dull-black powder before it is adapted for medicinal use. Prepared by pile-burning, charcoal is considerably denser than when obtained in retorts; the latter kind is therefore preferable, particularly that made from soft wood, which is more porous than that obtained from hard wood. Charcoal made from young shoots of the willow, poplar, or linden is for these reasons most esteemed. It contains the inorganic constituents present in the wood, and these amount in well-prepared charcoal to about 1 per cent.

Like other porous bodies, wood charcoal possesses the property of absorbing gases; this was first observed (1777) by Fontana and by Scheele, and Lowitz (1785) discovered the clarifying and decolorizing property of wood charcoal, in consequence of which it was used in the refining of sugar until animal charcoal was found to be better adapted for this purpose. The volumes of gases absorbed by recently-ignited wood charcoal are not uniform, but vary with the nature of the gas and of the charcoal, as was shown by Morozzo (1783), the absorbing power being for oxygen 10, for carbonic acid 35, for sulphuretted hydrogen 55, and for ammonia about 100 volumes, to 1 of the charcoal. Considerable heat is generated thereby, as also by the oxidation of some of the gases by the absorbed oxygen, and may increase to spontaneous ignition; and the increase in weight of pile-burned charcoal may amount to from 10 to 15 per cent. by absorption of watery vapors. This property explains the uses of charcoal as a deodorizer, for which purpose it should be freshly burned or reheated to expel the gases condensed in its pores. Odorous principles are not only absorbed by it from the atmosphere, but likewise from solutions in water and weak alcohol; its employment for the removal of the fusel oil from spirits is well known. (See Alcohol.) It acts in a manner similar to animal charcoal in precipitating from their aqueous solutions metallic salts, or even the metals, most bitter principles, and coloring matters; but for the latter purpose is much inferior to the former.

Composition.—Wood charcoal is amorphous carbon mixed with the inorganic constituents of the wood from which it has been prepared. If insufficiently burned it is also contaminated with empyreumatic products resulting from the partial decomposition of the organic principles.

Pharmaceutical Uses.—Wood charcoal is an ingredient of certain dentifrices, and is employed in some chemical processes for its deoxidizing action, as in the preparation of sulphurous acid and in the reduction of bromates and iodates to bromides and iodides. It is used in making Cataplasma carbonis, *Br.*

Carboneum, Carbonium.—Carbon, *E.;* Carbone, *Fr.;* Kohlenstoff, *G.*—Symbol C. Atomicity quadrivalent or bivalent. Atomic weight 12.—Carbon is extensively diffused in nature; combined with oxygen as carbonic anhydride, CO_2, usually called carbonic acid gas, it exists to a small extent as a constant ingredient of the atmosphere; it is found in the mineral kingdom in the free state as well as in various combinations, most notably as carbonates; and it is invariably present in all organized beings and organic compounds, which, when heated with a limited access of air, usually become black from carbonization—*i. e.* the separation of carbon.

Carbon exists in the following three allotropic modifications:

1. Diamond is found chiefly in India near Golconda, Borneo, Southern Africa, and Brazil, and is in colorless and variously colored octahedrons of 3.5 to 3.6 specific gravity. It is a non-conductor of electricity and the hardest substance known. Lavoisier proved it to be pure carbon; when burned it usually leaves between 0.05 and 0.2 per cent. ash; amorphous diamond, which is used for polishing the crystalline, may leave up to 2 per cent. The value of crude diamonds exported in 1881 from the Cape of Good Hope is estimated to exceed £4,500,000.

2. Graphite, Plumbago or black lead (Plombagine, Crayon noir, *Fr.;* Wasserblei, Reissblei, *G.*) has been found in many countries, crystallizes in hexagonal plates varying in specific gravity between 1.8 and 2.5, is of a black-gray color, fatty to the touch, quite soft, and a good conductor of electricity, and leaves between 0.2 and 5 per cent., occasionally even as much as 46 per cent., of ash.

3. Amorphous carbon exists in nature as *coal*, of which there are three principal varieties—namely, *lignite*, *bituminous coal*, and *anthracite* (*lithanthrax*)—which contain respectively about 66, 80, and 90 per cent. of carbon, partly in the form of organic compounds. Artificially prepared, it constitutes *wood charcoal*, *animal charcoal*, *coke*, and *lampblack*, the latter being obtained by the incomplete combustion of resinous matters; after it has been heated in covered vessels to expel the volatile organic compounds it constitutes a nearly pure carbon.

Coke is the residue left from the dry distillation of coal, and consists of amorphous carbon contaminated with the mineral constituents of the coal.

When burned with an insufficient supply of oxygen, carbon is converted into *carbonic oxide*, CO; with a full supply of air it yields *carbonic acid*, CO_2. The chemistry of carbon in its various combinations constitutes what is known as organic chemistry.

Physiological Action.—Charcoal in the stomach absorbs more or less of the gases and liquids contained in that organ. Unlike alcohol, salt, and some other substances, it does not retard—but, on the contrary, hastens—the decomposition of organic matter, while it renders latent the gases evolved during the process. Its power of absorption depends upon its remarkable porosity, and, as charcoal is indestructible, this property is lasting, and can be revived in its original power by heating the charcoal anew. It seems probable that the minute subdivision and insolubility of powdered charcoal, and consequently its great superficial extent, enables it to present a very large surface of the decomposing material to the oxygen of the air, and thus to ensure its destruction. In point of fact, the most fetid gases disengaged by putrefaction are among those which, on the one hand, are most abundantly absorbed by charcoal—viz. ammonia, sulphuretted hydrogen, and sulphurous acid—and, on the other hand, oxygen, which combines with the other substances and generates new and inodorous compounds. That a portion of this action is owing to the minute subdivision of the charcoal is shown by the analogous effects of dry earth, sand, and gravel upon decomposing organic matters; and whether the action is due to any other cause is more than doubtful. It is not determined absolutely whether charcoal derived from ivory or bone or box-wood, or that which is prepared from poplar or other light porous wood, is the more efficient, but it is certain that charcoal of any kind is most active when freshly made.

Medical Uses.—For all forms of *flatulence* charcoal is one of the most certain remedies, and at the same time for those other *dyspeptic* phenomena which sometimes attend it, particularly nausea, fetid breath, foul taste in the mouth, constipation, palpitation of the heart, etc. It is remarkable that charcoal does not tend to produce *constipation*, but rather to moderate it when it exists. The cases in which it is said to accumulate in the bowels and obstruct them are not well authenticated. Its power of relieving flatulence is not confined to that of the stomach and small intestine; it has proved efficient when the colon was alone distended and a stricture existed near the sigmoid flexure. It has seemed to be a remedy for intestinal *worms* in some cases of intestinal indigestion with colic, flatulence, and irregular stools. Jules Guérin, Maurel, and others (*Bull. de thérap.*, xcviii. 279; xcix. 274) found finely-powdered charcoal a very efficient remedy for choleriform *diarrhœa* both in adults and children. It was administered with milk diluted with water and sweetened. In epidemic *dysentery* it has proved very serviceable when administered by the stomach and also by the rectum, allaying the tormina and tenesmus and correcting the fetor of the stools, while it lessened their frequency and rendered them more feculent. It has been recommended for lessening *tympanites* in typhoid fever, but its administration does not produce this result, and has occasioned intestinal hæmorrhage. As an application to *gangrenous* and foul *ulcers*, incorporated largely in a poultice made with flaxseed, bread-crumb, or yeast, it is very efficient in correcting the smell and hastening a separation of the dead tissue. As an ingredient of dentifrices for cleansing the *teeth* and purifying the breath the use of charcoal is familiar. Its deodorizing power has caused it to be employed in the arts and for sanitary purposes, as for preventing the generation of *putrid gases* in graves, vaults, sewers, privies, and innumerable analogous places, and notably for the filtration of *foul drinking-water*, which it not only deprives of its smell, but also of its organic constituents, and renders it pure and clear. These two properties are extensively employed in the arts.

The *dose* of charcoal is 1 or more teaspoonfuls. It should be as freshly prepared as possible. If intended to correct digestive fermentation, it should be taken directly after meals, and is best administered in water, the portion adhering to the mouth being washed down by a mouthful of water alone. It has been prepared and given in gelatin capsules. This method ensures a more active preparation than one which has been exposed to the air.

CARBONEI BISULPHIDUM.—BISULPHIDE OF CARBON.

Carboneum sulfuratum, P. G.; *Alcohol sulfuris, Carbonii bisulphidum.—Carbon disulphide*, E.; *Sulfure de carbon*, Fr.; *Schwefelkohlenstoff, Schwefelalkohol*, G.

Formula CS_2. Molecular weight 76.

Origin.—Scheele (1777) noticed the production of a very fetid gas on heating a mixture of sulphur and charcoal, but Lampadius (1796) by accident first obtained the compound in a liquid state. Clément and Désormes (1802) elaborated a process for its preparation, and stated it to be a compound of carbon and sulphur; its exact composition, however, was first proven by Vauquelin (1811) and by Berzelius (1812).

Preparation.—Bisulphide of carbon is made on the large scale by heating fragments of charcoal or coke to redness and occasionally dropping through a tube, to the bottom of the retort, pieces of sulphur, which is vaporized and unites with the red-hot charcoal. The condensed liquid contains sulphur in solution, from which it is freed by distillation in a water-bath, and the compounds having a disagreeable odor are removed by prolonged agitation with milk of lime, litharge, certain metals, powdered corrosive sublimate, or copper sulphate, decanting, adding about 2 per cent. of a bland fixed oil or beeswax, and rectifying in a water-bath. E. Allary (1881) uses for the same purpose water and potassium permanganate, the latter added in small quantities, until after agitation the liquid retains its violet color; redistillation is not necessary. Bisulphide of carbon should be kept in well-stopped bottles in a cool place, remote from lights or fire.

Properties.—Thus obtained it is a very mobile colorless liquid having a high refracting power, and when quite pure a rather agreeable ethereal odor and a pungent aromatic and cooling taste; but often it is of a more or less fetid odor from the presence of other volatile compounds. It has the specific gravity 1.290 at 0° C. (32° F.) and 1.269 at 15° C. (59° F.) (1.272 *U. S.*). It boils at 46° C. (114.8° F.) (Buff), or at 47° C. (116.6° F.) (Kopp). It evaporates rapidly at the ordinary temperature, and on passing a rapid current of dry air over its surface partly congeals. It is very inflammable—more so than ether—and burns with a blue flame, yielding sulphur dioxide and carbon dioxide or monoxide. It requires about 1000 parts of water for solution, is soluble in almost all proportions of absolute alcohol, ether, chloroform, and fixed and volatile oils, and in 1½ to 2 parts of officinal alcohol. It dissolves freely phosphorus, sulphur, bromine, iodine, fats, volatile oils, caoutchouc, and other compounds, and unites with some of the sulphur bases, forming *sulphocarbonates*, which correspond to the carbonates containing sulphur in place of oxygen. Dissolved in alcohol and heated in the presence of ammonia, *sulphocyanide* (*sulphocyanate*) *of ammonium* and hydrosulphuric acid are produced; $CS_2 + 2NH_3$ yields $NH_4CNS + H_2S$.

Tests.—Carbon bisulphide should not change the color of moistened litmus-paper (absence of sulphurous acid), and when agitated with solution of lead acetate should not produce a brown or black color (absence of hydrosulphuric acid). A portion evaporated spontaneously in a glass or porcelain vessel should leave no solid residue (absence of sulphur).

Uses.—In the arts it is largely employed for the extraction of fats and in the vulcanization of caoutchouc, and has been proposed as a solvent for obtaining the delicate perfumes of flowers.

Sulphocarbonate of potassium, K_2CS_3, is prepared by agitating potassium monosulphide, K_2S, with carbon bisulphide, and evaporating at about 30° C. (86° F.). It forms yellow deliquescent prisms, which are sparingly soluble in alcohol, have a peppery and sulphurous taste, and above 60° C. (140° F.) are converted into the red-brown anhydrous salt. A solution containing also potassium carbonate, but sufficiently pure for destroying the *phylloxera* and other insects, is made by agitating potassa solution with carbon bisulphide as long as the latter is dissolved; and if alcohol be present *potassium xanthogenate*, $K(C_2H_5)CS_2O$, is also formed. Both salts are slowly decomposed in the soil, with the liberation of carbon bisulphide.

History and Physiological Action.—Bisulphide of carbon was described in 1826 by Lampadius, who discovered the compound in 1796. He noted its rubefacient and also its refrigerant action upon the skin, and recommended its vapor in syncope, and the use of liniments containing it for frost-bite, rheumatism, and local paralyses, as well as its internal administration. Mansfield and others employed it in gouty and rheumatic disorders and for quickening uterine contractions. Pellingahr wrote of it as a cardiac stimulant, diuretic, and emmenagogue, but found it useless in gout and rheumatism (Richter, *Ausfurlich. Arzneimittel.*, iii. 464; Supl. Bd., p. 457). Tiedemann described its effects upon animals, and Kaaf upon himself, confirming the observations of Pellingahr (Strumpf, *Arzneim.*, ii. 533). Krimer applied it to produce cold by evaporation in the reduction of strangulated herniæ. Turnbull employed a sponge saturated with the liquid and contained in a wide-mouthed bottle, which he applied over indurated lymphatic glands. Page of Boston applied its vapor to the relief of local pains; and Schiel of St. Louis used it in a liquid form with alcohol in similar cases, and especially in neuralgia (*U. S. Dispensatory*, 1830). A similar application of it was made by Nessley of Ohio in 1872. Michaelson applied it to burns on cotton wadding. It appears to have been first used as a general anæsthetic by Harold Tanlow in 1848 (Guibert, *Nouveaux médicaments*, p. 604), and soon afterward it was tried on man by Dr. Simpson of Edinburgh, and by Snow on mice (Pereira, *Mater. Med.*, 1848; Amer. ed., i. 377). Simpson described it as a very rapid and powerful anæsthetic, but in several instances it produced depressing and disagreeable visions, and was followed by headache, giddiness, and obstinate vomiting. It rendered the pulse very frequent. Its anæsthetic effect also was very transient; and another objection to its use was found in its very unpleasant odor, which was compared to that of putrid cabbage. When pure it loses this peculiarity. Applied topically, it blunts the sensibility of the skin. Its deleterious effects have been observed in manufactories where it was employed as a solvent for caoutchouc. They have been enumerated by several physicians (Delpech, Heurtaux), and consist primarily of a morbid excitement of body and mind, followed by mental feebleness, confusion of ideas, and even delirium, with sleeplessness, faintness, vertigo, headache, nervous pains, muscular cramps, debility, anæsthesia, atrophy, amaurosis, and sexual impotence. Anorexia, nausea, vomiting, constipation or diarrhœa, palpitation, and shortness of breath are also observed. Taken internally in the dose of 2 or 3 drops, it burns the mouth and throat, and occasions nausea, vomiting, flatulence, and dysuria. It does not appear to be decomposed in the blood.

Medical Uses.—This anæsthetic has been found useful for producing insensibility of the skin in limited surgical operations, such as *opening abscesses*, the *evulsion of nails*, etc. It has also been applied locally for the relief of *headache*, *neuralgia*, and *toothache*. It has been found to relieve the neuralgic pains of *locomotor ataxia* when applied along the spine; and recently Sanders (*Med. News*, xl. 371; xlii. 201) has stated that he found it very efficient as a topical remedy in pure *neuralgia*, especially of the occipital, cervical, intercostal, and sciatic nerves. In other words, its action, like that of chloroform, is counter-irritant and anæsthetic. It has been made use of, but not very successfully, to lessen the swelling of enlarged *lymphatic glands*, of *goitre*, and of *lupoid* and *syphilitic* growths. For the latter purposes it may be applied in an ointment containing 1 part of the preparation to from 5 to 10 of lard. For producing local anæsthesia it may be employed as an atomized vapor. It is alleged to be a very efficient application for indolent *ulcers* when slightly brushed over their surface, which should then be dusted with subcarbonate of bismuth and supported by a bandage. The liquid causes severe pain for a few moments. Tincture of iodine is said to correct the objectionable odor of this preparation when mixed with it in the proportion of one-fourth. The mixture may also be scented with mint, bergamot, etc. Bisulphide of carbon may be administered internally in doses of from 2 to 6 or more drops. It may be taken in an alcoholic liquor, in mucilage, or in milk.

CARBONEI TETRACHLORIDUM.—TETRACHLORIDE OF CARBON.

Carbonii tetrachloridum, *Carboneum chloratum*.—*Chlorocarbon*, *Tetrachlor-methane*, E.; *Bichlorure de carbone*, *Formène perchloré*, Fr.; *Chlorkohlenstoff*, G.

Formula CCl_4. Molecular weight 153.6.

Preparation.—Chlorocarbon was discovered by Regnault in 1839, and is produced by the action, in sunshine, of chlorine upon marsh-gas, CH_4, or upon chloroform, $CHCl_3$, hydrochloric acid being also formed in both cases. It is best prepared by passing well-dried chlorine gas through bisulphide of carbon, and afterward through a porcelain tube wrapped in sheet copper and filled with fragments of porcelain maintained at a red heat, whereby tetrachloride of carbon and chloride of sulphur are produced; $CS_2 + 3Cl_2$ yields $CCl_4 + S_2Cl_2$. The vapors are condensed by the aid of ice or a refrigerating mixture, and the liquid thus obtained is slowly added to an excess of potassa solution or milk of lime, whereby the chloride of sulphur is decomposed and dissolved. The chlorocarbon separates at the bottom and is purified by distillation.

Properties.—It is a colorless, thin, oily liquid of an agreeable aromatic odor, insoluble in water, soluble in alcohol and ether, and not decomposed by contact with aqueous solution of potassa, which, however, will remove any bisulphide of carbon that may be present. Chlorocarbon has the spec. grav. 1.599, and boils at 77° (170.6° F.). Geuther (1858) observed that by the action of nascent hydrogen it is gradually converted into hydrochloric acid and chloroform or dichlor-methane, CH_2Cl_2, according to the temperature at which the reaction takes place.

It is regarded as a chlorinated derivative of marsh-gas (see METHYLENI BICHLORIDUM); according to its elementary composition it is tetrachloride of carbon, or, according to the old notation, *bichloride of carbon*, CCl_2 or C_2Cl_4, which name is still occasionally used.

Allied Compound.—CARBON TRICHLORIDE, HEXCHLORETHANE, C_2Cl_6. Mol. weight 236.4.—It is prepared by passing, in sunshine, dry chlorine gas into ethyl chloride or ethydene chloride (see page 132) until the liquid congeals, when the mass is recrystallized from alcohol. Carbon trichloride forms colorless or white rhombic prisms, is brittle and easily pulverizable, has an aromatic camphoraceous odor, and is nearly tasteless. Its specific gravity is about 2.0. It is insoluble in water, freely soluble in alcohol, ether, fats, and volatile oils, burns in the presence of alcohol with a red flame, melts at 160° C. (320° F.), boils at 182° C. (359.6° F.), subliming in crystals, and volatilizes slowly at ordinary temperatures.

Physiological Action and Medical Uses.—Experiments on animals by Laffont and others show that this preparation produces anæsthesia, preceded by excitement, with tonic and clonic convulsions, great debility of the heart, and vascular tension. It causes death by arresting the action of the lungs and distending the right side of the heart with blood. From 10 to 15 Gm. are required to induce anæsthesia in dogs. When inhaled by man it produces a sense of coolness in the fauces and of general warmth, followed promptly by anæsthesia and a complete return of consciousness. It has been used with success in relieving *neuralgia* and various local pains, including *dysmenorrhœa* and the throes of *parturition*. As its primary, or at least proximate, action is upon the heart, and as several deaths are laid to its charge, this preparation ought never to be employed internally.

CARDAMINE.—Cuckoo-Flower.

Herba nasturtii pratensis.—*Cresson des prés*, Fr.; *Wiesenkresse*, *Kukukskraut*, G.

Cardamine pratensis, *Linné.*

Nat. Ord.—Cruciferæ, Siliquosæ.

Origin.—This perennial plant grows in wet meadows and boggy places, and is a native of Europe, Northern Asia, and North America, but is rather scarce in the United States south to New Jersey and westward to Wisconsin.

Description.—The ascending stem is about a foot (30 Cm.) high and nearly smooth. The leaves are pinnate, with seven to thirteen leaflets; those of the lower leaves are on short stalks, roundish, entire, or somewhat toothed, the terminal one largest and nearly reniform; those of the upper leaves are linear and mostly entire. The flowers are showy, white, or rose-colored, and the pods linear, flattened, and with veinless valves. The fresh plant has a pungent and bitterish taste.

Constituents.—According to Lepage (1846), the seeds contain myrosin, but no myronic acid. Winckler found in the herb of Cardamine amara an acid containing nitrogen and sulphur and yielding with myrosin a volatile oil resembling that of mustard.

Allied Plants.—The following Cruciferæ (see also Armoracia, Cochlearia, Nasturtium, and Sinapis) have sensible properties similar to those of the preceding plant, and have been occasionally used for similar purposes:

Cardamine hirsuta, *Linné.*—Small bitter-cress, common in Europe and North America; resembles the preceding, but is smaller; has small white flowers and slender, ascending pods.

Card. amara, *Linné.*—Bitter-cress, indigenous to Europe, has pinnate leaves, with seven or nine roundish-ovate, stalked leaflets, showy white flowers, and purplish-blue anthers. It is less pungent and more bitter.

Barbarea vulgaris, *R. Brown.*—Wintercress, Yellow scurvy-grass, *E.;* Herbe de Sainte-Barbe, *Fr.;* Winterkresse, *G.*—This biennial herb, like the very similar Bar. præcox, *R. Brown*, is sometimes cultivated for salad, and is common in Europe and North America; it has lyrate leaves, with large round or ovate sometimes heart-shaped terminal lobes, the upper leaves obovate, toothed; flowers numerous, yellow; pods somewhat spreading.

Dentaria.—Pepper-root, Toothwort, *E.;* Dentaire, *Fr.;* Zahnwurz, *G.*—The rhizomes have a very pungent taste, and are cylindrical in D. diphylla, *Linné* (North America), and D. bulbifera, *Linné* (Europe), but composed of several tubers in D. enneaphylla, *Linné* (Europe), and in the North American species, D. maxima, *Nuttall*, D. heterophylla, *Nuttall*, D. laciniata, *Muhlenberg*, and D. multifida, *Muhlenberg*.

Sisymbrium (Erysimum, *Linné*) alliara, *Scopoli*, s. Alliaria officinalis, *Andrews.*—Hedge-garlic, *E.;* Alliaire commune, *Fr.;* Knoblauchkraut, *G.*—Pless (1846) obtained from the herb and seeds a mixture of mustard and garlic oil, to which the alliaceous odor is due; they contain also a bitter principle.

Sisymbrium (Erysimum, *Linné*) officinale, *Scopoli.*—Hedge-mustard, *E.;* Herbe aux chantres, Tortelle, *Fr.;* Wilder Senf, Hederich, *G.*—An annual herb with runcinate leaves, small yellow flowers in terminal spicate racemes, and linear appressed pods. The seeds have a sharp mustard-like taste, and yield oil of mustard; the herb is milder.

Medical Action and Uses.—Cardamine contains an acrid principle when fresh, which causes it to resemble water-cresses and scurvy-grass in taste. Like them, it is sometimes eaten as a salad, and has popular reputation as a "purifier of the blood." The flowers were once claimed to display a certain efficacy in gout, and even in chorea, hysteria, and epilepsy, and to possess expectorant and diuretic virtues. Its medicinal use is now obsolete, even in Europe. The allied plants enumerated have analogous virtues.

CARDAMOMUM, *U. S., Br.*—Cardamom.

Cardamomi semina, Br.; *Fructus (Semen) Cardamomi (minoris)*, P. G.; *Cardamomum minus*, *Cardamomum malabaricum.*—*Malabar cardamoms*, E.; *Cardamomes*, Fr.; *Cardamomen*, *Kleine Kardamomen*, G.

The fruit of Elettaria Cardamomum, *Maton*, s. Alpinia (Amomum, *White*, Matonia, *Smith*, Renealmia, *Roscoe*) Cardamomum, *Roxburgh.* Bentley and Trimen, *Med. Plants*, 267. The dried ripe seeds kept in their pericarps, *Br.*

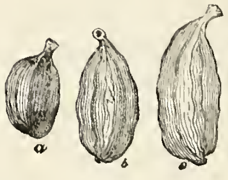
Nat. Ord.—Zingiberaceæ.

Origin.—This perennial plant is indigenous to Hindostan, more particularly to the mountainous region of the Malabar coast, where it is also extensively cultivated in clearings made in the forests, so that the plants will enjoy sufficient shade, or in the betel-nut plantations, as in Mysore. It grows to the height of 6 to 10 feet (1.8 to 3 M.) from a thick horizontal rhizome, has lanceolate leaves which are 1 to 2 feet (.3 to .6 M.) long, and almost sessile upon the long hairy sheaths, and produces three or four nearly horizontal scapes which bear several short racemes of greenish-white flowers. It flowers during the rainy season, and the inferior capsules are collected from and after October, before they are quite ripe, to avoid their splitting, and dried by artificial heat. The drug is exported in chests from Bombay, Madras, and other East Indian ports. 29,000 pounds of cardamom were imported into the United States in 1876, and 65,000 pounds in 1880.

Description.—Cardamom-fruits vary in length from $\frac{2}{5}$ to $\frac{4}{5}$ inch (1 to 2 Cm.), and are commercially divided into *shorts* and *short-longs* or *mediums* and *longs*. They are ovoid or oblong, obtusely triangular, rounded at base, beaked above, of a pale-buff color, longitudinally striate, and three-celled. The capsular integuments are thin, leathery, the three cell-partitions starting from the centre of the valves. The seeds are attached to a central placenta in two rows, brown, slightly glossy, about $\frac{1}{5}$ inch (5 Mm.) long and $\frac{1}{8}$ inch (3 Mm.) broad, angular, transversely rugose, with a depressed hilum and a channelled raphe on one side, and contain a club-shaped embryo, the radicle projecting toward the hilum, and the upper part completely surrounded by the horny endosperm, and this by a thicker saccate layer of granular perisperm. Each seed is enclosed in a thin membranous nearly colorless arillus. The integuments are nearly inodorous and tasteless; the seeds have an agreeable odor and a warm aromatic and pungent taste. The seed-coat consists of three distinct layers, each one formed of a single thickness of cells, those of the outer layer being brownish, rather thick-walled, and upon transverse section square in outline and small; those of the second layer, much larger, thin-walled, square; and those of the inner layer, radially elongated, dark-brown, and with a small cavity near the outer end. The outer albumen contains minute starch-granules and crystalloid proteids; the inner albumen and embryo are filled chiefly with fixed oil and mucilage; the volatile oil is mostly contained in the large thin-walled cells of the testa.

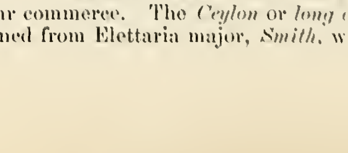
Good cardamoms should be full and plump, and yield 75 per cent. of their weight in seeds. Malabar and Aleppy cardamoms are usually ovoid and have a short beak; Madras cardamoms are more oblong and acuminate.

FIG. 50.



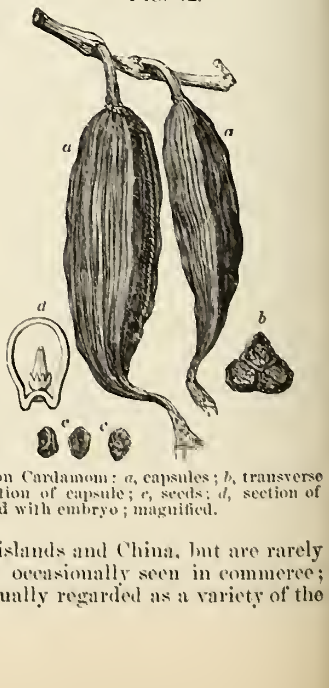
Malabar Cardamom: *a*, short; *b*, medium; *c*, long.

FIG. 51.



Cardamom-seed; transverse and longitudinal section; magnified 5 diameters.

FIG. 52.



Ceylon Cardamom: *a*, capsules; *b*, transverse section of capsule; *c*, seeds; *d*, section of seed with embryo; magnified.

Other Varieties of cardamoms are used in the East Indian islands and China, but are rarely met with in our commerce. The *Ceylon* or *long cardamoms* are occasionally seen in commerce; they are obtained from Elettaria major, *Smith*, which is now usually regarded as a variety of the officinal plant and is indigenous to Ceylon. The fruit is about 1½ inches (4 Cm.) long, lanceolate oblong, acutely triangular, with flat sides and a long, attenuated apex. It is usually of a darker color, and the seeds are less agreeable in odor and taste. The *round cardamoms* of Siam, Java, and other islands are the fruits of Amomum cardamomum, *Linné*, of the size of a cherry, globular or somewhat ovate in shape, the three sides convex; the taste of the seeds is more camphoraceous. The *Bengal cardamoms*, obtained from Am. aromaticum, *Roxburgh*, are an inch long, oblong or oval, rounded below, terminated by a short nipple, and near the apex provided with nine wings. Similar in appearance, but terminating above in a long beak-like calyx, is the *Nepal cardamom*, the origin of which is not known. The *large* or *winged Java cardamom* is the nearly globular capsule of Am. maximum, *Roxburgh*, about 1 inch (25 Mm.) long, obtusely triangular, each side provided with three or four firm, short membranaceous wings, which are best observed after soaking the fruit in water. The *round Chinese cardamoms*, which are rounded on the side, are probably produced by Am. globosum, *Loureiro*.

Constituents.—Trommsdorff (1834) obtained 4.8 per cent. volatile oil, 10.4 fixed oil, and smaller quantities of starch, malate (?) of potassium, gummy extractive, and coloring matter. The volatile oil has a spec. grav. of .93 to .94 and the odor and taste of the seeds, is colorless or yellowish, dextrogyre, and contains oxygen. Flückiger (1872) found nearly 11 per cent. of moisture and 15 per cent. of ash in the air-dry fruit, and in the ash 0.79 per cent. of manganese, which he also observed to be present in the leaves and fruits of other Zingiberaceæ.

Off. Prep.—Extractum colocynthidis comp., Pulvis aromaticus (cinnam. comp.), *U. S.*, *Br.;* Pulv. cretæ comp., *Br.;* Tinct. cardamomi, Tinct. rhei dulcis, *U. S.;* Tinct. cardam. comp., Tinct. gentianæ comp., Tinct. rhei, Vinum aloes, *U. S.*, *Br.* The British Pharmacopœia directs the seeds to be freed from the pericarps; the U. S. Pharmacopœia gives the same direction only for the second of the above preparations.

Medical Action and Uses.—Cardamom is a warm and agreeable carminative and stomachic. It may be added to tonic and stimulant preparations. An infusion made with 1 drachm (Gm. 4.00) of the bruised seeds in half a pint of boiling water may be given in doses of a wine-glassful. The officinal tinctures are more commonly employed.

CARDUUS BENEDICTUS.—Blessed Thistle.

Herba cardui benedicti, P. G.—*Chardon bénit*, Fr.; *Benedictendistel*, G.

The leaves and flowering tops of Cnicus benedictus, *Gaertner*, s. Centaurea benedicta, *Linné*.

Nat. Ord.—Compositæ, Cynareæ.

Description.—The "blessed thistle" is an annual woolly plant which is indigenous to Western Asia and South-eastern Europe, and has been naturalized in other parts of Europe, and sparingly so in the United States. It is about 18 inches (45 Cm.) high, has a reddish angular branching stem, and alternate, oblong or ovate-lanceolate, sinuately pinnatifid, and dentate leaves, each tooth bearing a soft spine. The lowest leaves are 8 inches (20 Cm.) or more long, and narrowed into an angular winged petiole; the upper ones are smaller, sessile, and somewhat decurrent. The flower-heads are terminal, ovate in shape, about 1¼ inches (31 Mm.) long, surrounded by large bracts, have the imbricate scales of the involucre prolonged into a yellowish spine, and contain numerous tubular yellow florets and terete many-ribbed akenes, which are crowned with ten short teeth and with a pappus consisting of ten long and ten alternate short bristles, the latter forming an inner row. The leaves and flowering tops are collected mostly from cultivated plants, and lose on drying about 75 per cent. The dry leaves have a grayish-green color. The taste is strongly bitter.

Constituents.—Analyzed by Morin, the widely-diffused constituents of herbs were found associated with a brown-yellow amorphous bitter principle. The latter was obtained pure by Nativelle (1839), and ascertained by Scribe (1842) to be present in allied plants. This *cnicin* is prepared like salicin, crystallizes in colorless needles, is very bitter, freely soluble in alcohol and wood-spirit, slightly so in cold water and ether, and dissolves in strong hydrochloric acid with a green, and in sulphuric acid with a red, color.

Pharmaceutical Uses.—The *Extractum cardui benedicti* of European pharmacopœias is made by exhausting the herb with hot water and evaporating.

Allied Plants.—CENTAUREA CALCITRAPA, *Linné*.—Star-thistle, *E.;* Chardon étoilé, *Fr.;* Sterndistel, *G.*—A European annual which is sparingly naturalized in some places of the United States near the coast. The pinnately-lobed leaves have the teeth prolonged into a thin spine, the involucre is spinous in the middle, the flowers are tubular and purple, and the akenes without pappus; the herb has a bitter taste.

Centaurea cyanus, *Linné*.—Bluebottle, *E.;* Bluet, *Fr.;* Kornblume, *G.*—A European annual somewhat naturalized in North America, also cultivated. It has a globular involucre, with appressed fringed scales and bright blue-colored tubular florets, the marginal ones being largest. The nearly tasteless florets are employed in fumigating-powders.

Medical Action and Uses.—The "blessed thistle" was anciently, and even until quite recent times, held in high esteem as a remedy for all manner of diseases, including fevers and pulmonary, urinary, hepatic, and digestive disorders. It appears to have acted mainly as a bitter tonic, but in large doses it produced nausea, vomiting, and diarrhœa. Its active principle, cnicin, in the dose of 5 or 6 grains, causes a burning sensation and constriction in the pharynx and œsophagus, warmth in the stomach, and sometimes nausea, vomiting, colic, and diarrhœa. It has really no virtues differing materially from those of numerous other bitter tonics, and it most nearly resembles dandelion and colombo in its operation. It may be used in atonic *dyspepsia*—preferably, perhaps, in cases attended with hepatic congestion. The infusion is prepared with from ½ ounce to 1 ounce (Gm. 15–30) of the herb to 8 fluidounces of water. The decoction is apt to nauseate. An extract has been employed in doses of from 5 to 15 grains. Star-thistle has virtues similar to those of "blessed thistle," and blue-bottle (corn-flowers) florets are slightly astringent and have been used in collyria. Milk-thistle (Carduus marianus) is alleged to have arrested hæmoptysis (*Med. Record*, xxii. 625), but the evidence in its favor is inadequate. A writer in the *Edinburgh Med. Journal* (xxix. 284) identifies "Carmedik" with Kardenbenedikt, or "blessed thistle," stating that the popular name is a corruption of the Dutch botanical title. It is an aromatic bitter, which possesses also a slight degree of astringency. (See Carthamus.) Cnicin has been given in doses of from 5 to 10 grains as an antiperiodic.

CAROTA.—Carrot-Fruit.

Fructus dauci s. carotæ.—*Wild carrot-fruit*, E.; *Fruits de la carotte sauvage*, Fr.; *Möhrenfrucht*, G.

The fruit of Daucus Carota, *Linné*. Woodville, t. 50; Bentley and Trimen, *Med. Plants*, 135.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant indigenous to Northern Asia and the greater part of Europe, and naturalized in this country, growing in dry fields and along roadsides, and cultivated to a considerable extent for its fleshy root. The furrowed stem is bristly, 1 to 3 feet (30 to 90 Cm.) high, branching; the leaves are bi- or tri-pinnatifid, the segments with lanceolate or linear incisions; the involucre consists of nine to twelve long pinnatifid leaves; the umbels are on long naked peduncles, at first level, finally concave; the flowers are white or whitish, the central one dark-purple, and commonly sterile, except in the first umbel, which, according to Meehan (1882), usually has a fertile central flower; the fruit is very hispid.

Description.—*The fruit*, which for medicinal purposes is collected from the wild plant, is about ⅛ inch (3 Mm.) long, oval, dorsally compressed, and gray-brownish; each mericarp has five hispid filiform primary ribs, two of which are lateral, the remaining three upon the back; between these are four secondary ribs, two lateral and two upon the back, each beset with long spiny bristles, and covering one small oil-tube, two additional oil-tubes being upon the nearly flat face. The fruit has a slight aromatic odor and a pungent aromatic taste.

The root of the wild plant is thin, spindle-shaped, woody, white, of an aromatic odor and a pungent bitter taste; but cultivated it becomes conical, thick, fleshy, red or yellow, and acquires an agreeable odor and a pleasantly sweet taste.

Constituents.—The fruit contains a small quantity of oxygenated volatile oil; 324 grains of it were obtained from 100 pounds of the fruit. The root has been analyzed by Vauquelin, Wackenroder, and C. Schmidt, who found a little volatile oil (0.011 per cent.), uncrystallizable sugar, mannit, starch, pectin, albumen, fixed oil, malic acid, and a coloring principle named *carotin*, which exists in the root in red crystals, is tasteless, insoluble in water, slightly soluble in alcohol, ether, and chloroform, freely soluble in carbon bisulphide, benzol, and the fixed and volatile oils; its formula is $C_{18}H_{24}O$. Husemann (1860) found it to be accompanied in the root by *hydrocarotin*, $C_{18}H_{30}O$, which is colorless, tasteless, and obtained from boiling alcohol in silky crystals.

Action and Uses.—Carrot-fruit is diuretic and stimulant, and has long been used for exciting the *menstrual* flow, for the cure of *dropsy*, and for the relief of *strangury.* Its medicinal properties appear to depend upon its volatile oil. The fresh root, reduced to a pulp by scraping or grating, forms an admirable poultice for indolent, gangrenous, and cancerous *ulcers.* The juice, used as a wash, is said to relive *itching* in several *diseases of the skin.* The powdered fruit may be given in the *dose* of from 30 to 60 grains (Gm. 2–4). An ounce (Gm. 32) of the bruised fruit to a pint of hot water forms an infusion which may be taken within 24 hours.

CARTHAMUS.—Safflower.

Flores carthami.—African or dyer's saffron, False (American) saffron, E.; *Carthame,* Fr.; *Saflor,* G.

The florets of Carthamus tinctorius, *Linné.*

Nat. Ord.—Compositæ, Cynareæ.

Origin.—An annual plant which is indigenous to India and extensively cultivated there, in Eastern and Western Asia, Northern Africa, and Southern and Central Europe. It is about 2 feet (60 Cm.) high, with sessile or clasping spinulous leaves, and rather large ovate flower-heads terminating the branches. The florets are collected after the shedding of the pollen and are freed from the ovaries.

Description.—The florets of safflower are about $\frac{4}{5}$ inch (2 Cm.) long, tubular, with the limb divided into five nearly linear lobes; the tube of the anthers is about $\frac{1}{5}$ inch (5 Mm.) long, protrudes from the throat, and is surmounted by the long filiform yellow style. The florets are at first yellow, but become red, and after drying of a brown-red color. They have a faint, peculiar, rather disagreeable odor and an insipid bitterish taste.

Constituents.—The analysis of Dufour and Salvétat proved the presence of the usual constituents of plants, and in addition a yellow and a red coloring principle, the former being exhausted by water, after which the latter is obtained in solution by treatment with solution of sodium carbonate and precipitated by acids. Schlieper (1846) gives to this *carthamin* or *carthamic acid* the formula $C_{14}H_{16}O_7$. The value of safflower as a dyestuff depends upon the carthamin, which in the dry state is red-brown, has a green metallic lustre, is insoluble in ether, but dissolves in alcohol with a handsome purple color, the solution becoming yellow by heat. The alkaline solutions of carthamin decompose and decolorize rapidly.

Medical Action and Uses.—Safflower passes for being diaphoretic if administered in a warm infusion made with 2 drachms (Gm. 8) of the flowers and a pint of boiling water. It may be used to dissipate commencing *catarrh* and muscular *rheumatism* and to favor the efflorescence of *eruptive fevers.* In large doses it is said to be laxative. Its action and uses closely resemble those of chamomile. Carmedik, from the Cape of Good Hope, is said to be closely related to Carthamus tinctorius, but, unlike it, is extremely bitter as well as aromatic and astringent. It is used at the Cape as a stomachic bitter, infused in water or in brandy (*Edinb. Med. Jour.*, xxviii. 1073).

CARUM, *U. S.*—Caraway.

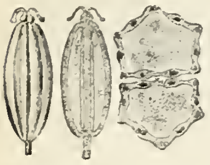
Carui fructus, Br.; *Fructus carvi,* P. G.—*Caraway-fruit (-seed),* E.; *Carvi, Cumin des prés,* Fr.; *Kümmel,* G.

The fruit of Carum Carui (Carvi), *Linné.* Woodville, *Med. Bot.*, plate 45; Bentley and Trimen, *Med. Plants*, 121.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant which is indigenous to the Western Himalayas and the Caucasus, and is found throughout Siberia and the greater portion of Europe, but is scarce in the southern part of that continent. It is extensively cultivated in Norway, Russia, Germany, Holland, England, Morocco, and also in the United States; the yield of fruit per acre is between 8 and 10 cwt. The hollow cylindrical stem is 1 to 3 feet (30 to 90 Cm.) high, branched; the leaves bi- and tri-pinnate, with the ultimate divisions linear; involucre filiform; involucel none; umbels numerous; flowers small, white. The fruit is oblong, laterally compressed, splits when mature into the two mericarps, and finds its way into commerce from the countries named above. During the fiscal year 1866–67, 216,000 pounds of caraway were imported into the United States; at present about 1,000,000 pounds, including coriander, are annually imported.

FIG. 53.



Carum: fruit and longitudinal section, 3 diameters; transverse section, 8 diameters.

Description.—The half-fruits are from ⅛ to ⅙ inch (3 to 4 Mm.) long, brown and smooth, somewhat curved, slightly narrowed at both ends, with a rounded stylopod above, five pale-colored filiform ridges, and between them on the back four grooves of a dark-brown color, which contain four large oil-tubes, two additional vittæ being on the flat face. Mogador caraway corresponds with this description, except that it is larger, attaining a length of fully ¼ of an inch (6 Mm.). Caraway has an agreeable aromatic odor and a sweetish and spicy taste.

Constituents.—Besides volatile oil (see OLEUM CARUI), Trommsdorff found in caraway a green fixed oil, a little wax, resin, sugar, mucilage, and some tannin, the latter being particularly present in the green fruit. The medicinal properties are due to the volatile oil.

Off. Prep.—Aqua carui, Confectio opii, Conf. piperis, Pulv. opii comp., *Br.;* Tinct. cardamomi comp., *U. S., Br.;* Tinct. sennæ, *Br.*

Medical Action and Uses.—Anciently, caraway was held to be diuretic and carminative. It is used at present chiefly to expel wind and allay pain in the flatulent *colic* of infants. An infusion is prepared with 1 or 2 drachms (Gm. 4–8) of the bruised seeds and half a pint of boiling water, of which the dose is a teaspoonful for infants and a tablespoonful for adults.

CARYOPHYLLUS, *U. S.*—CLOVES.

Caryophyllum, Br.; *Caryophylli*, P. G.; *Caryophylli aromatici.—Girofle, Gérofle, Clous aromatiques*, Fr.; *Gewürznelken, Nägelein*, G.

The unexpanded flowers of Eugenia caryophyllata, *Thunberg*, s. Eug. aromatica, *Willdenow*, s. Myrtus Carophyllus, *Sprengel*, s. Caryophyllus aromaticus, *Linné*. *Bot. Mag.*, vol. liv., plates 2749, 2750; Woodville, *Med. Bot.*, 193; Bentley and Trimen, *Med. Plants*, 112.

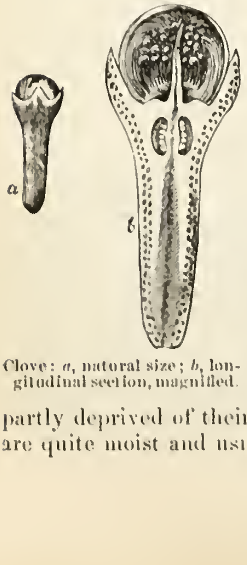
Nat. Ord.—Myrtaceæ.

Origin.—This handsome evergreen tree is supposed to have been indigenous only to the five small islands near the island of Jilolo, to which the name of Molucca or Clove Islands was formerly exclusively applied. The tree has been entirely destroyed there, but it is now cultivated in many of the islands of the Indian Ocean, in tropical Africa, Brazil, and the West Indies. It attains a height of 30 or 40 feet (9 or 12 M.), and is considerably branched, the branches forming an elegant pyramidal crown, and being terminated by cymes composed of fifteen to twenty-five flowers producing berry-like fruits.

Collection.—As soon as the buds change in color from green to red they are either picked by hand or detached from the trees by beating the branches with long bamboos, the buds being gathered upon cloths spread beneath the trees; they are afterward dried by exposure to the sun, whereby the color changes to brown. Between 1,000,000 and 1,500,000 pounds of cloves are annually consumed in the United States.

Description.—Cloves consist of a dark-brown, solid, nearly cylindrical calyx, somewhat tapering below, and above divided into four ovate lobes; these lobes clasp the four lighter-colored arched and imbricate petals, which form a globular head and cover the numerous bent stamens. The ovary is contained in the upper part of the adherent calyx, is divided into two cells, each containing about twenty ovules, and is crowned by a quadrangular disk, in the centre of which the simple style is placed. Cloves are ½ to ⅝ inch (12 to 16 Mm.) long, and, as obtained from different localities, vary somewhat in the shade of their brown color; the large, plump, and deep-brown cloves, as obtained from the Moluccas, Zanzibar, etc., are preferred, the smaller, shrivelled, and light-colored varieties, such as are often exported from Cayenne and the West Indies, being considered inferior. Cloves have a somewhat fatty appearance, a strong and highly aromatic odor, and a very pungent, warm, and aromatic taste. A large number of oil-cells are observed in the petals and in the outer tissue of the calyx; the latter are placed in two or three irregular circles beneath the epidermis, and yield some of their oil upon pressure with the finger-nail. Cloves partly deprived of their volatile oil are said to be occasionally used for adulteration; they are quite moist and usually without heads.

FIG. 54.

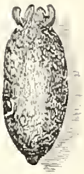


Clove: *a*, natural size; *b*, longitudinal section, magnified.

Other Parts.—Clove-stalks (Griffe de girofle (*Fr.*); Nelkenstiele, Nelkenholz (*G.*); Festucæ caryophyllorum, s. Fusti) are sometimes met with, and consist of the branching flower-stalks, about $\frac{1}{12}$ inch (2 Mm.) in thickness, which are of a light-brown color, and have a distinct though not strong odor and taste of cloves; they contain 4 to 5 per cent. of volatile oil, and are sometimes employed for adulterating powdered cloves and sometimes for distilling the volatile oil. The importation of clove-stalks into this country has increased from 15,128 pounds in 1877 to 184,464 pounds in 1880.

Mother Cloves (Mères de girofle, Clous matrices (*Fr.*); Mutternelken (*G.*); Anthophylli) are the clove-fruits, generally collected before they are quite ripe; they are about 1 inch (25 Mm.) long, oval, crowned with the four-lobed calyx, have one or two seeds in each cell, and resemble cloves somewhat in appearance and properties, but are thicker, lighter, and weaker in odor.

Fig. 55.



Mother Clove.

Constituents.—Trommsdorff found in air-dried cloves 18 per cent. of volatile oil, 13 of tannin (which has not been further investigated), 13 of gum, 18 of water, 6 of tasteless resin, and 4 of extractive. Bonastre (1833) obtained from the watery distillate *eugenin*, in white pearly scales of a slight clove odor, having the composition $C_{10}H_{12}O_2$. Ostermeyer isolated a green wax, and Lodibert (1825) inodorous and tasteless silky needles, *caryophyllin*, of the composition $C_{10}H_{16}O$, which are deposited from the concentrated tincture of cloves; they are colored blood-red by cold sulphuric acid, and, according to Mylius (1873), yield with fuming nitric acid crystals of *caryophillinic acid*, $C_{20}H_{32}O_6$. (For the composition of oil of cloves see Oleum Caryophylli.)

Off. Prep.—Infus. aurantii comp., Infus. caryophylli, Mist. ferri arom., Pulv. cretæ arom., *Br.;* Tinctura lavandulæ comp., Tinct. rhei arom., *U. S.;* Vinum opii, *U. S.*, *Br.*

Medical Action and Uses.—Cloves are general stimulants. They were formerly described as emmenagogue and aphrodisiac, and as suitable for expelling wind, allaying vomiting, and assisting digestion. They continue to be used for most of these purposes, but less as a medicine than as a condiment that promotes the digestion of fatty and crude food. Clove tea, made by infusing 2 or 3 drachms (Gm. 8–12) of bruised cloves in half a pint of boiling water, may be given in tablespoonful doses for the relief of *colic.* Powdered or bruised cloves wet with alcohol may be applied between cloths upon the epigastrium to allay *nausea* or *vomiting* and expel *flatus*, and upon the abdomen to relieve *colic;* but for these purposes the aromatic powder is preferable.

CASCARILLA, *U. S.*—Cascarilla-Bark.

Cascarillæ cortex, Br.; *Cortex cascarillæ*, P. G.; *Cortex eluteriæ*, *Cortex thuris.*—*Sweet-wood-bark*, E.; *Cascarille*, *Ghacrille*, *Écorce éleuthérienne*, Fr.; *Cascarilla*, *Kaskarillrinde*, G.

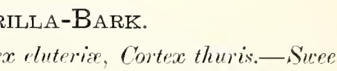
The bark of Croton Eluteria, *Bennett*, s. Clutia Eluteria, *Linné.* *Jour. Proc. Lin. Soc.;* *Pharm. Jour.*, 2d ser. vol. iv. p. 150; Woodville, *Med. Bot.*, 223; Bentley and Trimen, *Med. Plants*, 238.

Nat. Ord.—Euphorbiaceæ.

Origin.—This plant is a low or even a tree-like shrub with alternate, ovate-lanceolate, on the lower surface bronzed-silvery, leaves, and producing small white, monœcious, highly-odorous flowers in terminal and axillary spikes. The fruit is globular-ovate, scaly, silvery-gray, three-furrowed and three-celled, each cell containing a glossy orange-brown seed. The plant is indigenous to the Bahama Islands, where also Croton Cascarilla, *Bennett* (s. Clutia Cascarilla, *Linné*), and some other species of the same genus are met with, the barks of which may possibly sometimes be collected and sold as cascarilla. It is shipped in bags from Nassau, Bahamas, and has been known in Europe since the latter part of the seventeenth century.

Description.—It is in quills or channelled pieces 1 to 3 inches (25 to 75 Mm.) in length, about ½ inch (12 Mm.) in diameter, and about $\frac{1}{12}$ inch (2 Mm.) thick, mostly, however, in small fragments. It is covered with a thin, grayish, easily detached corky layer, upon which are smaller or larger white patches of a minute lichen (Verrucaria albissima, *Acharius*), the perithecia of which appear as black dots; the external layer, particularly of the older barks, is longitudinally and transversely fissured, presenting rectangular spaces with elevated edges, or is partly wanting. The inner bark is somewhat thicker, and has a brownish color and a smooth, brown-gray, inner surface. The bark breaks with a short somewhat resinous or horny fracture,

Fig. 56.



Cascarilla-bark; transverse section, magnified.

exhibiting in the outer layer some scattered oil- or resin-cells, and presenting a radially striate bast-layer in which but very few true bast-fibres are observed. It is rather fragrant when examined in bulk, but emits a strongly aromatic somewhat musk-like odor when burned; its taste is warm, aromatic, and very bitter.

Constituents.—Trommsdorff obtained from cascarilla 1.6 per cent. of volatile oil, 15.1 per cent. of resin, besides gum, potassium chloride, etc. The volatile oil consists of a hydrocarbon, $C_{10}H_{16}$ (Gladstone, 1872), and of an oxygenated portion. The resin is partly soluble in alkalies. Duval (1845), who isolated the bitter principle, *cascarillin*, in a crystalline state, announced also the presence of a little tannin, pectin, wax, fat, starch, and albumen. Cascarillin is obtained by concentrating the filtrate from the precipitate which is produced in an infusion by sugar of lead; it forms colorless needles or scales, is inodorous, bitter, fusible at 205° C. (401° F.), not precipitated by lead salts or tannin, freely soluble in ether and hot alcohol, sparingly soluble in cold alcohol and chloroform, and very sparingly in water; nitric acid converts it into a yellow resinous mass; sulphuric acid gives a red solution, from which water precipitates green floccules. C. and E. Mylius observed it (1873) in an extract separated in granules, and give its composition as $C_{12}H_{18}O_4$.

Allied Barks.—MALAMBO-BARK is obtained in Venezuela from Croton Malambo, *Karsten*. It is in quills ½ to 1 inch (12 to 25 Mm.) in diameter and 6 to 8 inches (15 to 20 Cm.) long. It has a thin, soft, whitish, longitudinally-fissured cork, which is easily removed, exhibiting a brown surface with fine transverse furrows; the inner surface is gray-brown, finely striate, the fracture short-splintery, the odor aromatic, and the taste unpleasantly aromatic and bitter, resembling that of cascarilla.

COPALCHI-BARK is obtained from Croton Pseudochina, *Schlechtendal* (C. niveus, *Jacquin*), indigenous to Mexico. It resembles the preceding, is about ⅕ inch (5 Mm.) thick, hard and dense, has a grayish or yellowish corky layer, and beneath this is transversely fissured; the bast is reddish-brown, is coarsely striate in a radial direction, and breaks with a short, irregular fracture.

Barks differing considerably from those described, which are occasionally found in commerce as malambo- and copalchi-bark, are obtained from different plants. The composition of both barks is probably similar to that of cascarilla. Holmes (1874) described a bark which was probably derived from Croton lucidus, *Linné*, and was found as an admixture in cascarilla; it had a fawn-colored, firmly-adhering corky layer, was reddish and closely ridged upon the inner surface, had an astringent, slightly bitter taste, and yields a darker-colored tincture and infusion than cascarilla.

Pharmaceutical Preparations.—EXTRACTUM CASCARILLÆ, P. G. The coarsely-powdered bark is exhausted by digestion with hot water and the infusion evaporated. When prescribed in mixtures, Mylius recommends the extract to be dissolved in a little hot alcohol and the solution to be added to the watery liquid, whereby the cascarillin becomes finely divided and remains in suspension.

Off. Prep.—Infusum cascarillæ, *U. S.*, *Br.*; Tinctura cascarillæ, *Br.*

Medical Action and Uses.—Cascarilla is stimulant rather than tonic, and its fumes when inhaled are intoxicating. The infusion occasions a sense of warmth in the stomach, but in excessive doses nauseates and purges. Cascarilla was originally used to enhance the febrifuge power of cinchona, and independently in the *typhoid state* of various diseases, especially epidemic *dysentery*. It is now chiefly employed in the treatment of *dyspeptic* conditions due to gastric or intestinal atony and attended with flatulence or vomiting. The *dose* in powder is about 30 grains (Gm. 2). The infusion, made with an ounce of cascarilla to a pint of water, is preferable. It may be given in wine-glassful doses.

Malambo-bark, says Strumpf, resembles Winter's bark in its action. In its native country it is used in atonic dyspepsia and in dysentery. The natives of Brazil have a superstition that the tapir *cures* itself of diarrhœa by eating this bark. It is also used by these people in asthma, spasms, and rheumatism, intermittent and yellow fevers, trismus nascentium, and worms. *Copalchi-bark*, according to the same authority, is employed as an antiperiodic-fever remedy, and tends to confine the bowels as well as to oppress the stomach. It is said to partake of the qualities of quassia, valerian, and menyanthis.

CASSIA FISTULA, *U. S.*—PURGING CASSIA.

Fructus cassiæ fistulæ.—*Casse officinale*, *Casse en batons*, Fr.; *Purgiercassie*, *Fistelkassie*, *Röhrencassie*, G.

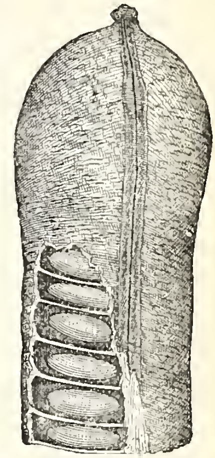
The fruit of Cassia Fistula, *Linné*, s. Cathartocarpus (Bactyrilobium, *Willdenow*) Fistula, *Persoon*. Woodv. t. 260; Bentley and Trimen, *Med. Plants*, 87.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—A tree 30 to 50 feet (9 to 15 M.) high, with large pinnate leaves appearing simultaneously with the long pendulous racemes of fragrant, golden-yellow, dark-veined flowers. Indigenous to the East Indies, it is now met with, spontaneous and under cultivation, in Egypt and other parts of Africa, the West Indies, and Brazil.

Description.—The fruit is an indehiscent, nearly cylindrical, woody legume, 1½ to 2 feet (45 to 60 Cm.) long and nearly an inch (25 Mm.) thick. blackish-brown, with fine transverse veins and two bands running from the short thick stalk to the blunt apex. These bands are ⅛ to ⅙ inch (3 to 4 Mm.) broad, somewhat paler in color, smooth, and correspond to the dorsal and ventral sutures, the former being marked by a fine ridge, the latter by a shallow groove in the centre of the bands. The seeds are numerous. ⅓ to ⅖ inch (8 to 10 Mm.) long, flattish, ovate or oval, orange-brown, glossy, with a long filiform funiculus, a firm albumen, and fleshy-veined cotyledons; each seed is imbedded in a blackish-brown sweet pulp, and separately enclosed in a cell, the thin woody dissepiments being formed by the transverse distension of the placenta after fructification. Theodor suggests that of prunes.

FIG. 57.



Cassia fistula: part of pod natural size.

Other Varieties.—A lighter-colored purging cassia is occasionally met with, which is from 12 to 18 or 20 inches (30 to 45 or 50 Cm.) long, about ½ inch (12 Mm.) in diameter, slightly pointed, and has a reddish-brown sweet and somewhat astringent pulp, but otherwise resembles the officinal drug. It is usually referred to Cassia bacillaris, *Linné filius* (Cathartocarpus bacillus, *Persoon*), a tree indigenous to Surinam: but Hanbury's investigations (1863) render it certain that it is partly if not wholly obtained from Cassia moschata, *Kunth* (Cathartocarpus moschatus, *Don*), a tree found in Panama and the northern part of South America.

Cassia brasiliana, *Lamarck* (C. mollis, *Vahl*, C. grandis, *Linné filius*, Cathartocarpus, *Persoon*), yields a large purging cassia, sometimes known as *horse cassia*, which is 2 feet (60 Cm.) and more long, often curved, laterally compressed, 1½ inches (38 Mm.) broad, rather coarsely veined, and has the dorsal suture indicated by one convex band and the ventral suture by two prominent obtuse ridges.

Constituents.—Purging cassia, treated with water, should yield about 30 per cent. of pulp, which, according to the analyses by Vauquelin and Henry, consists principally of sugar (about 60 per cent.), with some mucilage, pectin, salts, etc. In view of this composition it is difficult to understand why the drug should be unfit for medicinal use when the pulp has become dry and the seeds remain loose in their cells; it would seem, however, to be not indispensable.

Pharmaceutical Preparations.—Cassiæ pulpa, *Br.*—Cassia-pulp, *E.;* Pulpe de casse, Casse mondé, *Fr.;* Cassienmus, G.—It is extracted from the fruit by diffusing the pulp in water, straining, and evaporating. Cassia-pulp of British commerce, which has been imported from the East Indies. usually contains the seeds and dissepiments, and requires to be purified by softening with water and straining. It is blackish-brown, viscid, sweet, and of a somewhat sickly odor.

Confection of cassia, made by mixing cassia-pulp 100 Gm., syrup of violets 75 Gm., and sugar 20 Gm., evaporating to the consistence of a soft extract, and flavoring with a drop of oil of neroli, is known in France as *Casse cuite.*

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*

Allied Drug.—Ceratonia siliqua, *Linné.*—Fructus ceratoniæ, Siliqua dulcis.—St. John's bread, *E.;* Carouges, Caroubes, *Fr.;* Johannisbrot, Karobe, *G.*—This medium-sized evergreen tree grows in the basin of the Mediterranean, and bears purple-colored racemes of polygamous apetalous flowers. The fruit is 4 to 8 inches (10 to 20 Cm.) long, nearly 1 inch (25 Mm.) broad, about ⅛ or ⅙ inch (3 or 4 Mm.) thick, obtuse, linear, much flattened, and with somewhat elevated edges, causing the transverse section to be narrowly and obtusely rectangular. The epicarp is leathery, brown, glossy, finely striate, and encloses a light-brown softer sarcocarp of a pleasantly sweet taste. The seeds, six to twelve in number, are flattish ovate and polished brown, and are contained in separate transverse cells formed by the papery inner layer of the pericarp. The fruit contains 40 to 50 per cent. of cane- and grape-sugar, besides mucilage, protein compounds, a little tannin, and butyric acid, to which the odor is due. The presence of free butyric acid was observed by Redtenbacher (1846). St. John's bread is frequently used in Southern Europe as an addition to expectorant and demulcent medicines.

Medical Action and Uses.—Anciently used as a laxative to which special cooling virtues were attributed, and as a cleansing gargle for ulcerated sore throat, purging cassia is still esteemed as a mild and certain *laxative*, tending to promote the secretion of bile. It gives a brownish or greenish tinge to the urine. It is seldom used alone, owing partly to its tendency to occasion colic and flatulence. With manna it forms an active but mild laxative, and in hot climates and seasons it is usefully associated with tamarinds or with mild salines, especially in the treatment of *bowel complaints*. As a laxative the the *dose* is from 1 to 2 drachms (Gm. 4–8); as a purgative, 1 or 2 ounces. The sweet and acidulous pulp of the seeds of Ceratonia siliqua is used as a laxative in bronchitis and in the gastric and biliary derangements that are common in the south of Europe.

CASTANEA, *U. S.*—CHESTNUT-LEAVES.

Folia castaneæ.—Feuilles de châtaignier, Feuilles de marronier, Fr.; *Kastanienblätter*, G.

The leaves of Castanea vesca, *Gaertner* (C. vulgaris, *Lamarck*, C. sativa, *Miller*, Fagus Castanea, *Linné*), collected in September or October while still green.

Nat. Ord.—Cupuliferæ.

Origin.—A stately tree, 80 to 100 feet (24 to 30 M.) high, indigenous to Western Asia, Southern Europe, and to the United States from Maine to Michigan southward. The wood, though light, is very durable. The whitish staminate flowers, which appear in May and June, form slender, pendulous aments 6 to 8 inches (15 to 20 Cm.) long; the pistillate flowers form clusters of three or four in an ovoid involucre, which finally becomes globose and covered with sharp prickles, and encloses two or three one-seeded nuts. These *chestnuts* (châtaignes, *F.*; Kastanien, Maronen, *G.*) are flattish, hemispherical, or somewhat triangular, brown, glossy, silky-pubescent at one end, and contain a firm white embryo having a sweet taste. American chestnuts are smaller and sweeter than those of Southern Europe.

Description.—The leaves are from 6 to 10 inches (15 to 25 Cm.) long, about 2 inches (5 Cm.) wide, upon petioles less than 1 inch (25 Mm.) in length, oblong-lanceolate, acuminate, mucronate, sinuate-serrate, smooth throughout, shining above, neatly feather-veined beneath. The leaves of the American chestnut (Cast. americana, *Rafinesque*) differ from those of the Oriental only in being rather acute at the base. They are nearly inodorous and have a somewhat astringent taste. They should be collected in the fall, in September or October, while still green; on drying they lose from 50 to 60 per cent. in weight.

Constituents.—Chestnut-leaves examined by J. B. Turner (1879) and L. J. Steltzer (1880) were found to have the ordinary constituents of leaves—chlorophyll, fat, a little resin, gum, albumen, and extractive; the tannin, which gives a green-black precipitate with iron, was estimated at 9 per cent. by weighing the gelatin precipitate. The ash amounts to 5 or 6 per cent., and consists of carbonate, phosphate, and chloride of potassium, magnesium, calcium, and iron. The fruit contains nearly 50 per cent. of water, the remainder being starch 30 to 40, proteids 3 to 4, fat about 2, sugar ½ to 1 or 2 per cent., some mucilaginous matter and organic acids, and in the integuments resin, tannin, and bitter principle.

Off. Prep.—Extractum castaneæ fluidum, *U. S.*

Allied Plant.—Castanea (Fagus, *Linné*) pumila, *Michaux*, is indigenous to the United States, from Southern Pennsylvania and Ohio to Florida and Eastern Texas. It is shrubby, or in the Southern States a tree 40 or 50 feet (12 or 15 M.) high. The leaves are oblong or somewhat obovate, acute, pointedly serrate, and white-downy beneath. The prickly involucre contains a single ovoid, acute, and dark-brown nut, called *chinquapin*, which is smaller than the chestnut and very sweet. The bark, like that of the chestnut, is astringent.

Medical Action and Uses.—We are not acquainted with any experiments which denote the physiological operation of castanea, but, judging from its apparent action in *whooping cough*, its sedative influence upon the respiratory nerves may be inferred. In the disease just mentioned it appears to control the paroxysms in a remarkable manner, in some cases suspending them entirely after the lapse of a few days. It may be given without limit in the form of an infusion made with an ounce (Gm. 30) of the dried leaves in a pint of boiling water, or, more accurately, in the dose of from ½ fluidrachm to 1 fluidrachm (Gm. 2–4) of the fluid extract every 3 or 4 hours. Its taste is not unpleasant, and its administration requires no special circumspection.

CASTOREUM, *P. G.*—Castor.

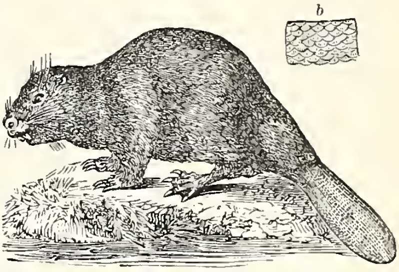
Castoréum, Fr.; *Bibergeil*, G.

The dried preputial follicles and their secretion obtained from the beaver, Castor Fiber, *Linné* (Castor americanus, *Cuvier*, s. C. canadensis, *Kuhl*), and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them.

Class Mammalia. Order Rodentia.

Origin.—This animal inhabits the continents of the northern hemisphere between 33° and 68° N. lat., but is disappearing in the southern parts of those regions. It is from 2 to 2½ feet (60 to 75 Cm.) long, with horizontally-flattened tail, which is about 10 inches (25 Cm.) long and 3 to 4 inches (7 to 10 Cm.) wide, hairy at the base and scaly above. The head resembles that of a rat, with no canine teeth, but with two incisors, and on each side four molars in the upper and lower jaw. The fur consists of two kinds of hair—one rather bristly, the other denser and downy; its color is brown, but black, white, and spotted beavers are also met with. The feet have five toes, the anterior being short and close, the posterior longer and palmated; the hind feet are webbed close to the toes. Anus, genitals, and follicles communicate in both sexes with one canal or cavity located near the tail. In the male a pair of oil-sacs, containing the formerly officinal *axungia castoris*, terminates in the cloaca; the castor-sacs, located near the former, open by a common aperture in the preputial canal. The female has the castor-sacs below the os pubis on each side of the vagina. The European and Siberian beaver closely resembles the American in appearance and habits, but is somewhat larger and has a paler-colored fur.

Fig. 58.



Castor Fiber, *Linné*: *b*, scales of the tail.

The beaver feeds on roots and barks, and builds houses about 10 feet (3 M.) wide and 6 feet (1.8 M.) high, the entrance being under the water, the depth of which is increased by the building of dams composed of billets of wood and earth; in more densely-populated districts, where they are disturbed, the beavers burrow on the banks of rivers and creeks.

Description.—When fresh, castor-sacs are flesh-colored, soft, more or less pyriform; they are dried by being suspended over fire, when they become brown. They consist of four distinct coats: the outer one is cellular, resembles hog's bladder in texture, and encloses a fibrous layer, which is followed by a vascular, and this by an iridescent glandular coat, with many folds and numerous semilunar scales upon the inner surface, the whole being covered by a thin epithelium. According to E. H. Weber (1849), castor is mainly secreted by the prepuce of the penis and clitoris, but J. Fuchs (1881) states that it is altogether separated from glands contained in the inner coat of the sac. The contents of the recent follicles are an unctuous, yellowish, odorous mass, which, after drying, becomes brown and friable, but is not fusible. Castor is commercially distinguished by the countries from which it is obtained, the most highly valued being obtained from Russia and Siberia.

Castoreum sibiricum, s. Castoreum moscoviticum, rossicum, germanicum, europæum. The sacs are oval or globular pyriform, united at the narrowed end in pairs, the contents of a dull rather light-brown color and a strong peculiar odor. The sacs vary in weight from about 3 to 8, or occasionally even 14, ounces, and if not too dry the two outer coats may be readily separated. This kind is mostly collected in Siberia and Eastern Russia, the sacs from Western Russia and Germany being usually smaller and rarer. It is now rarely met with in commerce.

Castoreum canadense, s. Castoreum americanum, anglicum. This is the variety generally met with in commerce, and which alone is recognized by the German Pharmacopœia, but has been omitted from the U. S. P. 1880 and Br. 1885. The sacs are more elongated, flatter, and usually more wrinkled and folded, than those of the preceding; they vary from club-shaped to narrow pyriform, are united in pairs, mostly between 1 and 4 ounces (rarely 8 ounces) each in weight; the outer coats adhere pretty firmly; the contents are often slightly glossy; the odor is aromatic, but weaker than the preceding; the taste about the same, pungent, bitter, and rather nauseous.

Russian and American castor are distinguished from each other by the characters indicated; the former yields 60 to 68 per cent. of its weight to alcohol, the latter between 45 and 50 per cent. The tincture of the former yields with much water a milky mixture, which becomes nearly clear on the addition of ammonia. The mixture obtained from the tincture of American castor is brownish, the precipitate being only partly soluble in ammonia.

Adulterations.—Castor is said to be occasionally adulterated with artificial mixtures of blood and earthy and resinous matters enclosed in some animal tissue; such substitution is easily detected by the absence of nearly all the characters described above.

Constituents.—The numerous older investigations have not thrown much light upon the composition of castor. The *volatile oil* of castor, present to the extent of 1 to 2 per cent., has the odor of that substance, and is of a pale-yellow color; according to Woehler (1844), it contains *carbolic acid.* The same chemist noticed also (1848) the presence of *salicin* and *benzoic acid.* Pereira (1851) believes the volatile oil to be mainly derived from the salicin, and observed that distilled castor-water gradually acquired the odor of salicyl-aldehyd (oil of Spiræa ulmaria). The bitter and acrid taste of castor is due to a dark-brown *resinous substance* which is insoluble in water and ether, but readily soluble in alcohol; it has not been further investigated. A peculiar crystalline body, *castorin*, was obtained by Bizio on cooling the strong alcoholic decoction. Valenciennes (1861) prepared it by boiling castor with milk of lime and treating the dried precipitate with hot alcohol; it forms colorless, readily fusible needles having a slight odor of castor and little taste; it volatilizes slowly with boiling water, is soluble in concentrated potassa, ether, benzin, and hot olive oil and oil of turpentine. Lehmann believes that the carbolic acid, if present, is obtained only from the smoke of the fire by which castor is dried; he found also *derivatives of bile, chlolesterin,* and a *protein compound,* the last two of which had already been obtained by Brandes. The inorganic constituents are carbonates, with some phosphates and sulphates of calcium, magnesium, potassium, and ammonium. Pereira obtained from Canadian castor 3.6 per cent. of ash. Castor-sacs containing a large proportion of calcium carbonate have been sometimes met with, and are said to be obtained from diseased animals.

Off. Prep.—Tinctura castorei, *P. G.*

Medical Action and Uses.—It seems doubtful whether castor, any more than musk, has a definite action upon the healthy nervous system, but there is just as little doubt that, like the other animal product just named, it is a stimulant to the nervous system disordered through exhaustion, direct or indirect. *Hysterical spasms*, those associated with *uterine colic, scanty menstruation,* and *tympanites*, and the muscular twitchings, tremblings, etc. which occur in the *typhoid state*, are palliated by this medicine. But for all purposes it is less efficient than musk, and scarcely superior to valerian, camphor, ammonia, ether, and some forms of alcohol. The *dose* of castor varies from 10 grains (Gm. 0.60) to ten times that amount, according to the strength of the preparation employed. The variable quality of the drug restricts its use.

CATALPA.—Beantree.

Catalpa, E., Fr., G.

Catalpa bignonioides, *Walter*, s. Bignonia Catalpa, *Linné.*

Nat. Ord.—Bignoniaceæ.

Description.—The tree is indigenous to the southern portion of the United States from Georgia and Florida westward, and is cultivated or wild farther north. It attains a height of 30 to 50 feet (9 to 15 M.), produces a light, close-grained, and very durable wood, and has spreading branches, large heart-shaped leaves, and compound racemes of showy flowers, which have the calyx two-lipped, the corolla bell-shaped, white, and in the throat dotted with purple and yellow. The fruit is capsular, nearly cylindrical, about 12 inches (30 Cm.) long, longitudinally striate and two-celled, and contains numerous very thin, long, and flat seeds which are enclosed in a delicate silky envelope, prolonged at both ends into finely-fringed wings. The bark, fruit, and seeds have been employed. The bark is externally gray-brown, smooth, somewhat glossy, with numerous small circular warts; in the middle layer green, and in the thick, tangentially arranged bast-layer white, becoming yellowish on drying; the inner surface is smooth. The bark of the trunk is about ¼ inch (6 Mm.) thick, one-half consisting of the scaly cork, the other half of the bast-layer. It has a strongly bitter taste. The catalpa of the Western States is regarded as a distinct species, Catalpa speciosa, *Warder;* it is found in

Southern Indiana and Western Kentucky, westward and south-westward, and has a rather heavier but equally durable wood.

Constituents.—The bark was analyzed by E. A. Rau (1870), who ascertained the presence of tannin in it. On dissolving the ethereal extract of the alcoholic extract in diluted alcohol, and boiling with oxide of lead, the liquid retained an amorphous bitter principle in solution, and hot alcohol dissolved from the lead precipitate a principle having an intensely nauseous, bitter taste and crystallizing in micaceous scales, which were very soluble in ether, chloroform, and hot alcohol. Sugar and tasteless resin were also found.

Allied Plants.—BIGNONIA CAPREOLATA, *Linné*, a native of the Southern United States, is a tall, climbing shrub, with orange-colored, bell-shaped, and somewhat two-lipped flowers, which are about 2 inches (5 Cm.) long. The root and stem have been used in place of sarsaparilla. A transverse section of the stem shows the wood in the shape of a cross. This plant, like the closely-allied Tecoma radicans, *Jussieu*, which bears large scarlet flowers, is known as *trumpet creeper.*

Several East Indian species of Bignonia are medicinally employed in their native country.

Medical Action and Uses.—This tree is more ornamental than it is useful in medicine. The bark, indeed, is said to be vermifuge, the wood emetic, and the leaves emollient and anodyne, yet the emanations of the tree are reported to be poisonous. A decoction of the pods, and the dried seeds also, have been used with alleged advantage in chronic *bronchitis* and in nervous *asthma*, especially when associated with senega , of which latter statement there need be no serious doubt. The juice of the root is also stated to be an efficient local remedy for chronic scrofulous *ophthalmia.*

"The root and vine of Bignonia capreolata in infusion or decoction answer the purpose of sarsaparilla. They are detergent and alterative, diuretic and sudorific, used in syphilis, chronic rheumatism, and in derangements arising from impurities of the blood" (Porcher, *Resources of the Southern Fields and Forests*).

CATAPLASMATA.—CATAPLASMS.

Poultices, E., *Cataplasmes*, Fr.; *Umschläge*, *Breiumschläge*, G.

These are topical applications, of a soft, pasty consistence which are prepared from coarse or fine powders, mixed with water, various solutions, or fixed oils. In this country the ingredients are usually furnished by the pharmacist, but the poultice is prepared for use at the patient's house.

CATAPLASMA CARBONIS, *Br.*—CHARCOAL POULTICE.

Cataplasme au charbon, Fr.; *Kohlenumschlag*, G.

Preparation.—Take of Wood Charcoal in powder ½ ounce, Crumb of Bread 2 ounces; Linseed Meal 1½ ounces; Boiling Water 10 fluidounces. Macerate the bread in the water for 10 minutes near the fire, then mix, and add the linseed meal gradually, stirring the ingredients, that a soft poultice may be formed. Mix with this half the charcoal, and sprinkle the remainder on the surface of the poultice.—*Br.*

Medical Uses.—Charcoal poultice is used as an emollient and disinfecting application to *gangrenous* and *fetid sores.*

CATAPLASMA CONII, *Br.*—HEMLOCK POULTICE.

Cataplasme avec la ciguë, Fr.; *Schierlingumschlag*, G.

Preparation.—Take of Juice of Hemlock 1 fluidounce; Linseed Meal 4 ounces; boiling Water 10 fluidounces. Evaporate the juice to half its volume, add this to the linseed meal and water previously mixed, and stir them together.—*Br.*

Medical Uses.—Hemlock poultice is employed especially to relieve the pain of *cancerous* and other *sores.* Extract of conium may be substituted for fresh hemlock-leaves in its preparation.

CATAPLASMA FERMENTI, *Br.*—YEAST POULTICE.

Cataplasme avec le levûre de bière, Fr.; *Hefenumschlag*, G.

Preparation.—Take of Beer Yeast 6 fluidounces; Wheaten Flour 14 ounces; Water heated to 100° F. 6 fluidounces. Mix the yeast with the water, and stir in the flour. Place the mass near the fire till it rises.—*Br.*

The rising of the mass takes place in consequence of fermentation, which speedily commences, and whereby carbonic acid gas is formed.

Medical Uses.—Yeast poultice or fermenting poultice is of great service to unhealthy, and especially gangrenous, *ulcers*, whether of a cancerous nature or not, in preventing fetor and hastening the removal of devitalized tissues. Its activity is indicated by the pain it sometimes causes.

CATAPLASMA LINI, *Br.*—Linseed Poultice.

Cataplasma emolliens s. communis.—Flaxseed poultice, E.; *Cataplasme de farine de lin, Cataplasme simple (commun)*, Fr.; *Leinsamen-Umschlag*, G.

Preparation.—Take of Linseed Meal 4 ounces; boiling Water 10 fluidounces. Mix the linseed meal gradually with the water with constant stirring.—*Br.*

The linseed meal of the British Pharmacopœia of 1867 was the *cake meal* of American commerce, and in preparing with this the linseed poultice the addition of ½ ounce of olive oil was deemed necessary. In the present Pharmacopœia the meal contains all the oil of the seed, and the further addition of oil is therefore not required. A mixture of ground flaxseed and cake meal is sometimes preferred for poultices.

Medical Uses.—Linseed or flaxseed poultice is usually employed in hospital practice as an emollient and protective to *inflamed* and *painful parts*. Owing to its tendency to ferment, it is apt to occasion an eruption of vesicles or pustules, and more than any poultice to render the skin white, wrinkled, and sodden. To prevent these effects its surface should be covered with fresh lard, sweet oil, linseed oil, or glycerin, or else one or the other of these articles should be mixed with the poultice.

CATAPLASMA SINAPIS, *Br.*—Mustard Poultice.

Sinapismus; Cataplasma rubefaciens.—Sinapisme, Cataplasme de moutarde, Cataplasme rubéfiant, Fr.; *Senfteig*, G.

Preparation.—Mix Mustard in powder 2½ ounces with 2 to 3 ounces of lukewarm Water; mix Linseed Meal 2½ ounces with 6 to 8 ounces of boiling Water; add the former to the latter and stir them together.—*Br.*

Mix recently prepared black mustard meal, 200 Gm., with scarcely tepid water in sufficient quantity to obtain a mass of the consistence of a poultice.—*F. Cod.*

Mustard of the British Pharmacopœia is a mixture of ground black and white mustard seeds, though the proportion of the two is not indicated. It is now very properly mixed with lukewarm water, but on incorporating this with the hot flaxseed poultice a portion of the rubefacient volatile oil is necessarily volatilized.

Medical Uses.—This poultice is convenient for maintaining a moderately stimulant action upon the skin, and at the same time protecting it. It is very useful in local muscular *rheumatism*, in thoracic and abdominal *inflammations*, in *colic*, and for exerting a derivative action upon the feet in congestive affections of the *head*. The preparation and uses of the sinapism or mustard *plaster* are described under Sinapis.

CATAPLASMA SODÆ CHLORINATA, *Br.*—Chlorine Poultice.

Cataplasme chloriné, Fr.; *Chlornatron-Umschlag*, G.

Preparation.—Take of Solution of Chlorinated Soda 2 fluidounces; Linseed Meal 4 ounces; Boiling Water 8 fluidounces. Mix the linseed meal gradually with the water, and add the solution of chlorinated soda, with constant stirring.—*Br.*

Medical Uses.—Chlorine poultices are useful in the same cases in which yeast poultices are appropriate; that is to say, for correcting the fetor of foul and sloughing *ulcers* and for stimulating them to become more healthy.

CATARIA.—Catnep.

Herba nepetæ s. catariæ.—Catmint, E.; *Cataire, Chataire, Herbe aux chats, Menthe de chats*, Fr.; *Katzenminze, Katzenkraut*, G.

The leaves and tops of Nepeta Cataria, *Linné*, s. Cataria vulgaris, *Moench.* Bentley and Trimen, *Med. Plants*, 209.

Nat. Ord.—Labiatæ.

A perennial herbaceous plant 2 to 4 feet (0.6 to 1.2 M.) high, indigenous to many parts of Asia and Europe and naturalized in the United States, where it grows near dwellings, in waste places, and along roadsides.

Description.—The stem is quadrangular, gray-hairy, and branched; leaves opposite, petiolate, 1 to 3 inches (25 to 75 Mm.) long, triangular ovate, cordate or rounded at base, pointed at apex, the margin strongly crenate-serrate, grayish-green, soft hairy above and velvety beneath. The flowers are in terminal panicles, the lower stalked, the upper sessile, with a gray, hairy, obliquely five-toothed calyx and a whitish, purple-spotted corolla, which is hairy on the outside, has the three-lobed lower lip crenately toothed, and four stamens inserted in its tube. The stem and larger branches are rejected, the leaves and flowering tops only being collected in June and July. It has a peculiar mint-like rather disagreeable odor, and a bitterish, aromatic, and pungent taste. A variety, N. citriodora, *Becker*, has an agreeable lemon-like or melissa-like odor. On drying, the fresh drug loses from 75 to 80 per cent. in weight.

Constituents.—The chemical constituents resemble those of other Labiatæ. The plant contains a small quantity of oxygenated volatile oil, some tannin, a bitter principle which has not been isolated, and other medicinally unimportant constituents.

Medical Action and Uses.—Catnep is stimulant and slightly tonic, and, like the mints and some other plants containing a volatile oil, it has been prescribed in various disorders attended with debility of the nervous system and of the functions immediately depending upon it. It is most commonly used for the relief of *flatulent colic* in infants and to promote *menstruation* when it is retarded or painful. Its local application excites a sense of warmth and causes partial anæsthesia, for which reason it is used to relieve *toothache* and other local pains. Cats are fond of it, hence the name *catnep* (cat-nepeta). It is given in an infusion made with from half an ounce to an ounce (Gm. 15–30) in a pint of water, and in the dose of from a teaspoonful to a tablespoonful.

CATECHU, *U. S., P. G.*—CATECHU.

Terra Japonica, Catechu nigrum.—Cutch, E.; *Cachou*, Fr.; *Katechu, Pegu-Catechu*, G.

An extract prepared principally from the wood of Acacia (Mimosa, *Linné filius*) Catechu, *Willdenow.* Woodville, *Med. Bot.* 157; Bentley and Trimen, *Med. Plants*, 95.

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—A tree about 30 to 40 feet (9 to 12 M.) high, with a pair of hooked brown prickles at the base of the numerous abruptly bipinnate leaves, which are 6 to 12 inches (15 to 30 Cm.) long, and with pale-yellow flowers arranged in dense cylindrical spikes about 3 inches (75 Mm.) long; the legume is brown, veined, flattened, and pointed. The glabrous and pubescent varieties have formerly been regarded as distinct species, Mimosa Sundra and M. catechuoides, *Roxburgh.* The tree is indigenous to the East Indies and Ceylon, and is completely naturalized in Jamaica, where it is common in dry localities.

Preparation.—The wood, which is heavy and very durable, is covered by a dark-brown fibrous bark, and consists of the whitish alburnum and of the dark-colored heartwood, varying in color from red-brown to blackish-brown. This latter portion is cut into chips, which are boiled with water in earthen pots arranged over a rude fireplace, the decoction when sufficiently strong being decanted or strained into other vessels, in which the evaporation is continued until the extract is of sufficient consistence to be poured into clay moulds, into cups formed of leaves, or upon mats covered with the ashes of cow-dung.

In Southern India the wood of Acacia (Mimosa, *Roxburgh*) Suma, *Kurz*, whose bark is externally white, is employed in the same manner, the bark of both species being removed and used for tanning. The last-named species is also common in the forests of tropical Eastern Africa, and has been introduced into South America.

The importation of catechu and gambir into the United States increased from 2,645,000 pounds during the fiscal year 1866–67 to over 47,750,000 pounds in the year 1879-80; in 1882 but little over 15,000,000 pounds were imported.

Description.—Catechu is chiefly exported from Pegu and Calcutta, packed in mats, chests, or boxes It forms several layers of dark-brown masses, in which remnants of the matting and of leaves are observed, and which are frequently soft near the centre. When dry it is hard and brittle, breaking into irregular, somewhat porous and glossy fragments, which are scarcely translucent on the edges, almost wholly soluble in alcohol, partly soluble in water. and have but little odor and a strongly astringent and sweetish taste. The solutions have a slight acid reaction. Examined by the microscope under water or glycerin, catechu is somewhat crystalline. The catechu in balls and in quadrangular cakes, made in moulds as above described, is rarely met with in our commerce. A fourth variety, which is never exported, is made in Kumaon in Northern India by stopping the evaporation before the liquid becomes too thick; it bears a closer resemblance to gambir than to the ordinary catechu. Good catechu yields between 1.5 and 4.5 per cent. of ash; Flückiger obtained from Pegu catechu 0.6 per cent.

The *Areca catechu*, obtained from the so-called betel-nuts, the seeds of Areca Catechu, *Linné*, does not form an article of commerce; it is said to be inferior to true catechu, and is known in India, in part at least, as *catta-cambu*. (See page 256).

Constituents.—The relation to one another of the principal constituents of catechu has been satisfactorily explained by the researches of Neubauer (1859), Hlasiwetz (1867), Etti (1877), and others. When catechu is treated with cold water mainly *catechu-tannic acid* is found in the brown solution, which yields precipitates of a grayish color with gelatin and of an olive-brown with ferric salts. The aqueous solution contains also some *catechin* and *quercetin*, the latter having been obtained by Löwe (1873) by treating the solution with ether. Most of the *catechin* or *catechuic acid* is, however, left undissolved by the treatment with cold water, and may be obtained pure by repeated crystallization and decolorizing with animal charcoal, or removing the adhering tannin by adding lead acetate until a dark-colored precipitate is no longer obtained. Catechin forms white silky needles which are sparingly soluble in cold water, but more readily in cold alcohol and ether; it requires for solution less than 4 parts of boiling water, about 3 parts of boiling alcohol, and 6 parts of boiling ether. It has a sweetish taste, imparts a green color to ferric salts, gives a violet color on being agitated with water and powdered iron, the color changing to green on exposure to air, and yields precipitates with most metallic salts, but not with tartar emetic nor with gelatin. Its formula, according to Roehleder (1869), is $C_{13}H_{12}O_5$. Subjected to dry distillation, it yields pyrocatechin, and when fused with potassa is converted into phloroglucin (see PHLOROZINUM) and protocatechuic acid. Gautier (1878) gives to catechin the formula $C_{21}H_{18}O_8$, and found among the products of decomposition by potassa, besides the two mentioned, also the hydrocarbon, CH_4, and carbonic and formic acids. By the action of dilute sulphuric acid at 140° C. an amorphous orange-colored body, protocatechuic acid, and a polyatomic phenol, probably $C_{14}H_{16}O_7$, were obtained. Etti adopts Hlasiwetz's formula, $C_{19}H_{18}O_8$, for catechin; this is partly decomposed at 110° C. (230° F.), and when heated to 160° C. (320° F.) yields an anhydrid, $C_{38}H_{34}O_{15}$, which is catechu-tannic acid, and has also been called *catechu-red;* it is a dark-red amorphous powder, soluble in water, alcohol, and ether. Below 180° C. (356° F.), or by continued boiling with dilute sulphuric acid, the anhydride, $C_{38}H_{32}O_{14}$, which is likewise a tannin, is obtained. By continuing the action of sulphuric acid the *catechuretin*, $C_{38}H_{28}O_{12}$, of previous investigators, and the anhydride, $C_{38}H_{30}O_{13}$, are obtained, which are insoluble in simple solvents and weak alkalies. H. K. Bowman (1869) determined the quantity of tannin in three samples of catechu, and found it to vary between 32.8 and 49.4 per cent. More than 30 samples examined by Lehmann (1880) yielded tannin varying between 22.6 and 50.8 per cent, and catechin varying between 13.8 and 33.8 per cent.

Protocatechuic acid, $C_7H_6O_4$, is formed from certain tannins, numerous resins, gum-resins, and other substances by adding them to melted potassa. It crystallizes in colorless shining needles or scales containing a molecule of water, dissolves readily in ether, alcohol, and hot water, melts at 199° C. (390.2° F.), and at a higher heat is decomposed into carbonic acid and pyrocatechin. Its solution is colored dark-green by ferric chloride, the color changing to blue, and subsequently to red, on the gradual addition of a very dilute solution of sodium carbonate.

Pyrocatechin or *catechol*, $C_6H_6O_2$, is contained among the products of destructive distillation of several tannins and vegetable extracts. It crystallizes in short rectangular prisms, melts at 104° C. (219.2° F.), and boils at 245° C. (473° F.). It sublimes in thin laminæ, and dissolves easily in water, alcohol, and ether. Its aqueous solution is colored dark-green by ferric chloride, the color changing to violet on the addition of ammonia, sodium bicarbonate, or tartaric acid. The methylic ether of pyrocatechin is guaiacol. (See CREASOTUM.)

Impurities.—Fragments of leaves, mats, or cloth are usually found in the commercial article. An *artificial catechu*, proposed by Rave (1873), may be obtained by slightly roasting powdered mahogany or allied woods, and then boiling with water; it is said to be serviceable in dyeing.

Off. Prep.—Tinctura catechu composita, Trochisci catechu, *U. S.*

Astringent Products of Other Species.—The bark of many species of acacia contains so much tannin as to render it valuable for tanning purposes. The *babul-bark* of India is obtained from Ac. nilotica, *Desfontaines*, the fruit of which is also used by tanners under the name of *neb-neb* or *bablah.* The Australian *wattle-bark* is produced by A. decurrens, *Willdenow*, and other species.

Cortex adstringens brasiliensis, which was used in Europe during the first half of the present century, is obtained from Stryphnodendron polyphyllum, *Martius*, a tree known in Brazil as *barbatimao* or *barbimao.* The bark is covered with a thick fissured blackish red-brown cork, has a light-brown bast-layer readily separating in bands, possesses a strongly astringent and somewhat mucilaginous taste, and contains about 30 per cent of tannin, which yields with ferric salts a blackish gray-green precipitate. Pithecollobium Avaremotemo, *Martius*, s. Acacia virginalis, *Pohl*, and Acacia Jurema, *Martius*, yield similar barks.

CATECHU PALLIDUM.—Pale Catechu.

Catechu, Br., P. G.; *Terra japonica*, *Gambir*, *Gambier*, E.; *Gambir cubique*, Fr.: *Gambir*, *Gambir-Catechu*, G.

An extract of the leaves and young shoots of Uncaria Gambier, *Roxburgh*, s. Nauclea Gambir, *Hunter. Trans. Linn. Soc.*, vol. ix. plate 22; Bentley and Trimen, *Med. Plants*, 139.

Nat. Ord.—Rubiaceæ, Naucleæ.

Origin.—This is a shrubby climber having opposite leaves, and bearing globular heads of pinkish flowers upon axillary laterally compressed peduncles, which taper toward the apex, are articulated above, and after the fall of the whole inflorescence curve backward and form stout and hard hooks, by which the plant supports itself in climbing. It is indigenous to Ceylon, Sumatra, and the countries about the Straits of Malacca, and is extensively cultivated near Singapore. Uncaria (Nauclea, *Hunter*) acida, *Roxburgh*, indigenous to Pulo Penang and neighboring islands, is nearly allied to the preceding species, and perhaps merely a variety of it; it appears also to be used in the preparation of gambir.

Preparation.—The fresh leaves and young shoots are boiled in water for an hour, after which the decoction is decanted and the residue expressed with the hands. The liquid is now evaporated to the consistence of a thin syrup, poured into buckets, and stirred by working a stick of soft wood up and down in a sloping direction, when it gradually sets into a soft mass; this is placed in shallow square boxes, and when sufficiently firm is cut into cubes and dried in the shade.

Gambir is principally exported from Singapore, packed in boxes. Catechu, *P. G.*, applies to gambir as well as to cutch.

Description.—It is met with in cubes or in large irregular masses, the latter having an external resemblance to, but are mostly of a lighter-brown color than, catechu, and presenting upon the irregular fracture a dull brown-gray appearance, with some streaks of a darker brown. The cubes are about an inch (25 Mm.) square on each side, externally light or deep brown, internally brownish-gray. Both varieties are friable, inodorous, of a bitterish astringent finally sweet taste, and show under the microscope numerous small acicular crystals. Gambir is only partially soluble in cold water, but yields with hot water a turbid solution, and with hot alcohol a clear dark-brown solution, leaving only the impurities undissolved, and these should not exceed 15 per cent. in weight (*P. G.*). On incineration gambir yields $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent. (not over 6 per cent., *P. G.*) of ash, consisting mostly of earthy salts.

Constituents.—Gambir contains the same constituents as catechu, but less *tannin* than the latter; the crystalline structure observed under the microscope is due to *catechin.* Hlasiwetz (1867) detected *quercetin* in gambir. De Vrij (1865) avers the presence of *quinovic acid* in many species of Nauclea, and it is not impossible that it may also be found in gambir. Gautier (1878) regards the catechin of gambir as differing in composition from that of catechu. Twelve samples of gambir examined by Lehmann (1880) yielded between 25.5 and 37.8 per cent. of tannin and between 19.96 and 28.69 per cent. of catechin.

Valuation.—Adolf Lehmann (1880) has proposed for both catechu and gambir the following method: Treat 1.5 Gm. with sufficient hot water to obtain 250 Ccm. and filter. Determine in a portion of the filtrate the tannin and catechin by Loewenthal's method (see Acid. Tannic., p. 105), and in another portion the tannin alone by Schulze's method (page 104). By subtracting the tannin from the mixed tannin and catechin the catechin (with coloring matter, etc.) is found.

Off. Prep.—Infus. catechu, Pulv. catechu comp., Tinct. catechu, Trochisci catechu, *Br.*

Medical Action and Uses.—Catechu is astringent by virtue of the tannic acid it contains, and was originally used to constringe relaxed tissues, arrest fluxes, and for similar purposes. It is harsher but more energetic than kino in its action. It continues to be one of the most commonly employed of astringent medicines for checking *diarrhœa* produced by cold or by irritating ingesta after their removal by purgation. It is best administered for this purpose in the officinal chalk mixture. It is alleged to check the bronchial secretion in chronic *phthisis* and *bronchitis*, and to moderate uterine *hæmorrhage* and *leucorrhœa*. It is of greater utility as a local astringent, applied to the nostrils in *epistaxis*, to the mouth in cases of spongy and bleeding *gums*, to the *vagina* in relaxation and leucorrhœa of this canal, and to the *throat* and *larynx* in cases of flaccidity of these parts. Lozenges containing it are used to correct *hoarseness* and roughness of the voice due to this cause. They sometimes are made with catechu, cascarilla, amber, orris, peppermint, etc. to conceal the odor of the breath caused by *fetid follicular secretions*, by *tobacco*, etc. The astringency of catechu renders it a useful ingredient of dentifrices. In gargles it relieves *sore throat* unattended with active inflammation; in lotions it forms a valuable application to ulcerated *nipples* and other *ulcers* after the acute stage has passed; such lotions may contain catechu alone, or, in addition to it, borax, alum, sulphate of copper, etc. Gambir catechu has the same medical properties, but its astringency is rather less. The *dose* of catechu is from 1 to 30 grains (Gm. 0.5–2.0). A compound infusion of catechu is made with 1 troyounce of this drug, 60 grains of powdered cinnamon, and a pint of boiling water. It is especially useful in the diarrhœa of children, to whom it may be given in doses of a tablespoonful or more.

CAULOPHYLLUM, *U. S.*—BLUE COHOSH.

Pappoose-root, *Squaw-root*, *Blueberry-root*.

The rhizome and rootlets of Caulophyllum (Leontice, *Linné*) thalictroides, *Michaux*. *Nat. Ord.*—Berberidaceæ.

Origin.—A smooth and glaucous perennial with a simple stem, bearing near its apex a large sessile triternately compound leaf, with obovate three-or five-toothed or lobed leaflets; the greenish-yellow flowers, about twelve in number, form a terminal raceme, and produce capsules which are soon ruptured by the two globular seeds, these remaining enclosed in a blue fleshy integument. The plant is found in rich woodlands from Canada south to Carolina and Kentucky. It flowers in April and May.

Description.—The rhizome is nearly horizontal, somewhat matted, 4 inches (10 Cm.) long, about ¼ to ⅖ inch (6 to 10 Mm.) thick, more or less bent, knotty from the numerous concave approximate stem-scars on the upper side, and from the short branches, externally brown-gray, internally whitish, the tough ligneous rays narrow and many. The numerous radical fibres are mostly on the lower side, 3 or 4 inches (75 or 100 Mm.) long and about $\frac{1}{25}$ inch (1 Mm.) thick, rather tough, pale yellowish-brown externally, and white internally. Blue cohosh is nearly inodorous and has a sweetish-bitter afterward somewhat acrid taste. As met with in commerce, it is sometimes mixed with a large proportion of the rhizome of hydrastis, which is easily recognized by its different shape and its bright-yellow color internally.

Constituents.—F. F. Mayer (1863) found blue cohosh to contain *saponin*; Ebert (1864) corroborated this statement, proved also the presence of two resins, starch, gum, and other common principles, and obtained 2½ per cent. of ash. On concentrating the alcoholic tincture and pouring it into water a precipitate of the resins is obtained amounting to about 12 per cent. of the root; it has the peculiar taste of blue cohosh and constitutes the so-called *caulophyllin*.

Medical Action and Uses.—Nothing has recently been added to our knowledge of its reputed virtues. It is said to be demulcent, antispasmodic, emmenagogue, and diuretic. It is not proved to possess medicinal powers. A decoction made with an ounce (Gm. 30) of the root to a pint of water may be given in the dose of 1 or 2 ounces.

CEANOTHUS.—RED ROOT.

New Jersey tea, E.; *Céanothe*, Fr.; *Seckelblumen-Wurzel*, G.

The root of Ceanothus americanus, *Linné*.

Nat. Ord.—Rhamnaceæ.

Origin.—This is a shrubby plant indigenous to the greater part of North America, growing in pine barrens and dry woodlands. It is about 3 feet (90 Cm.) high, and has alternate ovate or oblong-ovate, serrate leaves, which are sometimes heart-shaped at the base, downy underneath, and three-veined. The small white flowers are in axillary panicles and produce three-lobed capsules containing three seeds.

Description.—The root is about a foot (30 Cm.) long, nearly cylindrical, an inch (25 Mm.) or more thick, with a knotty head and a few branches, and covered with a firmly-adhering rust-colored bark, which is about $\frac{1}{12}$ inch (2 Mm.) thick, with some longitudinal ridges, hard, breaks with a short granular fracture, and when cut with a knife has a brown-red and waxy appearance. The wood is very tough, of a light red-brown color and of a waxy lustre upon the recently-cut surface. The branches have a rather lighter-colored bark and a whitish wood. The root is without odor and has a bitterish-astringent taste, which is strongest in the bark.

Constituents.—Red root has not been analyzed, but is known to contain tannin. Bowman (1869) estimated the tannin of the leaves to amount to 9.21 per cent.

Other Species.—Ceanothus ovalis, *Bigelow*, which has narrow oval leaves, is indigenous from Vermont to the Rocky Mountains.

Cean. cœruleus, *Lagasca*, s. C. azureus, *Desfontaines*, a native of Mexico, has been employed there as a febrifuge.

Medical Uses.—The leaves of this plant were used during the American War of Independence as a substitute for Chinese tea, and in the late Civil War it was employed in the same manner, and pronounced "a good substitute for indifferent black tea." The root is astringent, and was applied locally by the Cherokee Indians in *gonorrhœa* and *cancer*, and given internally in *syphilis*. A decoction of the leaves and seeds has been used in *ulceration* of the mouth and throat, and internally in *dysentery*. In the West Indies and Mexico it is said that a species of Ceanothus (C. reclinatus, *De Candolle*) is used for the purposes mentioned (*Bull. de thérap.*, xcvii. 119).

CELASTRUS.—Stafftree-Bark.

False bittersweet, *Fevertwig*, *Staff-vine*, E.; *Celastre*, Fr.; *Celaster*, G.

The bark of Celastrus scandens, *Linné*.

Nat. Ord.—Celastraceæ.

Origin.—The staff tree is a native of Canada, and of the United States southward to North Carolina, growing in woods and thickets and twining about trees, ascending to a considerable height. The leaves are alternate, ovate-oblong, acuminate, and serrate; the flowers are in small axillary racemes, greenish-white, and produce orange-colored three-valved capsules containing from three to six seeds, which are covered with a scarlet-red arillus.

Description.—The root-bark, which is usually preferred, is in irregular thin quills or double quills, is nearly smooth, externally brown or dark orange-brown; the outer layer, which is rather tough, separates concentrically and shows another layer of a bright orange-red color, which covers the white, fragile, likewise concentrically-arranged liber. The internal surface is whitish and finely striate. The bark of the stem resembles the root-bark, but is externally of an ash-gray or brown-gray color. It is without odor and possesses a bitterish-sweet taste. The tough white wood is occasionally found adhering to the bark as met with in commerce.

Constituents.—The bark has not been analyzed, but Prof. Wayne (1872) obtained from it a principle in white minute crystals resembling chloral hydrate in appearance. The process for obtaining this *celastrin* has not been published.

Medical Uses.—"The bark has considerable reputation in domestic practice as an emetic, discutient, and anti-syphilitic; it also appears to possess some narcotic powers" (Griffith). It is popularly supposed capable of "removing hepatic obstructions," whatever that may mean.

CEPHALANTHUS.—Buttonbush.

Buttonwood, *Crane willow*, *Swamp dogwood*, E.

The bark of Cephalanthus occidentalis, *Linné*.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Origin.—The buttonbush grows in wet places in Canada and the United States, attains a height of 10 to 15 feet (3 to 4.5 M.), has ovate, acuminate, and entire leaves, which are opposite or in whorls of three, and the white flowers are aggregated in dense globular terminal and axillary heads.

Description.—Buttonbush-bark, as found in commerce, is in narrow curved pieces an inch (25 Mm.) or more in length. The outer surface is somewhat glossy, gray-brown, finely striate longitudinally, or when older covered with a scaly and fissured ash-colored or brown-gray soft cork. The inner bark is white and smooth, after drying light rust-brown, rather tough, and breaks with a fibrous fracture. The bark is inodorous and has a slightly astringent and somewhat bitter taste.

Constituents.—Examined by E. M. Hattan (1874), the bark was found to contain tannin, a principle analogous to saponin, an uncrystallizable bitter principle freely soluble in alcohol and water, two resins, fat, gum, glucose, and starch. A fluorescent body was obtained from the precipitates occasioned by acetate and subacetate of lead; it crystallizes in needles, is soluble in water, alcohol, and ether, yields a yellow precipitate with subacetate of lead, and has in alkaline solutions a yellow color, which in reflected light appears blue.

Medical Uses.—There is no evidence to prove that this plant possesses medicinal virtues sufficient to entitle it to consideration. It is reputed to have been useful in *paralysis*, *coughs*, and constitutional *syphilis*.

CERA ALBA, *U. S., Br., P. G.*—WHITE WAX.

Cire blanche, Fr.; *Weisses Wachs*, G.

Yellow wax bleached by exposure to moisture, air, and light.

CERA FLAVA, *U. S., Br., P. G.*—YELLOW WAX.

Cera citrina.—*Beeswax*, E.; *Cire jaune*, Fr.; *Gelbes Wachs*, G.

The prepared honeycomb of the hive-bee or honey-bee, Apis mellifica. *Linné.*
Class Insecta. Order Hymenoptera.

Origin.—The insect has been domesticated from an early period, and several varieties are known; but the Apis fasciata of Egypt, A. unicolor of Madagascar, and A. pallida of South America may perhaps be all distinct species. The bees live in societies called *swarms*, which are composed of one female or *queen bee*, several hundred males or *drones*, and ten thousand or more *working bees*, which are females with undeveloped ovaries. The wax is secreted in thin scales between the rings of the belly, and is used in the construction of the hexagonal cells which form the comb and are filled with honey. To obtain the wax the honey is drained off, the comb expressed, melted in water, and after the impurities have subsided the wax is allowed to cool or run into suitable moulds. By filtering the crude wax through paper at a sufficiently elevated temperature a very handsome product is obtained. Beeswax is largely produced in the United States, particularly in some of the Western and Southern States, and its importation from the West Indies has decreased to 6000 or 7000 pounds annually.

Wax-Bleaching.—Melted beeswax is solidified in thin ribbon-like sheets by passing it over wet revolving cylinders, or it is finely granulated and then exposed to the light and air, being moistened from time to time and occasionally turned. It is then remelted, and the process repeated until the desired degree of whiteness has been attained. Wax may also be deprived of its color by chlorine, but such a product is much inferior to the sun-bleached wax.

Properties.—Beeswax is a solid body, having a more or less deep-yellow, or sometimes a brownish-yellow, color, a slight lustre, a somewhat unctuous touch, a finely granular fracture, a peculiar aromatic honey-like odor, and a slight balsamic taste. Its specific gravity varies between about .955 and .967, and its fusing-point between 62° and 63° C. (about 145° F.). The density of wax is, according to Hager, most conveniently determined by melting a small portion, dropping it upon a slightly dampened glass or porcelain tile, and immersing the solidified drops in alcohol of known density, in which they must float without rising to the surface or sinking to the bottom. Wax is brittle in the cold, becomes plastic by the heat of the hand, and when melted forms a clear reddish-yellow liquid, which congeals with a smooth and level surface and appears irregularly crystalline under the microscope. Wax is insoluble in water and slightly soluble in cold alcohol, but dissolves in 300 parts of boiling alcohol, leaving only a small-brownish-yellow residue, and depositing on cooling a whitish crystalline mass, while the filtrate is yellowish, and not rendered turbid by water. Wax is wholly soluble in 11 parts of chloroform, in 10 parts of boiling ether, in warm benzol, benzin, carbon bisulphide, oil of turpentine, and other volatile oils, and in fixed oils. The U. S. Pharmacopœia states that wax is soluble in 35 parts of ether, while, according to Hager, ether dissolves only about one-half of the wax at 15° C. (59° F.), and benzol or benzin about 27 per cent. On dry distillation wax yields an aqueous liquid, a butyraceous oil, a scaly crystalline body, and empyreumatic products, but no acrolein.

White wax is usually met with in yellowish-white thin circular cakes, which are about 4 inches (10 Cm.) in diameter, slightly translucent, of a somewhat splintery fracture in the cold, have a specific gravity of about .965 to .975, and fuse near 64° C. (147° F.) (65° C.=149° F., *U. S. P.*). Its slight odor suggests that of rancidity; its taste is insipid. In other respects it has the characteristics and answers to the tests of yellow wax.

Constituents.—Yellow wax contains some aromatic and coloring matters, which vary somewhat in wax from different localities, and are destroyed by the bleaching process; they are partly dissolved by cold alcohol, together with a very small quantity of *cerolein*, which resembles a fat in appearance. Boiling 90 per cent. alcohol dissolves 10 to 20 per cent. of *cerin* or *cerotic acid*, $C_{27}H_{54}O_2$, which exists likewise in Chinese wax, is crystalline, and fuses in its pure state at about 81° C. (177.8° F.). Schalfeief (1876) succeeded, by fractional precipitation with lead acetate, in separating it into several acids, one having the composition $C_{34}H_{68}O_2$. Repeated boiling of wax with alcohol leaves yellow *myricin* behind, which is *myricyl-palmitate*, $C_{30}H_{61}.C_{16}H_{31}O_2$; when pure it forms feathery crystals, has the fusing-point at 72° C. (161.6° F.), is very sparingly soluble in alcohol, more freely in ether and oil of turpentine, and is with difficulty saponified by boiling with concentrated solution of potassa. The principle to which bleached wax owes its rancid odor has not been ascertained.

Vegetable wax is obtained in different countries from various species of Myrica, Rhus, Corypha, etc. Some of them are glyceryl compounds of fatty acids, and therefore true fats, but the exact composition of most of them has not been ascertained.

Adulterations and Substitutions.—The coarse adulterations with flour, white lead, and similar substances are perhaps rarely practised at the present time, since they are so readily detected by their insolubility in ether, chloroform, and oil of turpentine, and by subsiding or mixing with hot water on fusing the wax with it. The materials most frequently employed are resin, commercial stearin (the residue left on expressing lard oil), suet, and similar fats, and paraffin and the closely-allied *ceresin* or *ozokerite* of Gallicia. The latter, which has also been termed *mineral-* or *earth-wax*, is found in nearly black masses, but is obtained in the process of purification of various shades of color varying between dark-yellow and white. This and *paraffin* may be readily detected and their quantity estimated by their stability when heated with concentrated sulphuric acid, by which the beeswax is completely destroyed, while they are not affected, and may be recovered nearly pure by fusing the residuary mass repeatedly with fresh portions of water. If the adulterated wax be previously exhausted with light petroleum benzin, which dissolves but little of the beeswax, the solution will contain the paraffin, together with any fat present, and the residue left on evaporation may be treated with sulphuric acid; this will destroy the fat and leave the paraffin. The determination of the specific gravity and fusing-point has been recommended for detecting adulterations, paraffin and tallow being lighter, while resins, stearin, Japan wax, etc. are heavier, than wax; but mixtures of the adulterants may be prepared which agree pretty well in these respects with the natural product. It must also be remembered that resins, like beeswax itself, are destroyed by the influence of hot sulphuric acid. But most resins and fatty acids are soluble without difficulty in cold strong alcohol, which takes up but minute quantities of beeswax; and this behavior affords a means of detecting such adulterations. Fats, however, are not dissolved by alcohol. With few exceptions they are readily soluble in cold petroleum benzin, and their quantity may be estimated. To apply these tests the wax should be cut into very thin pieces and digested for some time near the boiling-point. After cooling the liquid is decanted, and will then contain fatty acids and resin should alcohol have been used, or fats and paraffin if petroleum benzin should have been employed as the solvent. Advantage may also be taken of the behavior of Japan wax and other fats to form a milky emulsion on being boiled with an aqueous solution of borax, from which on cooling pure wax separates completely. When melted wax is allowed to congeal without being disturbed, it presents a level surface, but the surface of paraffin is concave; and A. W. Miller (1874) has observed this distinctly even in mixtures of pure wax and paraffin; the translucent appearance of the latter is even noticed on the edges of the mixture, while pure yellow wax is almost opaque. Another perhaps still more deceptive fraud has been practised in coating adulterated with a thin layer of pure wax of the same color; and completely artificial wax has been made (1876) by fusing together rosin and paraffin or rosin, soap, and stearic acid; the solubility in cold strong alcohol, and in the former case the indestructibility of the undissolved portion by hot sulphuric acid, serve to detect these frauds. The admixture of fats may also be detected by the acrid odor of the vapors given off on throwing the suspected wax upon red-hot charcoal. (See paper on white wax and its adulterations by Prof. Bedford in *Proc. Amer. Phar. Assoc.*, 1877, p. 444.)

Tests.—If 1 Gm. of wax be boiled for half an hour with 40 Gm. of solution of soda (sp. gr. 1.180), the volume being preserved by the occasional addition of water, the wax should separate on cooling, without rendering the liquid opaque, and no precipitate should be produced in the filtered liquid by hydrochloric acid (absence of fats or fatty acids, Japan wax, resin); nor should the same reagent produce a precipitate in water which has been boiled with a portion of the wax (absence of soap). If 5 Gm. of wax be heated in a flask for 15 minutes with 25 Gm. of sulphuric acid to 160° C. (320° F.), and the mixture diluted with water, no solid, wax-like body should separate (absence of paraffin).—*U. S.*

If the wax be boiled with alcohol sp. gr. .830, and the solution cooled and filtered, the filtrate should not, or only very slightly, redden blue litmus-paper, and should not become turbid on the addition of water (absence of resins and stearic acids). If 1 part of wax be boiled for 1 hour with 300 parts of alcohol sp. gr. 96 and 1 part of exsiccated sodium carbonate, and the liquid after cooling be filtered, the filtrate should not yield a precipitate on the addition of hydrochloric acid (absence of resins, fats, vegetable wax, and fatty acids).—*P. G.*

Off. Prep. of White Wax.—Ceratum, *U. S.;* Ceratum (Unguentum) cetacei, Charta cantharidis (epispastica), *U. S., Br.;* Suppositoria, *Br.;* Unguent. aquæ rosæ, *U. S.;* Ungt. plumbi subacet. comp., Ungt. simplex, *Br.*

Of Yellow Wax.—Ceratum (Emplastrum) cantharidis, *U. S., Br.;* Ceratum extracti cantharidis, *U. S.;* Ceratum (Unguentum) resinæ, *U. S., Br.;* Emplast. asafœtidæ, Empl. picis burgund., Emp. picis canad., Emp. resinæ, *U. S.;* Emp. calefaciens, Empl. cerati saponis, Empl. galbani, Empl. picis, *Br.;* Unguentum, Ungt. mezerei, *U. S.;* Ungt. cantharidis, Ungt. hydrarg. comp., Ungt. hydrarg. oxidi rubri, Ungt. picis liquidæ, Ungt. sabinæ, Ungt. terebinthinæ, *Br.*

Medical Action and Uses.—Wax is simply a protective. Its use in ancient times as a remedy for *diarrhœa* and *dysentery* was doubtless due to this property. Quite recently it has been similarly employed. *Propolis*, a resinous matter with which bees cover the bottom of their hives, has been used for the same purpose. Until the introduction of caoutchouc, wax was generally employed for preparing impermeable tissues, and in the treatment of *rheumatism, gout, neuralgia*, and other local diseases to protect the affected parts from cold and favor cutaneous transpiration.

CERATA.—CERATES.

Cérats, Céréolés, Elæocéréolés, Fr.; *Cerate, Wachssalben*, G.

The term cerate is applied to a class of unctuous preparations which in consistence are about intermediate between ointments and plasters, sufficiently soft to be spread at the ordinary temperature, and at the same time firm enough to adhere to the skin without melting. They are composed of wax, united with a fatty or oleoresinous substance, and to obtain them of proper consistence 2 parts of wax require about 3 parts of fixed oil, 4 parts of lard, or 1 part of soft turpentine. In preparing cerates the wax or resin should be melted first by the aid of a water-bath or otherwise carefully-regulated heat. When thoroughly melted, the warm oil or lard should be added in quantities small enough not to congeal the melted portion, and after all the ingredients have been liquefied and the vessel removed from the fire the mass should be well stirred or beaten with a spatula, to prevent the partial separation of the least fusible substances and ensure the perfect homogeneousness of the preparation. It is well to continue this manipulation until the temperature has been reduced to that of the room, but artificial refrigeration should not be applied until after the mass has thickened, and then only if vigorous stirring (or, better still, trituration) is kept up. With this in view, the soft cerate may be transferred to a mortar previously warmed by hot water, or the whole process may be completed in a well-enamelled iron vessel with a rounded bottom if a pestle fitting the curve of the latter be used. Straining is best avoided, and all the materials should therefore be free from dust and other foreign bodies. Powders, cantharides excepted, are gradually added while the cerate is merely soft enough to permit the whole to be uniformly mixed, and liquids should be previously warmed to 40° or 45° C. (about 110° F.). In dispensing cerates with extracts the latter should be previously rubbed with water in a warm mortar to a uniform thin paste, which should then be mixed with the cerate, added in small portions until the extract has been thoroughly incorporated; the remaining cerate may then be added in larger quantities.

Cerates should be kept in a cool place, where the temperature is not likely to rise much above 15° C. (59° F.), but even then those made with white wax, owing to its incipient rancidity, are liable to become rancid, while such as contain yellow wax keep unaltered for a much longer period. Some cerates, which are sufficiently firm, may be conveniently kept and dispensed in the form of square cakes, which are easily made by pouring the fused and nearly cool cerate into square moulds made of oiled or paraffin-paper and placed upon a flat slab. After the cerate has solidified it is without difficulty removed from the paper and cut into smaller pieces of any desired size or weight.

The name *steatina*, *steatins*, has been suggested by Mielck (1881) for a class of preparations which are of about the same consistence as cerates, but the base of which is suet, combined with either expressed oil of nutmeg, with wax, or with lead plaster deprived of glycerin and water.

CERATUM, *U. S.*—Cerate.

Ceratum simplex, *U. S.* 1850; *Ceratum adipis*, *U. S.* 1860; *Unguentum cereum*, *P. G.*—*Simple* (*lard*) *cerate*, E.; *Cérat simple*, Fr.; *Einfaches Cerat*, *Wachssalbe*, G.

Preparation.—White Wax 30 parts (6 oz.); Lard 70 parts (14 oz.); to make 100 parts (20 oz.). Melt them together, and stir the mixture constantly until cool.—*U. S.*

The simple cerate of the French Codex is composed of 1 part of white wax to 3 parts of expressed oil of almonds, and the wax ointment, P. G., of 3 parts of yellow wax to 7 parts of olive oil.

CERATUM CAMPHORÆ, *U. S.*—Camphor Cerate.

Unguentum (*Pomatum*, F. Cod.) *camphoratum*.—*Pommade camphrée*, Fr.; *Kampfersalbe*, G.

Preparation.—Camphor Liniment 3 parts ($14\frac{1}{2}$ grains); Olive Oil 12 parts ($57\frac{1}{2}$ grains); Cerate 85 parts (408 grains); to make 100 parts (480 grains). Mix the camphor liniment and the olive oil, and incorporate with the cerate.—*U. S.*

Melt at a moderate heat white wax 1 part and lard 9 parts; add powdered camphor 3 parts, and stir until the camphor is dissolved and until the ointment becomes cool.—*F. Cod.*

The consistence of the camphor cerate, U. S. P., is softer than that of most other cerates. The camphor pommade of the French Codex contains 12 per cent. of camphor, but the cerate of the U. S. P. only $\frac{3}{5}$ per cent.; it was made so weak solely for the purpose of preparing the Ceratum plumbi subacetatis extemporaneously.

Medical Action and Uses.—The only active ingredient of this preparation is camphor. It appears to be superfluous. If intended as an anti-pruriginous application, it is no better than camphorated oil. If proposed as an anodyne, it is vastly inferior to the ancient opodeldoc, which, it appears to us, should not have been laid aside in the revision of 1870 as well as in that of 1880.

CERATUM CANTHARIDIS, *U. S.*—Cantharides Cerate.

Emplastrum cantharidis, Br.; *Emplastrum vesicans*, F. Cod; *Emplastrum cantharidum ordinarium*, P. G.; *Emplastrum epispasticum s. vesicatorium*.—*Blistering cerate or plaster*, E.; *Emplâtre de cantharides*, *Emplâtre vésicatoire*, Fr.; *Spanischfliegen-Pflaster*, *Blasenpflaster*, G.

Preparation.—Cantharides, in No. 60 powder, 35 parts (7 oz.); Yellow Wax 20 parts (4 oz.); Resin 20 parts (4 oz.); Lard 25 parts (5 oz.); to make 100 parts (20 oz.). To the wax, resin, and lard, previously melted together and strained through muslin, add the cantharides, and by means of a water-bath keep the mixture in a liquid state for half an hour, stirring occasionally. Then remove it from the water-bath and stir constantly until cool.—*U. S.*

Take of Cantharides in powder 12 ounces; Yellow Wax, Prepared Suet, each 7½ ounces; Prepared Lard 6 ounces; Resin 3 ounces. Liquefy the wax, suet, and the lard together by a water-bath, and add the resin, previously melted; then introduce the cantharides, mix the whole thoroughly, and continue to stir the mixture while it is allowed to cool.—*Br.*

Cantharidin being freely soluble in fixed oils, the process of the U. S. Pharmacopœia always ensures an effectual blistering cerate, provided the cantharides are of good quality. It is important that the heat be not raised above 100° C. (212° F.), since cantharidin would volatilize with the watery vapors extricated from the powder, and, while weakening the cerate, vesication of the operator's face and hands would be apt to occur. The solution of the cantharidin in the cerate may be greatly facilitated by dampening the powdered cantharides with oil of turpentine or chloroform a day or two before the cerate is made. Dragendorff (1872) recommended a process for increasing the efficacy of the cerate by treating the powdered cantharides first with solution of potassa or soda, heating the mixture in a water-bath for half an hour, supersaturating with hydrochloric acid, drying rapidly in a water-bath, and powdering the residue. Rother (1872) obtained by this process an ineffectual preparation, unless the powder was finally kept moist for several days with chloroform or oil of turpentine, whereby, however, the activity of cantharides powder was likewise increased. H. G. Greenish (1880) again recommended the process.

The blistering cerate of the U. S. P. contains 35 per cent., that of the Br. P. and F. Cod. 33⅓ per cent., and that of the P. G. 25 per cent., of powdered cantharides.

Off. Prep.—Blistering cerate is an ingredient of Emplast. picis cum cantharide, *U. S.* The following two preparations are directed by the French Codex:

Camphorated cantharides plaster, E.; *Vésicatoire camphrée*, Fr.—It is made by diffusing upon the surface of the spread cerate a concentrated solution of camphor in ether or chloroform. As either solvent evaporates readily, a thin film of finely-divided camphor is left behind.

Vesicating cloth or taffetas, E.; *Sparadrap (Toile, Taffetas) vésicant*, Fr.—Melt together 100 parts each of purified elemi and resin, 375 of yellow wax, 225 of basilicon ointment, and 40 of olive oil; add 420 parts of finely-powdered cantharides and spread the mass over waxed cloth. Dubuisson proposed a substitute for this, made by forming a thick solution of 1 part of gelatin in sufficient water, adding 4 parts of hydro-alcoholic extract of cantharides, and applying three layers of the mixture upon waxed cloth, allowing each one to dry before the next is applied.

Various proprietary articles of a similar nature are in the market; but the above, in addition to blistering-paper (see Charta Cantharidis), will probably meet all necessities.

Medical Action and Uses.—Cantharides cerate forms the most usual blistering plaster. Its mode of action and remedial application are sufficiently explained under Cantharis.

CERATUM CETACEI, *U. S.*—Spermaceti Cerate.

Emplastrum spermatis ceti, *Ceratum labiale album.*—*Cérat de blanc de baleine*, *Onguent blanc*, Fr.; *Walrat-Cerat*, G.

Preparation.—Spermaceti 10 parts (1 oz.); White Wax 35 parts (3½ oz.); Olive Oil 55 parts (5½ oz.); to make 100 parts (10 oz.). Melt together the spermaceti and wax; then add the olive oil, previously heated, and stir the mixture constantly until cool. —*U. S.*

It should be white and free from rancidity. The preparation of the P. G. 1872 was similar, but firmer, so as to form a convenient application to chapped hands and lips. For the latter purpose it is usually colored red by carmine or by previously steeping some alkanet-root in the oil and scenting it with some volatile oil.

The following preparations are used for similar purposes:

Ceratum rosatum, *F. Cod.*—Rose cerate, Lip salve, *E.*; Cérat à la rose, Pommade pour les lèvres, *Fr.*; Lippenpomade, *G.*—Melt together at a moderate heat white wax 50 Gm. and expressed oil of almond 100 Gm.; when partly cooled add carmine 0.5 Gm. previously rubbed up with a little of the oil; stir well, and finally add essential oil of rose 0.5 Gm.—*F. Cod.*

Camphor ice.—Melt together 4 ounces of white wax and 12 ounces of benzoated suet; when nearly cool add 2 ounces of powdered camphor and 2 drachms of oil of lavender Mix and pour into suitable moulds (W. C. Bakes, 1867).

Medicated cacao-butter.—Melt together 4 ounces of yellow wax and 28 ounces of cacao-butter; add 1 drachm each of balsam of Peru and benzoic acid. Mix and pour into moulds (Ferris Bringhurst, 1867).

Medical Action and Uses.—Spermaceti cerate forms a very bland dressing for *blisters*, superficial *abrasions*, and *ulcers* after their primary stage. It is less apt than simple ointment to grow rancid.

CERATUM EXTRACTI CANTHARIDIS, *U. S.*—Cerate of Extract of Cantharides.

Cérat d'extrait de cantharides, Fr.; *Cantharidenextract-Cerat*, G.

Preparation.—Cantharides, in No. 60 powder, 30 parts (6 oz. av.); Resin 15 parts (3 oz. av.); Yellow Wax 35 parts (7 oz. av.); Lard 35 parts (7 oz. av.); Alcohol a sufficient quantity. Moisten the cantharides with 18 parts ($3\frac{3}{5}$ oz. av. or $4\frac{1}{4}$ fluidounces) of alcohol, and pack firmly in a cylindrical percolator; then gradually pour on alcohol until 180 parts (36 oz. av., or nearly $2\frac{1}{2}$ pints) of percolate are obtained, or until the cantharides are exhausted. Distil off the alcohol by means of a water-bath, transfer the residue to a tared capsule, and evaporate it on a water-bath until it weighs 15 parts (3 oz. av.). Add to this the resin, wax, and lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for 15 minutes. Lastly, strain the mixture through muslin and stir it constantly until cool.—*U. S.*

This was proposed by W. R. Warner (1860). The cantharidin is completely extracted by the alcohol, and again dissolved from the resulting soft extract by the lard, the solution in the latter being facilitated by the prolonged digestion. A quantity of blackish extractive matter, insoluble in fats, separates, and is removed by straining. The finished cerate is of a yellow or greenish-yellow color.

Medical Action and Uses.—They are the same as those of cantharides cerate, for which it is intended to be an elegant and efficient substitute.

CERATUM PLUMBI SUBACETATIS, *U. S.*—Cerate of Subacetate of Lead.

Unguentum plumbi subacetatis compositum, Br.; *Unguentum plumbi*, P. G.; *Ceratum cum subacetate plumbico*, F. Cod.—*Goulard's cerate*, *Compound ointment of subacetate of lead*, E.; *Cérat de saturne*, *C. saturné*, *C. de Goulard*, Fr.; *Bleisalbe*, *Bleicerat*, G.

Preparation.—Solution of Subacetate of Lead 20 parts (90 grains); Camphor Cerate 80 parts (360 grains); to make 100 parts (450 grains). Mix them thoroughly. This cerate should be freshly prepared when wanted for use.—*U. S.*

Take of Solution of Subacetate of Lead 6 fluidounces; Camphor 60 grains; White Wax 8 ounces; Oil of Almonds 1 pint (Imperial). Melt the wax with 16 ounces of the oil by the heat of a water-bath, remove the vessel, and as soon as the mixture begins to thicken gradually add the solution of subacetate of lead, and stir the mixture constantly while it cools; then add the camphor dissolved in the rest of the oil, and mix thoroughly.—*Br.* 1867.

The present formula of the U. S. P. is a simplification of the alternative one of 1870, and will yield an unobjectionable preparation as long as the camphor cerate from which it is made has not become rancid. It is far preferable to the similar preparations of the other pharmacopœias, that of Germany being made of 8 parts of solution of subacetate of lead and 92 parts of lard; while that of the French Codex contains more water than that of the British Pharmacopœia, and becomes rancid even more readily than the latter. By replacing the white wax with yellow wax the cerate will keep for a much longer time, but its yellowish color will change to white on exposure to the atmosphere.

Medical Action and Uses.—This cerate is astringent and protective, and is employed to promote the healing of suppurating surfaces, such as *excoriations*, *blisters*, *ulcers*, etc. It is objectionable from its tendency to become rancid, and therefore irritating; and it must be cautiously applied upon extensive raw surfaces, lest it cause lead-poisoning.

CERATUM RESINÆ, *U. S.*—Resin Cerate.

Unguentum resinæ, Br.; *Unguentum basilicum*, P. G.; *Unguentum tetrapharmacum.—Ointment of resin*, *Basilicon ointment*, E.; *Cérat de résine anglais*, *Onguent basilicum*, Fr.; *Harzsalbe*, *Königssalbe*, *Zugsalbe*, G.

Preparation.—Resin 35 parts (7 oz.); Yellow Wax 15 parts (3 oz.); Lard 50 parts (10 oz.); to make 100 parts (20 oz.). Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring.—*U. S.*

Take of Resin in coarse powder 8 ounces; Yellow Wax 4 ounces; Simple Ointment 16 ounces; Almond Oil 2 fluidounces. Melt with a gentle heat, strain the mixture while hot through flannel, and stir constantly while it cools.—*Br.*

The impurities always present in the resin necessitate the straining of this and the following cerate. By melting and straining the resin alone the purified resin may be kept on hand and subsequent straining avoided. The formulæ of the French and German Pharmacopœias differ considerably from the foregoing, the former ordering black pitch, the latter turpentine, among the ingredients.

Off. Prep.—Linimentum terebinthinæ, *U. S.*

Allied Preparation.—Ceratum resinæ compositum, *U. S.* 1870.—Compound resin cerate, Deshler's salve, *E.*—Take of resin, suet, yellow wax, each 12 troyounces; turpentine 6 troyounces. Melt them together, strain the mixture through muslin, and stir it constantly until cool.

This cerate, which was recognized by the U. S. P. until 1880, gradually becomes tough in consequence of the oxidation of the flaxseed oil—an alteration prevented by substituting for the flaxseed oil either a non-drying oil or paraffin oil, as suggested by S. A. D. Sheppard (1878).

Medical Action and Uses.—Resin cerate is one of the most common and useful of the dressings employed for slowly-healing and indolent *sores*, particularly when they have followed a local shock, such as is produced by a *burn* or *scald*.

Compound resin cerate is rendered more stimulant than resin cerate by the turpentine it contains, and may be applied where that preparation appears to act too feebly.

CERATUM SABINÆ, *U. S.*—Savine Cerate.

Unguentum sabinæ, Br., P. G.—*Ointment of savin*, E.; *Cérat de sabine*, Fr.; *Sadebaumsalbe*, G.

Preparation.—Fluid Extract of Savin 25 parts (5 oz.); Resin Cerate 90 parts (18 oz.). Melt the resin cerate by means of a water-bath, add the fluid extract of savin, and continue the heat until the alcohol has evaporated; then remove the heat and stir constantly until cool.—*U. S.*

Take of Fresh Savin Tops, bruised, 8 ounces, Yellow Wax 3 ounces; Benzoated Lard 16 ounces. Melt the lard and the wax together on a water-bath, add the savin, and digest for 20 minutes. Then remove the mixture and express through calico.—*Br.*

Of the two preparations, we prefer the first, which was first suggested by Prof. Grahame (1858), and which contains all the soluble principles of savin. It is difficult to imagine that the brief digestion of the fresh savin ordered by the second formula should extract enough of the principles to render the cerate equally efficient. Both are, however, in point of elegance, improvements over the old method of incorporating the powder. The German Pharmacopœia employs an extract made with diluted alcohol, which is incorporated with nine times its weight of simple cerate.

Medical Action and Uses.—It is used exclusively as a stimulant of suppurating surfaces, whose discharges it tends to increase. Hence it is applied to prolong the secretion of *issues*, *setons*, and *blisters*, and has the advantage over preparations of cantharides that it does not tend to occasion strangury. Its application produces a white pellicle of coagulable lymph, which should be from time to time removed, lest the part heal prematurely.

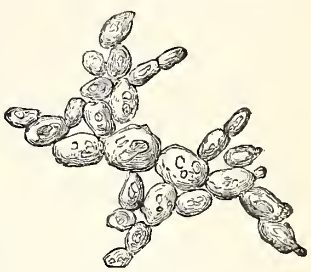
CEREVISIÆ FERMENTUM, *Br.*—Beer Yeast.

Fermentum, U. S. 1870.—*Yeast*, *Brewer's yeast*, E.; *Levûre de bière*, Fr.; *Bierhefe*, G.

The ferment obtained in brewing beer.

Origin and Description.—It has been previously stated (see ALCOHOL, p. 140) that alcoholic fermentation depends upon the development of a minute fungoid vegetable, Saccharomyces cerevisiæ, *Schwann et Meyen*, which has also been named Torula (Cryptococcus, *Kützing*, s. Hormiscium, *Bail*) cerevisiæ, *Turpin*. Leuwenhoek (1680) noticed already, under the microscope, the spherical granules in yeast, but their nature as vegetable organisms was not recognized until after 1820. Persoon, Desmazières, Kützing, and others determined their unicellular condition; Latour observed their budding; and Schwann studied their development. Besides the one named above, Reess (1870) has distinguished a number of other forms which are met with in fermenting liquids only under certain conditions. The possible vegetation of these organisms in the absence of free oxygen seems to have been proven, but the exact conditions have not been determined.

FIG. 59.



Yeast-cells.

There are two varieties of brewer's yeast—the *upper* or *top yeast*, and the *lower* or *bottom yeast* (*Oberhefe* and *Unterhefe* of the Germans). The former is the kind most generally met with in the United States, and is a viscid, semi-fluid, frothy mass containing large more or less globular microscopic cells from which smaller ones are developed; it appears upon the surface of the fermenting liquid, and is reproduced therein at a temperature ranging between about 15° and 20° C. (59° and 68° F.). But wort fermented with top yeast at a temperature near or below 10° C. (50° F.) will produce both top and bottom yeast, the latter being solely reproduced by the fermentation from below (Untergährung, *G.*) at a temperature of about 9° C. (48° F.) and less. It consists of various-sized cells differing from those of the top yeast in not having any small cells attached, and appears to be reproduced from isolated spores, while the other variety multiplies by budding. The cell-membrane consists of a kind of cellulose, and the contents of a protein compound analogous to albumen.

At a temperature less than 5° C. (41° F.) the yeast-plant ceases to vegetate, but it may be exposed to a cold of −60° C. (−76° F.) without being killed. At an elevated temperature of 75° C. (167° F.), and above, it loses its vitality unless water be absent, when it will not be destroyed by a temperature of 100° C. (212° F.) or more. On removing most of the water by pressure the *dry yeast* of commerce is obtained, which may be kept in this condition without material alteration. *Vienna yeast* is the same article, and is stated by Dr. Vigla (1871) to be made by fermenting a wort obtained from a mixture of maize and rye with barley malt, skimming off the froth, draining, and subjecting it to pressure. So-called *artificial* or *patent yeast* is either made of flour dough with the addition of a little yeast, or of an infusion of hops to which malt is subsequently added. The existence in hops of a ferment, as asserted by Sacc (1875), was denied by Soxhlet and Pasteur (1876), who proved that the only effect of hops, when used as stated above, is to impart some bitterness to the mass and somewhat delay the spoiling of the product.

When yeast is added to a solution of pure sugar, active fermentation takes place, the yeast being gradually rendered inert, but in the presence of albuminous matters in the saccharine liquid the yeast-plant is continually reproduced and augmented.

Some investigators have assumed the presence in yeast of a peculiar fermenting principle, *invertin*, which is prepared by Barth (1878) by expressing the water from yeast, drying it completely, heating for 6 hours to between 100° and 105° C. (212° and 221° F.), macerating with water at 40° C. (122° F.), and pouring the filtrate into six times its bulk of alcohol. The precipitate consists of the ferment and albumen, of which the latter is rendered insoluble by prolonged treatment with strong alcohol. Invertin is then dissolved by water, the solution precipitated by alcohol, and the precipitate dried, when it constitutes a brown horn-like mass, which is reduced to powder with difficulty.

Medical Uses.—As a topical remedy yeast has been spoken of under CATAPLASMA FERMENTI. Yeast is generally described as nutritive and antiseptic when used internally. The former it can be only in a slight degree, from the fermented malt liquor which may be mixed with it. It is antiseptic through the carbonic acid which it evolves. There is no doubt that it has appeared to be serviceable in the *typhoid states* of febrile diseases, and that it really is so when applied as a dressing to *gangrenous* and *phagedenic sores*, whose fetor it corrects while it stimulates the nutritive processes in the affected tissues. That its action is a stimulant one is shown by the pain it sometimes causes and by its popular use in the treatment of recent *bruises*. Through its carbonic acid it must also be anodyne. The power of yeast to convert starch directly into alcohol has been invoked in the treatment of *diabetes*, and in a few cases has caused the total disappearance of sugar from the urine. Some patients show signs of alcoholic intoxication while undergoing this treatment. The yeast may be given in doses of 2 tablespoonfuls (Gm. 32) immediately before meals. It has also been used in *scurvy*.

CERII OXALAS, *U. S.*, *Br.*—OXALATE OF CERIUM.

Cerium oxalicum, *Oxalas cericus.*—*Oxalate de cerium*, Fr.; *Oxalsaures Ceroxydul*, *Ceroxalat*, G.

Formula $Ce_2(C_2O_4)_3.9H_2O$. Molecular weight 708.

Origin.—The metal cerium was discovered in 1803 in a Swedish mineral simultaneously by Klaproth and by Berzelius and Hisinger. The last-named chemists called the mineral *cerite*, after the planet Ceres, then recently discovered, and the metal *cerium*. Mosander (1839 and 1840) observed in the supposed pure oxide of cerium the oxides of two other hitherto unknown metals, which received the names of *lanthanum* and *didymium*. The three metals exist together as silicates in the cerite and allanite, the latter mineral being found in Scandinavia and in the States of New York and Pennsylvania. Mendelejeff (1870) first showed the atomicity of cerium in ceric compounds to be quadrivalent $= C^{IV}$, and in cerous compounds sexivalent $= Ce_2^{VI}$; its atomic weight was afterward determined to be 141.2.

Preparation.—To obtain oxalate of cerium F. F. Mayer (1860) recommended the following process: The powdered mineral is heated with concentrated sulphuric acid to decompose the silicates, the dry mass ignited, then dissolved in dilute nitric acid, and treated with sulphuretted hydrogen to remove copper, etc. A little hydrochloric acid is added to prevent the precipitation of calcium salt, and the cerite metals are precipitated as oxalates by oxalic acid. The precipitate is mixed with carbonate of magnesium, the mixture calcined to decompose the oxalates, the residue dissolved in a small portion of concentrated nitric acid, and the solution thrown into a large quantity of water containing about ½ per cent. of sulphuric acid. Lanthanum and didymium remain in solution, together with the magnesium and a little cerium, most of which is precipitated as yellow *ceric* sulphate; the latter is dissolved in sulphuric acid and reduced to cerous sulphate by sodium hyposulphite, when the oxalate may be precipitated by oxalic acid.

Properties and Tests.—Oxalate of cerium is a white granular, inodorous, and tasteless powder, permanent in the air, insoluble in the simple solvents, but soluble in sulphuric and hydrochloric acids without effervescence (absence of carbonates); and this solution is not precipitated or colored by sulphuretted hydrogen (absence of heavy metals). When calcined in contact with the air the salt yields yellow ceric oxide, which has a brown tint if didymous oxide is present; 1 Gm. of the salt, thus treated, yields a residue weighing 0.466 Gm. Cerium oxalate dissolves in boiling potassa solution, and the clear liquid is not precipitated when mixed with sulphide of ammonium (absence of zinc), or when heated with excess of ammonium chloride (absence of aluminium compounds). When the potassa solution is acidulated with acetic acid it remains clear, but yields with calcium chloride a white precipitate of calcium oxalate, which is soluble in hydrochloric acid. When incinerated 10 grains lose 5.2 grains in weight.—*Br.*

Other Salts of Cerium.—CERII CARBONAS, $Ce_2(CO_3)_3.9H_2O$ (mol. weight 624), is prepared by precipitating cerous sulphate (see above) with carbonate of ammonium. The white, flocculent precipitate changes to scales of a silvery lustre, which are insoluble in water and contain 52.4 per cent. of cerous oxide and 26.2 per cent. of water of crystallization.

CERII BROMIDUM. On dissolving cerous carbonate in hydrobromic acid and evaporating the solution, Bullock (1871) obtained a chocolate-colored, sweet, styptic mass which is freely soluble in alcohol, but leaves an insoluble residue of cerous compound on treatment with water. Chloride and iodide of cerium are likewise readily decomposed, the former becoming yellow, the latter brown, on exposure to the air.

CERII NITRAS, $Ce_2(NO_3)_6.12H_2O$ (mol. weight 870). It is conveniently made by the mutual decomposition of cerous sulphate and barium nitrate, and filtering the cerous nitrate from the insoluble barium sulphate. The salt is very deliquescent, crystallizes in colorless prisms or scales, contains 37.9 per cent. of cerous oxide, and is freely soluble in water and alcohol.

Medical Action and Uses.—Oxalate of cerium was presumed to be a sedative of disordered nervous action, because it seemed to be an efficient remedy for the *vomiting of pregnancy*, and less frequently for vomiting due to irritable conditions of the stomach itself. This statement has been amply confirmed by general experience since it was first made. In proportion as vomiting is of reflex origin it is under the control of this medicine, which is far less efficient, or fails altogether, when the symptom is the result of material gastric disease, such as simple or cancerous ulcer, or the wasting of the mucous membrane which sometimes attends habitual vomiting in advanced phthisis. Many cases designated as "dyspepsia" present material lesions of the stomach, and in these oxalate of cerium is as useless as bismuth is useful; the one generally fails, the other usually succeeds, in relieving the irritability of the organ. Some have even attributed to it curative virtues in epilepsy and chorea, but experience has not confirmed these statements. In 1880 (*Med. Record*, xvii. 492, 664) attention was drawn to this preparation as an efficient palliative of the *cough* of phthisis. It was represented, however, to be by no means uniform in its effects, and as soon losing its primary control over the symptom. It was thought to have over other cough medicines the advantage of not deranging the digestion. It was administered in 10-grain, and even in 20-grain, doses, without injury, and some preparations of it were found quite inert. It may be prescribed in doses of from 1 to 4 grains (Gm. 0.05–0.20) three times a day, but if these doses prove inoperative they may be increased even to twice or thrice as much. It may be given in pill or in powder, the latter being preferable. Simpson, who first used the preparations of cerium in medicine, regarded the oxalate as "almost a specific in *chorea*," and the nitrate as a nervine tonic "useful in chronic intestinal eruption, irritable dyspepsia with gastrodynia and pyrosis, and chronic vomiting generally, as well as in that of pregnancy. The dose is the same as that of the oxalate" (*U. S. Dispensatory*, 1870).

CETACEUM, *U. S., Br., P. G.*—SPERMACETI.

Spermaceti.—Spermaceti, Fr., G.; *Blanc de baleine*, *Cétine*, *Ambre blanc*, Fr.; *Walrat*, G.

Nearly pure cetin, obtained from the head of the sperm whale, Physeter macrocephalus, *Linné*.

Class Mammalia. Order Cetacea. Family Physeteridæ.

Origin.—The sperm whale, or great-headed cachalot, is principally met with in the Pacific and Indian Oceans and the seas of Australia. It is 50 to 70 feet (15 to 21 M.) long, with a head fully one-third of its entire length and correspondingly thick. Anterior to the cranium the upper jaw has a large cavity containing an oily liquid, which is removed with buckets soon after the animal has been killed, and then congeals into a yellow mass. This is drained in suitable bags, and then strongly expressed to remove the oil; the pressed cake is purified by melting it in water, skimming off the impurities, boiling with weak potassa solution, and washing with water; it is finally allowed to congeal.

Description.—Spermaceti is in white, translucent, scaly-crystalline masses somewhat unctuous to the touch, of a slight fatty odor, a mild bland taste, a laminated pearly fracture, and of a neutral reaction. Its specific gravity is 0.943 (0.945, *U. S.*) at 15° C. (59° F.), melts near 50° C. (122° F.) (between 50 and 54° C., *P. G.*), to a clear and nearly colorless liquid, and congeals at about 45° C. (113° F.). It contains variable but small quantities of oil, which cause spermaceti to become yellowish on exposure to air and to acquire a rancid odor and acid reaction. It is slightly soluble in cold benzin and benzol, but dissolves in chloroform, ether, carbon bisulphide, warm methyl and ethyl alcohol, and in fixed and volatile oils. On dry distillation an oily liquid, a solid fatty compound, and various gases and volatile acids are obtained. Spermaceti is readily inflammable, and burns with a bright somewhat sooty flame.

Spermaceti oil is yellow, has an unpleasant odor, a density of .910, remains liquid at $-18°$ C. ($-0.4°$ F.), and is difficult to saponify.

Constituents.—When repeatedly recrystallized from boiling alcohol the fat is removed and Chevreul's *cetin* is obtained, which crystallizes in soft white pearly scales, melts between 50.5° and 53.5° C. (123° and 128.3° F.), and is slowly decomposed by aqueous solution of potassa, but readily saponified on fusion with potassium hydrate or on boiling with its alcoholic solution. It consists mainly of cetyl palmitate, $C_{16}H_{33}.C_{16}H_{31}.O_2$, which melts between 54.5° and 55° C. (130° and 131° F.), and yields on saponification palmitic acid and cetyl alcohol, or *ethal*, $C_{16}H_{34}O$. Heintz (1854) obtained also small quantities of myristic, lauric, and stearic acids, and of the alcohols methal, $C_{14}H_{30}O$, and stethal, $C_{18}H_{38}O$. When boiled with nitric acid spermaceti is slowly oxidized, œnanthylic, succinic, and other acids being found among the products.

Impurities and Adulterations.—Rancid spermaceti may be restored by boiling it with a weak solution of potassa, and afterward with water. The admixture of fats deprives it of its pearly lustre. "1 part of spermaceti should be completely dissolved by 40 parts of boiling alcohol spec. grav. .832 (absence of fats); after cooling the solution and filtering from the crystalline mass the filtrate should not have an acid reaction, and should yield at most a slight precipitate on the addition of water (absence of fatty acids). On repeating the boiling after the addition of 1 part of exsiccated sodium carbonate, the cold filtrate, on being acidulated, should merely become turbid."—*P. G.*

Pharmaceutical Preparations.—When needed in the form of powder, spermaceti is triturated in a mortar, a little alcohol being added from time to time; or, better still, it is fused, and then well triturated until cold.

CETACEUM SACCHARATUM s. PRÆPARATUM.—Prepared or saccharated spermaceti. *E.;* Blanc de baleine saccharé, *Fr.;* Walratzucker, *G.*—Spermaceti 1 part and white sugar 3 parts are rubbed together to a very fine powder.

Spermaceti is contained in Ceratum cetacei, *U. S.;* Charta cantharidis (epispastica), *U. S.*, *Br.;* Ung. aquæ rosæ, *U. S.;* Ung. cetacei, *Br.*

Medical Action and Uses.—Spermaceti, like other fatty substances, is a lenitive. In the form of a fine powder and mixed with sugar (1 part to 3), it is a popular and useful remedy for commencing *sore throat* and catarrhal inflammation of the *air-passages*. *Alvine* and *urinary irritations* are also reputed to be benefited by its use. For these affections it is best administered in emulsion with the yelk of egg or with almond oil.

CETRARIA, *U. S., Br.*—CETRARIA.

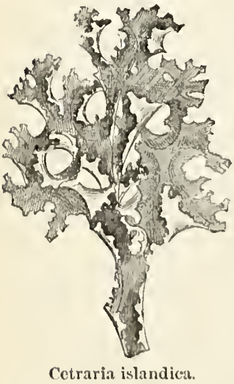
Lichen Islandicus, P. G.—*Iceland moss*, E.; *Lichen (Mousse) d'Islande*, Fr.; *Isländisches Moos*, *Isländische Flechte*, *Lungenmoos*, G.

The entire lichen, Cetraria islandica, *Acharius*, s. Lichen islandicus, *Linné*. Woodville, *Med. Bot.*, plate 205; Bentley and Trimen, *Med. Plants*, 302.

Nat. Ord.—Lichenes.

Origin.—The plant is indigenous to the northern hemisphere; in its southern limits it is found in mountainous regions, and farther north in the plains. In North America it is met with from New England southward to the mountains of North Carolina, northward throughout British America, and westward to the Rocky Mountains as far south as Colorado; in Europe it grows as far south as Spain and Italy, and in Asia throughout Siberia and in the Himalaya Mountains; it is plentiful in Iceland, from which island its name is derived.

FIG. 60.



Cetraria islandica.

Description.—It is from 2 to 4 inches (5 to 10 Cm.) high, foliaceous, irregularly branched, with smooth somewhat channelled, nearly linear, obtuse, toothed, and ciliate lobes; the upper surface is greenish-gray or olive-brown, lower surface whitish, with depressed spots; the apothecia or so-called fruits, when present, are situate near the margin, round or oval, chestnut-brown, and flattish with an elevated margin. When dry it is brittle and inodorous, but immersed in water it becomes soft, leathery, and cartilaginous, and has a slight odor; its taste is mucilaginous and bitter. Boiled with 20 parts of water, it yields a liquid which on cooling forms a bitter jelly; and on diluting this with an equal weight of water and adding alcohol, a flocculent precipitate is obtained which while moist is colored blue by iodine.

Impurities, such as pine-leaves, mosses, and other lichens, are usually found in the commercial article, and the drug frequently requires garbling. Adulterations are not likely to be intentional, but the lichen, as collected from different localities, is apt to vary somewhat in size and color and in the shape and width of the divisions.

Constituents.—Iceland moss was last analyzed by Knop and Schnedermann (1845). The principal constituent is *lichenin* or *lichen starch*, $C_{12}H_{20}O_{10}$, which is present to the amount of 70 per cent. It separates from its solution in hot water as a jelly, is insoluble in alcohol, but dissolves freely in solution of ammoniated copper, and by long-continued boiling with water is converted into a body resembling dextrin, and into glucose if boiled with dilute acids. In the moist state it is colored blue by iodine; the compound to which this behavior is due, according to T. Berg (1873), may be removed by continued washing with cold water. The bitter taste is due to about 2 per cent. of *cetraric acid* or *cetrarin*,

$C_{18}H_{16}O_8$, which is contained, in an uncombined state, mainly in the outer layer of the tissue. It forms colorless fine needles, which are nearly insoluble in water, soluble in boiling alcohol and alkalies, and yield with ammonia a yellow very bitter solution, which on exposure turns brown. The other constituents of Iceland moss are *lichen-stearic acid*, $C_{14}H_{24}O_3$ (about 1 per cent., soluble in alcohol, ether, volatile oils, and fats, fusible at 120° C.), *thallochlor* (a variety of chlorophyll, not soluble in hydrochloric acid), *fumaric* (formerly called *lichenic*) and *oxalic acid*, sugar, etc., and 16.7 per cent. of cellulose. The production of alcohol from Iceland moss, as proposed by Sten. Stenberg (1870), depends upon the formation of glucose from lichenin, noticed above. Iceland moss yields about 2 per cent. of ash.

Pharmaceutical Preparations.—Iceland moss is used in making Decoctum cetrariæ, *U. S.*, *Br.* The following preparations are used in Europe:

LICHEN ISLANDICUS AB AMARITIE LIBERATUS, Iceland moss free from bitterness. 15 parts of cut Iceland moss are macerated for 3 hours in 90 parts of tepid water containing 1 part of potassium carbonate in solution, and afterward well washed in cold water.—*P. G.* 1872.

GELATINA LICHENIS ISLANDICI, Iceland moss jelly. 3 parts of washed Iceland moss are boiled for half an hour with 100 parts of water, and expressed; the decoction is strained, and, after adding 3 parts of white sugar, evaporated to 10 parts.—*P. G.*

GELATINA LICHENIS ISLANDICI SACCHARATA SICCA.—Saccharure (Gelée sèche) de lichen, *Fr.*—10 parts of Iceland moss are deprived of bitterness by heating to boiling with a small quantity of water, expressing, and washing with cold water (or as stated above); the residue is exhausted by boiling with water for 1 hour; the decoctions are strained and decanted, mixed with 10 parts of sugar, evaporated, dried, and powdered.—*F. Cod.* It has a gray-brown color.

Medical Action and Uses.—Iceland moss is nutritious, demulcent, and tonic. The first two properties it owes to the starch in its composition, the last to its bitter principle, cetrarin. It increases the appetite, promotes digestion, and improves nutrition. It does not excite the circulation nor constipate, but in excessive doses may occasion nausea and diarrhœa. Its bitterness is said to be perceptible in the milk of nursing women who use it.

This medicine has been employed almost exclusively as a remedy for chronic *pulmonary affections* attended with profuse expectoration and cough and with more or less of the other symptoms belonging to consumption. It acts in these by its nutritious qualities in part, but more usefully by reducing the bronchial secretion, and thereby lessening both the waste of tissue and the fatigue of coughing. The amount of good which the medicine can effect will depend upon how far the *bronchitis*, which it chiefly influences, is simple. If this is accompanied by compression of the lung originating in pleurisy, or consolidation of the lung produced by pneumonia or by tubercle, etc., the influence of the remedy must necessarily be subordinate, or even null. Chronic *diarrhœa* and *dysentery* are sometimes greatly benefited by it. It is usually administered in decoction, but an infusion is sometimes prepared by steeping 3 ounces (Gm. 90) of bruised cetraria in a pint and a half of boiling water for 3 hours, evaporating the liquid with gentle heat to the consumption of one-half, and adding 60 grains (Gm. 4) of extract of liquorice. Of this a fluidounce may be taken every 3 or 4 hours in chronic bronchitis with urgent cough. A decoction made with milk is less bitter, and may be employed as food. Either of the pharmaceutical preparations mentioned above will be found convenient.

CHAMÆLIRIUM.—STARWORT.

Blazing star, *Devil's bit*, *False unicorn-root*, E.

The rhizome of Chamælirium (Veratrum, *Linné*) luteum, *Gray*, s. Cham. carolinianum, *Walter*, s. Helonias lutea, *Aiton*, s. Hel. dioica, *Pursh.*

Nat. Ord.—Melanthaceæ.

Origin.—The plant is indigenous to Canada and the United States, where it grows in low grounds west to the Mississippi. The stem is about 18 inches (45 Cm.) high; the leaves are alternate, spatulate below, lanceolate above, smooth; and the small whitish flowers are in a dense terminal raceme, which is rather slender on the barren plant, about 6 inches (15 Cm.) in length. It flowers in May and June.

Description.—The oblique rhizome is about 1 inch (25 Mm.) long and ¼ inch (6 Mm.) in diameter, somewhat curved, of a dark gray-brown color, closely annulated from the leaf-scars, on the upper side with a few circular stem-scars, on the lower side with wiry rootlets or their scars in lines parallel with the leaf-scars. The rhizome breaks with a nearly smooth and horny fracture, and shows on a transverse section the fibro-vascular bundles crowded together near the centre, with a few scattered near the surface, passing into the rootlets. The drug is destitute of odor and has a strongly bitter taste. We have repeatedly found it as an admixture with the commercial rhizome of Aletris, from which it is easily distinguished.

Constituents.—Dr. F. V. Greene (1878) extracted from it the bitter principle, which he proposed to call *chamælirin*, and of which over 9 per cent. was obtained. It is prepared by evaporating the cold aqueous infusion with magnesia, washing the dry mass with ether to remove fatty acid, and extracting with absolute alcohol, concentrating, diluting with water, treating with animal charcoal, and evaporating. It is a yellowish-white neutral powder, freely soluble in water and alcohol, the solutions frothing like those of saponin, but insoluble in other simple solvents. With sulphuric acid an orange color is produced, changing to crimson, brown, green, and purple, after which it fades. Chamælirin is also soluble in and colored reddish by strong hydrochloric acid, and yellowish-brown by Fröhde's reagent. It has a very bitter taste, and is split by dilute acids into glucose and a resinous body, *chamæliretin*, which is soluble in alcohol and ether, insoluble in water, and is colored brown by sulphuric acid. The so-called *helonin* of the eclectics is the hydro-alcoholic extract of the rhizome.

Medical Action and Uses.—The bitter principle has been made the subject of experiment by Dr. Greene, who concludes that it is "a cardiac poison, and that it produces its effect by virtue of a depressing influence on the pneumogastric centres, and likewise by more or less completely exhausting or paralyzing the heart-muscle by excessive stimulation of the intra-cardiac ganglia." This observer also found that, like digitalin and senegin, chamælirin dissolves the red corpuscles of the blood and disintegrates the white ones (*Phil. Med. Times*, x. 565). Therapeutically, starwort is reputed to be tonic, diuretic, and anthelmintic. An infusion of the rhizome has been found useful in atonic *dyspepsia* and for checking nausea and vomiting. It is also claimed by certain pseudo-physicians to be a "uterine tonic," "removing abnormal conditions and imparting tone to the reproductive organs." "It has been somewhat extensively used in the treatment of leucorrhœa, amenorrhœa, and dysmenorrhœa, and likewise with a view of correcting the tendency to repeated miscarriage." All of these ailments are usually associated with dyspepsia, constipation, and anæmia, and have from time immemorial been cured by bitter tonics, and for a long while with iron and cinchona. It is incredible that a medicine which depresses the heart and the nervous system should remove ailments that depend essentially upon the debility of exhaustion. An infusion of chamælirium may be prepared with an ounce of the rhizome to a pint of water (Gm. 32 to Gm. 500), and given in doses of a wine-glassful.

CHARTÆ.—MEDICATED PAPERS.

Papiers sparadrapiques, Fr.; *Medicamentirte Papiere*, G.

This class of preparations was introduced into the last editions of the United States and British Pharmacopœias; they resemble plasters spread upon non-absorbent paper, the process necessarily varying with the nature of the material. Similar preparations have been long in use on the continent of Europe; one which enjoys considerable popularity is—

CHARTA ANTIRHEUMATICA, S. ANTARTHRITICA, S. RESINOSA. Sparadrapum antharthriticum.—Antirheumatic paper, *E.*; Papier antirhumatique, P. antiarthritique, *Fr.*; Gichtpapier, *G.*—Melt together 10 parts of resin, 6 parts each of black pitch and turpentine, and 4 parts of yellow wax; strain and spread upon paper.—*P. G.* 1872. The same preparation of the Belgian Pharmacopœia is a cerate containing 1 per cent. of ethereal extract of mezereon. The *Papier au garou* of the French Codex is spread with a cerate containing 3 per cent. (No. 1) or 4 per cent. (No. 2) of ethereal extract of mezereon.

The process of coating such papers is sufficiently described by the pharmacopœial directions. It is, however, sometimes convenient to spread certain cerates or plasters directly upon paper, which may be accomplished by fastening the latter upon a smooth table by means of thin iron ledges attached lengthwise to the margin, then pouring the melted and partly-cooled material upon the paper and spreading it rapidly, using a warm smooth iron which is long enough to rest upon both ledges; a very uniform and quite thin coating may thereby be obtained. If the material melts to a uniform mass a flat brush may be employed, and care should be taken to apply it in one direction only. Should it be desirable to render the paper more impervious, it may be coated first with well-boiled linseed oil, and then exposed to the air until perfectly dry, after which the material is applied in the manner described. In most cases, however, the intention is to impregnate the paper to some extent with the plaster-like material, which is most readily effected by placing two sheets of the paper upon smooth sheet iron, which is kept warm by means of a low fire or of a sand-bath; some of the melted mass is poured upon the upper sheet, and spread with some pressure by means of a pad about 3 inches in diameter and formed of cotton or tow, which is first covered with tin-foil and then with two or three layers of flannel. When the upper sheet has been thoroughly and uniformly impregnated, it is replaced by another, and this is repeated until the desired quantity of paper has been obtained. The lower sheet of paper is used merely to protect the others from becoming soiled.

The last-described method is followed in making *wax paper*, *Charta cerata*, thin, well-sized paper being impregnated with white wax. It is very convenient for dispensing odorous substances, powders containing volatile oil, etc., for covering soft plasters, and for various other purposes. *Paraffin paper*, prepared in the same way, is employed in a similar manner.

Of an entirely different nature is the nitrate-of-potassium paper which was admitted into the U. S. Pharmacopœia of 1880, and which consists of unsized paper containing minute crystals of potassium nitrate uniformly distributed through the pulp.

CHARTA CANTHARIDIS, *U. S.*—CANTHARIDES PAPER.

Charta epispastica, Br.; *Charta vesicatoria.*—*Blistering paper*, E.; *Papier vésicant*, *P. épispastique*, *Papier à vésicatoire aux cantharides*, Fr.; *Spanischfliegen-Papier*, G.

Preparation.—White Wax 8 parts; Spermaceti 3 parts; Olive Oil 4 parts; Canada Turpentine 1 part; Cantharides, in No. 40 powder, 1 part; Water 10 parts. Mix all the substances in a tinned vessel and boil gently for 2 hours, constantly stirring. Strain through a woollen strainer without expressing, and by means of a water-bath keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces.—*U. S.*

Take of White Wax 4 ounces; Spermaceti 1½ ounces; Olive Oil 2 fluidounces; Resin ¾ ounce; Canada Balsam ¼ ounce; Cantharides, in powder, 1 ounce; Distilled Water 6 fluidounces. Digest all the ingredients, excepting the Canada balsam, in a water-bath for 2 hours, stirring them constantly; then strain, and separate the plaster from the watery liquid. Mix the Canada balsam with the plaster melted in a shallow vessel, and pass strips of paper over the surface of the hot liquid, so that one surface of the paper shall receive a thin coating of plaster. It may be convenient to employ paper ruled so as to indicate divisions, each of which is 1 square inch.—*Br.*

The first formula is that of the French Codex, the second a slight modification of it.

Medical Action and Uses.—Cantharides paper forms a neat and efficient blistering agent, and is very convenient when the vesicant action is to be accurately limited, as in blistering over nerves and veins, near the eye, etc. It is, however, less efficient than cantharides cerate when a full and prolonged vesicant operation is desired. Before applying it the skin should be cleansed with warm soap-and-water.

CHARTA POTASSII NITRATIS, *U. S.*—PAPER OF NITRATE OF POTASSIUM.

Charta nitrata, P. G.; *Saltpetre paper*, E.; *Papier nitré*, Fr.; *Salpeterpapier*, G.

Preparation.—Nitrate of Potassium 20 parts (450 grains); Distilled Water 80 parts (1800 grains or 4 fluidounces). Dissolve the nitrate of potassium in the distilled water. Immerse strips of white, unsized paper in the solution and dry them. Preserve the paper in securely-closed vessels.—*U. S.*

This is the formula of the P. G. 1872; in the recent edition of this work the salt is to be dissolved in 5 parts of water.

Ordinary saltpetre will answer if the paper is to be used for moxas, but for the preparation of *medicated cigarettes* nitrate of potassium free from chloride should be used, and the paper should also be free from chlorine compounds. Such cigarettes are either made in the same manner as ordinary cigars, except that stramonium, belladonna, hyoscyamus, or other leaves are substituted for tobacco, or the nitrated paper is impregnated with other solutions, or simply rolled into a thin tube having the edges fastened with a trace of gelatin; the substance whose smoke is to be inhaled is then introduced and the paper tube ignited at one end, when combustion without flame takes place. The following is a formula for *cigarettes antiasthmatiques* which is much employed in France: A decoction is made of 5 Gm. each of the leaves of belladona, stramonium, digitalis, and sage with 1000 Gm. of water, and strained. 75 Gm. of nitrate of potassium and 40 Gm. tincture of benzoin are added, and into this solution is then introduced, sheet by sheet, one quire of red-tinted absorbent paper, the whole remaining in contact for 24 hours; after which time the paper is dried and cut into rectangular pieces of 10 by 7 Cm., which are formed into tubes by rolling them around a thin cylinder about 1 or 1½ Mm. in diameter and fastening the edge with gelatin.

For forming *moxas* of nitrated paper it is rolled into pretty firm cylinders having a diameter of about ¼ inch, which are afterward cut into pieces of suitable lengths.

Medical Action and Uses.—Under POTASSII NITRAS the uses of this medicated paper are described. It is intended to be burned, while its fumes are inhaled. Since the investigations of Reichert on potassium nitrite (*Amer. Jour. of Med. Sci.*, July 1880, p. 158) there is some reason to think that, besides relieving nervous *asthma* by its irritant action on the bronchial mucous membrane, potassium nitrate may be converted during combustion into potassium nitrite, which, like nitrite of amyl, has an anæsthetic action.

CHARTA SINAPIS, *U. S., Br., F. Cod.*—MUSTARD PAPER.

Charta sinapisata, P. G.; *Papier sinapise, Moutard en feuilles*, Fr.; *Senfpapier*, G.

Preparation.—Black Mustard, in No. 60 powder, Benzin, Solution of Gutta-percha, each a sufficient quantity. Pack the mustard tightly in a conical percolator, and gradually pour benzin upon it until the percolate ceases to produce a permanent greasy stain upon blotting-paper. Remove the powder from the percolator and dry it by exposure to the air. Then mix it with so much of solution of gutta-percha as may be necessary to give it a semi-liquid consistence; apply the mixture, by means of a suitable brush, to one side of a piece of rather stiff, well-sized paper, so as to cover it completely, and allow the surface to dry. Each square inch (or 6.5 square Cm.) of paper should contain about 6 grains or 40 Cg. of mustard.

Before being applied to the skin the mustard paper should be dipped in warm water for about fifteen seconds.—*U. S.*

Take of Mustard (black and white), in powder, 1 ounce; Solution of Gutta-percha 2 fluidounces or a sufficiency. Mix the mustard with gutta-percha solution so as to form a semi-fluid mixture, and having poured this into a shallow flat-bottomed vessel, such as a dinner-plate, pass strips of cartridge-paper over its surface, so that one side of the paper shall receive a thin coating of the mixture. Then lay the paper on a table with the coated side upward, and let it remain exposed to the air until the coating has hardened. Before being applied to the skin let the mustard paper be immersed for a few seconds in tepid water.—*Br.*

The mustard, previous to powdering, should be deprived of most of its fixed oil by pressure, or the powdered mustard may, with the same end in view, be treated with benzin, as above directed, or with carbon bisulphide. Rigollot (1867), who introduced this preparation, already called attention to the removal of the oil to prevent rancidity, and gave preference to a solution of caoutchouc as the adhesive agent. Hager (1867) regarded a solution of resin as equally useful, and recommended the paper to be first covered with the solution, and the powder to be sifted upon the adhesive layer and pressed, preferably by passing between cylinders suitably adjusted so as to make the stratum uniform and the surface smooth. Following the pharmacopœial directions, by spreading the soft mixture upon paper a layer more uniform in thickness is obtained than by merely passing it over the surface of the former. If the paper has been properly prepared the mustard will adhere well without peeling off on bending.

Medical Action and Uses.—Mustard paper forms a very convenient means of obtaining the effects of a sinapism. Before being applied it should be immersed for a few seconds in warm (not hot) water.

CHELIDONIUM, *U. S.*—Chelidonium.

Herba chelidonii.—Chelandine, Tetterwort, E.; *Chélidoine, Herbe à l'hirondelle,* Fr.; *Schöllkraut,* G.

The herb of Chelidonium majus, *Linné.*

Nat. Ord.—Papaveraceæ.

Origin.—A perennial herb indigenous to Europe and introduced on this continent. It grows in waste places, and flowers from May to September.

Description.—The root is several-headed, fusiform, about $\frac{5}{8}$ inch (15 Mm.) in diameter, branching, somewhat scaly, and of a red-brown color externally, deeply wrinkled, and internally whitish. The stem is 1 to 2 or 3 feet (30, 60, or 90 Cm.) high, light-green, hairy, obtusely angled, with thickened joints, brittle and branching; the leaves are 6 or 8 inches (15 or 20 Cm.) long, and petiolate, the upper ones short-petiolate or sessile, alternate, oblong or oval in outline, lyrately pinnatifid or pinnate, the terminal segment obovate and mostly three-lobed, the others ovate, cut-toothed, or lobed, obtuse, somewhat hairy, light-green above and glaucous underneath. The flowers are in small four- to eight-rayed auxillary umbels on long peduncles, have a calyx of two caducous sepals, four obovate yellow petals, about twenty stamens, and produce long linear one-celled and two-valved capsules containing many crested seeds. All parts of the plant contain a bright saffron-colored milk-juice. In the fresh state the odor is rather unpleasant, disappearing almost completely on drying; the taste is bitter and acrid. The herb should be gathered when it begins to flower.

Constituents.—Probst (1838), and shortly afterward Polex, isolated from celandine two alkaloids, *chelidonine* and *chelerythrine* or *pyrrhopine;* the latter Probst (1840) declared to be identical with sanguinarine, which was proven by Shiel (1855). Chelidonine, $C_{19}H_{17}N_3O_3$, is separated from chelerythrine by ether, in which it is insoluble; it crystallizes in colorless shining plates, has a bitter, afterward acrid taste, and yields with acids colorless salts having an acid reaction and a strongly bitter taste. Probst isolated also *chelidoxanthin*, which crystallizes in small yellow needles, has a bitter taste, is insoluble in ether, sparingly soluble in alcohol, and freely soluble in hot water; it is not altered by acids or alkalies. The alkaloids are combined with malic and *chelidonic acid*, $C_7H_4O_6$ (Lerch, 1846). The latter is slightly soluble in cold water and alcohol, crystallizes from hot water in colorless silky needles having a strongly acid taste and becoming opaque on exposure, is bibasic, decomposes carbonates, dissolves metallic iron and zinc, and yields white lead salts insoluble in water and acetic acid. When boiled with an alkali, acetone and oxalic acid are produced. By an excess of cold alkali it is converted into a yellow acid yielding yellow lead salts and red ferric salts (Lieben and Haitinger, 1873); this new acid is doubtless identical with Zwenger's (1860) *chelidoninic acid*, which was regarded as succinic acid by Walz (1860). The other constituents are those of common occurrence—gum, extractive, albumen, chlorophyll, etc.

Pharmaceutical Preparations.—Extractum chelidonii. The expressed juice is freed from albumen by heating to 80° C. (176° F.), evaporated to a small bulk, mixed with an equal weight of alcohol, strained from the gummy precipitate, and the filtrate evaporated to the proper consistence.—*P. G.* 1872. It has a dark-brown color.

Allied Plants.—Glaucium luteum, *Scopoli*, s. Chelidonium Glaucium, *Linné.*—Horn poppy, *E.;* Pavot cornu, *Fr.;* Hornmohn, *G.*—A biennial plant, a native of Europe and to some extent naturalized in the United States. It grows mainly near the sea-coast, has pale-green, glaucous, clasping pinnatifid or sinuate toothed leaves, yellow flowers, and linear capsules which are beset with numerous short projections. It is less acrid than celandine; the juice, particularly of the root, is saffron-yellow, and contains, besides sanguinarine, the white alkaloids *glaucine* and *glaucopicrine;* the former is in the herb, the latter in the root. Glaucium corniculatum, *Curtius*, has similar properties: the petals are scarlet-red, with a black spot near the base.

Physiological Action and Medical Uses.—The yellow juice which exudes from this plant when wounded was formerly employed, according to the doctrine of signatures, as a remedy for jaundice; and it justified the superstition in so far that by violent purging it relieved cases of the disease depending upon obstruction of the gall-ducts with inspissated bile. In experiments upon animals, and in certain cases of poisoning in man, its effects were those of a violent local irritant, with a special narcotic action upon the nervous system. The fresh plant, as well as the juice, irritates the skin, and the latter is in popular use as a remedy for *warts.* In many rural districts of Europe the fresh juice is employed as a purgative in *jaundice*, abdominal *dropsy*, and inveterate *intermittent fever*, as well as in *scrofula* and chronic *diseases of the skin.* Like other drastic cathartics, it is sometimes used as a vermifuge. When the fresh juice can be obtained it is given in doses of 30 or 40 drops (Gm. 2–3) or more, in sweetened water or in whey. An extract is used in doses of about 10 grains (Gm. 0.60), and an infusion is made with half an ounce of the plant in a pint of water (Gm. 16 to Gm. 500).

Glaucium luteum is said by Cazin to be a narcotic poison, and he quotes the statement that, having been eaten by mistake, it occasioned delirium and made all objects appear yellow. It is said to be used by the peasants in Provence for the cure of ulcers, bruises, stings, etc., both in man and animals, and to act as an anodyne when applied to hæmorrhoids and spasmodic stricture of the anus. The juice, mixed with white of egg, is used for the latter purposes.

CHELONE.—BALMONY.

Snakehead, *Turtlehead*, *Shellflower*, E.; *Chelone*, Fr., G.

The herb of Chelone glabra, *Linné.*

Nat. Ord.—Scrophulariaceæ.

Origin.—The plant is perennial, a native of Canada and the United States south-westward to Texas, grows in wet places, and flowers from July to September. The white corolla is inflated, two-lipped, with the upper lip arched and the mouth a little open; hence the botanical and some of the popular names.

Description.—The stem is 2 to 3 feet (60 to 90 Cm.) high, nearly simple and smooth; the leaves are opposite, nearly sessile, oblong-lanceolate, pointed, serrate, smooth, and shining above. The flowers are in a short, dense terminal spike, and have the lower lip bearded in the throat and the four stamens with woolly filaments and woolly heart-shaped anthers. The plant is inodorous and has a decidedly bitter taste.

Constituents.—The bitter principle appears to be soluble in alcohol and water, but has not been isolated.

Medical Action and Uses.—The extreme bitterness of the leaves of this plant probably led to its medicinal use by the American aborigines. It is not, however, tonic, but laxative or purgative according to the dose of it employed. Like other active cathartics, it is reputed to "act upon the liver." It is sometimes used as a purgative in *jaundice* and as an *anthelmintic.* The *dose* of the powder is a drachm (Gm. 4). A decoction made with 2 ounces of the fresh herb in a pint of water (Gm. 60 to Gm. 500) may be given in the dose of 2 fluidounces.

CHENOPODIUM, *U. S.*—CHENOPODIUM.

Fructus chenopodii anthelmintici.—American Worm-seed, E.; *Semences de chénopode anthelmintique*, Fr.; *Amerikanischer Wurmsamen*, G.

The fruit of Chenopodium ambrosioides, *Linné*, var. anthelminticum, *Gray;* Ambrina anthelmintica, *Spach;* Orthosporum (Chenopodium, *Linné*) anthelminticum, *R. Brown.* Bentley and Trimen, *Med. Plants*, 216.

Nat. Ord.—Chenopodiaceæ.

Origin.—The genus Chenopodium is characterized by alternate leaves and bractless flowers with a five-cleft calyx, five stamens, two or three styles, and bearing a one-seeded utricle as fruit. The plants are frequently covered with a white mealiness. The officinal species is never mealy, but viscid glandular. The stem is angular and branched; the leaves are short petiolate, oblong or ovate, narrowed at both ends, remotely toothed; the small greenish flowers are in dense and leafy spikes; the fruit is enclosed in the calyx. The variety differs from the typical form by having usually a perennial root, the leaves more deeply toothed, the lower being often deeply incised, and the dense racemes usually leafless. Both forms are indigenous to the West Indies, Central and South America, and have become completely naturalized in this country, the typical form having also established itself in some portions of Europe and Southern Africa. The variety is cultivated in Maryland with a view of obtaining the oil, and is quite frequent in waste places in the Southern and in some of the Middle States.

Description.—The fruit is about $\frac{1}{12}$ inch (2 Mm.) in diameter, depressed or irregular globular, glandular when viewed with a magnifier, of a dull-green color, assuming a brownish tint on exposure; the thin, friable, but not brittle integuments enclose a vertical seed which is lenticular in shape, obtuse at the edge, brownish-black and glossy, and has the embryo strongly curved around the albumen. The fruit has a peculiar aromatic somewhat terebinthinate odor and a bitterish and pungent taste. The fruit of Chen ambrosioides cannot be distinguished from the officinal, except by its weaker and rather pleasanter odor.

Constituents.—American wormseed has not been analyzed; its medicinal importance is due to volatile oil (see OLEUM CHENOPODII), which is the only preparation for which the fruit is used.

Allied Species.—Several European pharmacopœias recognize the herb of Chen. ambrosioides, *Linné*, which is known as Herba botryos mexicanæ; Mexican tea, *E.;* Thé du Mexique, des Jésuites, *Fr.;* Mexikanisches Traubenkraut, *G.*

CHEN. BOTRYS, *Linné*.—Jerusalem oak, Feather geranium, *E.;* Chénopode à grappes, *Fr.;* Traubenkraut, *G.*—It is indigenous to Asia and Europe, and naturalized to some extent in North America. It is glandular pubescent, has oblong sinuate-pinnatifid leaves and leafless cymose racemes of greenish flowers, and is strongly aromatic.

CHEN. BONUS-HENRICUS, *Linné*.—Good King Henry, *E.;* Bon Henry, *Fr.;* Guter Heinrich, *G.*—A European plant somewhat naturalized here. It is slightly mealy, and has triangular halberd-shaped leaves which have a mucilaginous saline taste.

CHEN. ALBUM, *Linné*.—Pigweed, Lamb's quarters, *E.;* Ansérine sauvage, *Fr.;* Weisser Gänsefuss, *G.*—A variable mealy annual, common in cultivated ground. The leaves vary between rhombic-ovate and lanceolate and are angulate-toothed, the upper ones often entire. The taste is mucilaginous and saline.

Medical Action and Uses.—All parts of the plant producing worm-seed possess anthelmintic properties, and were long used by the Southern negroes and others as a vermifuge for *lumbricoid worms*, the expressed juice and the seeds being most commonly employed. These have been supplanted by the oil (Oleum chenopodii). The fresh expressed juice may be given in doses of a tablespoonful (Gm. 16) two or three times a day. A decoction made by boiling an ounce of the leaves in a pint (Gm. 30 in Gm. 500) of milk or water has also been used. The bruised or pulverized seeds may be given in an electuary in doses of 20 or more grains (Gm. 1.30) three times a day. Carbonate of iron may be advantageously added to this preparation. After the anthelmintic has been used for several days a purgative dose of castor oil should be administered.

Chenopodium ambrosioides and C. vulvaria are used in Europe for various nervous derangements, both internally and topically. C. Bonus-Henricus is a popular remedy in Europe for many local pains. The contused plant, mixed with butter, is applied. C. botrys is reputed to be a stimulant expectorant and antispasmodic, and C. olidum to have similar properties.

CHIMAPHILA, *U. S.*—CHIMAPHILA.

Pipsissewa, Prince's pine, Wintergreen, E.; *Herbe de pyrole ombellée*, Fr.; *Doldenblüthiges Harnkraut, Wintergrün*, G.

The leaves of Chimaphila umbellata, *Nuttall*, s. Chim. corymbosa, *Pursh*, s. Pyrola umbellata, *Linné*. Bigelow, *Med. Bot.*, ii. 21; Woodville, *Med. Bot.*, v.; Bentley and Trimen, *Med. Plants*, 165.

Nat. Ord.—Ericaceæ, Pyroleæ.

Origin.—The genus is characterized by flowers having five petals, ten stamens with the filaments enlarged in the middle and the anthers conspicuously two-horned; the short style, with the disk-like and five-lobed stigma, is nearly immersed in the top of the ovary; the capsule is five-celled and many-seeded. The officinal species is a low shrub, 4 to 8 inches (10 to 20 Cm.) high, bearing the leaves near the summit of the stem, and a terminal peduncle with five or six wax-colored flowers in a corymbose umbel. It is indigenous to North America, Northern Asia, and Northern and Central Europe; is found in dry woods, and flowers in June and July. 2 parts of the fresh yield about 1 part of air-dry leaves.

Description.—The leaves are 1 to 2 inches (25 to 50 Mm.) long, on very short petioles, oblanceolate and sharply serrate above, with the base wedge-shaped and entire, leathery, upper side dark-green and glossy, paler beneath. They are nearly inodorous, and have a sweetish afterward astringent and bitterish taste.

The closely-allied Chim. maculata, *Pursh*, spotted wintergreen or pipsissewa, with lanceolate or ovate-lanceolate and toothed leaves, which are variegated with white on the upper surface, is indigenous to North America, and is used like the preceding. The leaves have the same constituents as the Pyrolas, but contain citric instead of malic acid (E. N. Smith).

Constituents.—Besides the widely-diffused principles sugar, gum, etc., S. Fairbank (1860) found tannin, and obtained 5.24 per cent. (of the dry leaves?) of ash. The tannin amounts to 4.15 per cent (Bowman, 1869). On distilling the stems with water, golden-yellow crystals of *chimaphilin* are obtained in the neck of the retort; these are inodorous and tasteless, slightly soluble in water and freely soluble in alcohol, ether, chloroform, and the fixed and volatile oils. It may also be obtained from the tincture (of the leaves alone?) made with diluted alcohol by agitating it with water. Zwenger and Himmelmann (1864) isolated from the leaves *arbutin*, which, together with tannin, was found by J. Oxley (1872) and E. N. Smith (1881) in several other ericaceous plants. (See EPIGÆA, GAULTHERIA, and UVA URSI.)

Off. Prep.—Extract chimaphilæ fluidum, *U. S.*

Allied Plants.—1. PYROLA ROTUNDIFOLIA, *Linné;* 2. P. CHLORANTHA. *Swartz:* and 3. P. ELLIPTICA, *Nuttall.*—Shinleaf, Wintergreen, *E.;* Pyrole, *Fr.;* Waldmangold, *G.*—These species are indigenous to North America. the first one also to Europe and Asia. They have thin rhizomes, a cluster of radical petiolate leaves, and simple racemes of nodding wax-like flowers. The leaves are leathery, orbicular, and glossy (in 1), short-petiolate, suborbicular, and dull-green (in 2), or thin, not glossy, elliptic or oval-obovate (in 3); in odor and taste they resemble the preceding. E. N. Smith (1881) showed them to contain arbutin, ericolin, ursin, tannin, malic acid, gum, sugar, albumen, and a trace of volatile oil.

Medical Action and Uses.—The fresh bruised leaves of pipsissewa applied to the skin cause redness, and even vesication. Internally, it is diuretic, tonic, and astringent, and, like uva ursi, darkens the urine in consequence of the tannin it contains. Indeed, in all its operations it closely resembles uva ursi. It was used by the natives and by the early settlers of this country for *rheumatism* and for *nephritic* disorders. The former disease in the joints was treated with fomentations or poultices of the leaves, while a hot decoction of them was administered internally, to the production of sweating. In cases of scanty or suppressed secretion of *urine* it was often resorted to, as well as in *gravel* and *hæmaturia* from various causes. The cure of many cases of *dropsy* was attributed to its use, and the evacuation of the fluid through the kidneys in other cases depending upon incurable organic lesions. Physicians of sound judgment have testified to its usefulness in *scrofula* of the glands and skin, both as an internal remedy and as an application to scrofulous ulcers. In the treatment of dropsy and of scrofula the generally superior efficacy of other medicines should not cause this one to be overlooked. Chimaphila has also been prescribed in the treatment of *intermittent fever*, chronic *diarrhœa*, *leucorrhœa*, and *gleet*, and P. rotundifolia has been similarly employed. The best form of the medicine is the decoction or the fluid extract.

CHINOIDINUM, *U. S.*—CHINOIDIN.

Chinioïdinum, P. G.; *Chinoidina, Quinoidina.*—*Quinoïdine*, E., Fr.; *Amorphous quinine*, E.; *Quinine amorphe*, Fr.; *Chinoidin*, G.

A mixture of alkaloids, mostly amorphous, obtained as a by-product in the manufacture of the crystallizable alkaloids from cinchona.

Preparation.—In the preparation of sulphate of quinine, cinchonine, and the other alkaloids from cinchona-bark there remains finally a mother-liquor from which crystallizable salts cannot be readily prepared; this mother-liquor, on being precipitated with soda, yields chinoidine, which is further purified by redissolving it in diluted hydrochloric acid, precipitating by ammonia, washing, and drying. Blews (1874) proposed to effect the purification by adding sodium hyposulphite to the neutralized solution in dilute sulphuric acid, then filtering, warming, and finally precipitating by soda.

Properties.—Chinoidine is met with in commerce in cylindrical rolls or in masses having a more or less deep-brown (brownish-black or almost black, *U. S.*) color and a resin-like appearance. At a low temperature it is brittle and breaks with a glossy conchoidal fracture; exposed to the summer heat, it gradually assumes the shape of the vessel in which it is kept. When heated it becomes plastic, then melts, and at a still higher heat burns with a bright flame. It is almost insoluble in water, and has only a slight taste, faintly bitter on mastication, but not bitter, as stated by both the U. S. P. and P. G. It is freely soluble in alcohol, the solution showing an alkaline reaction, dissolves in chloroform and in diluted acids, and also more or less in ether and benzol. The solutions have a very bitter taste and are dextrogyre. The alcoholic solution is precipitated by water; the solution in diluted acids on being treated with chlorine-water in excess and ammonia assumes an emerald-green color, and with chlorine-water, potassium ferrocyanide, and ammonia, added successively, a red color closely resembling quinine in these tests.

Tests.—"If chinoidine be triturated with boiling water, the liquid after filtration should be clear and colorless, and should remain so on the addition of an alkali (absence of alkaloidal salts). On ignition chinoidine should not leave more than 0.7 per cent. [0.5 or 0.7 per cent. *P. G.*] of ash."—*U. S.* "One part of chinoidine should yield a clear solution and leave only a scanty residue on being treated with a cold mixture of 1 part of acetic acid and 9 parts of water (absence of resins, etc.); it should also yield a clear solution in the cold with 9 parts of alcohol sp. gr. .832 (absence of gummy matter, etc.)."—*P. G.*

Composition.—The alkaloidal nature of chinoidine was first observed by Sertürner. Subsequently, Henry and Delondre, Duflos, Winckler, and others showed that this amorphous mass still contained quinidine (then confounded with quinine) and cinchonine. Freed from the crystallizable alkaloids, Liebig regarded chinoidine as quinine rendered amorphous by the influence of heat and of chemicals. Hesse (1877) has shown that aside from the crystallizable bases which may be present chinoidine has been formed by the condensation or polymerization of their molecules.

Diconchinine, $C_{40}H_{46}N_4O_3$, is the principal constituent of chinoidine, of barks containing much quinine, and quinidine; it is amorphous and does not yield quinicine, but resembles the two cinchona alkaloids in the fluorescence of the sulphuric acid solution and in its behavior to chlorine and ammonia (green coloration). The chinoidine of barks yielding much cinchonine or cinchonidine contains amorphous *dicinchonine*, $C_{38}H_{44}N_4O_2$, which is not easily freed from diconchinine. *Dihomocinchonine*, $C_{38}H_{44}N_4O_2$, like diconchinine, has also a right rotation.

Pharmaceutical Preparations.—Chinoidinæ boras, Borate of chinoidine. De Vrij (1881) gives the following directions: Heat 20 parts of chinoidine, 10 parts of boric acid, and 200 parts of water to incipient boiling and filter through moist cotton; heat the clear liquid to boiling, again filter from the resinous matter, and repeat this operation until no more matter is separated on boiling; evaporate to 20 parts, set aside over night at a temperature not exceeding 15° C. (59° F.), filter from the boric acid, and evaporate. It forms brown-yellow transparent scales or a yellowish powder, becomes damp on exposure, has an alkaline reaction and a bitter taste, and yields with 3 parts of cold water a perfectly clear dark-yellow solution. Dissolved in 10 parts of water, the solution becomes cloudy on boiling, but clear again on cooling.

Chinoidinæ citras, Citrate of chinoidine, made by dissolving chinoidine in an aqueous solution of citric acid and evaporating, forms transparent red-brown scales soluble in water.

Chinoidinæ hydrochloras, Hydrochlorate of chinoidine, is prepared by saturating warm diluted hydrochloric acid with chinoidine, filtering, and evaporating; it is a yellow or brown-yellow hygroscopic powder.

Tinctura chinioidini, Tincture of chinoidine. Dissolve 10 parts of chinoidine in a mixture of 85 parts of alcohol sp. gr. .894 and 5 parts of hydrochloric acid. It is dark-brown, transparent in thin layers, very bitter, and without distinctive odor; on mixing it with an equal bulk of water and of ammonia the chinoidine is precipitated and the liquid becomes yellowish.—*P. G.*

Medical Action and Uses.—This preparation is officinal in the U. S. P., and also in the P. G. It was first employed in Philadelphia (1824) in the treatment of *intermittent fever*, and regarded as not less efficacious in the cure of that disease than quinia, provided it were given in larger doses. It was made officinal in 1830, but in the following decade was abandoned, probably because of its uncertain composition and its adulterations. It, however, continued to be used in Europe as a substitute for quinia, partly on account of its cheapness and partly because it was less bitter. In 1874 we said of it: "Its slight bitterness renders it appropriate for administration to children and others who object to the taste of the sulphate" (*Therapeutics*, 4th ed., i. 551). Its composition continues to be an objection to the medicine, which, however, is counterbalanced by its cheapness, which has become a serious consideration since the commercial value of quinine has been enhanced by its wasteful employment in non-malarial diseases. In 1878, Vinkhuysen (*Practitioner*, xx. 81) drew the following conclusions regarding it from his own observation: 1. "The only malarious disease in which chinoidine cannot be employed in place of quinine is pernicious fever, for it requires more time to act than quinine. 2. In all forms of pure malarial intermittent fever it is no less powerful than quinine, but acts more slowly. It must therefore be given in larger doses and at longer intervals before the paroxysm than quinine. 3. It may be taken during the fit without exciting any unpleasant feeling. 4. It never causes noises in the ears. 5. Persons liable to suffer from the toxic effects of quinine can take chinoidine without discomfort, and yet obtain a similar therapeutical result. 6. In chronic cases its influence is greater than that of quinine. 7. Its tonic action is similar to, and perhaps greater than, that of quinine. 8. Its action in cases of masked or larval malarial disease, and especially in rheumatic affections due to malarial influences, is incomparably greater than that of quinine." In 1882, Hagens of Dantzic, in an exhaustive examination of the various surrogates for quinine (*Zeitschrift f. klin. Med.*, v. 242), and from a clinical point of view, reaches almost identical conclusions respecting the citrate of chinoidine, admitting, however, that it is apt to provoke vomiting unless associated with proper correctives. According to Nothnagel and Rossbach, its dose must be two or three times greater than that of the quinine salts; and Bernatzik states the dose at one-half greater than that of quinine. Burdel, whose field of practice is in a very malarial region, states the dose for an adult at from 7 to 15 grains, and for very young children 2 or 3 grains, recommending it to be given in strong coffee highly sweetened. He points out its special merits as being exhibited in mild and also in chronic cases of the disease, especially where the malarial cachexia is marked (*Bull. de thérap.*, c. 142). Similar testimony abounds. There can be no doubt that this preparation might be very usefully substituted in many cases in which the bitterness of quinine or its cost renders it objectionable.

CHIRATA, *U. S., Br.*—Chirata.

Chiretta, U. S. 1870.—*Chiretta*, E., G.; *Chirette*, Fr.; *Ostindischer Enzian*, G.

The entire plant Ophelia (Swertia, *Wallich*) Chirata, *Grisebach*, Agathotes (Gentiana, *Roxburgh*) Chirayta, *Don.* Wallich, *Plant. Asiat.*, iii. 252; Bentley and Trimen, *Med. Plants*, 183.

Nat. Ord.—Gentianaceæ.

Origin.—The plant is an annual, and indigenous to the mountainous portions of Northern India, where it grows at an elevation of from 5000 to 9000 feet, and is collected when the fruit begins to form. It has long been in use in India, and became known in England as a medicine about 1839.

Description.—It is met with in flattened bundles about 3 feet (90 Cm.) long, tied with a thin slip of bamboo, and has a pale purplish-brown color. The simple and tapering root is about 3 inches (75 Mm.) long. The stem is 3 to 5 feet (0.9 to 1.5 M.) long, cylindrical below, slightly quadrangular above, much branched, smooth, and slightly thickened at the nodes. The leaves are opposite, closely sessile, ovate or ovate-lanceolate, entire at the margin, and five-nerved; in the outer layer of the bundles they are usually broken off, leaving the stems almost bare. The flowers are numerous and small, in loose axillary racemose cymes, on the upper branches often single, stalked, with a deeply four-lobed calyx and corolla, the latter upon each acute lobe with a pair of fringed scales; stamens four. The fruit is an ovate capsule, tapering above into the two styles and projecting but little from the persistent calyx and corolla. The seeds are very numerous, minute, and angular. The drug is inodorous and has a purely and persistently bitter taste.

Constituents.—The older analyses failed to isolate the active principles of chirata, and demonstrated only the presence of the common constituents of plants and the almost total absence of tannin. Henry Höhn (1869) succeeded in isolating two distinct bitter principles—*ophelic acid*, $C_{13}H_{20}O_{10}$, and *chiratin*, $C_{26}H_{48}O_{15}$, the former of which was obtained as a brown, very hygroscopic, amorphous mass which is readily soluble in water, alcohol, and ether, has a slightly acidulous afterward intensely bitter taste, precipitates cuprous oxide from Trommer's solution, and produces with the lead acetates yellow precipitates; a crystalline salt could not be obtained. Chiratin forms a pale-yellow powder, which, though hygroscopic, is not freely soluble in cold water, but dissolves readily in alcohol and ether, and has a neutral reaction to test-paper and an intensely bitter taste. Its aqueous solution produces a flocculent white precipitate with tannin, and is not affected by Trommer's solution. When boiled with diluted hydrochloric acid it is split into ophelic acid and *chiratogenin*, $C_{13}H_{24}O_{3}$, which is yellowish-brown, amorphous, bitter, nearly insoluble in water, soluble in alcohol, not precipitated by tannin, and not affected by Trommer's solution. It is not improbable that chiratogenin may exist in the drug. The presence of a yellow crystalline wax-like substance and of some tannin was also observed. Dried at 100° C., the stems yielded 3.7 and the leaves 7.5 per cent. of ash, which is mainly composed of potassa, lime, and magnesia, combined with carbonic and phosphoric acids.

Substitutes.—Several species of Ophelia and allied genera are known in India as chirata, and are distinguished from the officinal drug as *paharee* (hill), *dukhunee* (southern), *oodu* (purple), and *meetha* (sweet) chirata; they appear to be indiscriminately collected and sent to Bombay, where, according to Dymock, the drug is garbled. Prof. Bentley (1874) met with such a substitution (probably Ophelia angustifolia or O. pulchella, *Don*), which had the stem obscurely quadrangular below and evidently four-sided and winged above, the leaves narrow and tapering to both ends, the leaf-scars not prominently marked, the flowers larger, the woody circle of the stem thicker, and the infusion less bitter than the true chirata.

Off. Prep.—Infusum chiratæ, *Br.;* Tinctura chiratæ, *U. S.*, *Br.*

Medical Action and Uses.—In Hindostan this medicine is held to be *stomachic*, tonic, anti-periodic, cholagogue, and deobstruent, as well as efficient in chronic *bronchitis*. In truth, it possesses virtues very similar to those of gentian and other simple bitters. The dose of chirata is about 20 grains (Gm. 1. 30). An infusion may be made with half an ounce of chirata to a pint of boiling water (Gm. 16 to Gm. 500), or this preparation may be reduced by boiling for 20 minutes. *Dose*, 1 or 2 fluidounces (Gm. 60), three times a day.

CHLORAL, *U. S.*—Hydrate of Chloral.

Chloral hydras, Br., F. Cod.; *Chloralum hydratum*, P. G.; *Aldehydum trichloratum.*—*Chloral*, *Trichloraldehyd-hydrate*, E.; *Hydrate de chloral*, Fr.; *Chloralhydrat*, G.

Formula $C_2HCl_3O.H_2O$. Molecular weight 165.2.

Chloral should be preserved in glass-stoppered bottles in a cool and dark place.

Formation and Preparation.—Chloral was discovered by Liebig (1832), and its production and composition were soon after determined by him and by Dumas. The results of these investigations prove that when dry chlorine is passed into absolute alcohol, aldehyd and hydrochloric acid are first formed: $C_2H_6O + Cl_2 = C_2H_4O + 2HCl$. By the continued action of dry chlorine gas 3 atoms of hydrogen are abstracted from the aldehyd, with the formation of hydrochloric acid, and are replaced by 3 atoms of chlorine, producing chloral; the reaction is explained by the following equation: $C_2H_4O + 3Cl_2 = 3HCl + C_2HCl_3O$. Wurtz and Vogt regard the reaction as much more complicated. Other products of decomposition are formed in smaller quantities, and necessitate the subsequent purification of the chloral. The yield is very materially reduced if water be present, in which case a portion of the aldehyd at first produced is converted into acetic acid ($C_2H_4O + H_2O + Cl_2 = C_2H_4O_2 + 2HCl$), and this acid, reacting with some alcohol, forms acetic ether, which is not transformed into chloral by the action of chlorine. In preparing chloral, therefore, the materials reacting upon one another must be as nearly free from water as they can be obtained. Chlorine gas is generated in the usual manner, and passed first into a Woulf's bottle, where some of the moisture is condensed; then over chloride of calcium or through sulphuric acid, by which it is completely dried; and finally into the absolute alcohol, which is kept cool as long as the chlorine gas is rapidly absorbed, but after a few days requires to be warmed, the heat being slowly increased, until at the end of the process it has reached 60° to 70° C. (140° to 158° F.). The whole process requires about 2 weeks (for 600 Gm. of alcohol 3 days, Dumas); but if larger quantities of alcohol be operated upon a longer time is required. In the experience of Dr. Squibb (1870), 92 pounds of alcohol required the continuous generation of chlorine gas for 28 days, using about 1¼ tons of a mixture of manganese binoxide and common salt, and yielded about 160 pounds of crude chloral. Large quantities of hydrochloric acid gas containing some chloral escape during the latter part of the process, and if passed through a reversed condenser the vapors of the latter will be condensed and returned to the vessel. Kraemer observed (1874) that the ethereal liquid which accumulates beneath the hydrochloric acid is a mixture of the *chlorides of ethylene* and *ethylidene*.

Crude chloral for its purification should be treated first with about its own weight of strong sulphuric acid, by which the hydrate and alcoholate of chloral are decomposed and colorless chloral separates as an oily layer, which is at once rectified over some burned lime. To avoid combustion the lime must be completely covered by the liquid. Dr. Squibb prefers to distil the chloral directly from the sulphuric acid, to combine the distillate partly with water, rectifying it over a mixture of lime and calcium carbonate, and hydrating this second distillate completely by adding the necessary quantity of water, ascertained by calculation from the weight of the first distillate (82 parts require 10 parts of water); while still hot the mass is poured upon plates covered with a bell-glass and allowed to crystallize.

Properties.—Chloral (anhydrous) is a colorless, thin, oily liquid of a peculiar pungent, irritating odor and caustic taste. It has the density 1.502 at 18° C. (64.4° F.), boils at 99.1° C. (210.4° F.), and is gradually, or sometimes rapidly, converted into *insoluble chloral* or *metachloral*, which is a white mass or powder of the same elementary composition as chloral, but of a much weaker odor, and at about 180° C. (356° F.) distils without melting, and becomes again liquid and soluble in water. The change into the insoluble condition is prevented by the addition of a little chloroform (Markoe, 1870).

Chloral hydrate is met with in white crystalline masses or in separate colorless, oblique-rhombic crystals of a saccharoid aspect, and attracts moisture in a damp atmosphere, but in a nearly dry atmosphere evaporates slowly without liquefying. It has a peculiar aromatic and somewhat irritating odor, the pungency of which is increased with the temperature, and a bitterish caustic taste. Its vapors are but slightly affected by the vapors of ammonia, except at a somewhat elevated temperature, when white clouds are produced. It fuses at about 58° C. (136° F.) to a clear, colorless liquid having the spec. grav. 1.575, and congealing again to a crystalline mass at about 50° C. (122° F.) (between 35° and 50° C. = 95° and 122° F., *U. S.*). At about 78° C. (172° F.) it begins to yield vapors of water and of anhydrous chloral, and it boils near 95° C. (203° F.), and evaporates without leaving any residue. It is soluble in 4 parts of chloroform and in less than its own weight of water, alcohol, or ether. Chloral which has been insufficiently hydrated contains the insoluble modification, and is therefore not completely soluble in water. It dissolves in petroleum benzin, benzol, and carbon bisulphide, and may be readily obtained in crystals from the hot solutions. It is soluble in glycerin, liquefies in contact with camphor and carbolic acid (see below), and forms solutions with fats and volatile oils (Jehn, 1874). The solution of chloral hydrate in strong alcohol has and retains a neutral reaction, but when dissolved in water it slightly reddens blue litmus-paper; it is, however, not precipitated by nitrate of silver (absence of hydrochloric acid); exposed to a damp atmosphere or when kept in aqueous solution, it acquires a permanent acid reaction. Treated with warm soda or other alkaline hydrate, chloral is decomposed into chloroform and formate; $C_2HCl_3O + KHO$ yields $CHCl_3 + KCHO_2$.

On adding to the aqueous solution of chloral contained in a test-tube water of ammonia, and a few drops of test solution of nitrate of silver, a silver mirror will be obtained upon the glass. An aqueous solution, treated with test solution of sulphide of ammonium, gives a reddish-brown precipitate. Chloral hydrate which has acquired an acid reaction may be purified by recrystallization from hot benzin or carbon bisulphide; should the decomposition have proceeded further, it is best to treat with strong sulphuric acid, etc., as in the purification of crude chloral.

Tests.—The presence of chloral alcoholate is indicated by the combustion which takes place on heating a sample upon platinum-foil over a flame. Smaller quantities are detected by the turbidity resulting from the production of iodoform if a strong aqueous solution is warmed with a slight excess of potassa solution, iodine being then added as long as it is decolorized. On cooling, microscopic crystals of iodoform will separate. The presence of various organic impurities is detected by warming the chloral hydrate with sulphuric acid, which will then acquire a brown color. If decomposition has set in, the aqueous solution of chloral hydrate on being acidulated with sulphuric acid will readily decolorize a weak solution of potassium permanganate and cause a white precipitate with nitrate of silver. The decomposition of chloral hydrate by alkalies affords a means of estimating its value: when perfectly pure, 100 grains of it, dissolved in an ounce of water and mixed with 30 grains of slaked lime and distilled, yield not less than 70 grains of chloroform. Moist chloral hydrate yields less in proportion to the excess of moisture; chloral alcoholate produces only 60 per cent. of chloroform. V. Meyer and Heffter (1873) estimate the purity of chloral from the amount of formic acid produced by warming the solution of chloral hydrate with an excess of normal solution of soda and determining the excess of soda volumetrically by an acid. Pure sodium hydrate will decompose 4.1375 times its weight of pure chloral hydrate.

"Chloral should be dry, and should not readily attract moisture in ordinarily dry air; when dissolved in diluted alcohol it should not redden blue litmus-paper (absence of acids), nor be precipitated upon addition of a few drops of nitric acid and of test solution of nitrate of silver (absence of hydrochloric acid). Warmed in contact with an equal volume of sulphuric acid, it liquefies, but should not blacken, and when vaporized by heat no residue should remain. It should not dissolve in less than four times its weight of chloroform at 15° C. (59° F.) (difference from alcoholate). A portion in a test-tube containing a fragment of broken glass held in water nearly boiling should boil at about 97° C. (206.8° F.) (difference from alcoholate, which boils at 115° C. (239° F.), and evidence of due hydration). If 1 Gm. be dissolved in 2 Ccm. of distilled water, the solution warmed, and about 8 Ccm. (or a slight excess) of solution of potassa added, the mixture filtered clear through wet filter-paper, and the filtrate treated with test solution of iodine until it is yellowish, no yellow crystalline precipitate (iodoform) should appear even after standing half an hour (absence of alcoholate of chloral)."—*U. S.*

Pharmaceutical Preparations.—Chloral hydrate and camphor. In 1873 attention was drawn to the fact that if powdered camphor be triturated with an equal weight of chloral hydrate a colorless liquid of syrupy consistence is obtained, which has since been used under the name of *camphorated chloral.* E. C. Saunders (1876) regards it as a simple solution, camphor being the solvent; but from its optical behavior Cazeneuve and Imbert (1880) consider it a true chemical compound. It is soluble in alcohol, ether, chloroform, glycerin, fixed oils, and in aqueous solutions of chloral; but it is decomposed by water, chloral hydrate being dissolved and camphor precipitated.

Chlorate hydrate and phenol, equal parts of each, yield a liquid which, after impregnating cotton with it, has been recommended for relief in toothache. J. B. Garrison (1881) prefers for this purpose the firm and short cotton from the cottonwood tree, Populus canadensis, *Michaux;* when saturated with the liquid it is known as *chloro-carbolated cotton.*

Chloral Hydrate as a Solvent.—R. F. Fairthorne (1874) observed that solutions of chloral hydrate in water or glycerin will dissolve morphine, veratrine, and other alkaloids, and suggested a class of preparations which he named *chloral-glycerites*, the basis of which is a solution of 1 drachm of chloral hydrate in half a fluidounce of glycerin.

Off. Prep.—Syrupus chloral, *Br.*

Physiological Action.—*On Animals:* Chloral is hypnotic and anæsthetic. Many animals are very susceptible to its action. $1\frac{1}{2}$ grains hypodermically administered to a rabbit caused a lethargic sleep lasting 9 or 10 hours. In frogs a grain rapidly induced insensibility, coma, and death, immediately preceded by spasm or convulsion. In general, the sleep produced in animals by chloral is not profound, but prolonged, and resembles natural sleep. It lowers the pulse- and respiration-rates and lessens the blood-pressure. It reduces the temperature so considerably that of two animals to which equal poisonous doses are given, if one be kept warm artificially, and the other exposed to the air, the former will be saved, but the latter will die. These are the results when chloral is administered by the stomach or hypodermically. When it is injected into the veins the effect will vary with the dose employed; the heart and lungs may simultaneously and suddenly cease to act, or the latter may be first arrested, or the action of both may be interfered with in various degrees. But in general the respiratory movements cease before the arrest of the heart. The heart's muscles appear to be partially paralyzed, and its cavities become more distended with blood at each pulsation. If the animal survives the heart recovers slowly and irregularly its normal action. Meanwhile, the blood accumulates in the blood-vessels as well as in the heart, embarrassing still further respiration and oppressing the cerebro-spinal nervous centres. In all these organs, including the heart, and in the muscles also, the vessels are gorged with blood. This fluid is not altered unless chloral is directly mixed with it; in that case its red corpuscles may be disorganized. Observation of its effects upon animals appears to show that chloral in slowly-poisonous doses interferes with or arrests the functions in the following order: 1, those of the brain; 2, those of the voluntary muscles; 3, those of the respiratory apparatus; 4, those of the heart. Throughout the series the blood grows more and more unfit to sustain life.

The experiments of Brown-Séquard show that anhydrous chloral applied to the skin of animals acts more slowly than chloroform, but induces death much more frequently, as well as pulmonary, renal, and intestinal hæmorrhages—that it causes diarrhœa and diabetes, and is absorbed from the skin in larger quantities than chloroform. The mode in which this chloral, so applied, causes death is by producing general insensibility, relaxation, infrequent respiration, and gradual extinction of the heart-beats (*Times and Gazette*, Feb. 1881, p. 163)—in a word, the effects of chloral hydrate taken internally.

On Man: Applied in its pure state to the sound skin, it occasions a slight redness, but it acts as a powerful irritant upon the derm and upon wounds, even occasioning eschars, and it excites pain in healthy mucous membranes. A warm saturated solution of chloral in water is said to have acted as a caustic upon the skin of the temple, and a paste composed of chloral and finely-powdered tragacanth to have vesicated the skin of the forearm. Its taste, even in a watery solution, is somewhat acrid and bitter, causing a sense of burning in the throat, and sometimes in the stomach also, and producing more or less salivation. In enema it occasions heat and irritation in the rectum, and its subcutaneous injection is not only painful, but is apt to be followed by sloughing.

Like opium, chloral allays pain and produces sleep, but less perfectly than opiates. It seldom produces the untoward effects of opium, such as nausea, dryness of the fauces, constipation, anorexia, dysury, headache, giddiness, or malaise; nor, except in very large doses, does it occasion anæsthesia. Indeed, the effects of occasional and appropriate doses closely resemble natural sleep, except that the face is flushed and the pupils are more or less contracted; the patient may sometimes even be temporarily awakened to take food or obey a call of nature without interfering permanently with its soporific action. As in natural sleep, respiration and circulation are retarded and the temperature is slightly lowered. The pupils are contracted and insensible to light. Exceptions to these statements may be found in certain cases in which the sleep is restless or unrefreshing, or in which a state of delirious excitement exists, or in which there is subsequently experienced a degree of dulness or headache or sick stomach, or a partial loss of power in the limbs. Numerous cases are reported of violent delirium produced by this preparation (Kane, *Phila. Med. Times*, xi. 225). According to Bouchut, children can take chloral with much less danger than adults

Like chloroform, chloral sometimes produces poisonous, and even fatal effects, without its being possible to explain them by its excessive dose or by any special condition of the patient. Death has resulted from the use of even 10 grains of the drug. The phenomena of acute chloral-poisoning usually denote failure of the heart's action. They include faintness, feeble pulse, fluttering heart, paralyzed and cold extremities, a sense of sinking, pallor, and partial lividity of the face; in a word, the phenomena of syncope. In other cases narcotism and asphyxia occur, especially where the dose has been immoderate, as in a case in which death took place in about 4 hours after 480 grains of chloral hydrate had been taken with suicidal intent. The breathing is then apt to be stertorous and labored and the limbs blue and cold. The pulse and respiration are usually quickened, but not greatly unless danger is imminent. The breath exhales a sweet odor. In some cases the toxical effects come on suddenly in the midst of quiet sleep, the patient falling into collapse, with convulsions, presently ending in death. Or there may be no convulsion, and death is preceded only by hurried breathing and fluttering of the heart. Sometimes recovery takes place after enormous doses, such as in one case 165 grains, in another 350 grains. In a third case 1 ounce of the drug produced a sleep of 48 hours, after which the patient recovered (*Boston Med. and Surg. Jour.*, July, 1882, p. 22); and in a fourth case 28 Gm. (nearly an ounce) were taken soon after a meal without very serious consequences (*Bull. de thérap.*, cv. 516). The post-mortem lesions consist of venous congestion of the brain and lungs, distension of the heart with dark and mostly liquid blood, and sometimes dark congestion and hyperæmia of the gastric blood-vessels.

A state of chronic disorder, which may be called chloralism, and is sometimes very persistent, comprises many of the following phenomena: mental hebetude and irritability, hallucinations, insanity, emotional excitability and obstinate insomnia, loss of memory, with physical incapacity for exertion, and extreme prostration on attempting it; uncertainty of movement and a tendency to fall forward, or absolute inability to stand or walk or perform various co-ordinated movements, as writing, articulation, etc.; partial paralysis of the œsophagus; impairment and even loss of vision; dyspnœa, especially on exertion; wandering pains, and sometimes numbness of the limbs; cardiac debility, a slow pulse, lowered temperature, irritability of the bladder, and a low specific gravity of the urine; a dark, spotted, erythematous flush of the face, intensified by alcohol or by mental excitement; a bloodshot condition, and occasionally yellowness, of the conjunctivæ; caprice of appetite, nausea, diarrhœa or constipation with pale and hard feces. The eruptions upon the skin above noticed sometimes follow the occasional use of chloral, especially in excessive doses, but more commonly result from its habitual administration. They are described as exanthematic, including scarlatiniform rashes, roseola, urticaria, and lichen, but are occasionally vesicular or slightly pustular. Sometimes they have a yellow tint. Most frequently they are confined to the face and neck, but sometimes extend to the whole body, and on the limbs are apt to be most distinct upon the surfaces of extension, on the back, and joints. They have also been observed within the mouth. They are rendered more intense by physical and mental excitement and by the use of alcohol, tea, or coffee, and are often attended by palpitation of the heart and throbbing of the arteries, and are sometimes followed by a desquamation of the cuticle. In not a few instances injection, and even chemosis of the conjunctiva, follow the use of the drug, and may be attended with impaired vision or photophobia, due to congestion of the retinal vessels. Of the effects now enumerated many were disclosed by an inquiry set on foot by the Clinical Society of London in 1880 (*Transactions*, xiii. 117). Besides the effects which have been enumerated, there is sometimes observed a condition which denotes an altered state of the blood, such as a spongy and ulcerated state of the mucous membrane of the mouth, livid and hæmorrhagic spots upon the skin, purpurous effusions in the mucous membranes of the lungs, bowels, etc., general œdema, eczematous and scaly eruptions of the skin, alopecia, and shedding of the finger- and toe-nails. The latter effects correspond to the disorganization of the red corpuscles which is observed in some cases of acute fatal poisoning by this substance. It would seem that all such disorders assume exaggerated proportions in persons addicted to intemperance in alcohol.

Prof. Liebreich attributes a large share of these mischievous effects to the use of an impure preparation of chloral. He states that sometimes chloral, as it is sold, contains other compounds, which give rise by their decomposition to acid and irritating substances of a complex character, which have a very injurious physiological action and are liable to produce dangerous results. This eminent physician has called attention to a curious circumstance, already referred to—viz. that after a dose of chloral, alcohol produces much more than its ordinary effect in flushing the face. This seems to be due to the paretic action of chloral upon the arteries and capillaries as well as upon the heart.

When chloral was first introduced into medicine it was assumed to undergo in the blood a decomposition into formic acid and chloroform, to the latter of which its operation was ascribed, while the formic acid united with the alkalies of the blood. This view, which was purely hypothetical in its origin, has been disproved by demonstrating that chloral is not decomposed in the blood at all, and may be found in this fluid after having been taken by the mouth; that its action is the same whether the blood be normally alkaline or abnormally acid; and that in the frog its characteristic effects take place whether the circulating fluid be blood or a saline solution.

Medical Uses.—*Insomnia:* Chloral appears to be indicated when sleeplessness is dependent upon a vascularity due to exhaustion rather than to primary excitement of the brain; thus it has been found useful when loss of sleep follows severe and prolonged mental application or excitement of feeling, or accompanies the general debility following acute diseases attended with delirium or severe pain, or is associated with acute *mania*, especially of the puerperal form. The somewhat analogous condition which exists in *delirium tremens* is very amenable to this medicine, especially in the forming stage of the affection known as "the horrors," and which so frequently follows surgical injuries in drunkards; it is useful also when great nervous excitement and restlessness are associated with extravagant phantasms. Nevertheless, its depressing effects are to be guarded against in this affection as in the different forms of *insanity*. "The tide of opinion seems to have set directly against its use, save in certain cases and under certain conditions" of the latter disease. The weight of authority is opposed to its use, partly upon the ground that it tends to suddenly depress the heart and the nervous system, and partly because it aggravates the delirium in many cases. (Compare Kane, *Med. Record*, xix. 60.) The grounds of this condemnation are distinctly and emphatically set forth by Weiss (*Centralblatt f. Therapie*, i. 119), who from a large experience shows that the medicine does more harm by its depressing than good by its hypnotic influence in all protracted maniacal seizures, and by its continued use induces a cachectic condition that prolongs, and even perpetuates, the disease. He charges it with the production of numerous lesions from decubitus (ulcers, etc.) in the paralytic and chronic insane, and, in a word, as a double-edged sword that, while it overcomes maniacal manifestions, tends to undermine the powers of life.

Although far inferior for the relief of *pain*, chloral is a very useful substitute for opium and its preparations in many cases in which the pain is of moderate intensity or when an idiosyncrasy exists which renders these medicines ineligible. Pain in nervous trunks and extremities, particularly in neuralgia, whether of central or peripheral origin, in toothache, lead-colic, cancer, and tumors compressing nerves, is more or less palliated by chloral. But its anodyne influence is very transient, and when it passes off the pain appears to be intensified. This remark applies also to the use of chloral in nervous *headache*. It has been employed with advantage in cases of *angina pectoris* unconnected with obstructive disease or degeneration of the heart; but it should be used with extreme caution, if at all, whenever, from these or other causes, the action of the heart is irregular, feeble, or tumultuous. Chloral is very efficient during *labor* in producing those effects for which chloroform and ether are commonly employed; that is to say, for allaying fruitless and excessive pains and permitting rhythmical contractions of the uterus to occur; for promoting dilatation of the os uteri; for procuring repose for the mother during prolonged labor; and for quieting alarm and allaying nervous irritability. It should be given in doses of not less than 30 grains (Gm. 2), repeated every half hour until the desired effect is produced.

Among spasmodic affections, *tetanus*, especially of the subacute form, has proved very amenable to this remedy, administered hypodermically and also by the mouth and rectum. Statistics appear to show that the mortality under its use is rather less than under that of curare, Calabar bean, and other medicines. It is said that in the more acute and active forms of the disease its efficacy is less demonstrable, but in three acute cases out of four occurring in the Pennsylvania Hospital cure followed the use of chloral. The tetanic spasm produced by *strychnia-poisoning* is equally under its control; it seems to reduce the force and frequency of the paroxysms, but a lethal dose of strychnia cannot be combated by an adequate dose of chloral, for the latter would be equally dangerous to life. A summary may here be given of Th. Husemann's conclusions after a thorough rational and experimental investigation of this subject in animals: There is no reciprocal antagonism between chloral and strychnia. But an animal under the influence of chloral will escape the effects of five or six times the minimum lethal dose of strychnia, or even of much larger doses of the latter, so long as the proper toxical effects of the chloral are not developed. In this way, even when it does not prevent death, it may greatly delay it. In animals, and also in man, its power of saving life in strychnia-poisoning depends very much upon its ability to prevent or to moderate the spasms which, if unchecked, hasten so greatly the fatal issue by exhausting the nervous centres and lowering the temperature. (Compare Faucon, *Archives générales*, Jan. 1883, pp. 74, 153, who advises that chloral should be administered hypodermically as well as by the mouth, and even by the veins.) In some instances of *tonic spasm* its effects have been beneficial. It has been used to mitigate the fits of *epilepsy* by giving it before their regular hour of recurrence when they are periodical. It may lessen the movements in *paralysis agitans*. *Puerperal convulsions* are perhaps more amenable to the influence of chloral than any other form of spasmodic disease, although it is far from being a certain remedy. To ensure its favorable action it should be given in doses of not less than 15 or 20 grains, repeated every 15 minutes until its appropriate effects appear. Its use in *infantile convulsions* is common, but its utility is not clearly proved. In a case of *hydrophobia* the medicine was found to control the active symptoms completely, but the patient died by syncope (Gunning). A case of supposed hydrophobia, reported by Broadbent as recovering under the use of chloral, was considered by some members of the Clinical Society of London as being of a different nature (*Times and Gaz.*, March, 1883, p. 308). In *chorea* it displays a decided control over the spasmodic element of the disease, and must be regarded as a valuable adjuvant in the cure of cases depending upon definite blood-disorder, nervous shock, or reflex irritation. In some uncomplicated cases it suffices for the cure, especially if given in full doses. It appears to have been very serviceable in *laryngismus stridulus* when taken by children six months old in doses of 2 grains three times a day. It has been recommended in the form of an atomized solution of 10 grains to the ounce as a remedy for the "*winter cough*" of old persons. In *whooping cough* it is of service by mitigating the violence of the paroxysms and preventing the loss of strength occasioned by their occurrence at night. It sometimes also appears to shorten the duration of the attack. In other varieties of *cough* it is a useful palliative, but is not to be compared with opium. The paroxysms of nervous *asthma* are sometimes very favorably modified by this medicine, but it is unsuited for the continuous treatment of so chronic a disease. It is one of the best remedies for obstinate *hiccup*. There is an alleged physiological antagonism between chloral and *Calabar bean*, but it is exhibited only when the doses of the two agents are duly proportioned and the chloral is administered within a very few minutes after the bean.

A mixture of chloral and morphia has been used by Trélat to produce partial anæsthesia for surgical purposes, and either exclusively for minor operations or as preparatory to the use of chloroform in graver ones. It is contended that in this manner the dangers of the latter agent are diminished, both by the action of the morphia and by the smaller quantity of the anæsthetic required (Choquet, 1880). Equal parts of camphor and chloral form an excellent topical anodyne in *neuralgia*. A 50 per cent. solution of chloral has been applied in *diphtheria* by means of a brush at intervals of half an hour, with the effect of loosening the false membrane. After the separation of the latter a weaker solution was applied at longer intervals, which appeared to hasten the cure. The combined deodorizing, antiseptic, and stimulant qualities of chloral have caused various applications of it, especially as a *surgical dressing.* A solution of 1 part in 100 of water has been found sufficiently strong. This is applied on lint to unhealthy surfaces, such as gangrenous, indolent, erysipelatous, diphtheritic, cancerous, mercurial, and carious *ulcers*, or as an injection for parts not so easily reached, as in cases of *dysentery.* It has been recommended internally (Curci) in acute dysentery and in *typhoid fever*, but should unequivocally be condemned, as well as in the treatment of the acute *gastro-enteritis* of children. It also corrects the fetor and lessens the discharge in *ozæna*, for which purpose a solution of 1 part in 200 to 300 may be applied by means of the nasal douche. A solution of 1 or 2 parts in 100 corrects *fetor of the feet.* Stronger solutions, containing from 20 to 40 grains of chloral to an ounce of water, have been used to prevent the decomposition of animal tissues immersed in them, which they are stated to do without injuring the color or the texture. They have also been successfully employed to inject dead bodies used for dissection. A solution of 1 part in 20 of water forms an excellent lotion in *pityriasis* of the scalp, and sometimes cures the disease if it is recent. A 10 per cent. solution of chloral injected into an *erectile tumor* has effected its cure, and a like result has followed in *varicocele.* A 1 or 2 per cent. solution has been found an efficient injection in *gonorrhœa.*

Poisoning by chloral should be treated by the same general method which is applicable to other forms of narcotism, including cold to the head and neck, the use of coffee or caffeine, galvanism applied to the diaphragm, mechanical stimulants, such as friction and flagellation, etc. Atropia and digitalis have been employed to stimulate and tonify the heart, and nitrite of amyl for an analogous purpose. Carbonate of ammonia has been injected into the veins. Strychnia has also been used as a physiological antidote to chloral. Strychnia would seem appropriate, so far as it tends to rouse the activity of the spinal cord, but it does not tend to diminish the action of chloral upon the brain. But clinical evidence leaves no doubt of the efficacy of *strychnia* in chloral-poisoning. Its first effect is to reduce the abnormal frequency of the pulse and increase its volume, while it causes the respiratory act to be fuller (Moore, *Med. News*, xli. 566; Da Costa, *Phila. Med. Times*, xiii. 421). A hypodermic injection of 2 minims of "solution of strychnia," *Br. Ph.* (gr. $\frac{1}{60}$), may be given at intervals of about half an hour. It is of the utmost importance to combat the singular coldness which the poison tends to produce by means of artificial heat, such as hot cloths, bottles, sand, etc. applied over the heart, to the spine and extremities, and by small and repeated doses of alcohol, which may be administered by the mouth or rectum or hypodermically.

Administration.—Chloral is too irritating for ordinary hypodermic use, but in strychnia-poisoning it may be so administered in the dose of from 10 to 20 grains (Gm. 0.60–1.20). This operation is apt to be followed by abscess. Its injection into the veins may be mentioned only to be condemned. By the mouth the average dose for an adult is between 10 and 30 grains (Gm. 0.60–2.00), which may be repeated at intervals of 1 or 2 hours. In convulsive disorders much larger doses may be required. For children about 1 grain (Gm. 0.05) may be prescribed for each year of the child's age. The solution should be flavored with an agreeable syrup; peppermint-water masks its taste effectually. Enemas of chloral may be prepared by dissolving from 15 to 60 grains (Gm. 1–4) of the compound in a little water, rubbing up the solution with the yolk of egg, and mixing it with a sufficient quantity of milk. Suppositories may be made as follows: Cocoa-butter, spermaceti, of each 2½ Gm.; powdered chloral, ½ Gm.; or, cocoa-butter 2 Gm.; spermaceti, powdered chloral, of each 3 Gm., for one suppository (Mayet). The ready solubility of chloral hydrate in fatty excipients has led to the preparation of the following for external use: Chloral 6 parts, almond oil 30 parts; or chloral 7 parts, lard 27 parts, white wax 3 parts; or, for a plaster, chloral 1 part, white wax 2 parts, cocoa-butter 2½ parts.

CHLORAL BUTYLICUM.—Butylchloral Hydrate.

Butyl-chloral hydras, Br.—*Hydrate de chloral butylique*, Fr.; *Butylchloralhydrat*, G.
Formula $C_4H_5Cl_3O.H_2O$. Molecular weight 193.2.

Preparation.—It is prepared by passing chlorine gas into acetic aldehyd, C_2H_4O, which should be placed in a refrigerating mixture to lessen the violence of the reaction. The apparatus is connected with a reversed condenser, which carries the condensable products back into the flask, while the uncondensable gases are allowed to escape. Gradually the temperature is permitted to rise, and when the hot liquid ceases to absorb the chlorine gas this part of the operation is finished. The mass is now subjected to repeated fractional distillation until a product is obtained boiling uniformly between 163° and 165° C. (325.4° and 329° F.), which is butylchloral, and by dissolving in water and crystallizing the hydrate is obtained. That portion of the crude product distilling at a lower temperature requires treatment with sulphuric acid to decompose the hydrate contained in it, and subsequent fractional distillation.

Properties.—Butylchloral is a colorless oil heavier than water, of a peculiar odor somewhat like that of ordinary chloral. The hydrate crystallizes from water in thin white scales of a silky lustre, a peculiar somewhat fruit-like odor, a warm bitterish taste, and a neutral reaction. It melts at 78° C. (172.4° F.) to a colorless clear liquid, and at a higher heat vaporizes without leaving any residue. It is freely soluble in alcohol and ether, from which it crystallizes unaltered, is soluble in cold water with difficulty, freely soluble in glycerin and hot water, and volatilizes with the vapors of boiling water. By soda and other alkalies it undergoes decomposition in a manner analogous to the officinal chloral under the same conditions, yielding *bichlorallylene*, $C_3H_2Cl_2$, formate and chloride of sodium. The alcoholic solution of butylchloral acidulated with nitric acid does not yield a precipitate with nitrate of silver. Its solutions gradually undergo decomposition, and should therefore not be kept on hand except for a short time.

Composition.—When Krämer and Pinner first obtained this body (1870) they considered it to be *crotonchloral*, $C_4H_3Cl_3O$, but have since (1875) ascertained that it is *trichlorbutylaldehyd*, which is butylaldehyd, C_4H_8O, with 3H replaced by 3Cl. The hydrate contains a little over 9 per cent. of water.

Physiological Action.—*On Animals:* Administered to animals, it produces a tendency to drowsiness, which is, however, usually preceded by some degree of excitement, and then motility and sensibility become successively impaired, beginning at the head and gradually extending to the rest of the body. Under its full operation anæsthetic sleep occurs, with muscular resolution, during which the respiratory movements and the pulse become less ample and the temperature of the body falls, it may be as much as from 1° to 3° C. Small doses increase, but large doses diminish, the respiration-rate; the pulse-rate only declines when the respiration falls greatly below its norm. Thus, if a dose of 12 grains (Gm. 0.75) be given, the pulse falls to one-half, and the respiration to one-fourth, of its normal rate. If the dose is mortal, it destroys life by arresting the action first of the lungs, and then of the heart. After death there is found vascular congestion of the meninges of the brain, and in a less degree of the membranes of the spinal cord. Intra-venous injections of this substance are said to be peculiarly adapted to prepare animals for vivisection: "the most delicate and difficult dissections may then be made without awakening either sensibility or reflex movements."

On Man: In the dose of from 10 to 30 grains it occasions, in the course of from 5 to 10 minutes, a sense of heaviness, confusion of ideas, and dulness of the senses; cutaneous sensibility is blunted, in the face first, and afterward in the limbs, motility being at the same time more or less impaired. In from 10 to 30 minutes sleep sets in; it is deep and tranquil, and while it lasts neither respiration, circulation, temperature, nor muscular tone is greatly affected. On the return of consciousness some dulness or lightness of the head may be experienced, but it soon passes off. The most striking peculiarity of these symptoms is the conservation of muscular tone. It was pointed out by Liebreich in his original communication respecting "croton-chloral hydrate." He described two maniacs to whom it was administered as "remaining quietly sitting on their chairs in a deep sleep for 2 whole hours together." In medicinal doses it does not appear to derange the stomach, but its acrid taste, which persists in the throat, may excite nausea, and even vomiting. Very large doses may cause both vomiting and diarrhœa, and the former effect has been induced by the hypodermic administration of the medicine.

The question as to the *modus operandi* of this preparation has been variously explained by different investigators. Some will have it that in the blood it is resolved into chloroform and formic acid, of which the former is the real cause of the characteristic phenomena. But since these phenomena, and especially the conservation of muscular tonicity, are not produced by chloroform, the theory may be discarded as inadequate. It is not worth while to pursue such investigations, which are as vain as those which have arisen respecting the soporific effect of opium, and which the satirist has answered as intelligibly as the scientist by referring them to a "vis dormitiva."

Medical Uses.—Butylchloral is anodyne or anæsthetic rather than narcotic. The indications for its employment were originally stated to be: 1, its substitution for chloral hydrate in cases of heart disease; 2, in neuralgia of the trigemini; 3, when very large doses of hydrate of chloral are necessary to produce sleep. In the last case it was recommended to associate the two hypnotics. Experience has proved that it is of little use even in *neuralgia* unless the pain affect the fifth pair. In that form of the disease, however, it is a most useful anodyne. If doses of from 5 to 20 grains (Gm. 0.30–1.30) are given at intervals of 15 or 30 minutes, the pain is apt to be palliated even before sleep is induced. In this manner it has proved very efficient in cases of *painful spasm* (tic douloureux) of the face. In ordinary facial neuralgia occurring in young persons, especially in anæmic women and girls, it is peculiarly efficient. It is also serviceable in *nervous headache*, and is a palliative of *dysmenorrhœa*. In some cases of *insomnia*—such, for instance, as are frequent in chronic phthisis—a dose at bedtime of from 5 to 15 grains (Gm. 0.30–1.0) is useful, but its primary effect is not maintained, and larger doses become necessary. Butylchloral is contraindicated by hyperæmia of the brain, by an irritable condition of the gastro-intestinal mucous membrane, and by diseases which impair the vigor of the heart.

It may be given as a soporific in doses of from 3 to 10 grains (Gm. 0.20–0.60), but the smaller dose is preferable, and may be repeated at intervals of an hour or less until the due effect is obtained. Females are much more readily than men affected by small doses. Much larger doses have been recommended, as from 8 to 15 grains, and even from 30 to 60 grains (Gm. 0.40–1.00, 2.00–4.00); but they can rarely be necessary or safe. The extreme bitterness of the medicine requires it to be administered in a solution capable of masking its taste, such as glycerin and syrup flavored with essence of peppermint, or, still better, in syrup of liquorice-root. It may also be given in a mixture of the following description: butylchloral hydrate 5 to 10 parts; glycerin 20 parts; distilled water 130 parts; the mixture to be shaken before it is used. The dose of this preparation is half an ounce, followed in 5 minutes by a second, and in 10 minutes by a third. It is well to begin with a small dose, so as to avoid hypnotism, when the anæsthetic effect alone is desired; but to produce sleep, from 15 to 45 grains (Gm. 1–3), according to the patient's constitution, may be given at bedtime. As a topical application for the relief of neuralgia a mixture of equal parts of butylchloral and tincture of camphor may be applied. Its hypodermic use is not to be recommended, on account of the abscesses it occasions. If poisonous effects result from an overdose, it is advised to combat them with artificial respiration and electricity along the spine and at the superficial portion of the pneumogastric nerves, while stimulants are applied to the extremities.

CHLOROFORMUM VENALE, *U. S.*—COMMERCIAL CHLOROFORM.

Chloroforme vénal, Fr.; *Käufliches Chloroform*, G.

CHLOROFORMUM PURIFICATUM, *U. S.*—PURIFIED CHLOROFORM.

Chloroformum, Br.; *Chloroformium*, P. G.; *Formylum trichloratum.*—*Chloroforme pur*, Fr.; *Reines Chloroform*, G.

Formula $CHCl_3$. Molecular weight 119.2.

Origin and Preparation.—Chloral is formed from alcohol and chlorine, and, on decomposing chloral by an alkali, chloroform and a formate of the alkali are produced; the conditions for these two reactions are present on bringing together alcohol and chlorinated lime, the chlorine of which converts the former into chloral, which is at once decomposed by the calcium hydrate, yielding chloroform and calcium formate, $Ca2CHO_2$ (see CHLORAL). Calcium formate is, however, not found in the residue of the distillation, but is decomposed by another portion of the chlorinated lime into calcium carbonate and chloride and water. Omitting all intermediate reactions, and using for chlorinated lime the formula of Odling or of Stahlschmidt (see page 361), the final result is expressed by the equations:

$$2C_2H_6O + 10CaOCl_2 = 2CHCl_3 + 7CaCl_2 + 2CaCO_3 + CaH_2O_2 + 4H_2O,$$
$$\text{or } 2C_2H_6O + 11CaHClO_2 = CHCl_3 + 4CaCl_2 + 3CaCO_3 + 4CaH_2O_2 + 7H_2O.$$

The theoretical quantity of chloroform obtainable according to the first of these equations would be 33.6 per cent., according to the second 30.6 per cent., of the weight of available chlorine contained in the chlorinated lime; by working on the large scale the yield of chloroform ranges between 22 and 24 per cent.

To prepare chloroform, 6 parts of the assayed chlorinated lime are mixed with about 24 parts of water, and the mixture strained into a still; 1 part of stronger alcohol is added, and the whole heated to 40° C. (122° F.). With the further application of very little heat the reaction now proceeds rapidly, the temperature rises, and the chloroform, mixed with some alcohol, distils over. The distillate is washed with water; the subsiding layer constitutes *crude chloroform.* The washings are preserved and employed in a subsequent operation. (For papers on the manufacture of chloroform consult *Amer. Jour. Phar.*, 1862, pp. 25, 42; and 1868, p. 289.)

The British Pharmacopœia gives a process for preparing chloroform in which less water (18 parts for the above quantities) is used, and slaked lime is put into the still with the chlorinated lime—an addition which has been recommended by Siemerling, Larocque, and others, but seems superfluous; otherwise, the process scarcely differs from the one given, except that the water is mixed with the alcohol and the solid ingredients are mixed with the liquid in the still.

Thus prepared, crude chloroform varies in specific gravity between 1.45 and 1.49, and imparts to strong sulphuric acid, after having been agitated with it, a brownish or brown color, the degree of coloration depending upon the amount of impurities present.

Chloroform may likewise be prepared by distilling wood-spirit (methylic alcohol) or acetate of calcium with chlorinated lime. Chautart proposed to prepare chloroform from oil of turpentine, but Soubeiran proved that chlorinated lime diffused in water acts violently upon the oil, and that but little chloroform having a turpentine odor is obtained. Damoiseau (1881) thinks that pure chloroform may be advantageously prepared by passing a mixture of methyl chloride, CH_3Cl, and chlorine in proper proportion through a long tube containing animal charcoal and heated to between 250° and 350° C. (482° and 662° F.).

Purification.—Commercial chloroform 200 parts (100 oz. av.); sulphuric acid 40 parts (20 oz. av.); carbonate of sodium 10 parts (5 oz. av.); lime, in coarse powder, 1 part (½ oz. av.); alcohol 2 parts (1 oz. av. = 9¾ fluidrachms); water 20 parts (10 oz. av. = 9⅝ fluidounces). Add the acid to the chloroform, and shake them together occasionally during 24 hours. Separate the lighter liquid, and add to it the carbonate of sodium previously dissolved in the water; agitate the mixture thoroughly for half an hour and set it aside; then separate the chloroform from the supernatant layer, and mix it with the alcohol. (When the mixture has separated into two transparent layers.—*U. S.* 1870), transfer the chloroform to a dry retort, add the lime, and, taking care that the temperature in the retort does not rise above 67.2° C. (153° F.), distil, by means of a water-bath, into a well-cooled receiver until the residue in the retort is reduced to 2 parts (1 oz. av.). Keep the product in glass-stoppered bottles, in a dark place. —*U. S.*

The process is identical with that of the U. S. P. 1870, except that the alcohol has been slightly reduced, and that the sentence above enclosed in brackets, has been omitted. The process of the British Pharmacopœia is essentially the same, but it directs the agitation of the crude chloroform for 5 minutes with an equal volume of sulphuric acid, and omits the addition of the alcohol directed in the above formula, thus obtaining a somewhat heavier product. On agitating crude chloroform with strong sulphuric acid the impurities contained in the former are destroyed, the chloroform separating as a colorless layer upon the acid. It may now be at once transferred to a retort containing some chloride of calcium and lime, or preferably is deprived of the adherent acid by washing with a solution of sodium carbonate. The clear chloroform now obtained will, on the addition of the alcohol, again become slightly turbid from the separation of water; this water should be removed by allowing the mixture to rest for a short time, as directed in the U. S. P. 1870, or the mixture should be well agitated and left in contact with the lime for some time before distillation is commenced; the whole of the distillate will then be transparent. If the distillation is now effected at a temperature not exceeding 67.2° C. (153° F.), with the precaution of leaving a small quantity of liquid in the still, all impurities will be effectually separated which may have escaped the action of the acid, because they have a higher boiling-point than chloroform.

Properties.—*Commercial chloroform*, U. S. P., should contain at least 98 per cent. of chloroform, should have a density not less than 1.470, and otherwise should have the sensible properties of the following:

Purified chloroform is a limpid, colorless, diffusive liquid, not inflammable, of an agreeable ethereal odor, a hot saccharine taste, and of a neutral reaction. It is soluble in about 200 parts of water, to which it imparts its taste, and in all proportions in alcohol and ether; also in benzol, benzin, and fixed or volatile oils. Sp. gr. 1.485–1.490 at 15° C. (59° F.). It boils in a dry flask at 60° to 61° C. (140° to 142° F.), corresponding to the presence of ¾ to 1 per cent. of alcohol. It is a solvent for paraffin, gutta-percha, caoutchouc, many resins, most alkaloids, iodine, bromine, etc.

Pure (*absolute*) *chloroform* has at 15° C. (59° F.) the density 1.499 (Hirsch), is very prone to change when in contact with air and diffused light; it keeps, however, entirely unaltered in direct sunlight if the air has been completely expelled from the vessel. Chloroform reduced by the addition of alcohol to 1.49 is readily decomposed by direct sunlight, more slowly when exposed to diffused daylight. If reduced to the density 1.480–1.484, it remains unaltered in diffused light for years, and for 10 hours in direct sunlight, provided all moisture has been excluded; in the presence of some water decomposition gradually commences. Chloroform below the density 1.475 is not affected by light. This behavior explains the necessity of keeping chloroform of 1.49 protected from the light, which is not required if the density is lowered to about 1.48 by the addition of 1½ per cent. of alcohol. The products of decomposition have the suffocating odor of *phosgene gas*, $COCl_2$, redden and often bleach moistened blue litmus, and liberate iodine from potassium iodide; even an incipient decomposition is detected by evaporating spontaneously a drachm of chloroform with a drop of a neutral solution of litmus, which will thereby acquire a red color.

Partially-decomposed chloroform may be restored to its original purity by agitating it with solution of sodium carbonate and rectifying it afterward over a little lime. Previous treatment with strong sulphuric acid will be necessary only when it becomes colored on being agitated with the chloroform.

When chloroform is shaken in a perfectly clean glass-stoppered vial with an equal bulk of sulphuric acid, no color should be imparted to either liquid after remaining in contact for 24 hours. Should a coloration appear, the chloroform must be regarded as unfit for inhalation, and should be purified by the officinal formula. When it is agitated with an aqueous solution of nitrate of silver a white precipitate of chloride of silver is not produced.

Tests.—The purity of chloroform is ascertained by its complete volatility, its neutral reaction, its behavior to concentrated sulphuric acid, nitrate of silver, and iodide of potassium, and by its physical properties.

"If 1 Ccm. of *commercial chloroform* be agitated with 20 Ccm. of distilled water, the latter, when separated, should not render test solution of nitrate of silver more than slightly turbid (limit of foreign chlorine compounds). When shaken whith an equal volume of sulphuric acid the subsiding acid layer should not become quite black within 24 hours. A portion evaporated should leave no fixed residue. If 5 Ccm. of *purified chloroform* be thoroughly agitated with 10 Ccm. of distilled water, the latter, when separated, should not affect blue litmus-paper (absence of acids) nor test solution of nitrate of silver (chloride) nor test solution of iodide of potassium (free chlorine). If a portion be digested, warm, with solution of potassa, the latter should not become dark-colored (absence of aldehyd). On shaking 10 Ccm. of the chloroform with 5 Ccm. of sulphuric acid in a glass-stoppered bottle, and allowing them to remain in contact for 24 hours, no color should be imparted to either liquid. If a few Ccm. be permitted to evaporate from blotting-paper, no foreign odor should be perceptible after the odor of chloroform ceases to be recognized."—*U. S.*

Detection of Chloroform.—Chloroform has sometimes been used for the adulteration of volatile oils; in these and in other liquids it may be detected by distilling them with a little alcohol at a temperature of about 65° C. (149° F.). Hager (1868) recommended the treatment of this distillate with zinc and sulphuric acid, when the chloroform will be decomposed and hydrochloric acid recognized in the liquid by nitrate of silver. Lustgarten (1882) suggested as a reliable test the transient blue-green color which is produced on warming chloroform with naphthol and soda solution. A. W. Hofmann (1870) recommended the addition of the alcoholic liquid to a mixture of anilin and alcoholic solution of soda and warming, when the characteristic odor of isonitrites will be developed; 1 part of chloroform in 5000 to 6000 parts of alcohol may thus be detected, and it may be readily distinguished from *chlorethylidene*, which closely resembles chloroform in physical properties. All compounds, however, which on treatment with an alkali produce chloroform, iodoform, or bromoform give the same reaction.

Pharmaceutical Uses.—Chloroform is used as a solvent in the preparation of atropine and other alkaloids.

CHLORAMYL, recommended by Dr. Sanford (1879), is a mixture of chloroform 1 pound and amyl nitrite 2 drachms. There being a chloride and several chlorine substitution-products of amyl, the name does not appear to be a proper one.

LIQUOR CHLOROFORMI COMPOSITUS. Some years ago a nostrum was introduced under the name of *chlorodine* (or *chlorodyne*), and subsequently several formulas were published, differing, however, considerably in their composition. The following formula has been devised by Prof. Remington, and is based upon that given by C. Bullock (1865), the chief difference being the substitution of alcohol for molasses: Dissolve 16 grains of hydrochlorate of morphia in 1 drachm of water and 1 fluidounce of alcohol; add to this chloroform 3 fluidrachms; tincture of Cannabis indica 2 fluidrachms; tincture of capsicum 18 minims; oil of peppermint 4 minims; dilute hydrocyanic acid 24 minims; and perchloric (or hydrochloric) acid ½ fluidrachm. Each fluidrachm contains 1 grain of morphia.

Off. Prep.—Of commercial chloroform: Linimentum chloroformi, Liquor gutta-perchæ, *U. S.*, *Br.* *Of purified chloroform:* Mistura chloroformi, *U. S.;* Spiritus chloroformi, *U. S.*, *Br.;* Tinctura chloroformi composita, *Br.*

Physiological Action.—*On Animals:* In animals whose power of cutaneous absorption is very great, such as frogs and snails, the effects of chloroform are very prompt, decided, and prolonged. The last peculiarity is due to the slowness of their pulmonary exhalation. Of warm-blooded animals, birds are the most susceptible, and cats, rabbits, and rats are more so than dogs. In general, great facility in coming under the influence of the vapor implies a tendency to recover rapidly from its effects. These effects vary for the same animal and for man according to the amount of the vapor inhaled in a given time. Some experimenters have maintained that the blood in the arteries becomes dark during chloroform anæsthesia, while others declare that it acquires a lighter hue. In truth, the color varies according to the freedom of the respiratory act. If the vapor is slowly introduced into the lungs, so as to produce its effects gradually, there is no tendency to darkening of the arterial blood; but a rapid and excessive use of chloroform induces a dusky color of the integuments, by occasioning a degree of asphyxia, which is the more readily produced in consequence of the simultaneous insensibility of the nervous centres. Immediately on suspending the inhalation the natural color returns to the arterial blood, and even the venous blood for a time is less dark than natural. During the first stage of chloroform inhalation nervous symptoms are apt to be developed, and sometimes spasms and convulsions, which are ascribed, not to the action of the absorbed vapor upon the nervous centres, but to the reflex irritation by that vapor of the branches of the superior laryngeal and pneumogastric nerves, which also interferes with the action of the heart and of the lungs. Hence the inhalation of chloroform vapor in large quantities acts by cutting off the supply of atmospheric air; by irritating the respiratory passages and thereby occasioning spasm of their walls, as well as reflex spasm of other muscles; and finally by absorption into the blood.

The experiments of Bernard led him to the conclusion that all general anæsthesia is central in its source; that is to say, is due to the direct action of the anæsthetic upon the spinal cord alone or upon the brain alone, or upon both at once, and that from these centres it controls the sensibility of the distal extremities of the nerves. If the brain alone receives the direct influence of chloroform, the sensibility of the spinal marrow and of the nerves is not impaired; if the agent is limited in its operation to the spinal cord, it does not affect the brain, but it deprives the nerves of sensibility; and finally, if applied only to the extremities of the nerves, its influence is not propagated to the nervous centres. 1 grain of chloroform injected hypodermically into a rabbit is said to cause an anæsthetic sleep of several hours' duration. The experiments of Brown-Séquard prove that chloroform may act in a different manner. Applied rapidly on the shoulder of a guinea-pig, it at first excited reflex contractions of the subjacent muscles, but in a short time the respiration diminished, the temperature declined, and the animal staggered, and fell into a state of insensibility which lasted for several hours. These effects may be regarded as inhibitory phenomena (*Times and Gazette*, Nov. 1880, p. 627).

The vascular condition of the nervous centres during chloroform inhalation differs at the different stages of that process. So long as the agitation lasts which usually precedes complete anæsthesia the cerebral blood-vessels are congested, and the brain will project through an aperture made in the cranium of the animal experimented upon, but with the approach of the full anæsthetic state this congestion subsides, the swollen convolutions shrink, and the excessive vascularity is replaced by unusual pallor of the tissues. In this particular the sleep produced by chloroform (and by ether) is identical with natural sleep, in which also there is a diminished vascularity of the brain. Compression of the carotids in like manner, by lessening the amount of blood, and therefore the tissue-changes in the brain, induces first of all diminished sensibility in the brain, and then loss of consciousness. The first or congestive stage of chloroform-anæsthesia resembles that of the sleep produced by alcoholic intoxication and by excessive doses of opium; it is stupor or coma rather than sleep. Although the brain during the full anæsthesia of chloroform is anæmic, it does not follow that this condition suffices to explain the loss of general sensibility; for not only is the loss far greater than is ever observed in natural sleep, but the local application of chloroform occasions a partial anæsthesia, and there are surgical cases in which the perception of touch and of pain has been completely lost, although consciousness, a cerebral function, remained quite unimpaired. These cases are exceptional, but they seem to show that in chloroform-anæsthesia there must be a change produced in the conducting channels of sensibility as well as in the central perceptive organ which recognizes the existence of pain. Ringer has shown (*Practitioner*, xxvi. 437, 1881), as Mommsen had already done (*Virchow's Archiv*, lxxxiii. 273), that chloroform arrests the frog's heart in diastole; but the former also observed that if, before the arrest becomes complete, ammonia be applied, the pulsations may be renewed and the life of the animal saved. Vulpian too has called attention to the double action of chloroform on the respiratory centres as well as on the motor ganglia of the heart, and the greater danger to life involved in the latter action. The committee on anæsthetics of the British Association (1879) found that chloroform may cause death in dogs by primarily paralyzing either the heart or the respiratory organs, and that its action on the former is sometimes unexpected, and apparently capricious, as it is found to be in surgical operations performed with chloroform

The order in which the several organs are successively affected is generally this: first, the brain, the organ of consciousness, is benumbed, and simultaneously voluntary motion is impaired, while reflex motility may be momentarily increased in the voluntary muscles and persist in the muscles of organic life; finally, the first-named muscles undergo complete relaxation, and the only remaining signs of life are given by the lungs and the heart.

In regard to the nature of the action by which chloroform impairs or destroys for a time sensibility little more than conjecture can be advanced. According to Bernard, it consists in a partial and temporary coagulation of the contents of the nerve-cells—a view which he derived from the action produced in living muscle by injecting its blood-vessels with chloroform or by suspending it in the vapor of this liquid. In the animal thus treated the muscle gradually returns to its normal condition. Similar effects are produced by a like treatment of the nerve-trunks themselves. It is suggested that this partial and temporary hardening of the nerve-tissue suspends the functions of the nerve, and that some analogical reason for adopting it as an explanation may be found in the fact that Infusoria lose all signs of life when dry, and regain them on being moistened; and in the case also of a frog to which salt has been administered, and which so abstracts the circulating fluids of the animal as to reduce it to a state of apparent death, in which, among other things, the crystalline lens grows opaque. The rapid, not to say instantaneous, return of a chloroformed animal to its normal state does not appear to harmonize with this theory

In the view of Bernard, that anæsthesia is due to anæmia of the nervous centres, may be found the most plausible theory of chloroform-narcosis, but it is by no means in harmony with the observations which go to demonstrate that the entire vascular system is paralyzed and all the blood-vessels in the body dilated. This paralysis and consequent dilatation of the blood-vessels are invoked by Schiff to explain the suspension of the heart's action, which, according to him, is due, not to an inhibitory influence of the chloroform directly operating through the nervous system, but to the fact that the increased capacity of the vascular system withdraws from the heart the blood which is the normal and necessary excitor of its movements. It is argued that this view is sustained by the effects which, under the circumstances, are produced by ligatures upon the limbs, by means of which the blood is retained in the trunk and the heart is duly supplied. But it should not be overlooked that this expedient not only restores a due amount of blood to the heart, but also to the brain, and that to the latter influence may be attributed the recovery from apparent death which has been observed in several instances, in man as well as in animals, when they have been so placed that the blood in the trunk gravitated toward the head.

On Man: Chloroform is an irritant, producing redness of the skin when topically applied, and even vesication if its evaporation is prevented. When from 10 to 20 minims of pure chloroform are injected subcutaneously, very considerable pain is experienced, which, however, presently subsides, and is succeeded by a feeling of numbness and by anæsthesia of the adjacent parts; a puffy swelling forms at the seat of the injection, and an induration which remains for several days. The numbness may continue even for a week or more, and in the case of the leg may affect all the region to which the nerve is distributed near which the injection was made (Bartholow). Other observers have noted the persistent induration following the puncture, and have also described gangrene as an effect of it, but they have not spoken of the numbness just referred to. The local phenomena of swelling and inflammation appear to have been due to an imperfect manipulation of the syringe; indeed, one reporter (Féréol) declares that the operation causes no more pain than if water instead of chloroform were injected. The soporific action of chloroform used in this manner comes on slowly, but is curiously prolonged. At least 4 Gm., and sometimes more, of chloroform are necessary to cause sleep even at the end of several hours; it is not accompanied by anæsthesia, the least disturbance sufficing to arouse the patient, but it may last for 6 or 7 hours. The temperature is reduced by 1° or 2° C., and the pulse by perhaps ten beats. The tardy and feeble sleep can only be explained by the very gradual absorption of the chloroform into the blood. A large number of cases of poisoning by chloroform taken into the stomach are recorded (*Am. Jour. of Med. Sci.*, July, 1881, p. 277). In one of recovery a weakly man had swallowed 3 ounces of chloroform (*Practitioner*, xxx. 47). Doses of half an ounce or more produce general convulsions, insensibility, dilated pupils, trismus, foaming at the mouth, slow and stertorous respiration, and lividity of the face. The pulse is feeble, and sometimes irregular. The stools may be bloody and blood may be vomited. Death may result from pulmonary asphyxia alone, or from this together with gastritis. After death the brain is found greatly congested, and the mucous membrane of the air-passages and of the alimentary canal are in a similar condition. The bronchia are filled with mucus tinged with blood or mixed with pus. The blood in the vessels is fluid. A similar condition of the bronchia has been met with in persons who died with suffocative symptoms 1 or 2 days after inhaling chloroform, especially in the old and obese (Richet).

The vapor of chloroform when inhaled slowly is apt to produce excitement, usually of an agreeable sort, with extravagant gaiety and gesticulation. In fuller anæsthetic doses it occasions a sense of warmth and stimulation, radiating from the chest to the extremities, followed by whirring noises in the ears and a sense of numbness throughout the body, soon followed by a complete loss of consciousness. Sometimes consciousness is more or less preserved, while the sense of touch and that of pain are abolished. But, as a rule, sensibility is first suspended, then perception, and finally motility. Sensibility to pain is lost before the sense of temperature or tactile sensibility is greatly impaired. During the full anæsthetic sleep the respiration is at first soporose and quickened, but soon becomes tranquil and slow; the pupil presents all degrees of dilatation; the pulse is at first fuller and more frequent, but subsequently nearly normal; the voluntary muscles are relaxed, but sometimes rigid or even cataleptic; and in females hysterical phenomena occasionally appear.

The question has been raised whether a person could be chloroformed during sleep, the numerous alleged instances of its having been done with criminal intent being naturally open to doubt, and even to suspicion. It is certain that on various occasions the experiment has been tried with the result of awaking the sleepers (Girdner, *Med. Record*, xxiv. 454), but it is equally certain that when conducted with due precautions it has been successful, especially with children. In a girl eight years old an abscess was opened under such circumstances by Curtis in 1873 (*Med. Record*, xxiii. 595). Schauffler (*Kansas City Med. Jour.*, June, 1875, p. 106) removed a pebble from the nostrils of a child that he had chloroformed while sleeping. The experiments of Cercenil in France, although for the most part negative, were in several instances affirmative (*Ohio Med. Recorder*, Jan. 1877, p. 337), and the editor of the journal just referred to says: "Of three attempts at chloroforming during natural sleep of which we were personally cognizant, two were successful." Dr. Quimby also not only accomplished it upon a person forewarned of the intention, but also upon two lads, on one of whom he performed evulsion of the toe-nail, and in the other case opened an abscess in the mouth and extracted several teeth. In both of the latter cases the anæsthetic was administered during the first sleep at night, and neither patient awoke until the usual hour the next morning (*Trans. Amer. Med. Assoc.*, 1880, xxxi. 519). Halderman reports two successful cases as well as several failures (*Med. Record*, xxiii. 594), and Neilson a complete chloroform narcosis obtained during sleep in a boy of ten years, during which the operation of circumcision was performed (*ibid*, p. 595). (For additional illustrations see *Boston Med. and Surg. Jour.*, June, 1883, p. 595, and *Med. Record*, xxiv. 23, 613.)

The advantages of chloroform over other anæsthetics consist in its agreeable odor, the small quantity of it required, its non-inflammability, and the rapidity and completeness of its effects. Its one disadvantage is that it often destroys life. The number of deaths caused directly and exclusively by the administration of chloroform, independently of any error in the mode of its inhalation or in the quality of the agent or any unfitness of the patient, may now be counted by hundreds. A large proportion of them took place during operations which under other circumstances are considered trifling. It seems probable that many of these operations, such as that for strabismus, the extraction of teeth, the opening of abscesses, etc., were performed while the patient was in a sitting posture, and therefore most exposed to the dangers of syncope, which it has been shown is the chief cause of death in chloroform inhalation. No other solution is so plausible of the otherwise singular fact that the danger of chloroform is in an inverse proportion to the severity of the operation performed. Again, the almost complete safety of chloroform inhalation during natural labor lends itself to a similar explanation. The gravid uterus restricts the circulation of the blood in the lower limbs and increases it in the upper portion of the body, and this condition is mechanically exaggerated by the throes of labor, as well as by the mental excitement of the parturient female. On the other hand, in the state of exhaustion and terror which accompanies most of the serious accidents of labor and of operative obstetrics the conditions of safety are reversed, and chloroform becomes peculiarly dangerous. It is maintained by some of those who admit the dangers of chloroform that they do not exist when this agent is employed in operations upon children. It is alleged that their immunity is owing to the absence of that dread of the possible consequences of the inhalation which older persons experience, and to the much greater rapidity with which they fall into the anæsthetic condition. These reasons may be valid in favor of using a safe anæsthetic in operations upon infants and children, but they do not appear to be sufficient to warrant the selection of chloroform for this purpose. It may be stated that the preference given to chloroform over other anæsthetics by European surgeons has been sensibly modified since the death of its introducer, Sir James Y. Simpson, and that professional opinion tends to the point occupied by Schiff, who "considers that chloroform should be banished from practice as an anæsthetic agent, except in cases in which extraordinary resistance to the action of ether shows itself, in which instances it might be allowed to mix a little chloroform with it in order to produce the commencement of anæsthesia, which should afterward be continued with pure ether." Long ago (1858) Snow declared, "I believe that ether is altogether incapable of causing the sudden death by paralysis of the heart which has caused the accidents which have happened during the administration of chloroform;" and Perrin, one of the most earnest advocates of the latter anæsthetic, admits that its dangers are "the result of an accident arising most frequently during an incomplete or untimely administration of it." In 1872, Dr. Thomas Jones, who was for eleven years administrator of anæsthetics in St. George's Hospital, London, wrote: "I have administered chloroform in more than six thousand cases.". . . . "I confess experience has taught me that chloroform, even when most carefully administered, is more dangerous than is generally supposed. If I was unfortunately compelled to take an anæsthetic, nothing would induce me to take chloroform." In 1880, Mr. Osborn, chloroformist to St. Thomas's Hospital, stated, in his report on anæsthetics, "Ether is given in all possible cases because of its undoubted greater safety." And in 1881 it was declared that "there have been *reported* an average of about a death [from chloroform] for every month since the time of its introduction" (Reichert). Citations like these might be multiplied to show that in England and Ireland and on the continent of Europe the use of chloroform as an anæsthetic in surgery is much less general than it was formerly. The deaths directly due to its use—occurring, with one exception, in London alone, and published in the *Medical Times and Gazette* during the four years from 1875 to 1878—amounted to fifteen, and in every case but one the mode of death was by syncope. Such deplorable results ought certainly to be considered seriously by surgeons before they add to the ordinary and inevitable risks of an operation one which no sagacity can foreknow and no skill prevent.

When chloroform is repeatedly used, or employed, as it frequently is, to produce intoxication, it occasions cerebral disorders resembling those caused by alcohol and by morphia. According to Svetlin, this occurs in two forms, of which the most usual may continue indefinitely, as hypochondriasis, melancholy, irritability, moral depravity, the delirium of persecution, or intellectual decay. More rarely the symptoms are acute, lasting for about a week, and characterized by violent delirium, maniacal fury, and hallucinations of sight or hearing. Similar effects have been produced by chloral (*Archives gén.*, Juill. 1883, p. 96). The chloroform habit is as inveterate as the opium habit, and far more pernicious.

Uses.—What has been said above indicates the limits of the uses of chloroform in *surgery* which, in our judgment, experience has established. If the patient is robust and not exhausted, if the anæsthetic is administered to him in a recumbent position, and if its action is restrained within the limits of complete narcotism, its dangers are diminished, but they are not removed, and they cannot always be foreseen.

During pregnancy chloroform has been given with advantage, both by the stomach and by inhalation, to arrest obstinate *vomiting*, but its tendency to relax the mouth of the uterus should restrict its use to cases in which other remedies have failed, and also to the production of the first stage of narcotism only. During *labor* chloroform is indicated by the presence or the imminence of convulsions, by excessive sensitiveness of the maternal soft parts, by irregular and inefficient pains, and by the necessity of manual or instrumental interference. In all operations for the success of which the contraction of the uterus is essential the full anæsthetic action of chloroform is unsafe. Chloroform is contraindicated during labor by great relaxation of the uterus, with a tendency to flooding, and when there is persistent vomiting or acute or chronic disease of the lungs or heart, and especially degenerative changes in the latter. It is worthy of notice that in France chloroform-anæsthesia is far from being accepted by obstetricians, the two professors of obstetrics of the Medical Faculty of Paris, among others, having warmly opposed it (1878). As regards its use for palliating the ordinary pains of labor, its action ought not to go beyond the production of the first, or analgesic, stage, not only because it is sufficient, but also because in the stage of complete anæsthesia the contractile power of the uterus is very apt to be suspended.

Various spasmodic diseases have been favorably influenced by chloroform inhalation. Of these, spasmodic *asthma* is very speedily relieved, but the habit of using the medicine soon lessens its influence. *Tetanus*, traumatic as well as idiopathic, has been cured by it in many instances, and in the tetanoid spasms produced by *strychnia*-poisoning its influence is salutary and has often saved life. It has been used beneficially in *chorea* by subjecting the patient to its moderate operation for an hour or two every day, but in this disease its virtues do not counterbalance its dangers.

In *puerperal convulsions* the advantages of chloroform are very decided. Its inhalation should be commenced as soon as the indications of an impending paroxysm appear, such as restlessness, rigidity of the muscles, a staring expression, etc. *Infantile convulsions*, excited by a reflex irritation proceeding from the teeth, the digestive apparatus, etc., may be promptly allayed by chloroform inhalation, and its use for this purpose does not appear to have been injurious. All pains due to spasm are readily relieved by it, as in painter's and other forms of *colic*, including *biliary* and *nephritic*, *dysmemorrhœa*, *spasms of the bladder*, *rectum*, etc.

It affords prompt relief in paroxysms of *angina pectoris*, but when this affection is associated with heart disease chloroform vapor must be very circumspectly employed.

As a local anodyne the applications of chloroform are as numerous as the seats and varieties of pain. It is very efficient in ointments or liniments made with lard, vaseline, or camphorated oil, or used hypodermically. It may also be applied as an atomized vapor on wads of cotton at the bottom of a cupping-glass or wine-glass, etc. As a topical anodyne and revulsive, chloroform with aconite is particularly useful in *neuralgia* when applied over the neuralgic points upon compresses protected by an impermeable covering. In 1873, Dr. Bartholow published three cases of *tic douloureux*, two of which were alleviated by the deep injection of chloroform, and not temporarily, but for weeks or months. In 1874, Dr. Mattison reported a case with a like issue; in 1877, Dr. Doe related a case of intercostal neuralgia accompanying *herpes zoster* which was relieved by the same method; and Dr. Stedman treated eight cases of different forms of neuralgia and produced a suspension or a marked mitigation of the paroxysms. These cases, all of which occurred in the United States, appear to have suggested a trial of the method in Europe, where it seems to have been first used in Switzerland by Cérenville, and afterward by Besnier in Paris. The latter judged it to be no less efficient than hypodermic morphia as an anodyne. Dujardin-Beaumetz (1879), on the other hand, concluded that it is not comparable to morphia as a local anodyne in *cancer;* that, moreover, nervous patients and those addicted to alcohol experience no general impression from it; and, finally, that in unskilled hands it is apt to cause serious local mischief. Cotton saturated with a solution of camphor in chloroform is one of the best applications for the pain of an *aching hollow tooth*, and rheumatic *toothache* is palliated by bathing the gum with chloroform. Among the many affections for which chloroform is topically useful are *headache*, *rheumatism*, *dysmenorrhœa*, *painful parturition*, *swelled testicle*, the use of the *moxa* and the *cautery*, *painful hæmorrhoids*, etc. In the case of a woman affected with an accumulation of the larvæ of the house-fly in her nostrils, insufflations of calomel and of salt water proving ineffectual, the vapor of chloroform caused the *maggots* to be discharged (*Med. Record*, xvi. 326).

Administration.—No food should be taken by the patient for 4 hours previous to the administration of chloroform, and then in small quantity and of a digestible nature. Immediately before the chloroform is inhaled a draught of brandy or whiskey and water should be given. The first portion of vapor should be largely diluted with air, or, in other words, the full effect of the anæsthetic should be reached gradually in this manner, and not by intermitting its administration. A too rapid inhalation of it tends to produce symptoms of asphyxia. It should always be given by some one who is in the constant habit of using it, and who will attend to it alone (Osborn). Chloroform vapor should be administered by means of a napkin folded into a funnel-shape, and held closely over the nostrils and the mouth during inspiration, yet so as to admit a sufficient supply of atmospheric air; and in every case the patient should be in a recumbent position. To protect the skin of the face from irritation it should first be anointed. The quantity of chloroform used must vary with numerous conditions, but in surgery chiefly with the duration and painfulness of the operation. An intermittent administration prolongs unduly the ante-anæsthetic stage. The best guide is the condition of the pulse and the respiration; if these are normal and unembarrassed, the administration may be continued, provided the pulse warrants it by its strength and regularity. No more chloroform should be administered than is necessary to produce and preserve the requisite degree of anæsthesia. W. R. Williams (*British Med. Jour.*, 1883) lays down as the most important rules: 1. In chloroformization too much air cannot be admitted; in etherization as much as possible should be excluded. 2. The full effects of chloroform cannot be obtained in less than 15 minutes; those of ether are secured in 5 minutes. 3. The epigastrium should be bared, so that the respiratory movements may be accurately watched. 4. The indications furnished by the pulse appear too late to be practically useful. In 1879, Claude Bernard originally suggested the use of morphine to intensify and prolong chloroform-anæsthesia. Its effects were clinically demonstrated by Nussbaum and others, and still earlier by Labbé, who administered hypodermically $\frac{1}{8}$ grain of morphine 15 or 20 minutes before the inhalation of chloroform was commenced, and concluded that this method dispensed with the use of a large amount of chloroform and avoided its dangers (*Annuaire de thérap.*, xxxiii. 56). In 1879, Bossis contended that this method produced complete analgesia without altogether suspending consciousness or the senses of touch, sight, and hearing (*Bull. de thérap.*, xcviii. 476). Finally, Dr. Crombie reported the results of his extensive use of the method in India, where, however, he did not administer the morphine until the inhalation of chloroform had commenced. He fully concurred with previous reporters in regarding it as safer and more convenient than the use of chloroform alone. (For details see *Practitioner*, xxv. 401.) In 1880, Fraser advised the hypodermic injection of $\frac{1}{120}$ to $\frac{1}{60}$ grain of sulphate of atropine and $\frac{1}{12}$ to $\frac{1}{8}$ grain of acetate or hydrochlorate of morphine 15 or 20 minutes before the administration of chloroform is commenced (*ibid.*, xxvi. 210). The hypodermic use of chloroform is certainly efficient, but there are two dangers associated with it: the first is of throwing the liquid into a vein; the second is the production of local inflammation and abscess, and even gangrene. These dangers may be lessened, the former by puncturing the skin with the tube unattached, and waiting to see that no blood escapes from it, the other by avoiding to wound the lower surface of the skin. The dose thus administered has varied from 15 to 60 grains (Gm. 1–4).

There is no medicinal antidote to chloroform. It destroys life more or less gradually by asphyxia or more or less rapidly by syncope. For the former condition artificial respiration is the appropriate remedy. For the latter the essential treatment consists in instantly placing the patient in such a position as will cause the blood to flow into the brain. It has been proposed by Dr. G. E. Sanford (1878) to counteract the dangers of chloroform by administering it mixed with nitrite of amyl, in the proportion of 1 pound of the former to 2 drachms of the latter. After having employed it in a number of surgical operations and obstetrical cases, he arrived at the conclusion that "it seems to be fully as safe as sulphuric ether, and far more pleasant in its administration, possessing all the advantages of pure chloroform, but without its dangers." Burrall refers to nine cases, in all of which impending death seems to have been averted by nitrite of amyl inhaled or injected hypodermically (*Med. Record*, xxi. 235). In some cases the symptoms have been removed by titillating the nostrils with a feather or by the emanations of ammonia (Schirmer); and a case is reported of reaction from alarming syncope induced by swallowing a fluidounce of chloroform "after four half-drachm injections of liquor ammoniæ (*B. P.*)" had been introduced into the veins of the arm. The patient, however, died (*Times and Gaz.*, May, 1871, p. 616). Billroth and many other surgeons endeavor to prevent the dangers of chloroform by diluting it with ether and alcohol. A mixture of 3 parts of chloroform, 1 of sulphuric ether, and 1 of alcohol is often employed. But a death under the use of this mixture occurred to Billroth himself in a case of attempted reduction of a dislocation of the hip-joint (*Boston Med. and Surg. Jour.*, Dec. 1880, p. 649).

CHLORODYNE is the name given to a popular nostrum which is much used for the relief of flatulent colic, and generally as an anodyne. According to E. Smith (1870), its composition is as follows: ℞. Chloroformi ʒiv; morphiæ mur. gr. xx; æther rect. ʒij; ol. menthæ pip. ♏viij; acid. hydrocyan. dil. ʒiv; tinct. capsici ʒvj; mucil. acaciæ ℥j; theriacæ [syr. fusci.] ad ℥iv.—M. Such a combination is often useful, but is too dangerous to be entrusted to ignorant persons.

CHONDRUS, *U. S.*—IRISH MOSS.

Carrageen, P. G.; *Caragahen, Fucus crispus.—Carragaheen, Mousse marine perlée*, Fr.; *Irländisches Moos, Perlmoos, Knorpeltang*, G.

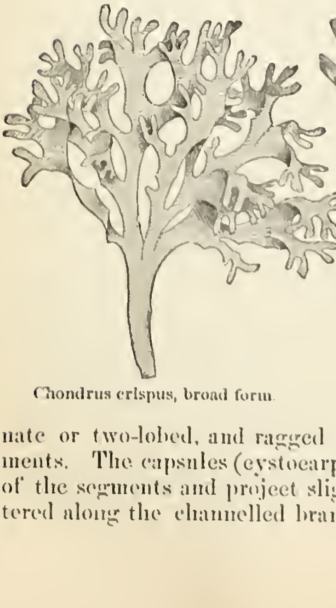
The entire plant, Chondrus (Sphærococcus, *Agardh*, Fucus, *Linné*) crispus, *Lyngbye*, and Chondrus (Sphærococcus, *Agardh*, Mastocarpus, *Kützing*) mamillosus, *Greville*, s. Gigartina mamillosa, *J. G. Agardh.* Bentley and Trimen, *Med. Plants*, 305.

Nat. Ord.—Algæ, Florideæ.

Origin.—These plants grow on rocks of the American and European shores of the Atlantic Ocean, and are collected in the spring on the coasts of New England and Ireland. On the coast of Massachusetts about 15,000 barrels of Irish moss are stated to be annually collected.

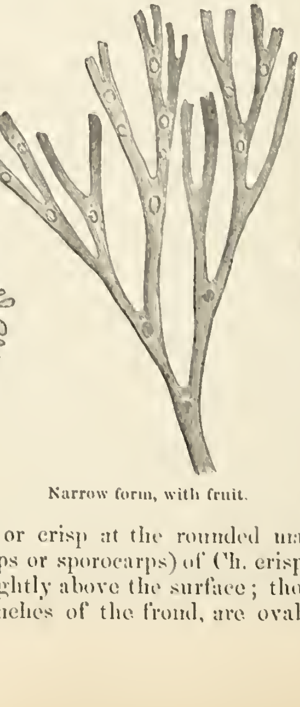
Description.—Both plants are attached to the rocks by means of a small disk. The frond, about 6 to 8 or 12 inches (15 to 20 or 30 Cm.) long, is cylindrical below, repeatedly forked above, flattened, and gradually dilated, acquiring a width varying at the forks between $\frac{1}{8}$ and 1 inch (3 and 25 Mm.), and across the branches between $\frac{1}{12}$ and $\frac{1}{4}$ inch (2 and 6 Mm.); the final lobes are linear or more or less broadly wedge-shaped, emarginate or two-lobed, and ragged or crisp at the rounded margin from newly-forming segments. The capsules (cystocarps or sporocarps) of Ch. crispus are imbedded near the end of the segments and project slightly above the surface; those of Ch. mamillosus are scattered along the channelled branches of the frond, are oval or elliptic, and raised upon a

FIG. 61.



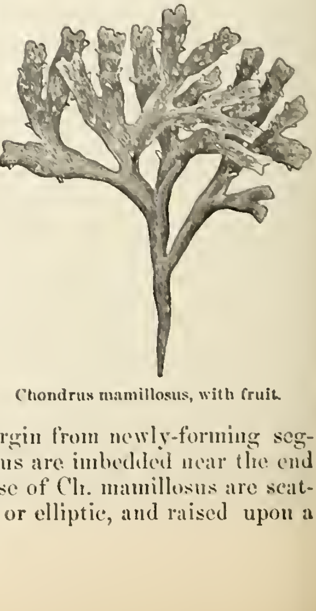
Chondrus crispus, broad form.

FIG. 62.



Narrow form, with fruit.

FIG. 63.



Chondrus mamillosus, with fruit.

short stalk. In the fresh or softened state both plants are cartilaginous, of a brownish or purple, or frequently yellow or green, color. After washing in water and drying in the sun they turn whitish or yellowish, and become somewhat translucent and of a horny appearance. The drug has a slight seaweed-like odor and a mucilaginous somewhat saline taste. 1 part (15 grains) of it boiled with 30 parts (1 fluidounce) of water yields a solution which after cooling forms a thick mucilage; and with 20 parts ($5\frac{1}{2}$ fluidrachms) (or 1 part of the well-dried drug with 30 parts) of water gelatinizes on cooling.

Constituents.—The principal constituent is mucilage, of which Herberger (1834) obtained near 90 per cent., 9.5 of which were soluble in cold water. The mucilage is precipitated by lead acetate, and yields mucic acid on being treated with nitric acid. Flückiger found the mucilage to contain 0.88 per cent. and the whole plant 1.012 per cent., of nitrogen. The same author obtained over 15 per cent., Herberger only 8.8 per cent., of ash, which the latter found to consist of chlorides, sulphates, and phosphates of sodium, potassium, calcium, and magnesium. Grosse detected also traces of iodine and bromine. Church (1877) determined in the air-dry drug 6.4 per cent. of sulphur, a portion of which is present as sulphates; also 9.38 albuminoids, 55.54 mucilage, 2.15 cellulose, 14.15 ash, and 18.78 water. Starch is absent, and the decoction is not colored blue by iodine; yet after treating thin sections of the drug for a day with alcoholic solution of potassa, and then washing with water, the cell-contents, but not the cell-walls, acquire a dark-blue color on being left in contact with solution of iodine (Flückiger).

Admixtures.—Other Algæ are not unfrequently collected with the officinal species, and are in most cases readily distinguished from the latter: those of similar appearance are Gigartina acicularis, *Lamouroux*, with slender cylindrical branches, and Gig. pistillata, *Lamouroux*, with prominently stipitate capsules.

Allied Drugs.—Dulse is the name given to Halymenia (Fucus, *Linné*, Rhodomenia, *Greville*, Sphærococcus, *Kützing*) palmatus and edulis, *Agardh*, two florideous Algæ growing on the coasts of the Atlantic and Mediterranean. Both are of a deep blood-red, or after drying dark-purple, color, and have flattened fronds, that of the first species being palmately divided into oblong, wedge-shaped lobes. Stenhouse (1844) found it to contain mannit, and Magin-Bonet proved the presence of bromine and iodine.

Helminthochorton, Corsican moss. This consists partly of Sphærococcus (Fucus, *Linné*, Ceramium, *Willdenow*, Gigartina, *Lamouroux*, Alsidium, *Kützing*) Helminthochortos, *Agardh*, which grows in the Mediterranean, but as found in commerce is always a mixture, sometimes of twenty or thirty different species of Algæ. The drug is cartilaginous, filiform, repeatedly forked, varies in color between brown, yellowish, and whitish, and has the odor of sea-weeds and a strongly saline and mucilaginous taste. It is known to contain mucilage, gelatinous principles, and various salts, among them bromides and iodides, but its anthelmintic principle, if any, is unknown.

Fucus amylaceus, Ceylon moss, also called *jaffna* and *edible moss*, comes from the Indian Ocean, and consists of Sphærococcus (Plocaria, *Montag*, Gracilaria, *Greville*) lichenoides, *Agardh*. It is about 4, sometimes 8 or 10, inches (10, 20, or 25 Cm.) long, about $\frac{1}{16}$ inch (1.5 Mm.) thick, cylindrical, rather irregularly forked, filiform above, and has in the fresh state a reddish color, but on drying becomes nearly white and rather brittle. It has a slight sea-weed odor and a mucilaginous taste. The latest analysis is by H. G. Greenish (1882), who, besides moisture 15, ash 10.2, albuminoids 7.5, and matter soluble in alcohol 0.1 per cent., determined the absence of mannit and the presence of various carbohydrates differing in their behavior to water and alkalies and in the sugar they yield with acids—namely, metarabin 1.32, and others soluble in soda 3.12; gelose and others soluble in hot water 36.7; paramylon 6.5, wood-gum 3.2, and cellulose 10.2 per cent.

An allied drug is the *agar-agar* of Celebes, which consists of Eucheuma spinosum and E. gelatinæ, *Agardh*, is of a brownish-white color, and has thorn-like projections on the branches. The so-called *Japanese* or *Chinese gelatin* or *isinglass* is prepared from the two Algæ named and from several other species.

Edible birds' nests are the nests of Collalia (Hirundo) esculenta and several other swallows of the Indian Archipelago, and consist of different species of Gelidium and allied sea-weeds after they have been altered in the crop or gizzard of the bird. They contain a large amount of gelatinous matter.

Pharmaceutical Preparation.—Gelatina carrageen, *P. G.*—Irish moss jelly, *E.*—1 part of Irish moss is boiled for half an hour in 40 parts of water; the decoction is expressed, mixed with 2 parts of sugar, and evaporated to 10 parts.—*P. G.*

Carrageen gelatin dried in sheets has been used as a substitute for other fomentations and poultices. A piece of convenient size is placed between two pieces of cotton cloth or flannel, then dipped in hot water, pure or medicated, until it is saturated, and then applied to the skin and covered with waterproof cloth. *Ceylon moss* is identical with carrageen in its qualities.

Medical Action and Uses.—Carrageen is demulcent and slightly nutritious. Its nutritious elements exist in an exceedingly minute proportion. It once had an extensive reputation in the treatment of chronic *bronchial* and *intestinal fluxes* and irritations of the *urinary passages*. The degree of its efficacy in these affections was probably due to its protective qualities, and possibly also to the influence of its iodic constituent upon nutrition, which has generally been admitted, but not demonstrated. The following preparation is agreeable and useful: Irish moss, macerated and washed, gr. xxx; pure water ℥xvj; boil down to one-half and strain with expression, and add white sugar ℥iv; gum-arabic ʒj; powdered orris-root gr. xxx; heat to dryness with a gentle temperature, stirring constantly so as to obtain a pulverulent mass, to which 3 ounces of arrowroot should be added with trituration. To prepare a jelly with this powder, rub a teaspoonful of it with a little cold water and then pour a cupful of boiling water on it (Neligan).

Helminthortocon, as its name indicates, is used as a *vermifuge*, and is given in coarse powder, mixed with honey or milk, in the dose of from 15 to 150 grains (Gm. 1.0–10.0). It is also used, in decoction, for induration of the *lymphatic glands*.

CHRYSAROBINUM, *U. S., Br., P. G.*—CHRYSAROBIN.

Chrysarobine, Fr.; *Chrysarobin*, G.

A mixture of proximate principles extracted from Goa-powder, a substance found deposited in the wood of the trunk of Andira Araroba. *Aguiar.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The *po' de Bahia, araroba* or *arariba* tree, is closely allied to the West Indian cabbage tree (see page 202), and is common in the damp forests of Bahia, Brazil, where it is locally known as *angelim amargoso.* It attains a height of about 100 feet (30.5 M.), has long petioled paripinnate leaves and paniculate racemes of purple flowers with a one-ovuled ovary. It was first described by Aguiar (1879), but Monteiro (1878) had recognized it already as being distinct from Andira anthelmintica, *Bentham*, and from And. vermifuga, *Martius*, known in Brazil as *angelim doce.* According to Peckolt (see ANDIRA), the former, and according to F. M. de Mello Oliveira (1878) both species named, are known in Brazil as angelim amargoso. Oliveira gives *uraréma* as the common name of And. spectabilis, and Martius mentions in his *Materia Medica of Brazil* that the name araroba is given to two species of Centrolobium (C. robustum and C. tomentosum).

ARAROBA is contained in the large porous vessels and in clefts or cavities which traverse the wood in the direction of the diameter and are prolonged through the entire trunk; it is obtained by cutting down the tree, splitting the trunk, and scraping the powder from the clefts, and is seen in commerce as a rough powder or in small irregular pieces, originally of a light-yellow color, but usually darkened by exposure to light and moisture to a dull-ochrey, pale-brown, or even umber-brown or deep-purple color. It has a bitter taste. When carefully heated it yields a moss-like sublimate, which is colored red by alkalies. Formerly it was largely exported from Brazil to Portugal, whence it appears to have been shipped to the Portuguese colonies in Africa and Asia, and from the settlement Goa on the Malabar coast it became known in East Indian pharmacy, and subsequently in European and American, as Goa-powder; its identity with araroba was first pointed out by Dr. Da Silva Lima (1875); the wood to which the powder is attached was found by E. M. Holmes to be very similar to that of Cæsalpinia echinata, *Lamarck*; but J. L. Macmillan (1879) observed that this wood yields its coloring matter to water, while araroba does not. Examined by Prof. Attfield (1875), araroba was found to be free from starch, to leave only .43 per cent. of ash, and to yield to boiling water about 7 per cent. of gum, a glucoside precipitable by lead subacetate, and a bitter principle precipitated by lead subacetate; from the residue benzol dissolves over 80 per cent. of chrysarobin, and alcohol afterward takes up 2 per cent. of resin, leaving 5½ per cent. of red wood-fibre.

Properties.—Chrysarobin is "a pale orange-yellow, crystalline powder, permanent in the air, odorless and tasteless, almost insoluble in water, only slightly soluble in alcohol, readily soluble in ether and in boiling benzol. When heated to about 162° C. (323.6° F.) it melts, and may be partially sublimed. On ignition it is wholly dissipated. In solutions of alkalies it is soluble with a yellowish-red or reddish-yellow color, which is changed to red by passing air through the liquid. Sulphuric acid dissolves it with a deep blood-red color; on pouring the solution into water the substance separates again unchanged."—*U. S.* The dust of chrysarobin is irritating to the eyes and nostrils.

As obtained from araroba by hot benzol, chrysarobin was by Attfield supposed to be chiefly chrysophanic acid, until Liebermann and Seidler (1878) showed it to be mainly a hitherto unknown compound, $C_{30}H_{26}O_7$, for which they retained the name chrysarobin proposed by Attfield. It is a pale-yellow powder, consisting of small wart-like crystals and acquiring on exposure a darker tint. By repeated crystallization from glacial acetic acid it is obtained pure in the form of small yellow scales, which are fusible and partly sublimable, nearly insoluble in water and ammonia, sparingly soluble in alcohol, more freely soluble in amylic alcohol, ether, collodion, chloroform, and various hydrocarbons. It is inodorous and, on account of its insolubility in water, tasteless. Chrysarobin dissolves in concentrated sulphuric acid with a yellow color, is nearly insoluble in very diluted potassa solution, and yields with melted potassa a brown mass. Chrysophanic acid, on the other hand, dissolves in concentrated sulphuric acid and in very dilute potassa solution with a red color, and on being melted together with potassa yields a blue mass. The solution of chrysarobin in strong potassa solution has a yellow color and a strong green fluorescence, and on being agitated with atmospheric air rapidly acquires a red color, through the formation of chrysophanic acid; $C_{30}H_{26}O_7$ (chrysarobin) $+ 2O_2$ yields $2C_{15}H_{10}O_4$ (chrysophanic acid) $+ 3H_2O$.

Tests.—If boiled with 2000 parts of water, chrysarobin should not be completely dissolved; the filtrate should be pale reddish-brown, tasteless, neutral to test-paper, and should not be colored by ferric chloride. Chrysarobin should be almost wholly soluble in 150 parts of hot alcohol. If .001 Gm. ($\frac{1}{64}$ grain) of chrysarobin be sprinkled upon a drop of fuming nitric acid, the red solution extended to a thin layer, and a little ammonia added by means of a glass rod, a violet color should be produced.—*P. G.*

Pharmaceutical Uses.—Chrysarobin, having been at one time mistaken for chrysophanic acid, is still occasionally prescribed by the latter name. It is an ingredient of Unguentum chrysarobini, *U. S.*

Acetum araroBæ, *vinegar of araroba*, is prepared by Da Silva Lima by digesting for a week 25 parts of araroba in 100 parts of diluted acetic acid. When used it may be mixed with glycerin.

Medical History.—In British India, in 1874, attention was called to a secret medicine known as Goa-powder and po' de Bahia, and which was found to be very efficacious in certain chronic diseases of the skin. Investigation showed that it was known in Brazil as araroba, and esteemed as a remedy for various cutaneous affections, and especially for *herpes circinatus*, *chloasma*, and *intertrigo*.

Physiological Action.—It is stated that the irritating effects of araroba on the skin and mucous membranes are such that the workmen employed in cutting up and pounding it are obliged to protect the face, nostrils, and throat against its dust. Gaskoin relates that in treating ringworm of the scalp he first wetted the part thoroughly with lemon-juice or carbolic acid water, and for a few minutes rubbed in the powder, after which the face was apt to become swollen and covered with an ugly brown stain, accompanied by considerable inflammation. This effect was observed oftenest in children. In some cases, although the paste was applied to the hairy scalp only, the whole face and shoulders became stained of a dark purple-gray, which was speedily removed by desquamation. Yet Mr. Squire declares that Goa-powder and chrysophanic acid (chrysarobin) applied to the sound skin occasion no irritation, and that they may be used upon a raw surface as a salutary stimulant. The usual experience with chrysophanic acid (chrysarobin) is that when applied to the face or scalp it is very apt to occasion redness of the eyes and erythema with swelling of the skin, followed by desquamation of the cuticle. The inflammation is sometimes intense and painful, producing a crop of boils and lasting for several weeks. Applied to the broken skin, as in psoriasis, it has been known to excite vomiting. Its absorption was also supposed to be shown when in a case of general psoriasis, although the preparation was applied only to one side of the body, it cured the eruption of the opposite side, which had been carefully wrapped up in cotton wool (Charteris). In the same or a similar case it also occasioned gastro-intestinal symptoms.

Internally, chrysophanic acid is by some alleged to be purgative in the dose of 7 grains (Gm. 0.50). It is stated, however, to be very slow in its operation, which begins only at the end of 24 hours, but may continue for several days, without griping. It is more apt to act at first as an emetic when given to children of twelve years in doses of 6 grains, and to adults in doses of 25 grains, according to Thompson, who adds that chrysarobin is likely to purge and chrysophanic acid to vomit (*British Med. Jour.*, May, 1877, p. 607). A case is reported in which after a 3-grain dose of chrysophanic acid a woman was seized with burning pain in the stomach, vomiting, pain in the bowels, diarrhœa, hæmaturia, and pain over the bladder, with tenesmus (*Glasgow Med. Jour.*, Oct. 1881). It is probable that the substance taken was not chrysophanic acid merely.

Medical Uses.—The use of Goa-powder in *ringworm of the scalp* is thus described by Dr. Fayrer: A few grains of the powder are mixed with common vinegar or lemon-juice to about the consistence of cream, and with it the eruption is painted over, as well as the skin a little distance beyond its margin. It causes no pain at first, but in the course of a few hours there is a sensation of a dull, heavy nature, the eruption becoming white, while the surrounding skin is stained of a dark color. The sense of uneasiness soon passes away, the integument resumes its natural color, and all traces of the disease disappear at the same time. In chronic cases the process of cure is necessarily more gradual. Da Silva Lima has verified these statements, and also tested the virtues of the application in an obstinate case of *mentagra*, in which he twice a day applied to the roots of the affected hairs, by means of a camel's-hair pencil, an ointment composed of 20 grains of araroba-powder, 10 drops of acetic acid, and an ounce of benzoin ointment.

Chrysarobin has been oftener used in the treatment of *psoriasis* than of any other disease of the skin. When Goa-powder was employed, 1 part of it was mixed with 3 of lard, and applied with friction twice a day for 6 successive days. An ointment made with from 10 to 60 grains (Gm. 0.60–4) of chrysarobin to an ounce of lard may be applied to the patches only with a mop night and morning, after removing the scales with warm water. It should not be used on the face and head, on account of the discoloration of the skin it produces.

To prevent irritation of the sound skin, a paste made by adding only a small quantity of water to the acid may be applied to the patches alone, and when dry it may be covered by a film of collodion, which will preserve it for several days (Fox). Continued experience in the use of chrysarobin has not increased confidence in its virtues. Besides the objectionable discoloration and inflammation of the skin produced by it, the eruption, after being cured, is apt to break out anew and more extensively (Jarisch, *Centralbl. f. Therap.*, i. 14). These conclusions are confirmed by Morrow (*Amer. Jour. of Med. Sci.*, Apr. 1883, p. 565). Napier claims that cases of psoriasis which had resisted arsenic and external applications were cured by chrysophanic acid administered in pills containing half a grain each of the preparation. At first, one was given after each meal, and the dose gradually increased until signs of gastro-intestinal disturbance occurred. In one case 9 grains a day were taken without trouble. In nearly all the cases the improvement of the skin disease was marked and rapid (*Practitioner*, xxix. 132). Externally, the medicine has proved its efficacy in the treatment of contagious or parasitic *ringworm*, and is more or less useful in that of *herpes tonsurans*, *herpes circinatus*, *chronic lichen*, and the *ephilides* of pregnancy. It seems to possess no special virtues in pityriasis, acne, eczema, or tinea versicolor.

Administration.—Originally, Goa-powder was made into a paste with a little vinegar or lemon-juice and smeared over the eruption daily for several days. Afterward an ointment was used containing from 10 to 60 grains (Gm. 0.60–4) of the powder, or of chrysophanic acid (chrysarobin) melted together with an ounce of lard. The officinal chrysarobin ointment is preferable. Better still is probably the gelatin mixture proposed by Pick, containing from 5 to 15 per cent. of chrysarobin. Its action can be confined to the affected spot (Jarisch, *loc. cit.*).

According to Liborius, a tincture made from the fibres of a Siamese plant, Rhinacanthus communis, which contains chrysarobin, may be used to cure *ringworm*.

CICHORIUM.—CHICORY.

Succory, E.; *Chicorée*, Fr.; *Cichorie*, G.

The root of Cichorium Intybus, *Linné*.

Nat. Ord.—Compositæ, Cichoreæ.

Origin.—Chicory is a perennial herb indigenous to Europe and the Levant and extensively naturalized in North America. The stem is about 3 or 4 feet (.9 to 1.2 Mm) high, with spreading branches. The leaves are oblong or lanceolate, the lowest lyrately runcinate, the upper one sessile, clasping, toothed, or entire. The flower-heads are in axillary clusters of two or three, have a double involucre, blue or whitish ligulate, and five-toothed florets and striate akenes, with a chaffy pappus. It flowers from June to October. The root should be collected late in autumn or early in spring.

Description.—The root of the wild plant soon becomes woody; that of the cultivated plant remains fleshy and has a thicker bark. It is several-headed, 10 to 12 inches

(25 to 30 Cm.) long, somewhat branched, longitudinally wrinkled, light-brown externally and whitish internally. The bark is rather thin, white, radially striate from the dark-colored milk-vessels and by a brown cambium-line separated from the finely porous yellow wood, marked by fine medullary rays and one or more annual layers. The root is inodorous and has a mucilaginous and bitter taste. From 3,500,000 to 4,000,000 pounds of chicory are annually imported into the United States from Europe. It is not unfrequently sold as dandelion-root, from which it is distinguished by its lighter color, its thinner bark, and its radiating milk-vessels. Much of it is used for the adulteration of coffee.

Constituents.—Chicory-root contains, besides the ordinary constituents of vegetables, inulin and a bitter principle which has not been isolated. The cultivated root, collected in the beginning of July, was found by Dragendorff to contain 36 per cent. of inulin. This principle being readily saccharified by the influence of diluted mineral acids, chicory-root has recently (1882) been proposed as a source of alcohol, which is said to be easily obtainable in a state of purity and possessed of a pleasant aromatic taste. Nietzki (1876) separated from the flowers a crystalline colorless glucoside, which he found to be insoluble in ether, freely soluble in hot water and alcohol, and with a golden-yellow color in alkalies.

Allied Species.—Cichorium Endivia, *Linné*—Endive, *E.;* Scarole, *Fr.;* Endivie, *G.*—is a native of the Levant and cultivated for salad. The leaves are obovate and finely toothed, the upper ones lanceolate and entire. The blue flowers are axillary, one head being on a long and three or four on a short peduncle.

Medical Action and Uses.—Chicory is thought to increase the appetite, promote the digestion, and stimulate the liver—in a word, to operate very nearly as dandelion is supposed to act. Its excessive use is alleged to occasion venous congestion of the abdominal organs, the brain, and the organs of the senses. In this manner it has been accused of causing amaurosis. The fresh young plant is generally eaten, like endive, as a salad in the spring season, as a "purifier of the blood"—*i. e.* as a promoter of the secretions of the liver, bowels, and kidneys. Even from ancient times it has been recommended in cases for which dandelion is commonly used, including those of *feeble digestion* with flatulence, constipation, and light-colored stools—a condition supposed to denote torpor of the liver. It is alleged to have cured *intermittent* fevers which quinia failed to arrest, especially when engorgement of the liver and spleen was present, with general dropsy. It is also asserted to have been useful in chronic diseases of the *skin*, particularly in those of a gouty origin. Chicory-root dried, roasted, and reduced to a coarse powder has a close resemblance to ground coffee, and is extensively used for mixing with the latter or for fraudulently adulterating it. To those who are not aware that the proper flavor of coffee depends upon its aromatic volatile oil, and who measure its strength by its bitterness, the substitution of chicory can work no disappointment or injury. Very probably an infusion of chicory taken at meals as a substitute for coffee would be preferable to the latter on the score of health, and it is still more probable that pure water would be more wholesome than either; but such facts furnish no reason why the public should be deluded into believing that in drinking an infusion of chicory they are using a true substitute for coffee.

CICUTA.—WATER-HEMLOCK.

Cowbane, E.; *Cigüe vireuse*, Fr.; *Wasserschierling*, G.

The herb of Cicuta virosa, *Linné*, s. Cicutaria aquatica, *Lamarck*. Bentley and Trimen, *Med. Plants*, 119.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Water-hemlock is a native of the northern section of the northern hemisphere, and is found in America from Canada northward. It grows in swamps and wet places, has a short, thick, rather ovate, hollow rhizome beset with circles of thin rootlets, and flowers from July to September.

Description.—The stem is about 40 inches (1 M.) high, hollow, often purplish. The leaves are on sheathing petioles, bright-green, and smooth, triangular-oblong in outline, twice or thrice pinnate, the leaflets opposite, narrow lanceolate, narrowed at both ends, sharply serrate, and the teeth with whitish points. The umbels are large, compound, the flowers small, white, and the fruit subglobose, laterally flattened, with thick corky ribs, and six oil-tubes in each mericarp, the two on the face being very thin. The herb has a slight aromatic odor and a somewhat aromatic and acrid taste.

Constituents.—Polex, Wittstein, and Buignet have observed the presence of a volatile alkaloid, *cicutine*, which, however, according to Van Ankum (1868), does not exist in the root. The fruit yields about $1\frac{1}{4}$ per cent. of a volatile oil which was proved by Trapp (1858) to be identical with oil of cumin. *Cicutoxin* is a tenacious, non-drying, amorphous, resinous principle in bright yellow drops, which is contained in the resinous cortical zone of the rhizome. It was isolated by Van Ankum, and further examined by Boehm and Trojanowski (1877); it is insoluble in petroleum benzin, but dissolves readily in alcohol, ether, and chloroform; also in hot water and in alkalies. The dried root yields about 3.5 per cent. of it.

Allied Plants.—Cicuta maculata, *Linné*—*Spotted water hemlock*, *Spotted parsley*—is a common perennial of North America, and is distinguished by its elongated, fleshy, tuberous roots, the purplish spotted stem, and the broader leaflets. Its properties are similar to those of the preceding species. J. E. Young (1855) obtained from the fruit a volatile alkaloid which he regarded as being identical with *conine*.

Sium latifolium, *Linné*—*Water-parsnip*—is a European perennial, probably indigenous to California: the nearly-allied S. lineare, *Michaux*, which is a native of North America, has been often mistaken for it. Another poisonous species, S. angustifolium, *Linné*, is indigenous to Europe and North America. The subterraneous portion of the California plant was examined by A. R. Porter (1876), who found in it an aromatic volatile oil, and attributed its poisonous properties to a resinous body. These results were in the main confirmed by N. Rogers (1876), who in addition obtained a non-poisonous volatile alkaloid resembling Wittstein's *pastinacine;* but according to Porter, this is probably ammonia.

Œnanthe crocata, *Linné* (Bentley and Trimen, *Med. Plants*, 124)—*Water-dropwort* or *dead-tongue*, also known as *water-hemlock*—is a European perennial, with fleshy fusiform roots containing a yellow juice, roundish-obovate, wedge-shaped, lobed, or toothed leaflets, and oval-oblong fruits, which are crowned with the long erect style, have thickened lateral ribs and six oil-tubes in each mericarp. *Œnanthin*, an acrid and emetic principle, was observed by Gerding (1849) in Œnanthe fistulosa, *Linné*, and is probably an impure alkaloid.

Physiological Action.—It is only since 1876 that the source and operation of the poisonous elements of this species have been rendered clear by the investigations of Boehm. Before that date it was well known that the root of the fresh plant is its most active part, although the stalk and leaves are scarcely less poisonous. Administered to dogs, the root is found to cause salivation, vomiting, diarrhœa, and tetanoid convulsions, followed by resolution; in man it produces essentially the same effects, with the addition of syncope and strabismus. A child six years old, having eaten some of the root of this plant, suffered from burning pain in the stomach, lost sensation and consciousness, expelled his urine forcibly, and then was seized with violent tetanic convulsions, with grinding of the teeth, strabismus, and bleeding from the ears. Death occurred within half an hour. In various fatal cases it is reported that the gastro-intestinal mucous membrane was inflamed, and even ulcerated and gangrened; but it is possible that these appearances, if they existed, were due to the mechanical irritation of the ingested root. Certain it is that in a recent fatal case no lesions of the sort were found (Trojanowski). More important is the extreme engorgement of the lungs and of the right side of the heart, and to a great extent of the brain also, which always occurs—a fact which denotes that the agent is a heart-poison.

It was long since demonstrated that the oil in which this plant abounds is destitute of poisonous qualities, and that, on the other hand, they are fully possessed by the alcoholic resinous extract. They appear to depend upon a principle which has been called cicutoxin (Trojanowski). It is so slowly absorbed from the digestive organs that full 20 minutes elapse after the administration of a fatal dose before its characteristic effects begin to appear. It does not produce any irritation of the fauces or of the stomach. When injected hypodermically it acts still more slowly than by the stomach. It is partially absorbed by the intact skin of frogs. Injected into the veins of animals, its operation is almost instantaneous.

Injected subcutaneously in frogs in the dose of from 1 to 3 Mg., in from 20 minutes to $1\frac{1}{2}$ hours *cicutoxin* produces tonic and clonic convulsions alternately, and if the animal dies it is in a state of complete resolution. Meanwhile, the respiration is very hurried, the inspiratory so far exceeding the expiratory act that the animal becomes distended with air. During the spasms the heart's action is suspended in diastole. In mammals poisoned by cicutoxin the first symptom, occurring in about half an hour, is profuse salivation, with signs of distress, presently followed by a slight quivering or jerking of the muscles, which passes into violent spasm if the animal is irritated. Breathing grows very rapid and signs of suffering are manifested, when suddenly violent tonic and clonic spasms supervene, with frothing at the mouth from the agitation of the saliva; the respiration is suspended by spasm of the respiratory muscles, the urine is violently expelled by a similar action of the abdominal muscles, and the heart acts so violently that its impulse may be heard at the distance of several feet. After a minute or two the spasms subside, and the animal lies exhausted and breathes deeply, or walks staggering until overtaken by a fresh paroxysm, which still further restricts the function of the lungs, and death by asphyxia and convulsion takes place. With smaller, non-lethal doses there may be no convulsion, but only wandering spasms of the muscles over all the body.

Medical Uses.—This plant, in consequence partly of its poisonous qualities, and partly because its efficacy is not established, is hardly ever used internally. It is said to be employed by the Kamschatdales as a topical adodyne in *rheumatism*, and others have applied it for a similar purpose in *gout* and *neuralgia*.

CICUTA MACULATA.—A case is reported of poisoning with the root of this plant, mistaken for angelica. The symptoms were delirium; cold skin; pulse 46, thready, and scarcely perceptible; vomiting of blood and mucus; a haggard and pale countenance; and complete prostration. Recovery took place after the internal and external use of stimulants and the hypodermic injection of morphia (*Med. News*, xl. 524). Linnæus ascribed narcotic qualities to Sium latifolium, and it has been used to treat diseases of the skin. Œnanthe crocata has been the cause of a great many cases of poisoning in Europe, where its root is apt to be eaten by mistake for that of parsnip, celery, radish, carrot, etc. Hogs, cows, and horses have frequently been killed by it. It excites a burning pain in the throat and stomach, nausea and vomiting, and sometimes purging, vertigo, delirium, coma, and violent convulsions, with trismus and bloody foam on the lips, while consciousness and sensibility are lost. Respiration is labored, the face cyanosed, the pupils dilated, the pulse small. Death occurs in asphyxia, with convulsions. The bruised root has been applied to hæmorrhoidal swellings. In poisoning by any of these plants the stomach should be emptied at once by emetics, and anæsthetics and narcotics used to control the spasm. (Compare Leme, 1857, and Falck, 1880.)

CIMICIFUGA, *U. S.*—CIMICIFUGA.

Cimicifugæ rhizoma, s. *Actææ radix*, Br.—*Black snakeroot, Black cohosh*, E.; *Racine d'actée à grappes*, Fr.; *Schwarze Schlangenwurzel*, G.

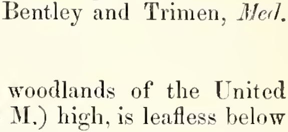
The rhizome and rootlets of Cimicifuga racemosa, *Elliott*, s. Cim. Serpentaria, *Pursh*, s. Actæa racemosa, *Linné*, s. Macrotys actæoides, *Rafinesque*. Bentley and Trimen, *Med. Plants*, 8.

Nat. Ord.—Ranunculaceæ, Acteæ.

Origin.—A perennial herbaceous plant growing in rich woodlands of the United States and Canada. The slender stem is 6 to 8 feet (1.8 to 2.4 M.) high, is leafless below and above, and bears near the middle several large, petiolate, thrice-ternate leaves, with ovate-oblong, acute, and deeply-toothed leaflets. The white flowers are in terminal racemes 8 to 12 inches (20 to 30 Cm.) long, have small clawed two-horned petals, numerous stamens on slender filaments, and usually one pistil, producing a dry capsular fruit containing many flat seeds. It flowers in June and July and ripens its fruit in September, after which time the rhizome should be collected.

Description.—The rhizome is about 2 inches (5 Cm.) long, and 1 inch (25 Mm.) thick, horizontal, somewhat flattened, with distinct nodes and numerous stout branches, the remains of overground stems, which are upright or curved upward, and increase the length of the underground portion to 6 inches (15 Cm.) or more. These branches are somewhat annulate by the prominent nodes, and are, according to their age, either hollow or have a cup-shaped, flat, or even convex, termination; like the rhizome, they are hard and tough, and break with a slightly fibrous nearly smooth fracture. The rootlets originate mainly from the nodes, are 6 to 10 inches (15 to 25 Cm.) long, the older ones $\frac{1}{4}$ inch (6 Mm.) in diameter near their place of attachment, mostly about $\frac{1}{12}$ inch (2 Mm.) thick; when dry of a wiry appearance, obtusely quadrangular, and longitudinally wrinkled; brittle, and break with a short fracture. The color of the fresh rhizome and root is dark-brown, becoming purplish-black or brown-black after drying, the stem-remnants of a grayish tint. It has a slight but heavy odor and a bitterish and acrid taste. As met with in commerce, the rootlets, and often also the rhizomes, are much broken.

FIG. 64.



Cimicifuga racemosa: transverse section through a branch of the rhizome and through rootlets.

The transverse section of the branches shows a large central usually dark-colored pith, which is surrounded by numerous almost linear wood-bundles, the whole being covered by a rather thin, firm bark. The rhizome itself has irregular-shaped wood-bundles and a thicker bark. The rootlets have a thick dark-colored bark and a white woody meditullium, projecting with from five to two rays into the former; the largest number of rays is near the base, and gradually diminishes toward the tip of the rootlets.

Constituents.—Tilghman (1834), J. S. Jones (1843), and G. H. Davis (1861) analyzed black snakeroot, finding starch, some tannin, gallic acid (?), resin, a little volatile oil, and other widely-diffused principles. F. H. Trimble (1879) found tannin to be absent; a principle which is colored green-black by ferric chloride is not a glucoside, and the white precipitate of the aqueous infusion, after having been washed with water, is not colored by ferric salts; the portion of the resin which is precipitated by lead acetate yields a crystallizable acid. T. E. Conard (1871) obtained a crystalline principle which is insoluble in benzin, oil of turpentine, and bisulphide of carbon, slightly soluble in ether and water, and freely in chloroform and diluted and strong alcohol; its alcoholic solution has an intensely acrid and sharp taste. It was obtained from the fresh root by exhausting it with alcohol, precipitating the tincture with subacetate of lead, removing excess of lead by sulphuretted hydrogen, evaporating the alcohol, washing the residue with benzin and water, and crystallizing the undissolved portion from alcohol after decolorizing with aluminium hydrate. It appears to be a neutral principle. It was isolated by L. F. Beach (1876) from the so-called *cimicifugin* or *macrotyn*, which is prepared by precipitating a concentrated tincture of cimicifuga with water.

Off. Prep.—Extractum cimicifugæ fluidum, Tinctura cimicifugæ, *U. S.*

Medical Action and Uses.—Cimicifuga appears to depress the nervous and vascular systems, in that it occasions, in large doses, vertigo, dimness of vision, nervous tremors, depression of the pulse, and more or less nausea, with increased pulmonary and cutaneous secretion. It was originally employed in the treatment of chronic pulmonary diseases, and particularly of *chronic bronchitis* with profuse purulent expectoration. In *chorea* independent of definite local disease there is no doubt of its efficacy when administered so as to produce its specific effects. Probably it is most useful in rheumatic chorea, since it has proved to be an efficient remedy for acute *articular rheumatism* when freely administered. It is also excellent in muscular rheumatism, and especially in *lumbago*. That it exerts a powerful impression upon the uterine system is rendered probable by the relief it affords to the symptoms of pelvic congestion which often are present during the decline of the *menstrual function*, and by its curing many cases of atonic *amenorrhœa* when its administration is duly prolonged. It is also alleged to be useful in the treatment of *seminal emissions.*

The average *dose* of cimicifuga is represented by 20 grains (Gm. 1.30) of its powder. This form is seldom used, a decoction or the fluid extract being preferred. The latter is officinal; the former may be prepared by boiling for a short time an ounce (Gm. 32) of the bruised root in a pint of water. 1 or 2 fluidounces may be given at a dose. The tincture is the least eligible of its preparations, but may be given in the dose of 30 to 60 minims.

CINCHONA, *U. S.*—CINCHONA-BARK.

Cinchonæ cortex, Br.; *Cortex chinæ*, P. G.—*Peruvian bark*, E.; *Quinquina*, Fr.; *Chinarinde*, G.

The bark of any species of Cinchona containing at least 3 per cent. (3.5 per cent., *P. G.*) of its peculiar alkaloids, *U. S.*; containing the peculiar alkaloids of the bark, *Br.*

Officinal Kinds.—1. CINCHONA FLAVA, *U. S.*; Cinchonæ flavæ cortex; Cortex chinæ calisayæ; Cinchona calisaya, Cortex chinæ regius, China regia.—Yellow Cinchona, Calisaya bark, *E.*; Quinquina calisaya, Quinquina jaune royal, *Fr.*; Calisayarinde, Königschina, *G.*

The bark of Cinchona Calisaya, *Weddell* (containing at least 2 per cent. of quinine). Weddell, *Hist. Nat. des Quinq.*, plates 3, 3 *bis*, and 28; Bentley and Trimen, *Med. Plants*, 141.

2. CINCHONÆ PALLIDÆ CORTEX; Cinchona pallida, *U. S.* 1870; Cortex chinæ fuscus; China fusca, s. grisea, s. pallida, s. cinerea.—Pale cinchona, Pale Peruvian bark, Loxa bark, Crown-bark, *E.*; Quinquina gris de Loxa, *Fr.*; Braune (Graue) Chinarinde, Loxarinde, Kronchina, *G.*

The bark of Cinchona officinalis, *Hooker*, s. C. Condaminea, *Humboldt et Bonpland*

(*Plant. æquinoct.*, i. 33; Bentley and Trimen, *Med. Plants*, 140), and of Cinch. micrantha, *Ruiz et Pavon* (*Flor. Peruv.*, ii. 52).

3. CINCHONA RUBRA, *U. S.*—Cinchonæ rubræ cortex, *Br.;* Cortex chinæ ruber, China rubra.—Red cinchona, Red Peruvian bark, Red bark, *E.;* Quinquina rouge, *Fr.;* Rothe Chinarinde, *G.*

The bark of Cinchona succirubra, *Pavon* (containing at least 2 per cent. of quinine). Pavon, *Nueva Quinologia;* Howard's *Illustrations*, plate 9; Bentley and Trimen, *Med. Plants*, 142. The Br. P. now directs the bark of the stem and branches of cultivated plants.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Origin.—The genus Cinchona, as at present constituted, consists of about thirty-one or thirty-six species, all of which are indigenous to South America, from 10° north latitude to 19°, or probably 22°, south latitude. It follows the eastern slope of the central chain of the Andes from the southern limits, beginning in Bolivia, through Peru; and from about 2° south latitude in Ecuador, it occupies also the eastern slope of the western chain of the Cordilleras until by two narrow belts it enters the highlands of New Granada, whence it spreads north-east and northward into Venezuela, to the neighborhood of Caracas and in proximity to the Caribbean Sea. The climate in which the most valuable species are found is, according to Karsten (1858), characterized by a rainy season lasting for 9 months, heavy rains falling principally during the night and alternating with sunshine and fog through the day; during the remaining 3 months the temperature frequently sinks in the night to below the freezing-point, but reaches in the daytime 25° C. (77° F.), producing dense fogs. The mean annual temperature of these regions is 12° to 13° C. (about 55° F.). The less valuable species are found in regions in which the moisture is less evenly distributed throughout the year, and in which the mean temperature is higher, rising, according to Martius (1863), to about 20° C. (68° F.).

The cinchonas are not met with in the valleys; the lowest altitude observed by Karsten was at the northern limits of the cinchona region, where the valueless Cinch. barbacoensis, which is not a true cinchona, is at an elevation of 100 M. (330 feet). Caldas gives the highest limits at 3270 M. (10,700 feet), Karsten at 3500 M. (11,500 feet). The really valuable species, however, according to Weddell, grow at an altitude of 1600 to 2400 M. (5300 to 7900 feet); an exception is C. succirubra, which descends to about 700 M. (2300 feet). They are confined within about 11° to the north and south from Loxa, beyond which limits the barks are of little or no value. The most southern species is Cinch. australis, *Weddell*, the most northern ones Cinch. tucujensis, *Karsten*, and C. cordifolia, *Mutis*. All grow in the primeval forests either singly or with but few specimens together.

The cinchonas are evergreen trees or shrubs, most of the valuable species attaining a height of from 40 to 80 feet (12 to 24 M.). Their laurel-like opposite leaves have deciduous stipules, are entire at the margin, and vary in shape between lanceolate and roundish obovate, occasionally with a heart-shaped base. The petiole and the leaves are often purplish or red while young or before falling, and most of the valuable species (Cinch. succirubra is an exception) are pitted (scrobiculate) on the lower side in the angles formed by the prominent midrib with the lateral veins. The fragrant flowers form terminal panicles, and have a tubular often soft-hairy corolla, with the margin divided into five spreading lobes, and of a white-rosy or purplish color. The small five-toothed calyx crowns the ovate or oblong two-celled capsular fruit, which splits from the base upward to the persistent short calyx margin, and contains many flat and winged seeds. With several allied genera they constitute the tribe Eucinchoneæ, which is characterized by the valvate præfloration, and with the two genera Cascarilla and Remijia they form a group in which the dehiscence of the fruit is septicidal and the placentas are found upon the middle of the dissepiments, the principal distinction of the two genera being the dehiscence of their capsules from the apex downward. Most of the species are variable in their foliage and in other characters, and easily produce hybrids; hence the species form more or less distinct varieties, and are connected with one another by intermediate forms. The most important medicinal species are—

CINCH. CALISAYA, *Weddell*, discovered by Weddell (1847), a stately tree, is found in Bolivia and Peru, between 17° and 13° S. lat., at an altitude of 1500 to 1800 M. (5000 to 6000 feet), and has an ovate smooth capsule about ⅖ inch (10 Mm.) long. At a higher elevation it forms the shrubby variety Josephiana, and in Bolivia is seen the variety boliviana, which has the lower surface of the leaves purplish. Several other varieties are distinguished, including C. Ledgeriana, which by some botanists is regarded as a hybrid or even as a species, and the bark of which has attracted much attention for its richness in alkaloids.

C. OFFICINALIS, *Hooker filius*, the first species discovered by La Condamine (hence the name Condaminea), is a tree of about 15 M. (50 feet), and is found in Ecuador and Peru, principally near Loxa; its oblong capsules are ribbed and $\frac{1}{2}$ to $\frac{4}{5}$ inch (12 to 20 Mm.) long.

C. MICRANTHA, *Ruiz et Pavon*, and C. SCROBICULATA, *Humboldt et Bonpland*, are trees 10 and 20 M. (33 and 65 feet) high, met with in Peru, between about 13° and 4° S. lat.

C. SUCCIRUBRA, *Pavon*, 15 to 25 M. (50 to 82 feet) high, has oblong smooth capsules 1 or 1$\frac{1}{4}$ inches (25 or 31 Mm.) long, and is chiefly confined to the western declivity of Chimborazo, but is found south to Northern Peru.

The barks of the above species constitute the officinal cinchona-barks. Several other species yield barks which are consumed in the manufacture of the cinchona alkaloids.

From his observations made in the cinchona-plantations of Java and the Himalayas, O. Kuntze (1878) endeavored to reduce the numerous recognized species of cinchona to four typical forms, regarding all others as hybrids; and he finds this view supported by the fact that hybrids capable of perpetuation by seed are known to exist in the plantations; his four species are named: I. C. Weddelliana = C. Calisaya, *Weddell*, in part (and perhaps C. glandulifera, *Ruiz et Pavon*); II. C. Pavoniana = C. micrantha, *Weddell* (and perhaps C. nitida, *Ruiz et Pavon*); III. C. Howardiana = C. succirubra, *Pavon* (and perhaps C. purpurea, *Ruiz et Pavon*); and IV. C. Pahudiana (as characterized by Howard).

Regarding Kuntze's views of the other species, we indicate here the supposed derivation of the best-known ones only: C. pubescens, *Vahl*, is a hybrid of III. and IV.; C. officinalis, *Hooker*, of II. and I.; C. pitayensis, *Weddell*, of II. and I.; C. cordifolia, *Mutis*, of III. and IV.; C. lancifolia, *Mutis*, of III. and I.; and C. scrobiculata, *Humboldt et Bonpland*, of II., I., and II.

Karsten unites Cascarilla, Buena, and Remijia with the genus Cinchona as a sub-genus, Ladenbergia, and groups nearly all true cinchonas in the sub-genus Quinquina, the two sub-genera being united by his sub-genus Heterasca, in which the capsules are dehiscent both from the base and apex, and which, among others, contains Cin. micrantha.

Collection and Commerce.—The great distance from populous districts at which the cinchonas are found renders it necessary to undertake expeditions of several months' duration. The *cascarilleros* (from *cascara*, the bark) are mostly Indians and half-breeds, a number of whom unite in gangs, each being under the direction of a magistral or mayor-domo and in the employ of speculators or of companies. Supplied with provisions, they undertake the journey over the mountains during the dry season, and locate their camp near a stream, where they frequently plant maize and beans as an additional supply of food during their protracted stay. A rude shed or hut is constructed in which the collected bark is dried, and the cascarilleros search for the trees, which they recognize either from the dry leaves and fruits on the ground or at a distance by their foliage and flowers. The trunk of the tree and the large roots just beneath the ground are then stripped of their bark, after it has been loosened by previously beating it with a mallet, by which in some cases (Calisaya) the corky layer is almost completely removed. The tree is then felled with an axe, and the climbing plants and adjacent trees which may support the cinchona are likewise cut, after which the peeling is completed and the bark carried, often for considerable distances, to the camp, where it is completely dried. The bark of the branches is simply exposed to the sun and rolled up into single or double tubes or quills, but the thick bark of the trunk, after some exposure, is often piled up in layers, crossing each other at right angles, and heavy weights are placed on the top. By this arrangement the curving or quilling of the pieces is prevented. In some places in New Granada the fresh bark is placed upon hurdles under a shed and dried by means of a fire made on the floor. (For further particulars see the interesting account of "A Visit to the Cinchona Forests of South America," by H. L. Wellcome, in *Proc. Amer. Phar. Assoc.*, 1879, pp. 814–830.)

After a superficial examination for the purpose of rejecting the bad bark, the remainder is assorted according to its size and made into bundles, which are sewn up in coarse canvas. These bundles, weighing about 150 pounds, are finally transported to the dépôts in the towns, where they are enclosed in fresh hides, which on drying contract and make a firm and compact package, the so-called *seroon*. Cinchona-bark is also frequently shipped packed in bales and in wooden boxes. The principal ports of exportation of the officinal barks are—for Calisaya bark, Arica, and to some extent Islay, in Peru; for the pale bark, Payta in Peru; and for the red bark, Guayaquil in Ecuador. Callao, on the coast of Peru, the shipping-port of Lima, exports also considerable quantities of cinchona-bark. The Colombian (New Granada) barks are exported from Santa Marta and Savanilla, formerly also from Carthagena, and some bark collected in Venezuela is shipped from Puerto Cabello. During the years 1875–82 the average annual importation of all kinds of cinchona-barks into the United States was over 4,500,000 pounds.

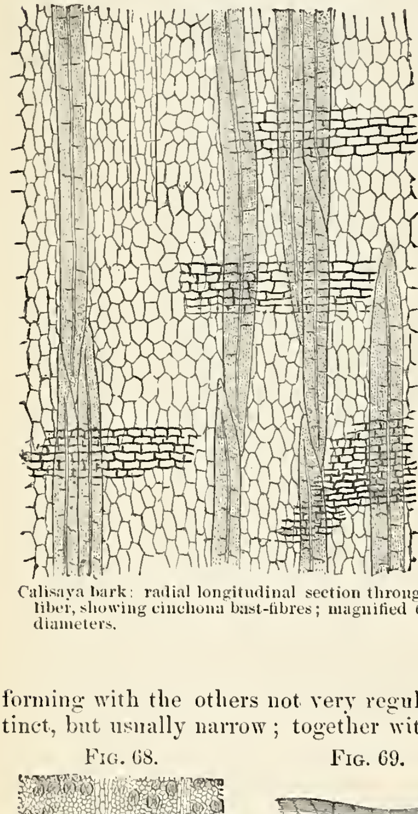
For the collection of cinchona-barks in India several methods are in use. One, known as *mossing*, originally recommended by Karsten (*Deutsche Flora*, p. 1201), and introduced by MacIvor, consists in removing rather narrow longitudinal strips of the bark, and then covering the trunk with moss, when the bared portion will again become covered with bark, frequently richer in alkaloids than the unmossed bark. Another method is that of *coppicing:* the trees are cut down above the root and deprived of the bark, while the remaining stumps again produce shoots, from which bark may be collected after the lapse of about 8 years; a portion of the roots may then also be used for the collection of bark (*uprooting*). A third method is that of *shaving*, introduced by Moens in 1880, and consisting in the removal and collection of the outer layers, leaving a sufficiently thick layer of the inner bark to preserve the vitality of the tree. Shaved cinchonas have been attacked in Ceylon by a stag-beetle, a species of Lucanus, and mossed trees in Bengal have suffered from the destruction of the young bark by ants and other insects.

Commercial Terms.—The word *quina* (pronounced *gheena*) in the language of the Peruvian Indians signifies bark, and *quina-quina* a medicinal bark, the term being originally applied to other barks. It is equivalent to the Spanish *cascarilla*, the diminutive of *cascara*, by which name the cinchona, with many other barks, is known in South America and in Spain. From the former word comes the French *quinquina* and the German *china*, by which terms the cinchona-barks are known in those countries. As the barks of different species are collected, they are in the first place distinguished as *quilled* or *flat* according to the manner in which they were dried; and, secondly, by some striking peculiarity, principally the color. The color of the external layer necessarily varies with the age of the bark and with the presence or absence of lichens and other cryptogamous plants. The fresh inner surface is always light-colored, but becomes darker on drying; it is always distinct in color from the natural surface, and in the bark of branches is invariably lighter than in the trunk-bark. The commercial terms used in this country are—at least for the unofficinal barks—almost altogether geographical ones, and refer to the town in which the dépôt was situated or to the port from which it was shipped. Lima, Huamalies, Huanuco, Jaen, etc. barks are sent from Peru; Loxa and Guayaquil barks, from Ecuador; and Bogota, Pitaya, Carthagena, etc. barks, from Colombia (New Granada). Since the cultivated cinchonas in India and other countries have commenced to yield valuable bark, this is now also frequently found in the market, and is, as a rule, distinguished by the botanical name of the species and the manner of production. (See below, under *Cultivation.*)

General Physical Description.—The shape of the commercial bark depends upon its treatment during the drying process, as described above. The South American quilled bark is usually much broken and quite irregular in size; the flat barks are rather more uniform, though their original size, about 18 inches (45 Cm.) in length and 4 inches (10 Cm.) in width, has mostly been considerably reduced through repacking and long transportation. These remarks apply also to the curved pieces of trunk-bark. But the cultivated bark is generally seen in rather uniform quills. The corky layer of the branch-bark, unless this is quite young, is usually more or less cracked. The surface of the bark of old wood is influenced in appearance by the presence or absence of the corky layer, which in some species is easily detached. The inner surface, if not torn, always presents a striate appearance, which is coarser or finer according to the relative thickness of the bast-fibres and their arrangement; the immature barks of very young branches have a slimy appearance upon the inner surface. The size, arrangement, and relative number of the bast-fibres impart to the transverse fracture its peculiar character, and the almost complete absence of these in younger barks causes them to break with a smooth fracture. The density of cinchona-barks varies considerably, but, according to Arnaud (1881), is in most cases less than that of water; Calisaya and Pitaya barks, however, are slightly heavier than water.

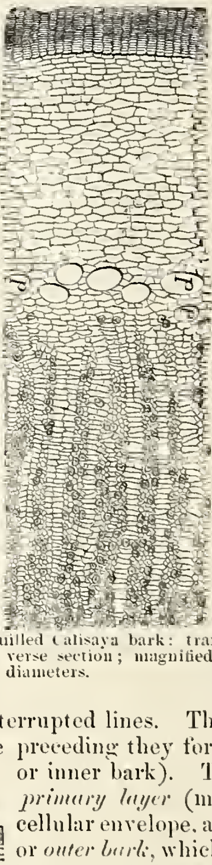
General Structural Characters.—The most important characteristics of cinchona-barks are due to their bast- or liber-fibres, which are never branched, are rather short, with their ends obtusely pointed, of a rather quadrangular appearance upon the transverse section under the microscope, showing the secondary deposits of the cell-walls.

FIG. 65.



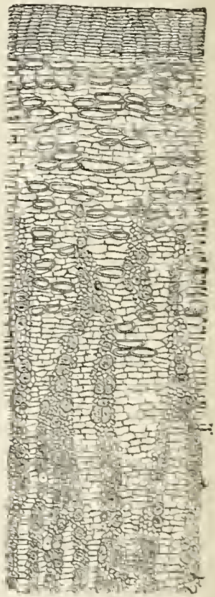
Calisaya bark: radial longitudinal section through liber, showing cinchona bast-fibres; magnified 60 diameters.

FIG. 66.



Quilled Calisaya bark: transverse section; magnified 30 diameters.

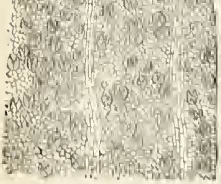
FIG. 67.



Bark of Cinchona lancifolia, with numerous thick-walled cells in the outer bark and outer bast-layer; magnified 30 diameters.

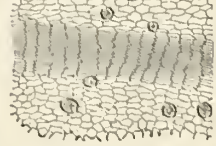
by which the central cavity has been almost closed. They present some distinctions in their arrangement as seen upon the transverse section. In some species they are grouped together to the number of four to six, rarely more; in others they form single or double radial rows, four to ten in number; in others, notably in Calisaya, nearly every bast-cell is entirely distinct from the others, and is separately imbedded in the bast-parenchyma, forming with the others not very regular interrupted lines. The medullary rays are distinct, but usually narrow; together with the preceding they form the *liber* (endophlœum or inner bark). The liber is covered by the *primary layer* (middle bark, mesophlœum, cellular envelope, and green layer of authors) or *outer bark*, which consists of parenchyma; in some of the species (C. Calisaya, succirubra, scrobiculata, officinalis) one or two irregular rows of *laticiferous ducts* (or vessels—lacunæ of Pereira) are found just outside of the bast-rays; these ducts are thin-walled, rather short, not anastomozing, upon transverse section subcircular, and occasionally more or less filled with delicate cells, and they are observable even in old barks, unless the primary bark has been destroyed by secondary cork. Some species have in the primary bark laterally-elongated cells with thickened walls, either scattered or in groups; some of these *stone-cells* contain a brown mass of resinous aspect; others are filled with granular crystals containing calcium oxalate; hence they have been sometimes distinguished as *resin-cells* and *crystal-cells*. The epidermis is never present in the commercial bark; its place has been taken by a thinner or thicker *corky layer*, the primary cork (or epiphlœum). In some species, like Calisaya, bands of thin-walled suberous tissue, or *secondary cork*, penetrate into the primary, and even into the bast-layer, of the bark, throwing off the outer tissues and remaining as the outer covering of the bark—Mohl's rhytidoma, the periderm of Wed-

FIG. 68.



Flat Calisaya bark: section through inner layer; magnified 30 diameters.

FIG. 69.



Flat Calisaya bark: section through outer layer, showing secondary cork; magnified 30 diameters.

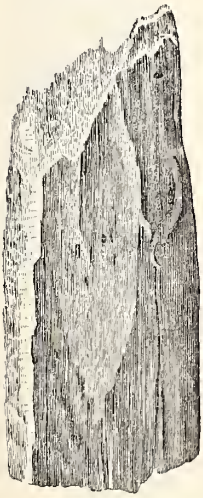
dell and others. The distinction between these tissues is neglected by some authors, but the formation of secondary cork evidently tends to obliterate characteristics observed in young barks.

General Chemical Characteristics.—All cinchona-barks contain astringent and alkaloidal principles, but they are present in very variable proportions. Grahe (1858) showed that if about 10 grains of the bark are heated in a test-tube characteristic red vapors are evolved, which condense in an oily carmine-red liquid. Cinchona-barks which have been deprived of their alkaloids by treatment with dilute acids do not show this reaction, but ligneous tissue which has been impregnated with a solution of cinchona alkaloids yields the sublimate; and the reliability of the reaction is increased, according to Hesse, by incorporating an alcoholic tincture of cinchona with powder of the same bark. This reaction, in connection with the presence of cinchona bast-fibres, noticed above, may be regarded as conclusive proof of the genuineness of cinchona-barks, in the absence of the peculiar bast-fibres, merely as evidence of the presence of cinchona alkaloids; for Flückiger (1871) observed a white bark which contained cinchona bast-fibres and an alkaloid (*paytine*), but yielded a brown tarry instead of a red oily sublimate; and the latter is obtained from *cuprea-bark* (see below), which contains cinchona alkaloids, but is destitute of cinchona bast-fibres.

Description of the Officinal Barks.—1. CALISAYA BARK is met with in quills and flat pieces. The quills are either single or double, and vary considerably in length, and between $\frac{1}{2}$ inch and 2 inches (1 and 5 Cm.) in diameter. The bark is from $\frac{1}{16}$ to $\frac{1}{8}$ inch (1.5 to 3 Mm.) thick, and covered with a grayish cork in which longitudinal and transverse fissures are observed. They are about 1 inch (25 Mm.) apart, and form irregular meshes with raised edges, frequently enclosing shorter transverse and oblique cracks. The corky layer is readily removed, leaving the impressions of the meshes upon the cinnamon-colored primary bark as lightly elevated lines corresponding to the deeper cracks. The inner surface is cinnamon-brown, darker than the primary layer, and finely striate from the bast-fibres. Occasionally quills are observed with the outer surface formed by a layer of secondary cork, which is brown, rather smooth, and has fine transverse fissures.

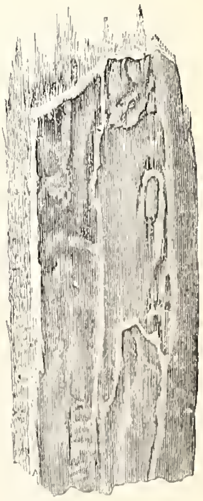
Flat Calisaya is met with in pieces occasionally 15 inches (38 Cm.) long, 3 to 5 inches (7 to 12 Cm.) broad, and from $\frac{1}{6}$ to $\frac{2}{5}$ inch (4 to 10 Mm.) thick. The external layer of secondary cork is very rarely present, except as small irregular dark-brown patches which line the shallow longitudinal depressions, the so-called *conchas* of the cascarilleros or *digital furrows* of Pereira and others. Otherwise, the entire bark consists only of bast-layer, is of a bright-rusty cinnamon-brown color, and has the inner surface closely and uniformly marked with fine often wavy striæ.

FIG. 70.



Calisaya bark: showing digital furrow and short fibrous fracture.

FIG. 71.



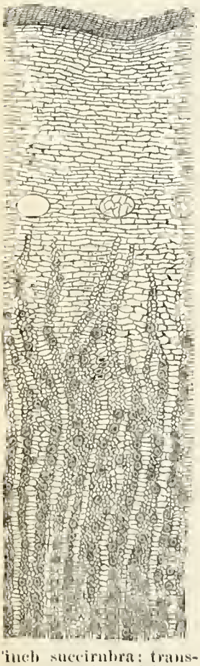
Bark of Cinch. scrobiculata.

The structural characteristics (see figs. 65, 66, 69) of the bark are found in the one or two rows of large laticiferous ducts outside the bast-layer, which are present only in young bark, in the almost total absence of stone-cells, and in the single bast-cells. Secondary cork is soon formed, and penetrates obliquely into the bast, thereby throwing off the primary bark and laticiferous ducts, and after its removal leaving the conchas. In the young and old bark the bast-fibres are, with occasional exceptions, singly imbedded in the bast-parenchyma, and show radially, and still more tangentially, an imperfect arrangement in rows. The disposition of the bast-fibres, their fineness and brittleness, permit them to be easily detached and to penetrate the skin on handling the flat bark; in the same way may likewise be explained the short, fibrous transverse fracture of the bark.

The flat Calisaya bark of commerce is often found mixed with flat pieces of the bark obtained from the variety boliviana (see *Origin*). It is distinguished by being thinner, with the conchas more shallow and numerous, and by showing upon the longitudinal and transverse fracture large whitish spots. It agrees with the bark of the typical form in anatomical structure, but occasionally the secondary cork is found to penetrate the primary bark-layer only, leaving the laticiferous ducts present, and it has a portion of the bast-fibres arranged in but slightly interrupted radial lines; its transverse fracture is therefore more fibrous. Similar in physical appearance to Calisaya bark, but breaking with a long fibrous fracture, are the barks of Cinch. scrobiculata and C. lancifolia; they have for this reason been known as *fibrous Calisaya bark*. The tissue of both barks is of a reddish-yellow tint, and contains in the outer portion numerous large stone-cells. The scrobiculata-bark has the inner bast-fibres in nearly uninterrupted radial lines, and contains on the margin of the bast-layer a circle of laticiferous ducts. The lancifolia-bark has the bast-fibres in interrupted single or double radial lines, often forming groups, and accompanied by axially elongated but transversely narrow stone-cells, called *staff-cells;* laticiferous ducts are absent; the cork, if present, is soft and scaly, gray or whitish.

2. Pale Cinchona.—Loxa bark is found in commerce in quills which vary very much in size and appearance. The thinnest bark has a nearly smooth and but slightly wrinkled surface; the older and somewhat thicker bark is marked by at first rather distant, finally more approximate, transverse sometimes annular fissures, and with longitudinal wrinkles or slight wart-like corky ridges. Aside from the variously-colored lichens, which are frequently present in patches, the external surface varies in color from dark brown-gray to blackish-brown, and the finely-striated inner surface between pale-brown and reddish-brown. The bark breaks with a smooth fracture, which is somewhat fibrous in the inner layers and of a light yellowish-brown color. The quills or double quills are usually much broken, though pieces a foot (30 Cm.) or more in length are sometimes met with.

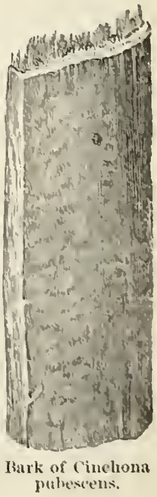
Fig. 72.



Cinch succirubra: transverse section of bark: magnified 30 diameters.

In structure Loxa bark is characterized by thin laticiferous ducts, which are found only in very young bark, and by the arrangement of the bast-fibres in interrupted radial rows. The bark of Cinch. micrantha has no laticiferous ducts, and the bast-fibres are either single or in scattered groups of two or three; the cork of the young bark is always of a brown-gray color, and has the transverse fissures less prominent.

Fig. 73.



Bark of Cinchona pubescens.

3. Red Cinchona-bark is met with in quills and flat pieces. The former are often from ½ to 1 inch (12 to 25 Mm.) in diameter, with the bark about ⅛ inch (3 Mm.) or less thick. The outer surface of even very young bark shows a somewhat netted arrangement, which becomes plainer in older bark, the long meshes being formed by confluent corky warts. The suberous layer is of a brown-gray color, and of a darker gray-brown to rust-brown in older barks; the inner layers and inner surface are of a cinnamon-brown, in thicker quills of a more or less deep red-brown or brown-red color. The bark breaks with a short fibrous fracture.

The bark of old wood is termed flat, but is often in curved pieces 2 to 4 inches (5 to 10 Cm.) in width and ½ inch (12 Mm.) or less in thickness. It shows the characteristics described, except that the bark throughout is of a deeper red color, the inner surface more closely striate, and the suberous layer thicker, very warty and firm, sometimes longitudinally fissured, more or less scaly, rather soft and spongy.

Its structural characteristics are a row of laticiferous ducts, and in the inner bast-layer narrow medullary rays and radially-arranged bast-fibres in interrupted lines.

Unofficinal Cinchona-Barks.—A large number of commercial varieties have appeared in the market, made up frequently of the barks of different species, and therefore difficult to characterize. This difficulty is greater with the small quills, but even the old barks of botanical varieties of the same species often present considerable differences in their physical and histological characters. We shall give brief descriptions of the most important varieties:

Pitaya bark is in flattish or curved pieces about ¼ inch (6 Mm.) thick, covered with a nearly smooth, soft, brownish ochre-colored cork, marked with nearly circular scars; the bast-layer is of a bright reddish-cinnamon color, and breaks with a short splintery fracture. The powder is of a brighter yellow tint than that of Calisaya bark. It is derived from Cinch. pitayensis, *Weddell*, and is valuable for the manufacture of quinine and quinidine.

Cusco bark comes, partly at least, from Cinch. pubescens, *Vahl*, and is in pieces similar to the preceding; but the corky layer is pale brown-yellow or whitish and warty, the bast-layer cinnamon-colored, and the fracture smooth on the outside and coarse splintery in the inner layer. Some varieties yield the alkaloid *aricine*. A red-colored variety of this species is called *China rubiginosa*.

Carthagena bark is in flat or usually curved pieces, occasionally in quills, with a pale ochre-yellow or whitish soft cork, often with somewhat glossy patches, internally of a dull-reddish or orange-cinnamon color, often interspersed with fine white dots of crystal cells; fracture, long or short fibrous. It is derived from Cinch. lancifolia, *Mutis*, the latter from Cinch. cordifolia, *Mutis*. The China rubiginosa of European writers is partly referred to a variety of the former species having a deeper red color. The bark is much used in the manufacture of quinine.

Lima or Huanuco bark is generally a mixture of the quilled branch-barks of Cinch. peruviana, *Howard*, C. nitida, *Ruiz et Pavon*, and C. micrantha, *Ruiz et Pavon*. and perhaps of other species; the bark of the last mentioned is the most valuable of the three. The physical qualities must necessarily vary with the predominance of the different species. The same remark applies also to *Huamalies bark*, to which Cinch. micrantha, glandulifera, purpurea, *Ruiz et Pavon*, and other species contribute, and to the various *gray barks* of commerce.

The structural characteristics of cinchona-barks, as described above, vary in the different species, and may be briefly stated as follows:

1. Bast-fibres single, occasionally in groups of two, or rarely more:

C. Calisaya.—No stone- (or resin-) cells, but laticiferous ducts in young bark. Secondary cork in old bark; bast-fibres of medium thickness; medullary rays narrow.

C. glandulifera.—Very few stone-cells; laticiferous ducts in one or two rows; bast-rays narrow; bast-fibres of medium thickness; medullary rays large celled.

2. Bast-fibres occasionally single, more frequently in groups of three or more:

C. micrantha.—Few or no stone-cells; no laticiferous ducts; medullary rays narrow; bast-fibres of medium thickness, in groups of two and three, and in older barks of five to eight.

C. purpurea.—Numerous stone-cells; laticiferous ducts in one or two rows; medullary rays narrow and broadly wedge-shaped; bast-fibres of medium size, some larger, in groups of three to five, intermixed with some incomplete fibres.

C. pubescens.—Stone-cells numerous; laticiferous ducts in one row; medullary rays rather broad; bast-fibres variable, large, in groups of two and three, intermixed with incomplete fibres or staff-cells.

3. Bast-fibres in interrupted single, or occasionally double, radial lines:

C. succirubra.—No stone-cells; laticiferous ducts in one row, in old bark often filled with cells; bast- and medullary rays narrow; bast-fibres medium, in lines of two to five, and occasionally eight.

C. officinalis.—No stone-cells; laticiferous ducts thin, soon obliterated; medullary rays narrow; bast-fibres medium, in somewhat irregular lines of two to four.

C. pitayensis.—Few or no stone-cells; no laticiferous ducts; medullary rays with wedge-shaped opening; bast-fibres uniform, thin, in mostly single lines.

C. cordifolia.—Few stone-cells; no laticiferous ducts; medullary rays large celled; bast-rays narrow, the nearly uniform fibres in single or rarely double lines of two to four, with some incomplete fibres or staff-cells.

C. lancifolia.—Stone-cells numerous; laticiferous ducts none; medullary rays large celled; bast-rays rather narrow, the fibres medium and thicker, in single and double lines of two to four, intermixed with incomplete fibres (staff-cells).

C. nitida.—Few or no stone-cells; no laticiferous ducts; medullary rays narrow; bast-fibres thin, with numerous others of medium or thick size, in single, or some double, lines of two to four.

C. peruviana.—Stone-cells present, small; laticiferous ducts small, in one row; bast-fibres small, varying, many incompletely filled, single or in double lines of two to six.

4. Bast-fibres in nearly uninterrupted radial lines:

C. scrobiculata.—Stone-cells numerous; laticiferous ducts in one or two rows; medullary rays large celled; bast-fibres very numerous, in but little interrupted single, or occasionally double, lines.

The structural peculiarities of cinchona-barks are, to some extent, influenced by the local conditions of growth, more particularly as regards exposure to or protection from the sunlight. This influence becomes more marked in the artificially-protected (*mossed*) bark of the Eastern plantations, and still more in the second and third crops of (*renewed*) barks, in which the modifications of the parenchymatous tissue are very considerable, while the arrangement and characteristics of the bast-fibres are likewise subject to striking changes.

Allied Barks.—So-called *spurious cinchona-barks* are now rarely if ever met with in commerce. They were mostly obtained from trees belonging to the genera Cascarilla, Ladenbergia, Nauclea, and Exostemma; some of these are quite similar to cinchona-barks in appearance, while others have not the slightest resemblance to them. In those barks most nearly allied to the cinchona a cinchona bast-fibre is occasionally met with, but nearly all the bast-fibres have large central cavities. Others (Nauclea) have the thin fibres nearly filled up, but regularly arranged in radial and tangential rows. Grahe's test—and, more reliable still, the microscope—will at once prove their distinctiveness.

Spurious cinchona-barks—which, however, are very valuable for the manufacture of quinine—are the *cuprea* or *copper-colored barks*, a name given to them by Flückiger (1870) on account of their dull copper-red color. Samples of this bark were noticed in London in 1820, and occasionally it was observed as an admixture to the soft bark of Cinchona lancifolia; at the present time it is imported in large quantities, both from the central and southern parts of Colombia, along the eastern chain of the Andes. The bark from the former region was ascertained by Triana (1882) to be derived from Remijia Purdieana, *Weddell*, and R. (Cinchona, *Karsten*) pedunculata, *Triana*. It is in quills or curved pieces with a brown-red inner surface, externally with fragments of gray or brownish cork, and copper-red in the interior; the transverse fracture is coarsely granular, the longitudinal fracture rather splintery; the transverse fracture shows thick-walled cork-cells; sometimes scattered laticiferous ducts, many transversely elongated stone-cells, both in the outer bark and bast-layer, and in the latter numerous wavy medullary rays and radial lines of closely-packed, thin, elongated, obtuse bast-fibres, with the central cavity usually large; these bast-rays are less numerous in the inner than in the outer portion of the liber. The bark is very compact, hard, and heavier than water; that from Southern Colombia is denser, more compact, and shows a more horny fracture. Cuprea-bark varies considerably in the amount of alkaloids, which in bark from high elevations sometimes reaches 3 per cent. or 2 per cent. of quinine, the balance being quinidine and cinchonine; De Vrij (1882) obtained even 5.9 per cent. of alkaloids (Flückiger). Hesse first pointed out the entire absence of cinchonidine; and his observations have been confirmed by Howard and others. Cuprea-bark from Southern Colombia contains cinchonamine; Planchon (1882) found this bark to be free from laticiferous ducts and stone-cells, and the inner layer of the outer bark to be formed of laterally-elongated parenchyma.

Fraudulent red barks have been offered which had been made by exposing inferior cinchona-barks to ammonia, whereby cinchona-red is produced. Such barks were found by Thomas and Guignard (1882) to be deep-red in the parenchyma, to have pale-yellow bast-fibres, to yield red-colored infusions and decoctions, and these to give brown-red precipitates with Nessler's reagent, while the infusion of normal cinchonas gives a white precipitate with the same reagent; the chloroplatinate precipitate was found to contain 22 per cent. Pt, while that with the cinchona alkaloids contains only between 16.8 and 17.8 per cent. of this metal.

PINCKNEYA PUBENS, *Michaux*, s. Cinchona caroliniana, *Biret*, is a small tree growing in swampy localities from South Carolina to Florida. The bark is employed as a tonic and febrifuge under the name of *Georgia bark*. Dr. Farr claims having detected a considerable amount of cinchonine in the bark (Porcher, *Resources*, p. 442), which is probably incorrect, though the plant is likely to contain an alkaloid.

CROSSOPTERYX FEBRIFUGA, *Bentham*, s. Cross. Kotschyana, *Fenzl*, is a tree of tropical Africa having febrifuge properties, and, like the preceding, belonging to the sub-order Cinchoneæ. Hesse (1879) isolated from the bark .018 per cent. of an amorphous white alkaloid, *crossopterine*, which is easily soluble in alcohol, ether, and ammonia, and yields bitter salts. The aqueous infusion of the bark shows blue fluorescence, which disappears on acidulation with sulphuric acid, and even after boiling reappears on the addition of an alkali.

Cinchona-Culture.—La Condamine (1738) noticed the reckless destruction of the cinchonas in South America, and after him most scientific men who had visited the cinchona region corroborated his statements. As early as 1792 the cultivation of cinchonas was suggested by Ruiz, and since 1837, Fritze, Blume, Miquel, and others advocated their transplantation to Java, while Royle (1839) pointed out certain districts in India as suitable for the cultivation of the plant. La Condamine's collection of living cinchonas and seeds was lost; Weddell (1848) procured considerable quantities of seeds, mostly of C. Calisaya, which germinated at the Jardin des Plantes in Paris, the seedlings being afterward sent to Algeria and some to Java.

Weddell's *Histoire naturelle des Quinquinas* (1849) was the means of directing the attention of the Dutch government more prominently to this subject. Pahud, the colonial minister of Holland, selected Carl Hasskarl, previously director of the botanical garden at Buitenzorg, Java, who left Holland Dec. 4, 1852, to procure seeds and plants from Peru. His first collection of 50 plants remained through an oversight in Panama, and was afterward returned to Lima, but the seeds reached Holland and yielded a number of seedlings, which were sent to Java. A collection of 400 plants of C. Calisaya was transported amid many difficulties to the sea-coast, there packed in Wardian cases, and shipped Aug. 21, 1854, from Callao to Batavia, where, notwithstanding every care, only 46 plants arrived Dec. 13 in a good or partly sickly condition. They were planted a short distance from Batavia at an elevation of 4700 feet. In 1855, Junghuhn arrived there from Holland with 139 seedlings, nearly half of which perished, and when Hasskarl resigned in 1856 there were only 251 living cinchonas in the plantations. Junghuhn (died 1864) established plantations in more favorable localities, but ripe seeds were not obtained until 1858. Propagating from seeds and cuttings, there were toward the close of 1863 nearly 1,160,000 cinchonas in the plantations, not quite one-half of which number had been planted in the open air. Only 1.1 per cent. of the plants belonged to the more valuable species. The remaining one was Cinch. Pahudiana, *Howard*, a rapidly-growing species yielding a handsome-looking bark, which, however, contained but 0.2–0.7 per cent. of quinine, 0.8 cinchonidine, and a total of 1.4–4.8 per cent. of alkaloids. Since De Vrij had undertaken frequent assays of the barks of the different species grown under different conditions, the cultivation of the less valuable ones was abandoned by K. W. Van Gorkom, who succeeded Junghuhn, and by the close of 1876 nearly 2,000,000 cinchonas, not counting C. Pahudiana, were planted in the open air in the government plantations, and of this number 1,142,715 were C. Calisaya (including C. Hasskarliana). At present these plantations are in charge of J. C. B. Moens.

In the mean time, Boyle, Falconer, and others had again urged the introduction of the cinchonas into India, and, after several unsuccessful attempts to procure good plants and seeds through the British consuls on the west coast of South America, the British government decided in 1859 to organize an expedition under the direction of Clements Robert Markham, embracing all the districts of the most valuable species. Aided by John Weir, Markham explored the border-land of Peru and Bolivia, April and May, 1860, and collected 529 plants, 497 of which belonged to different varieties of C. Calisaya, the remainder to C. ovata and C. micrantha. 63 of this number perished during the transportation to the coast, 456 being shipped from Islay in Wardian cases June 24. Owing to the jealousies of the population and the obstacles raised by the Bolivian government, he was unable to return to the districts for the purpose of collecting seeds, which do not ripen before August. (See Markham's interesting work, *Peruvian Bark*, London, 1880.)

Richard Spruce undertook the collection of plants and seeds from the red bark districts (C. succirubra) in Ecuador, in the forests of Chimborazo, where he arrived in June, and was joined near the end of July by Robert Cross, who collected a large number of cuttings and young plants, and with these and the seeds gathered by Spruce embarked at Guayaquil Jan. 2, 1861. Plants and seeds in the neighborhood of Huanuco were collected by G. J. Pritchett, who embarked from Lima in Sept., 1860, mainly with specimens of C. micrantha and nitida. The government having neglected to provide for their direct transportation to India, the shipments were made by way of Panama to England, and thence through the Red Sea to Bombay. The plants, and particularly those collected by Markham, suffered considerably from various delays and from the hot weather encountered during a part of the journey; but those in charge of Cross mostly arrived in good condition, as also did the seeds collected by the explorers mentioned, and those obtained on a second journey undertaken by Cross in 1861 to the neighborhood of Loxa.

The first cinchona-plantation in India was established in the south-west, in the Neilgherry Mountains, near Ootacamund, at an elevation of 7000 feet. Under the care of William Graham McIvor (died 1876), who made many valuable observations on the cultivation of the different species, this was soon extended, so that in this district alone there were in 1866 over 1,500,000 cinchonas, besides those which had been distributed to or raised by private parties. While here C. officinalis appears to be the most valuable, C. succirubra and Calisaya succeed better in the Himalaya Mountains in Sikkim, where the cultivation was commenced in 1862. Plantations were also formed in Ceylon (1861), in Punjab (1864), and other portions of India. Since 1867 these barks have appeared in European commerce, and recently they are also met with in the United States. The packages of the Indian bark are always made up from the same species cultivated under the same circumstances, so that the *unmossed*, *mossed*, and *renewed* barks are never mixed. This distinction is due to McIvor, who proved that under an artificial covering of moss the bark of certain species becomes thicker and richer in alkaloids, and also that trees which have been partly peeled will under a covering of moss rapidly *renew* the bark.

Attempts at the cultivation of cinchonas have been made in many countries and islands, and have been partly abandoned. Of some importance is the experiment made in Jamaica where the plants were introduced late in 1861; the cultivation on a large scale, however, was not commenced until 1868, and under the care of Robert Thomson had in 1876 extended over 300 acres, the plantations being situated in the Blue Mountains at an elevation of from 4000 to 6000 feet, with a variation of temperature between about 50° and 70° F. The officinal species, C. Calisaya, succirubra, and officinalis, are mainly cultivated here, and since 1880 cinchona-bark has been sent into the market from Jamaica. The same species appear also to be cultivated to some extent near Cordova, Mexico, where seeds were distributed in 1866; at least, Hugo Finck exhibited (1876) handsome specimens of these barks and sections of the trees. The cultivation of cinchonas has been also commenced on a limited scale in Bolivia (Wellcome, *loc. cit.*, p. 828).

It is not unlikely that the cultivation of the above-mentioned valuable species of Remijia may be extended to many countries where the cinchonas cannot be profitably raised.

Constituents.—(1) ALKALOIDS. Cinchona-barks contain one or more of four alkaloids, which, according to their composition, form two groups—namely, *quinine* and *quinidine* $= C_{20}H_{24}N_2O_2$, and *cinchonine* and *cinchonidine* $= C_{19}H_{22}N_2O$. Gomes of Lisbon (1812) obtained a crystalline body without recognizing its chemical relations; its basic properties were discovered by Houton-Labillardière (1820), and Pelletier and Caventou found in its two alkaloids, which they named quinine and cinchonine. Henry and Delondre (1833) obtained from a red-colored bark a distinct alkaloid, which they named *quinidine*, and which constituted, most likely, the greater portion of Van Heijningen's *betaquinine*, obtained (1849) from chinoidine, and of the *cinchotine*, which Hlasiwetz (1850) found in the alcoholic mother-liquor of cinchonine. Quinidine is identical with the *conchinine* of Hesse (1869), but the latter considers Henry and Delondre's alkaloid to have been chiefly cinchonidine. F. L. Winckler (1847) separated from Maracaibo bark an alkaloid which he likewise called quinidine, but which Pasteur (1853) proved to be distinct from the former and named *cinchonidine*. Pasteur's nomenclature has been adopted not only in France, but also in England and America; until recently several German writers, however, followed Winckler, and to some extent Hesse's nomenclature is employed in Germany.

Pasteur observed that by fusing the alkaloids of either group in the presence of acids they are converted into the amorphous bases *quinicine* and *cinchonicine*, which have the composition of the alkaloids from which they are obtained.

The bark of C. succirubra, cultivated in Sikkim, was found by Hesse (1872 and 1877) to contain also two other alkaloids, *quinamine*, $C_{19}H_{24}N_2O_2$, and *paricine*, $C_{16}H_{18}N_2O$. The latter is pale-yellow, amorphous, when fresh soluble in ether, and converted into a dark-green resinous mass by strong nitric acid. The same acid yields a dark-green solution with *aricine*, $C_{23}H_{36}N_2O_4$, discovered in Arica bark by Pelletier and Coriol (1829). It is crystallizable, and its oxalate and acetate are sparingly soluble. Winckler (1842) regarded it as identical with an alkaloid, *cusconine*, obtained by Leverköhn (1829) from Cusco bark, and with the *cinchovatine* of Manzini (1842), from Jaën bark, and the production of a green color by nitric acid due to the presence of impurities. But cusconine, though of the same composition as aricine and in the same bark, differs from all cinchona alkaloids in the gelatinous form of many of its salts, including the sulphate, which is not soluble in sulphuric acid. The same bark contains also the yellow amorphous alkaloid *cusconidine*, discovered by Hesse in 1877, and amorphous *cuscamidine* and crystalline *cuscamine*, discovered by the same chemist in 1880; the last two alkaloids are insoluble in nitric acid, cuscamine also in oxalic acid; both are readily soluble in ether, chloroform, and hot alcohol, and melt at 218° C. (424.4° F.). The *pitoyine* of Peretti (1835) does not exist, according to Kerner (1872) and Hesse (1873); it had been obtained from so-called Pitoya bark, or Cinchona bicolorata, the bark of a species of Ladenbergia, characterized by the gray and fawn-colored patches of its external surface.

Quinamine (chinamine), together with its isomer *conquinamine*, is found in the bark of Cinch. succirubra, rosulenta, and other species; both are crystalline, dextrogyre; their solutions are not fluorescent, do not produce thalleioquine, are precipitated by chloride of platinum only when in concentrated solutions, and yield with chloride of gold yellow precipitates changing to purple. Their hydriodates are slightly soluble in cold water and crystallizable. Quinamine melts at 172° C. (341.8° F.), conquinamine at 123° C. (253.4° F.). The former is dextrogyre, is soluble in 32 parts of ether, and on boiling with dilute sulphuric acid is converted into amorphous *quinamidine*, isomeric with the former and having a similar behavior to chloride of gold; its hydrochlorate crystallizes in prisms and is sparingly soluble in water. On heating sulphate of quinamine to 100° C. (212° F.)

it is converted into the isomeric *quinamicine*, which is white, amorphous, fusible in boiling water, and precipitated from acid solutions by sodium bicarbonate. When sulphate of quinamine, however, is heated to 120° C. (248° F.), *proto-quinamicine*, $C_{17}H_{20}N_2O$, is formed, which is insoluble in ether, and the sulphate of which is nearly insoluble in cold water. By treating quinamine or conquinamine with concentrated hydrochloric acid, H_2O is eliminated, and *apoquinamine*, $C_{19}H_{22}N_2O$, is formed, which is white, amorphous, very soluble in ether; its hydrochlorate is amorphous and freely soluble in water; the precipitate with chloride of gold does not turn purple.

The last-named alkaloid is isomeric with *homocinchonidine*, *homocinchonine*, and *homocinchonicine*, the first of which forms the bulk of Winckler's *cinchovatine* (*aricine*), from Cinch. ovata, has a left rotation, and forms a sulphate crystallizing with $6H_2O$ in delicate needles of a gelatinous aspect which fuse near 30° C. (86° F.). It resembles magnesia when anhydrous, and in this condition forms with chloroform a jelly-like mass. On melting, the anhydrous monobasic sulphate of this alkaloid, homocinchonicine, is formed. Homocinchonine is present in the bark of Cinch. rosulenta, which contains also *dihomocinchonine*, $C_{38}H_{44}N_4O_2$; it has a right rotation and is amorphous, like its salts.

Commercial cinchonidine sometimes contains the preceding alkaloids, and in addition thereto *hydrocinchonidine* or *cinchamidine*, $C_{19}H_{24}N_2O$, which was isolated (1881) by Hesse and by Forst and Boehringer; it melts near 230° C. (446° F.), is levogyre, and sparingly soluble in chloroform, ether, and water.

The same chemists have shown (1881, 1882) in commercial quinidine the presence of *hydroquinidine* or *hydroconchinine*, $C_{20}H_{26}N_2O_2$, which melts near 167° C. (332.6° F.), is dextrogyre, dissolves freely in hot alcohol and chloroform, and with some difficulty in ether, and yields fluorescent solutions and thalleioquine, like quinine. This base has been found by Hesse also in cuprea-bark.

Hesse (1882) isolated also from cuprea-bark *hydrocinchonine*, $C_{19}H_{24}N_2O$, which differs in some of its properties from Skraup's cinchotine (see CINCHONINÆ SULPHAS), and *hydroquinine*, $C_{20}H_{26}N_2O_2$, which melts at 168° C. (334.4° F.), is easily soluble in ether, and yields fluorescent solutions and thalleioquine, like quinine. The above hydro-bases are not oxidized by potassium permanganate in the cold.

Homoquinine, $C_{19}H_{22}N_2O_2$, was observed in cuprea-bark by Tod (1880), and further studied by Howard, Paul, Whiffen, and others. It melts at 177° C. (350.6° F.), is freely soluble in alcohol and chloroform, sparingly in ether, and shows fluorescence and thalleioquine reaction, like quinine. It is Whiffen's *ultraquinine*. Arnaud's *cinchonamine*, $C_{19}H_{24}N_2O$, discovered (1881) in a Colombian cinchona-bark, is soluble in ether, melts at 195° C. (383° F.), and yields crystallizable salts which, with the exception of the sulphate, are sparingly soluble in cold water and in diluted acids.

Diconchinine, $C_{40}H_{46}N_4O_3$, and *dicinchonine*, $C_{38}H_{44}N_4O_2$ are the principal constituents of *chinoidine*. (See CHINOIDINUM.)

The white cinchona-bark of Payta contains, according to Hesse (1870), crystallizable *paytine*, $C_{21}H_{24}N_2O + H_2O$, and amorphous *paytamine*, which resemble quinamine in their behavior to chloride of gold and solubility in ether, but differ in being levogyre and readily precipitated by chloride of platinum. This bark, however, has been ascertained by Hesse (1883) to come from a species of Aspidosperma.

Hesse (1877) obtained from a young Bolivian Calisaya bark a liquid alkaloid having a penetrating odor suggesting that of quinoline, and from Java Calisaya bark crystallizable *javanine*, which is very easily soluble in ether and dissolves in dilute sulphuric acid with an intense yellow color. From the mother-liquors of the preparation of quinine, Hesse (1882) obtained a volatile base, *cincholine*, as a pale-yellow oil, freely soluble in ether, alcohol, and chloroform, and nearly tasteless in neutral solutions. Flückiger (1883) suggests that it may have originated from the hydrocarbons used in the process. Howard's liquid alkaloid (1871) had the composition $C_{20}H_{24}N_2O_2$, and yielded thalleioquine and a crystallizable freely-soluble oxalate.

The relation of the cinchona alkaloids to each other in regard to their ultimate composition will be observed from the following:

$C_{23}H_{26}N_2O_4$: cusconine and aricine.
$C_{21}H_{24}N_2O$: paytine.
$C_{20}H_{26}N_2O_2$: hydroquinine, hydroquinidine (hydroconchinine).
$C_{20}H_{24}N_2O_2$: quinine, quinidine, quinicine, and $2(C_{20}H_{24}N_2O_2) - H_2O$: diconchinine.
$C_{19}H_{24}N_2O_2$: quinamine, conquinamine, quinamidine, and quinamicine.
$C_{19}H_{24}N_2O$: hydrocinchonine (cinchotine), hydrocinchonidine (cinchamidine), and cinchonamine.

$C_{19}H_{22}N_2O_2$: homoquinine, apoquinine.

$C_{19}H_{22}N_2O$: cinchonine, cinchonidine, cinchonicine, apoquinamine, homocinchonine, homocinchonidine and homocinchonicine, and $2(C_{19}H_{22}N_2O)$: dicinchonicine.

$C_{17}H_{20}N_2O$: protoquinamine.

$C_{16}H_{18}N_2O$: paricine.

Not analyzed: cusconidine, cuscamine, cuscamidine, javanine, cincholine.

The characteristic properties of the four principal cinchona alkaloids may be compared as follows:

	QUININE.	QUINIDINE.	CINCHONINE.	CINCHONIDINE.
Rotary power,	Levogyre.	Dextrogyre.	Dextrogyre.	Levogyre.
Soluble in water,	167 parts.	2000 parts.	3740 parts.	1680 parts.
Soluble in 80 per cent. alcohol,	6 "	26 "	133 "	20 "
Soluble in ether,	23 "	30 "	371 "	76.4 "
Sulphuric acid solutions,	Are fluorescent, 1 in 200,000.		Not fluorescent.	
Chlorine-water and ammonia,	Emerald-green thalleioquine.		White precipitates.	
Chlorine-water, ferrocyanide of potassium, and ammonia,	Dark-red solutions.		No coloration.	
Anhydrous sulphate, soluble in chloroform,	1000 parts.	19.5 parts.	60 parts.	1000 parts.
Hydriodate,	More soluble than next.	Soluble in 1270 parts water, or 110 parts alcohol.	Readily soluble in chloroform, alcohol, ether, and water.	Slightly in water, readily in alcohol.
Iodosulphate,	Green in reflected, colorless in transmitted light; soluble in 1000 parts boiling water.	Similar to preceding, but different tint.	Purplish-black: in transmitted light yellow or reddish.	Purplish garnet-red: in transmitted light like preceding.

The iodosulphates are obtained by dissolving the sulphates in weak alcohol, acidulating with sulphuric acid, precipitating with tincture of iodine, and crystallizing the precipitate from alcohol.

A mixture of the more or less purified alkaloids obtained from red and other cinchona-barks has been used in India and other countries under the designation of *quinetum*, *cinchona febrifuge*, etc. In this country several secret preparations have been introduced under various names, consisting either wholly or chiefly of cinchonine or chinoidine.

Other Constituents.—The alkaloids are combined with one or more of the following acids: kinic, kinovic, and cinchotannic acids.

Kinic or *quinic acid* (Chinasäure), $C_7H_{12}O_6$, is found in cinchona-barks and in many plants of the natural orders Rubiaceæ, Vaccineæ, etc. The calcium salt was first prepared by De Legaraye (1745); the acid was recognized by Hermbstaedt (1785) as being organic, and supposed to be tartaric acid. But F. C. Hoffmann (1790) proved it to be distinct, and named it kinic acid. The investigations of Deschamps (1795), Vauquelin (1806), and others corroborated these results, and Liebig (1830) and others determined its composition. According to Hesse, it is not present in cuprea-bark. In the preparation of quinine it is contained in the filtrate from the precipitated alkaloids. It appears to be present to the amount of 5 to 7, or even 9, per cent., and when pure forms transparent colorless oblique rhombic prisms which fuse at 162° C., are readily soluble in water, less in strong alcohol, and slightly in ether. On treating it or one of its salts with manganese peroxide and sulphuric acid, it yields, besides carbonic and formic acids, a golden-yellow crystalline sublimate of *kinone* or *quinone*, $C_6H_4O_2$. On being heated with hydriodic acid it is converted into benzoic acid, and when fused with potassa it yields protocatechuic acid.

Kinovic or *quinovic acid*, $C_{21}H_{38}O_4$, is met with in the East Indian barks, and forms a tasteless shining crystalline powder which is insoluble in water and chloroform, slightly soluble in ether and cold alcohol, but soluble in alkalies and alkaline carbonates. It was discovered by Hlasiwetz (1859) as a product of the decomposition of kinovin.

Kinovin or *quinovin*, $C_{30}H_{48}O_8$, was discovered by Pelletier and Caventou (1821), and at first named *quinovic acid*, afterward *quinova bitter*; its glucoside nature was determined by Hlasiwetz (1859). It is an amorphous mass of a disagreeable bitter taste, sparingly soluble in cold water, soluble in ether, acetone, chloroform, fixed and volatile oils, and freely soluble in alcohol. Its compounds with the alkalies, lime, and magnesia are soluble in water. Its solution in alcohol, treated with hydrochloric acid gas, yields kinovic acid and uncrystallizable mannitan (kinovin sugar), $C_6H_{12}O_5$. It has been found in different cinchona-barks in quantities varying between 0.11 and 1.74 per cent., and is also contained in the barks of Esenbeckia febrifuga and Buena magnifolia (*China*, s. *Quina nova*, hence its name).

Cinchotannic (or *quinotannic*) *acid* appears to be present in the best cinchona-barks to the amount of 2 to 4 per cent. By treating the decoction with magnesia, precipitating the filtrate with lead acetate, decomposing with sulphuretted hydrogen, and repeating this process, it is obtained as a pale-yellow mass of an acidulous and astringent taste, readily soluble in water, alcohol, and ether, turning greenish with salts of iron, and yielding cinchona-red with alkalies or on being boiled with water. According to Rembold (1867), by boiling with dilute sulphuric acid it is split into sugar and

Cinchona-red, $C_{28}H_{22}O_{14}$, which is nearly insoluble in water and ether, but dissolves readily in alkaline solutions and alcohol. It yields protocatechuic acid when treated with fusing potassa. Though contained in all cinchona-barks, those having a red color contain it in largest proportion —thick red bark over 10 per cent.

The odor of cinchona-barks is due to a minute quantity of a butyraceous *volatile oil*, which was first obtained by Fabbroni. Trommsdorff obtained 2 grains from 20 pounds of pale bark. The remaining constituents are of no importance either medicinally or pharmaceutically; they comprise starch, gum, sugar, resin, fat, wax, ammonium salts, and calcium oxalate, all in small quantities. Kerner's *cinchocerotin*, $C_{27}H_{48}O_2$, according to Helms (1883), appears to be related to betulin. The ash amounts to between 1 and 3 per cent., and consists mostly of the carbonates of calcium and potassium.

Variation of Alkaloids.—The *distribution* of the various constituents, and more especially of the alkaloids, is a matter of as great importance to the physician and pharmacist as to the manufacturer of quinine. It has been amply demonstrated that barks obtained from the same species grown in different localities, according to Karsten, even in their native forests, may vary greatly, not only in the total amount of the alkaloids contained therein, but likewise in the relative proportion of the alkaloids. Cultivated barks have been found to contain from 9 to 12 per cent. of alkaloids, and Cinch. Ledgeriana is often very rich in quinine, containing sometimes 13 per cent.; yet these same species yield frequently much smaller amounts. While there can be no doubt that this variation is caused by external influences, the proper course to be pursued in cultivation for increasing the percentage of alkaloids, of quinine in particular, has as yet not been discovered. Young barks are known to yield, as a rule, a smaller percentage of alkaloids than the bark of older wood, and attention has been directed to the frequently large yield from the root-bark. Investigations by D. Howard (1877) point to the general tendency of the root-barks obtained from different species of cinchona to augment very materially the amount of dextrogyrate alkaloids (quinidine and cinchonine), while the levogyrate alkaloids (quinine and cinchonidine) are produced in much smaller proportion. The bark of the root-fibres usually contains a still smaller percentage of these alkaloids.

That a certain protection is beneficial for the production of the alkaloids has been shown by experiments made in the East Indies. Howard (1871) demonstrated the presence of 9.75 per cent. of quinine (or a total of 11.40 per cent. of alkaloids) in bark from Cinch. officinalis, var. lanceolata, and Broughton (1870), a total of 13.5 with 9 per cent. of quinine. The variety pubescens, of the same species, yielded to Howard (1878) 12.90 per cent. of alkaloids, of which 6.94 was quinine and 4.48 cinchonidine. Indian red bark in quills often yields from 9 to 11 per cent. of alkaloids, one-sixth to one-third of which is quinine (De Vrij, 1873), and from the bark of C. officinalis, grown at Ootacamund, between 3.72 and 10.86 per cent. of alkaloids, one-fifth to two-thirds of which is quinine; the extraordinary yield of some of this bark has been referred to above.

The *wood* of the root and trunk contains kinovin, and occasionally about ½ per cent. of alkaloids, according to Moens (1880). A minute amount of alkaloid has also been found by Broughton (1870) in the *leaves*, the bitter taste of which is mainly due to about 2 per cent. of kinovin; while Happersberger (1883) reports having obtained 0.5 per cent. of alkaloids from the leaves of C. officinalis, 1.5 per cent. from those of C. succirubra, and 2 per cent. from those of C. Calisaya. The bitter taste of the *flowers*, according to Broughton, is due to kinovin, and the *fruit*, which is likewise bitter, contains mere traces of alkaloid.

Valuation of Cinchona-Bark.—Cinchona should contain at least 3 per cent. of alkaloids; yellow cinchona and red cinchona, at least 2 per cent. of quinine.—*U. S.* Yellow cinchona should contain at least 2 per cent. of alkaloids soluble in ether; red cinchona, at least 1½ per cent. of alkaloids soluble in chloroform.—*Br.* Cinchona should contain at least 3.5 per cent. of alkaloids soluble in ether.—*P. G.*

Process of U. S. P.—I. For total alkaloids: Cinchona, in No. 80 powder and fully dried at 100° C. (212° F.), 20 Gm.; lime 5 Gm.; diluted sulphuric acid, solution of soda, alcohol, distilled water, each a sufficient quantity. Make the lime into a milk with 50 Ccm. of distilled water, thoroughly mix therewith the cinchona, and dry the mixture completely at a temperature not above 80° C. (176° F.). Digest the dried mixture with 200 Ccm. of alcohol in a flask, near the temperature of boiling, for an hour. When cool, pour the mixture upon a filter of about 6 inches (15 Cm.) diameter. Rinse the flask and wash the filter with 200 Ccm. of alcohol, used in several portions, letting the filter drain after use of each portion. To the filtered liquid add enough diluted sulphuric acid to render the liquid acid to test-paper. Let any resulting precipitate (sulphate of calcium) subside; then decant the liquid, in portions, upon a very small filter, and wash the residue and filter with small portions of alcohol. Distil or evaporate the filtrate to expel all the alcohol, cool, pass through a small filter, and wash the latter with distilled water slightly acidulated with diluted sulphuric acid until the washings are no longer made turbid by solution of soda. To the filtered liquid, concentrated to the volume of about 50 Ccm., when nearly cool add enough solution of soda to render it strongly alkaline. Collect the precipitate on a wetted filter, let it drain, and wash it with small portions of distilled water (using as little as possible), until the washings give but a slight turbidity with test-solution of chloride of barium. Drain the filter by laying it upon blotting- or filter-papers until it is nearly dry. Detach the precipitate carefully from the filter and transfer it to a weighed capsule, wash the filter with distilled water acidulated with diluted sulphuric acid, make the filtrate alkaline by solution of soda, and, if a precipitate result, wash it on a very small filter, let it drain well, and transfer it to the capsule. Dry the contents of the latter at 100° C. (212° F.) to a constant weight, cool it in a desiccator, and weigh. The number of Gm. multiplied by 5 equals the percentage of total alkaloids in the cinchona.

II. For Quinine: To the total alkaloids from 20 Gm. of cinchona, previously weighed, add distilled water acidulated with diluted sulphuric acid, until the mixture remains for 10 or 15 minutes after digestion just distinctly acid to test-paper. Transfer to a weighed beaker, rinsing with distilled water, and adding of this enough to make the whole weigh seventy times the weight of the alkaloids. Add now, in drops, solution of soda, previously well diluted with distilled water, until the mixture is exactly neutral to test-paper. Digest at 60° C. (140° F.) for 5 minutes, then cool to 15° C. (59° F.), and maintain at this temperature for half an hour. If crystals do not appear in the glass vessel, the total alkaloids do not contain quinine in quantity over 8 per cent. of their weight (corresponding to 9 per cent. of sulphate of quinine, crystallized). If crystals appear in the mixture, pass the latter through a filter not larger than necessary, prepared by drying two filter-papers of 2 to 3½ inches (5 to 9 Cm.) diameter, trimming them to an equal weight, folding them separately, and placing one within the other, so as to make a plain filter fourfold on each side. When the liquid has drained away, wash the filter and contents with distilled water of a temperature of 15° C. (59° F.), added in small portions, until the entire filtered liquid weighs ninety times the weight of the alkaloids taken. Dry the filter, without separating its folds, at 60° C. (140° F.), to a constant weight; cool, and weigh the inner filter and contents, taking the outer filter for a counterweight. To the weight of effloresced sulphate of quinine so obtained add 11.5 per cent. of its amount (for water of crystallization), and add 0.22 per cent. of the weight of the entire filtered liquid (for solubility of the crystals at 15° C.). The sum in Gm. multiplied by 5 equals the percentage of crystallized sulphate of quinine, equivalent to the quinine in the cinchona.

Process of the Br. P.—Cinchona in No. 60 powder 200 gr.; mix intimately with calcium hydrate, 60 gr., then with water ½ oz. and set aside for an hour or two. Transfer the moist dark-brown powder to a six-ounce flask, add 3 fl. oz. of benzolated amylic alcohol (benzol 3 vol., amyl alcohol 1 vol.); boil for half an hour; decant and drain off the liquid on to a filter, leaving the powder in the flask; repeat boiling and decanting; then boil a third time; turn the contents of the flask on to the filter, and percolate with benzolated amylic alcohol until the bark is exhausted. (During the boiling a convenient condenser is formed by placing a funnel in the mouth of the flask, and in the funnel a flask with cold water.) Mix in a stoppered glass separator the still warm filtrate with 20 minims of diluted hydrochloric acid and 2 fluidrachms of water; shake well, let separate, draw off the acid liquid, and repeat this process with slightly acidulated water until the alkaloids have been removed. Neutralize while warm exactly with ammonia; evaporate to 3 fluidrachms, add solution of tartarated soda 15 gr. in water 30 gr.; stir, after an hour filter, and dry the precipitated tartrates; eight-tenths of their weight, divided by 2, represents the percentage of *quinine* and *cinchonidine*. To the mother-liquor add ammonia in slight excess; collect, wash, and dry the precipitate; its weight, divided by 2, represents the percentage of the *other alkaloids*, and this, added to the preceding, gives the percentage of *total alkaloids*.

Process of the P. G.—Agitate powdered cinchona, 20 Gm. with ammonia-water 10 Gm., alcohol 20 Gm., and ether 170 Gm., and macerate for a day; decant off the clear liquid 120 Gm., add to it 3 Ccm. normal hydrochloric acid; distil and evaporate the ether, and, if necessary, acidulate the residue with hydrochloric acid; filter, and, without heating, add 3.5 Ccm. normal potassa solution, and when the precipitate has subsided drop into the clear liquid potassa solution as long as a precipitate is produced; collect the precipitate upon a filter, and wash it repeatedly with small portions of water until the filtrate ceases to produce a precipitate on being dropped into a cold neutral saturated aqueous solution of quinine sulphate; drain the precipitate, press it between bibulous paper, and dry it first in the air, next over sulphuric acid, and finally in the water-bath, when it should weigh at least 0.42 Gm. If a small quantity be boiled with 300 parts of water, the liquid, filtered while hot, should on cooling separate floccules of quinine, and on adding to 5 parts of the clear cold liquid 1 part of chlorine-water, and afterward a little ammonia-water, a bright-green color should be produced.

De Vrij's Process (1873).—20 Gm. of powdered and sifted bark, dried at 100° C., are mixed with milk of lime containing 5 Gm. of slaked lime; the mixture is slowly dried, and then boiled with 200 Ccm. of strong alcohol; when cool the liquid is passed through a small filter; the residue, mixed with 100 Ccm. of alcohol, is then put upon the same filter and washed with another 100 Ccm. of alcohol. The mixed filtrate is freed from calcium by a little sulphuric acid and the alcohol recovered by distillation; the residue, together with the alcohol and water used for washing the retort, is poured into a capsule and the alcohol carefully evaporated. The cooled solution is filtered to separate quinovic acid and fat, the filter washed with some acidulated water, the filtrate reduced by evaporation to about 50 Ccm., and while still warm precipitated by a slight excess of caustic soda. The precipitate is collected upon a filter, washed with the smallest possible amount of water, and the filter pressed between bibulous paper until the alkaloids can be readily removed. They are now transferred to a tared capsule, completely dried and weighed; the weight multiplied by 5 indicates the percentage of the mixed alkaloids. These alkaloids are powdered, treated with ten times their weight of ether, the undissolved portion is converted into neutral sulphates, and the solution, treated with iodide of potassium to separate the *quinidine;* from the filtrate *cinchonidine* is separated by tartrate of potassium and sodium, and after again filtering *cinchonine* is precipitated by soda. To determine the *quinine* the ethereal solution is evaporated, the residue dissolved in ten times its weight of weak alcohol sp. gr. 0.915, containing $\frac{1}{20}$ of its volume of dilute sulphuric acid, and the solution heated to about 50° C. (122° F.); tincture of iodine is added to produce iodosulphate of quinine, which is collected after cooling. The filtrate, if necessary, is slightly acidulated, warmed to expel the alcohol, and precipitated by potassa or soda, by which the *amorphous alkaloid*, including quinamine, is obtained.

Since none of the cinchona alkaloids are insoluble in ether, the process requires some modifications should a large amount of cinchonine be present; the mixed alkaloids left on evaporating the ethereal solution should then again be treated with a small quantity of ether. The weights as above ascertained are multiplied with 0.718 for quinidine, 0.804 for cinchonidine, and 0.565 for quinine—or, according to De Vrij, with 0.5509 for anhydrous quinine—to find the weights of the alkaloids named. Cinchonine and chinoidine are by the above process weighed directly as such. To determine from the mixed alkaloids merely the quinine, De Vrij (1875) proposed iodosulphate of chinoidine as a test solution.

Manufacturers of quinine generally prefer to ascertain by direct experiment the amount of sulphate of quinine obtainable.

Off. Prep.—1. Of Calisaya bark: Decoctum cinchonæ flavæ, *Br.;* Extr. cinchonæ, Extr. cinchonæ fluidum, Tinct. cinchonæ, *U. S.;* Extr. cinch. flavæ liquidum, Infusum cinchonæ flavæ, Quiniæ sulphas, Tinctura cinchonæ flavæ, *Br.* 2. Of pale bark: Mistura ferri aromatica, Tinctura cinchonæ composita, *Br.* 3. Of red bark: Tinct. cinchonæ comp., *U. S.*

Medical Action and Uses.—The action and uses of cinchona will be more conveniently studied in connection with its several preparations, to the articles upon which the reader is referred.

CINCHONIDINÆ SULPHAS, *U. S., Br.*—SULPHATE OF CINCHONIDINE.

Cinchonidinum sulfuricum.—*Cinchonidine sulphate*, E.; *Sulfate de cinchonidine*, Fr.; *Cinchonidin-Sulfat*, G.

Formula $(C_{19}H_{22}N_2O)_2H_2SO_4.6H_2O$. Molecular weight 794.

The neutral sulphate of an alkaloid prepared from certain species of Cinchona, chiefly red bark.

Origin.—Certain cinchona-barks, notably those obtained from Cinch. succirubra, *Pavon*, and Cinch. officinalis, *Hooker*, cultivated in India, and the South America barks from Cinch. lancifolia, *Mutis*, and Cinch. tucujensis, *Karsten*, contain cinchonidine. A very similar alkaloid, called *homocinchonidine*, is rarely, and then only in minute quantities, found in these barks; but in certain lots of South American red barks the second alkaloid named is present in considerable proportion, wholly or partly replacing the former (Hesse, *Berichte*, 1881, p. 1890). These alkaloids were at first described by Winckler (1847) and others as *quinidine* or *chinidine*, a name which was retained for them long after Pasteur's investigations in 1853 (see CINCHONA, *Constituents*) by several chemists, and until recently by several manufacturers in Germany and Austria.

Preparation.—In the process of manufacturing quinine sulphate, and while recrystallizing this salt, mother-liquors are obtained containing mainly cinchonidine sulphate. On concentrating the solutions the salt crystallizes, and requires purification by recrystallization from water in order to obtain it free from quinine and quinidine sulphate. Formerly, it could be prepared from commercial chinoidine, which sometimes contained notable quantities of this alkaloid.

Properties.—Like the corresponding salts of the other cinchona alkaloids, cinchonidine sulphate is colorless, inodorous, very bitter, and has a neutral or faint alkaline reaction. It crystallizes from alcohol in handsome prisms containing $2H_2O$, but from water it may be obtained in two forms—either in colorless square glossy prisms, or in less lustrous fine and silky needles, the formation of either crystals depending upon both the concentration and the quantity of the solution. The commercial salt resembles quinine sulphate in appearance. The anhydrous salt dissolves, according to Hesse, at 22° C. (71.6° F.) in 97.5 parts, and the crystallized salt in 67 parts (100 parts at 15° C., *U. S. P.*), of water; it is soluble in 71 parts of alcohol at 15° C. (59° F.), in 4 parts of boiling water, and in 12 parts of boiling alcohol (*U. S. P.*); it dissolves readily and freely in diluted acids, the solutions being free from fluorescence, is very sparingly soluble in ether and benzol, becomes gelatinous from the separation of its water of crystallization when immersed in chloroform, and dissolves in 1000 parts of that liquid at 15° C. (59° F.) and in 300 parts at 63.5° C. (146.3° F.), but more freely in chloroform containing alcohol. On exposure the salt effloresces, parting with $1H_2O$; at 100° C. (212° F.) it loses its water of crystallization, and in moist air absorbs again $2H_2O$; on ignition it is decomposed and volatilized, without leaving any residue. The aqueous solution yields with barium chloride a white precipitate insoluble in diluted hydrochloric acid; it is precipitated by potassio-mercuric iodide and other regents for alkaloids, by neutral tartrates, and by ammonia. The latter precipitate dissolves in about seventy-five times its weight of ether, and requires about twelve times more ammonia-water for solution than the precipitate from a corresponding solution of quinine sulphate (Kerner, 1862). On mixing a drop of an aqueous solution of the salt with a drop of solution of potassium sulphocyanide, microscopic crystals are formed, which are either feathery and stellately arranged around a centre, or are spike-like and united in star-like or fan-shaped groups. According to Hesse (1878), cinchonidine sulphate is so completely precipitated by an excess of potassium sulphocyanide that the filtrate is not rendered turbid by ammonia.

Fig. 74.

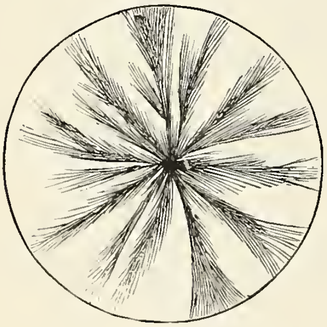
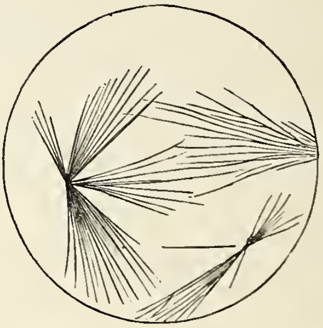


Fig. 75.



Cinchonidine sulphate with KScy: microscopic crystals.

Homocinchonidine sulphate has the composition and properties described above, but crystallizes either in dull-white prisms or in delicate white needles, requires at 22° C. (71.6° F.) 69 parts of water for solution, and its aqueous solution, saturated at 50° C. (122° F.), congeals on cooling to a gelatinous mass consisting of delicate crystals and enclosing the mother-liquor, while under the same conditions the cinchonidine salt yields glossy needles, from which the mother-liquor may be readily drained. Both salts on being treated with potassium permanganate yield *cinchotenidine*, $C_{18}H_{20}N_2O_3$, which was discovered by Skraup (1879), crystallizes with $3H_2O$ in colorless prisms, melts at 256° C., and is not fluorescent in acid solutions (Hesse, 1881).

Tests.—The moderately dilute aqueous solution of the salt, acidulated with sulphuric acid, should not show more than a slight blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). The salt should not be colored by the addition of sulphuric acid (absence of foreign organic matters). If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.92 Gm. (water of crystallization = $3H_2O$). If 0.5 Gm. of the salt be digested with 20 Ccm. of cold distilled water, 0.5 Gm. of tartrate of potassium and sodium added, the mixture macerated, with frequent agitation, for 1 hour at 15° C. (59° F.), then filtered, and a drop of water of ammonia added to the filtrate, not more than a slight turbidity should appear (absence of more than 0.5 per cent. of sulphate of cinchonine or of more than 1.5 per cent. of sulphate of quinidine).

Composition.—Pasteur (1853) gave to cinchonidine the formula $C_{20}H_{24}N_2O$; Skraup (1879) corrected it to $C_{19}H_{22}N_2O$, which has been verified by Hesse and Claus (1881), although the latter states that commercial cinchonidine occasionally corresponds better with the first formula. Skraup and Claus regard homocinchonidine as slightly impure cinchonidine. Besides the differences given above, Hesse states that the alkaloid cinchonidine melts at 200° to 201° C. (392° to 393.8° F.), while homocinchonidine melts between 205° and 206° C. (401° and 402.8° F.). The sulphate crystallizes with $6H_2O$, according to Goddefroy (1878), from hot concentrated solutions with $3H_2O$. The formula given above requires 13.6 per cent., and for the salt with $3H_2O$ 7.3 per cent., of water of crystallization. The U. S. P. has adopted the formula $(C_{20}H_{24}N_2O)_2H_2SO_4.3H_2O$ (mol. weight 768), requiring 7.03 per cent., and for the salt with $6H_2O$ 13.13 per cent., of water of crystallization.

Physiological Action.—This salt, which has often been confounded with sulphate of quinidine, appears not to have been made a frequent subject of physiological investigation. According to Dr. Bockius, when given to the lower animals in poisonous doses it produces "intense congestion of the anterior portion of the cerebral hemispheres," the same effect essentially that is caused by quinine. In a number of experiments made with this alkaloid Cerna found that "its effects are more or less similar to those produced by quinine," but larger doses of it are required to produce the same results (*Phila. Med. Times*, x. 495). This conclusion has been confirmed by Sée and Rochefontaine. In regard to its action on man, it would seem to occasion less disturbance of the nervous system than quinine, less ringing in the ears, and less disturbance of vision, and vertigo. Like quinine, it reduces the febrile pulse. In a word, there does not appear to be any difference between the two alkaloids in their mode of action, but the intenser operation seems to belong to quinine. Laborde, however, pronounced it to be a convulsing poison.

Medical Uses.—Repeated and extended observation of the use of cinchonidine in the treatment of *intermittent fever*, *remittent fever*, and malarial *neuralgia*, made both in this country and in British India, proves conclusively it equal, or nearly equal, in efficacy to quinine in these diseases, both as a prophylactic and as a remedy. In *typhoid fever* it has been found to induce the same subsidence of the pulse as quinine, and its equal advantages as a tonic have been fully shown. It has seemed to be well borne where quinine could not be tolerated, and to be especially favorable in its action upon children. *Hydrobromide* of cinchonidine has been used in the summer complaint of children, in various malarial diseases, inflammations, and organic affections. The chief result of these experiments is, that it may be administered hypodermically without local irritation, and that it is a more efficient antipyretic agent than quinine in an equal dose (*Med. Record*, xviii. 10, 153). *Salicylate* of *cinchonidine* has been found useful by Prosser James "as a tonic and anti-periodic" in doses of from 5 to 10 grains (*British Med. Jour.*, 1881, i. 428).

The modes of administration of sulphate of cinchonidine are the same, in general, as are employed for sulphate of quinine, but it does not appear to have been given hypodermically. As an anti-periodic it should, like quinine, be prescribed in doses of from 10 to 20 grains (Gm. 0.60–1.30) 5 or 6 hours before the expected paroxysm. In mild cases 10 grains (Gm. 0.60) in divided doses may be given during the day.

CINCHONINA, *U. S.*—CINCHONINE, CINCHONIA.

Cinchoninum.—*Cinchonine*, Fr.; *Cinchonin*, G.
Formula $C_{19}H_{22}N_2O$. Molecular weight 294.

An alkaloid prepared from different species of Cinchona.

Origin.—This alkaloid was discovered by Pelletier and Caventou in 1820, and has been found in most cinchona-barks, in largest proportion in some of the pale cinchonas.

Preparation.—It is best prepared by precipitating the aqueous solution of cinchonine sulphate with ammonia-water, washing the precipitate with water until free from ammonium sulphate, and crystallizing from alcohol.

Properties.—Cinchonine is in transparent "white, somewhat lustrous prisms or needles, permanent in the air, odorless, at first nearly tasteless, but developing a bitter aftertaste, and having an alkaline reaction; almost insoluble in cold or hot water, soluble in 110 parts (84.3 parts, Prunier, 1879) of alcohol at 15° C. (59° F.), in 28 parts of boiling alcohol, 371 parts of ether, 350 parts (101.6 parts, Prunier) of chloroform, and readily soluble in diluted acids, forming salts of a very bitter taste. At about 250° C. (482° F.) it melts and turns brown with partial sublimation. On ignition the alkaloid is dissipated without leaving a residue."—*U. S.* Cinchonine is insoluble in ammonia and potassa, but dissolves in 108 parts of amylic alcohol, in warm fixed oils, volatile oils, benzol, and benzin. Its solutions are dextrogyrate; its acid solutions are not fluorescent, and do not give the thalleioquine reaction, but with chlorine-water and ammonia yield a white precipitate. Its alcoholic solution gives a yellow precipitate with picric acid which is insoluble in acids. The aqueous solutions of its salts are not precipitated by bicarbonates in the presence of tartaric acid, but yield precipitates with ammonia and other alkalies, their carbonates, with tannin, potassio-mercuric iodide, chloride of gold, chloride of platinum, phosphomolybdic acid, picric acid, and other reagents for alkaloids; also, by potassium ferrocyanide (Dollfus, 1848). This last reaction has been recommended by Dr. J. H. Bill (1858) as a test for cinchonine, the precipitate being insoluble in an excess of the precipitant and crystallizing from the hot mother-liquor on cooling in golden-yellow needles or scales. Seligsohn (1861) showed the presence of free acid to be necessary for obtaining these crystals, and that neutral solutions of cinchonine salts are merely rendered turbid or yield a resinous precipitate.

By the action of potassa on cinchonine Gerhardt (1842) obtained chinoline, and Greville Williams (1855, 1864) showed that in addition to this base the distillate also contained lepidine, cryptidine, and other bases. By long-continued boiling of its chloride with alcohol and potassa, Koenigs (1881) produced from cinchonine a crystallizable volatile base, *cinchene*, $C_{19}H_{20}N_2$. On oxidizing cinchonine or its salts by the action of lead dioxide and sulphuric acid, E. Marchand (1844) obtained *cinchotenine*, which is more readily obtained, according to Caventou and Willm, by the action of potassium permanganate, formic acid being formed at the same time. Cinchotenine, $C_{18}H_{20}N_2O_3$, by the further action of oxidizing agents yields Weidel's (1874) *cinchonic* (chinolin-carbonic acid), $C_{10}H_7NO_2$, *cinchomeronic*, $C_7H_5NO_4$, and other acids.

Tests.—"A solution of the alkaloid in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of quinine or quinidine). On precipitating the alkaloid from this solution by water of ammonia it is very sparingly dissolved by the latter (difference from and absence of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine). It should not be colored, or but very slightly colored, by the addition of sulphuric acid (absence of foreign organic matters)."—*U. S.*

Composition.—The formula given above is that of Laurent (1848). Pasteur's (1853) formula, $C_{20}H_{24}N_2O$ (mol. weight 308), has been adopted by the Pharmacopœia, but researches made since 1877 by Skraup and others prove the former to be correct. The alkaloid crystallizes anhydrous. As found in commerce, it contains a very similar alkaloid, which is not affected by cold potassium permanganate, is freely soluble in alcohol, yields a sulphate crystallizing in sharp needles, and is freed from cinchonine by fractional precipitation; Skraup proposed to call it *cinchotine*, and found it to be identical with Caventou's and Willm's *hydrocinchonine*, $C_{19}H_{24}N_2O$.

Derivative.—CHINOLINA.—Chinoline, quinoline, *E., Fr.:* Chinolin, *G.* Formula C_9H_7N. Mol. weight 129.—This base was obtained by Runge (1834) from coal-tar, and described as *leucol*. Gerhardt (1842) obtained it by distilling quinine or cinchonine with potassa. Greville Williams (1855) first prepared pure chinoline free from other bases. The purification by treatment with acids and fractional distillation is difficult, and the commercial article is usually a mixture. At present chinoline is cheaply and readily prepared by a patented process devised by Skraup; a mixture of aniline, nitrobenzol, glycerin, and sulphuric acid is heated, then diluted with water, and distilled to drive off nitrobenzol; on rendering the residue alkaline and distilling with steam, chinoline passes over. Chinoline is a colorless, mobile liquid, of the specific gravity 1.081 at 10° C. (50° F.), strongly refractive like carbon bisulphide, of a pungent somewhat bitter almond-like odor, and of a burning and bitter taste. It does not congeal at — 20°, volatilizes at ordinary temperatures, boils at 238° C. (460.4° F.), and distils unchanged. It has an alkaline reaction, dissolves phosphorus, sulphur, arsenic, resin, and camphor, is sparingly soluble in water, and soluble in all proportions in alcohol, methyl alcohol, ether, aldehyd, fixed oils, volatile oils, and carbon bisulphide. Ignited, it burns with a bright sooty flame. On treating chinoline with amyl iodide and afterward with soda, crystals of *cyanin*, having a golden-green color and dyeing wool blue, are obtained; Williams found (1872) that the leucoline from coal-tar, treated in the same manner, did not yield an identical product. Chinoline—but not leucoline—yields a yellow crystalline precipitate with bichromate of potassium.

The salts of chinoline are inodorous when pure, mostly crystallizable, and precipitated by most reagents for alkaloids. *Chinoline tartrate* crystallizes in white permanent scales, and is more soluble in water than *chinoline salicylate*, which requires over 100 parts of water for solution. The salts with mineral acids are mostly deliquescent.

CINCHONINÆ SULPHAS, *U. S., Br.*—SULPHATE OF CINCHONINE.

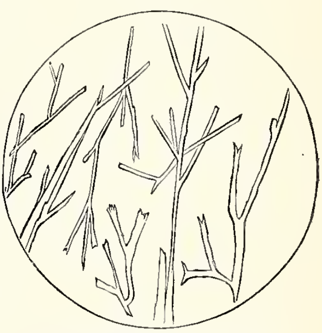
Cinchoniæ sulphas, U. S. 1870; *Cinchoninum sulfuricum.—Sulfate de cinchonine*, Fr.; *Schwefelsaures Cinchonin*, *Cinchoninsulfat*, G.

Formula $(C_{19}H_{22}N_2O)_2.H_2SO_4.2H_2O$. Molecular weight 722.

Preparation.—The first mother-liquors obtained in the preparation of quinine sulphate are precipitated with soda, and the precipitate is washed first with water to free it from sodium sulphate, afterward with small quantities of cold alcohol, in which the other cinchona alkaloids are more readily soluble than cinchonine. The residue is then mixed with about eight times its weight of water, the mixture heated, and sulphuric acid is dropped in until a clear neutral solution is obtained, which is treated with animal charcoal, filtered while hot, and set aside to crystallize; the crystals are drained and dried.

Properties.—Sulphate of cinchonine crystallizes in hard, transparent and colorless, or semi-transparent and white clinorhombic prisms, which have a glassy lustre, are permanent in the air, inodorous, lose their (4.98 per cent.) water of crystallization at 100° C. (212° F.), fuse like wax at a somewhat higher temperature (at about 240° C. = 464° F., with partial sublimation, *U. S. P.*), then acquire a handsome red color, and finally burn, giving off a peculiar empyreumatic odor and leaving no residue. It is apt to form supersaturated solutions with water, of which it requires 14 parts to dissolve it at the boiling temperature; its solubility in cold water has been variously determined: 1 part of the salt was found to be soluble in 54 parts of water at 15° C. (Kerner), in 65.5 parts (Hesse), and in 75 parts (Schwabe) at 13° C. (55.4° F.); these solutions have a neutral, or frequently a slight alkaline, reaction. The salt is very readily soluble in dilute acids, requires 1.5 of boiling and 5.8 parts of cold 80 per cent. alcohol for solution, dissolves in 60 parts of chloroform, readily in dilute acids, and is insoluble in ether, benzin, and benzol. Its solutions have a very bitter taste and are destitute of fluorescence. They yield a white precipitate with barium chloride (sulphate), are insoluble in dilute hydrochloric acid, and are precipitated by the reagents mentioned above, the precipitate by ammonia being so sparingly soluble in an excess that this reagent may be employed for the quantitative determination of the alkaloid. When a drop of a saturated aqueous solution of the salt is mixed with a drop of solution of potassium sulphocyanide, crystals will be formed which under the microscope will appear long, radiating, and considerably branched, resembling antlers or equisetum.

FIG. 76.



Cinchonine sulphate with KScy: microscopic crystals.

Composition.—The formula as given above is that of Laurent (1848), which has been adopted by most writers since Skraup's investigations (1877, 1879); it requires 82.8 per cent. of cinchonine. The Pharmacopœia has adopted Regnault's formula, $(C_{20}H_{22}N_2O)_2H_2SO_4.2H_2O$ (mol. weight 750), which requires 82.14 per cent. of cinchonine and 4.8 per cent. of water. Skraup found that by repeated fractional precipitation the commercial salt will yield *cinchotine*, $C_{19}H_{24}N_2O$, an alkaloid very similar to cinchonine, and identical with Caventou's and Willm's (1869) *hydrocinchonine*. It is more freely soluble in alcohol than cinchonine, yields a sulphate crystallizing in sharp needles, and is not affected by a cold solution of potassium permanganate.

Tests.—"A moderately dilute solution of the salt acidulated with sulphuric acid should not show more than a faint blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.952 Gm. If the salt, dried at a gentle heat, is macerated for half an hour, with frequent agitation, with seventy times its weight of chloroform at 15° C. (59° F.), it should wholly, or almost wholly, dissolve (any more than traces of sulphate of quinine or sulphate of cinchonidine remaining undissolved). It should not be colored by contact with sulphuric acid (absence of foreign organic matters)."—*U. S.*

Other Salts of Cinchonine.—ACID SULPHATE OF CINCHONINE—$C_{19}H_{22}N_2O.H_2SO_4.3H_2O$, mol. weight 446—obtained by dissolving the officinal sulphate in dilute sulphuric acid and crystallizing, forms octahedral crystals, which become opaque in dry air, and dissolve in about half their weight of water and in 90 parts of alcohol. They are insoluble in ether, and contain 5.92 per cent. of cinchonine.

HYDROCHLORATE OF CINCHONINE—$C_{19}H_{22}N_2O.HCl.2H_2O$, mol. weight 366.4—made by treating an excess of cinchonine with dilute hydrochloric acid, crystallizes in needles closely resembling sulphate of quinine, dissolves in 24 parts of water at 10° C. (50° F.), in 3.2 parts of boiling water, in 22.2 parts of chloroform, in 1.3 parts of 80 per cent. alcohol, and in 273 parts of ether spec. grav. .730, at 15° C. The salt melts above 130° C. (266° F.). It has been occasionally used for adulterating, or fraudulently sold for, sulphate of quinine, from which it is readily distinguished by the absence of fluorescence of its acidulated solution, by the white precipitate occasioned with silver nitrate, and by the sparing solubility in ether of the white precipitate with ammonia. It contains 80.24 per cent. of cinchonine.

Physiological Action and Medical Uses.—Sulphate of cinchonine is more poisonous to frogs and dogs than sulphate of quinine. The former in full doses does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it is more apt to occasion a peculiar pain and sense of oppression in the frontal region of the head. It is also prone to excite præcordial pain, jerking of the tendons, muscular exhaustion, and faintness when freely used. Laborde, indeed, denies to this alkaloid and to cinchonidine an equality with quinia, alleging that they belong to the class of convulsing poisons (*Archives gén.*, Mar. 1880, p. 368).

Its therapeutical application is generally regarded as identical in nature with that of quinine, at least in the treatment of *periodical fevers*. But the certainty of its curative effects is by no means so well established. It has the advantage over quinine of being less bitter and much more soluble in water, as well as cheaper, but it has the disadvantage of being less reliable. The dose of sulphate of cinchonine is variously stated to be from one-third to twice as large as that of quinine.

Biach and Loimann (*Virchow's Archiv,* lxxxvi. 456) performed experiments upon rabbits with the neutral tartrate of *chinolin*. The preparation had a very offensive smell and an acrid and burning taste. It was administered hypodermically in doses gradually increased from 1½ grains (Gm. 0.1), and was found to act promptly and decidedly in lowering the temperature, especially when the dose was large. After doses of gr. v to gr. viij (Gm. 0.3–0.5) the temperature fell to 90° F., and even lower, and the animal grew dull and numb and its reflex irritability declined. After doses of from gr. x to gr. xv (Gm. 0.60–1) general paralysis and collapse were followed by death. Donath (1882) states that 2 per cent. of tartrate of chinolin prevents lactic fermentation in milk, the decomposition of urine and gelatin, the development of bacteria, etc. Dr. Conrad Berens (*Inaug. Thesis*, Univ. of Penna., 1883) drew the following, among other conclusions, from a series of experiments with chinolin tartrate: It causes death by asphyxia; increases the force and frequency of the respirations, and then arrests the latter; it does not cause convulsions; it lessens, and finally abolishes, reflex action; it directly diminishes or abolishes muscular contractibility; it coagulates myrosin and albumen, and causes an increased flow of saliva and bile, but does not act upon the spleen: it lowers blood-pressure by a direct action on the heart-muscle, as well as by paralyzing the vaso-motor centres; it lowers the temperature; and it is a powerful antiseptic.

As for the therapeutical value of this artificial product, of whose use the most important effects were predicted, the result, as usual, has not answered the anticipations. Like many other agents, it is an anti-pyretic, and must therefore be credited with sometimes interrupting the course of simple *intermittent fevers*. Brieger employed it without the slightest benefit in typhus, pneumonia, rheumatism, and remittent fever; in some cases it was vomited, and thereby reduced the temperature very slightly. In Philadelphia, Harrington found it valueless as an anti-periodic (*Phila. Med. Times*, xii. 392). It had also bad effects, such as disturbed digestion, vomiting, and nausea. The observations of Hiller, which extended to phthisis and typhoid fever, gave like results. He therefore abandoned its use (*Amer. Jour. of Med. Sci.*, July, 1882, p. 246). Seifert claims that a 5 per cent. solution of chinolin is an efficient solvent of *diphtherial* membranes; and Marcell makes a similar statement (*Centralbl. f. Ther.*, i. 540). Brieger pointed out anew that the similarity of composition of chinolin and quinine led physicians into the common error of concluding that the therapeutical action of the two were identical, but that when the former was subjected to the only legitimate test, clinical experience, it proved to be worthless as a medicine (*Zeitschrift f. klin. Med.*, iv. 296).

CINNAMOMUM, *U. S.*—CINNAMON.

Canelle, Fr.; *Zimmt*, G.

The inner bark of the shoots of Cinnamomum zeylanicum, *Breyne*, s. Laurus Cinnamomum, *Linné* (Ceylon cinnamon), or of Cinnamomum Cassia, *Blume*, s. Cinn. aromaticum, *Nees*, s. Laurus Cassia, *Aiton*, s. Laur. Cinnamomum, *Loureiro* (Chinese cinnamon). Bentley and Trimen, *Med. Plants*, 223, 224.

Nat. Ord.—Lauraceæ.

Officinal Kinds.—1. CINNAMOMI CORTEX, *Br.;* Cortex cinnamomi zeylanici, Cinnamomum acutum, s. verum.—Ceylon cinnamon, Cinnamon-bark, *E.;* Canelle de Ceylon, *Fr.;* Zeylonzimmt, *G.*

2. CORTEX CINNAMOMI, *P. G.;* CORTEX CINNAMOMI CHINENSIS; Cortex cinnamomi cassiæ, Cinnamomum chinense, Cassia cinnamomea.—Chinese cinnamon, Cassia-bark, Cassia lignea, *E.;* Canelle de Chine, *Fr.;* Zimmtkassie, Chinesischer (Gemeiner) Zimmt, *G.*

Origin.—The tree first mentioned above is variable in size, but usually of small stature, and is met with in forest districts of Ceylon, reaching an elevation of 3000 feet (920 M.). It has opposite coriaceous three- to five-nerved leaves, which are bright-green and glossy above and glaucous beneath; the small flowers are in terminal panicles, producing a somewhat fleshy ovoid fruit, which at the base is surrounded by the enlarged perianth. Not less than seven or eight well-marked varieties are distinguished, some of which are regarded by some botanists as distinct species.

The second species is likewise a small tree, 20 to 30 feet (6 to 9 M.) high, and has oblong elliptical three-nerved leaves, which when young are downy, like the petioles and young branches. The panicles are smaller; the flower and fruit resemble the preceding. It is indigenous to Southern China and Cochin China, and cultivated in Java.

Cinnamon was known and highly esteemed as a spice in the most remote times of history, but the kind first used appears to have been that derived from China, while Ceylon cinnamon is first mentioned about the year 1275. Cinn. zeylanicum is now cultivated in many tropical countries, without, however, producing a bark equal to that of Ceylon in the delicate aroma.

Collection.—Ceylon cinnamon, the cultivation of which is gradually declining through the extension of coffee-culture, is produced in the south-western part of that island, in the vicinity of Colombo, where the plants are pruned so as to cause them to form stools from which four or five shoots are raised for 18 months or 2 years, until the bark begins to turn brown by the production of a corky layer. The shoots, which are now about 8 feet (2.4 M.) high and 2 inches (5 Cm.) or less thick, are cut off and deprived of their leaves and thin portions, which are sold as *cinnamon chips*. The bark is cut transversely, either obliquely or in a straight line, at distances of about a foot, after which two or more longitudinal incisions are made and the strips of bark removed by inserting beneath it the peeling-knife called *mama*. The pieces are put one within the other, and the sticks thus formed tied together into bundles. After about 24 hours the external layers of the bark are carefully removed by placing each piece upon a suitable stick of wood and scraping with a knife. The small quills are then placed in the larger ones in such a manner as to form congeries of quills about 40 inches (1 M.) long. These sticks are kept 1 day in the shade, then dried in the sun, and finally made into bundles of about 30 pounds each. Cinnamon produced in Senegal, Brazil, and the West Indies is inferior in quality; that from Tellichery and Java comes nearest to Ceylon cinnamon.

The tree yielding Chinese cinnamon is extensively cultivated in the south-eastern provinces of China, occasionally with Machilus velutina, *Champ.*, also a lauraceous tree, the bark of which is used for obtaining a glutinous extract. With this exception only Cinnamomum Cassia is cultivated in the Chinese cinnamon-plantation, as was ascertained through personal observation by Charles Ford in 1882 (*Jour. Linn. Soc.*, Dec. 1882), who gives the following description of the collection of cinnamon: "When the trees are about 6 years old the first cut of bark is obtained. The season for barking commences in March and continues until the end of May, after which the natives say the bark loses its aroma, and is therefore not removed from the trees. The branches, which are about an inch thick, being cut to within a few inches of the ground, are carried to houses or sheds in the vicinity of the plantations. All the small twigs and leaves being cleared off, a large-bladed knife, with the cutting edge something like the end of a budding-knife, is used to make two longitudinal slits and three or four incisions, at 16 inches apart, round the circumference through the bark; the bark is then loosened by passing underneath it a kind of slightly-curved horn knife with the two edges slightly sharpened. Pieces of bark 16 inches long and half the circumference are thus obtained. The bark, after its removal and while it is still moist with sap, is then laid with the concave side downward, and a small plane passed over it and the epidermis removed. After this operation the bark is left to dry for about 24 hours, and then tied up in bundles about 18 inches in diameter, and sent into the merchants' houses in the market-towns."

Cinnamomum obtusifolium, *Nees*, and Cinn. Burmanni, *Blume*, appear to yield similar products, but they are not cultivated, and their bark is probably rarely, if ever, found in the commercial article.

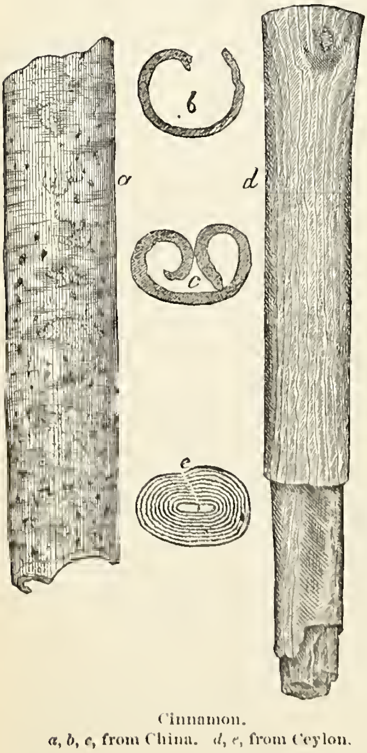
The U. S. Pharmacopœia recognizes the two kinds of cinnamon under the title of *Cinnamomum*, the British Pharmacopœia only the Ceylon, and the German Pharmacopœia the Chinese cinnamon. The importation into the United States of Ceylon cinnamon has decreased from 20,600 pounds in 1877 to about 5000 to 10,000 annually, while little over 1,000,000 pounds of Chinese cinnamon were imported in 1877, against nearly 2,500,000 pounds in 1880.

Description.—Ceylon cinnamon is in sticks about 40 inches (1 M.) long and nearly ½ inch (12 Mm.) thick, formed of eight or ten layers of very thin bark, which are together spirally rolled up from both edges. The bark itself has the thickness of stout writing-paper, is brittle and splintery, and has the external surface of a dull light yellowish-brown, smooth, marked with faint longitudinal wavy lines of bast-bundles, and with a few scars or holes left by the leaf-stalks or branchlets. The inner surface is smooth, scarcely striate, and of a somewhat darker brown. The odor is fragrant, peculiar; the taste sweetish, aromatic, and pungent. Inferior kinds of cinnamon are usually somewhat thicker, darker in color, of less agreeable fragrance, and occasionally of a bitterish taste. Cayenne cinnamon has a reddish tinge and is quite mucilaginous. Java cinnamon is often very similar to Ceylon cinnamon in appearance, though hardly equal to it in flavor; sometimes it is of a darker color, resembling Chinese cinnamon, but thinner and of better flavor.

Chinese cinnamon, cinnamon cassia, or cassia-bark, comes loose or packed in bundles with bands of bamboo. The pieces vary considerably in length, and are either curved, double quilled, or in quills of ¼ to 1 inch (6 to 25 Mm.) in diameter. The bark is $\frac{1}{25}$ inch (1 Mm.) or more thick, and has a smooth or finely-wrinkled reddish-brown outer surface, marked with some dark leaf-scars, occasionally with lighter-colored lines, and very generally covered with larger or smaller irregular patches of cork. It breaks with a short fracture, and when of good quality has a strong though less delicate cinnamon odor and taste.

Under the microscope Chinese cinnamon is seen to consist of the bast-layer only, the outer surface being formed by a continuous circle of stone-cells intermixed with bundles of bast-fibres; the narrow medullary rays separate the broad bast-wedges, consisting of regularly-arranged small groups or single bast-fibres and of bast-parenchyma, containing starch-granules and mucilage and scattered oil-cells. Chinese cinnamon, aside from the cork, consists of primary bark and of the bast-layer, in which the bast-fibres, groups of stone-cells, and oil-cells are scattered, and which contains more mucilage and starch than the preceding kind.

Fig. 77.



Cinnamon.
a, b, c, from China. *d, e,* from Ceylon.

A kind of Chinese or *Saigon cinnamon*, of late occasionally met with, is in more regular unscraped quills, yields a darker-colored powder, but has a very sweet and warm cinnamon taste. Its histological structure is very similar to Ceylon cinnamon.

The term *cassia lignea* is sometimes applied indiscriminately to Chinese cinnamon, or it is used only for the inferior varieties. Some writers have restricted it to a thicker bark, of a slight cinnamon odor and a mucilaginous, faint cinnamon taste. The origin of these barks is not positively known.

Constituents.—The two kinds of cinnamon agree in the main in their chemical constituents, the most important of which is volatile oil. (See Oleum Cinnamomi.) They also contain a considerable amount of tannin, some sugar, mannit, starch, and mucilage. Flückiger and Hanbury noticed that the infusion made with cold water becomes turbid on the addition of iodine or iodide of potassium, and the decoction of both cinnamons discharges the color of a considerable quantity of iodine before it permanently assumes the blue color of iodide of starch. The body producing this reaction with iodine appears to be insoluble in alcohol and ether, but its nature has not been ascertained. A strong tincture of cinnamon gradually becomes gelatinous and loses its astringent taste.

Pharmaceutical Uses.—Syrupus cinnamomi, P. G. Macerate for 2 days cinnamon 10 parts, cinnamon-water 50 parts, and dissolve in 40 parts of the filtered infusion 60 parts of sugar.—*P. G.*

Tinctura aromatica, P. G. Macerate Chinese cinnamon 5 parts, ginger 2 parts, cardamom, cloves, and galanga, each 1 part, in alcohol, sp. grav. 893, 50 parts.—*P. G.*

Off. Prep.—Acidum sulphuricum aromat., Aqua cinnamomi, Decoctum hæmatoxyli, Infusum catechu, *Br.;* Infusum digitalis, Pulvis aromaticus, *U. S.;* Pulv. catechu comp., Pulv. cinnamomi comp., Pulv. cretæ aromat., Pulv. kino comp., *Br.;* Tinctura cardamomi comp., Tinct. catechu comp., Tinct. cinnamomi, Tinct. lavandulæ comp., Vinum opii, *U. S.*, *Br.;* Tinct. rhei aromat., *U. S.*

Allied Products.—Cassia-buds, *Flores cassiæ*, s. *Clavelli cinnamomi*, are the small, pedicellate, unripe fruits of one or more species of Cinnamomum; they bear some resemblance to cloves, but are smaller, and consist of the thick perianth, the six small lobes of which are folded over the depressed ovary. They have a cinnamon-like but less agreeable odor and taste, and contain a volatile oil and tannin. The average importation of cassia-buds into the United States is about 40,000 pounds annually.

The following barks, which resemble cinnamon in some respects, are similarly employed in their native countries and are occasionally met with in commerce:

Culilawan-bark is obtained from Cinn. Culilawan, *Nees*, indigenous to the Moluccas. It is in flat or curved pieces $\frac{1}{10}$ to $\frac{1}{4}$ inch (2.5 to 6 Mm.) thick, grayish or brownish externally, dark cinnamon-brown internally, with the fracture corky and short fibrous. The odor resembles cinnamon with a mixture of cloves and sassafras; taste mucilaginous and aromatic.

Cassia caryophyllata, s. *Cortex caryophyllatus*, the clove-bark (Nelkenzimmt, *G.*), from Dicypellium caryophyllatum, *Nees*, of Brazil. It usually comes in quills $\frac{3}{4}$ to $1\frac{1}{2}$ inches (2 to 4 Cm.) thick, and about 2 feet (60 Cm.) long, which are made up of from six to ten pieces of bark rolled up together. The bark is about $\frac{1}{16}$ inch (1.5 Mm.) thick, smooth or slightly wrinkled, chestnut-brown, often with a bluish tinge, fracture short, showing a whitish line near the outer margin; odor clove-like; taste mucilaginous, resembling cinnamon.

Medical Action and Uses.—The oil of cinnamon, like that of other aromatics, first stimulates, and then exhausts and depresses, the nervous system. Locally, it is a rubefacient and stimulant. The water and the oil of cinnamon are used to impart an agreeable flavor to medicines, and the former is associated with astringents in the treatment of *diarrhœa*. Cinnamon was anciently believed to stimulate the uterus, and recently has been used in conjunction with more powerful medicines, such as borax, ergot, cotton-root, etc., to promote *parturition* and to check *uterine hæmorrhage* after labor and during menstruation or depending upon disease of the womb. Powdered cinnamon may be prescribed in doses of from 10 to 30 grains (Gm. 0.60–2.00). An infusion may be made with a drachm (Gm. 4.0) of the bruised bark to half a pint of boiling water, and administered in doses of a tablespoonful or two every hour.

CLEMATIS.—Virgin's Bower.

Clematite, Fr.; *Waldrebe*, G.

The herb of different species of Clematis.

Nat. Ord.—Ranunculaceæ, Clematideæ.

Description.—The genus consists of perennial herbs or woody vines climbing by the aid of the bending petioles of their opposite pinnate leaves. The flowers have four to six colored sepals, minute or no petals, numerous stamens, and many akenes, which are prolonged into a feathery or rarely naked tail, consisting of the permanent style. The following species have been used:

Clem. erecta, *Linné*, indigenous to Europe. The leaflets are five to nine in number, oblong, narrowed below or usually cordate at the base, acute, entire, pale-green beneath, three- to five-nerved. The white flowers are in cymose clusters. It was formerly known as *Herba flammulæ Jovis*.

Clem. Vitalba, *Linné*, indigenous to Europe. The leaflets are about five in number, ovate, heart-shaped at the base, acute, coarsely serrate or entire, three- to five-nerved, pubescent when young. The white flowers are in cymose clusters and have the sepals clothed with felt-like hairs.

Clem. Flammula, *Linné*, indigenous to Southern Europe. The leaves are twice pinnate, the leaflets small, varying between lanceolate and oblong, entire, but two- or three-lobed.

Clem. virginiana, *Linné*, common in Canada and the United States. Leaflets three, ovate, rounded or heart-shaped at base, lobed and cut-dentate, with mucronate teeth. Flowers white, in cymose panicles.

Clem Viorna, *Linné*—*Leather flower*—indigenous to the Southern States. Leaflets three to seven, ovate, acute, smooth. Flowers single, nodding, with dark-purple leathery sepals.

Clem. cylindrica, *Sims*, resembles the preceding, but has single bell-shaped, bluish-purple flowers, with the sepals dilated and often crisped above.

Constituents.—The above species possess in the fresh state a very acrid taste, which is gradually lost. Braconnot observed that the acrid principle may be distilled with water and is soluble in fixed oils.

Physiological Action.—All the numerous species of Clematis possess essentially the same properties, which are those of an acrid irritant. The juice or the bruised plant applied to the skin is apt to cause blisters, and even ulcers, and its emanations when it is crushed readily make the eyes water and inflame them. In Europe beggars avail themselves of these properties to produce ulcers upon their limbs for the purpose of exciting compassion. Hence, clematis is known as beggar's-weed (*l'herbe à gueux*). These irritant properties are very feeble in the dried plant. The American appear to be less acrid than the European species.

Medical Uses.—An infusion of the flowers and leaves of clematis has been used internally in chronic *rheumatism*, *syphilis*, *scrofula*, *dropsy*, and *quartan ague*. An infusion of the fresh buds of C. vitalba (gr. xv to gr. xl in water f℥vi–viij) (Gm. 1.00–3.00. in water Gm. 200–250), with the addition of anise or other carminative, when taken in three doses at intervals of an hour, is said to act as an efficient hydragogue cathartic. The dried leaves in weak infusion have been used with advantage as a diuretic in some cases of *dropsy* following intermittent fever. In Europe the peasantry employ the fresh leaves as *vesicants*, and physicians have applied them in the same manner to relieve local *pains*, and also in chronic *rheumatism*, *gout*, and *paralysis*. Even in ancient times this plant was used in the substitutive treatment of chronic *skin diseases*, and much more recently an infusion of it in oil was employed to cure the *itch*. The affected parts, it is said, having been subjected to several frictions, became violently inflamed, but with the subsidence of the inflammation the itch was cured.

COCCUS, *U. S.*, *Br.*—COCHINEAL.

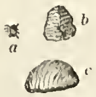
Coccionella.—*Cochenille*, Fr., G.

The female insect, Coccus cacti, *Linné*.

Class Insecta; Order Hemiptera.

Origin and Collection.—The cochineal insect is indigenous to Mexico and Central America, and has been introduced into and is cultivated in some of the West Indian Islands, the Canaries, Algiers, and Southern Spain. It feeds on different species of cactus, particularly on Opuntia cochinillifera, *Miller*, O. ficus indica, *Haworth*, O. Hernandezii, *De Candolle*, and others. The male insect is very small, has the rostrum or snout in the breast, two large wings, and the red body terminated by two long bristles. The female is nearly twice as large, is furnished with a rostrum, and has a bluish-red body, flattened below, convex above, wingless, and without terminal bristles; they attach themselves firmly to the plant, where they couple, after which they increase considerably in size and lay several thousand eggs; the insect then dies, and the body dries up, still enclosing the eggs, from which the young soon escape. During the rainy season in Mexico the insects are kept under cover upon cactus-branches, and when the weather begins to be favorable they are *sown* upon the plants, and the young ones allowed to develop until the females become fecundated and enlarged, when they are brushed off from the branches, killed by dipping them into hot water, and afterward dried in the sun or near a fire. This process yields the black cochineal, while the silver-gray is obtained by killing and drying the insects by exposure to the hot sun or in suitable ovens. Some females are left upon the plants, and in this way three harvests are made before the rainy season again sets in.

FIG. 78.



Coccus cacti: female insect, natural size; *a*, before, and *b*, *c*, after, impregnation; dry, and soaked in water.

Description.—Commercial cochineal is about $\frac{1}{5}$ inch (5 Mm.) long, nearly hemispherical, somewhat oblong and angular in outline, convex above, flat or concave on the lower side, transversely wrinkled, readily pulverizable, yielding a dark-red powder of a faint odor and slightly bitterish taste. Immersed in water, it imparts to it a red color, and swells up so that the ringed structure of the insect can be readily examined. There are two varieties met with in commerce—the *silver-gray* and the *black*. The former is of a purplish-gray, the latter of a purplish-black, color; it differs from the former in the absence from the furrows between the rings of the white wool which imparts to the other kind the gray color. Gray cochineal, when pure, contains a larger amount of coloring matter than the black variety, but has been often found adulterated; hence the latter was more esteemed, but is now also adulterated. An inferior kind, called *granilla* or *grana sylvestra*, consists of the uncultivated, mostly very small, insects, but is rarely seen in commerce. The United States import annually about 1,500,000 pounds of cochineal.

Adulterations.—Adulterated cochineal is not uncommon, the black being weighted with black lead, ferro-ferric oxide, or manganic binoxide, while the weight of the silver-gray variety is increased by barium or lead salts, talcum, and similar substances. The adulteration is now effected by exposing the cochineal to steam until the insects have attained their normal size without becoming wet, adding the powder, rotating the mixture in a drum, and finally drying by heat, when the adulterant will adhere between the wrinkles. Or an inferior quality of cochineal, moistened with warm water, is superficially colored by a mixture of barium sulphate or lead carbonate and ivory-black. Such frauds are readily detected by macerating some of the insects in water, when the powder is soaked off and the insect may be examined, or the cochineal is incinerated and the adulterant determined in the ash.

Factitious cochineal is said to have been occasionally met with, and to have been made of gums, starch, and various coloring and mineral matters.

A similar product is the *kermes*, *chermes*, or *alkermes*, which consists of the fully-developed females of Coccus ilicis, *Fabricius*, indigenous to the basin of the Mediterranean and living upon Quercus coccifera, *Linné*. By moistening with vinegar and drying in the sun they acquire a brown-red color. They are of the size of a pea, nearly globular, almost smooth, yield a carmine-colored powder, and produce with tin salt, like cochineal, a fine scarlet-red.

Constituents.—Besides fat, about 6 per cent. of moisture, a small amount of volatile acid, mucilaginous and glutinous compounds, cochineal contains *carminic acid*, $C_{17}H_{18}O_{10}$, which Belhomme believes to be also met with in the blossoms of Monarda didyma. It is readily soluble in water, alkalies, and alcohol, little in ether, and insoluble in the fixed and volatile oils. Its alcoholic solution is precipitated by alkalies, but the crimson color of its aqueous solution is succeeded by a purplish-red and precipitated on the addition of alkaline earth. Most metallic salts yield colored precipitates with it; the deposit with aluminium hydrate is called *lake*. On incineration pure cochineal leaves from .5 to .7 per cent. of ash. When decoctions of cochineal containing a little alum, cream of tartar, or salt of sorrel are set aside, they will deposit *carmine*, which in commerce is often found adulterated with starch and other substances; pure carmine should be entirely soluble in ammonia-water.

Off Prep.—Tinct. cardamomi comp., *U. S.*, *Br.*; Tinct. cinchonæ comp., Tinct. cocci, *Br.*

Medical Action and Uses.—It is very doubtful if cochineal possesses any medicinal virtues. It has indeed been reputed to be stimulant, anti-spasmodic, and diuretic, and cases are not wanting, especially of *whooping cough* and *neuralgia*, to prove its curative virtues. The beautiful carmine color which it imparts to various medicinal preparations is its only substantial title to a place in the Pharmacopœia.

COCHLEARIA.—Scurvy-grass.

Herba cochleariæ, P. G.—*Spoonwort*, *E.*; *Herbe au scorbut*, Fr.; *Löffelkraut*, G.

Cochlearia officinalis, *Linné*.

Nat. Ord.—Cruciferæ, Siliculosæ.

Description.—This biennial or annual herb is a native of Northern and Central Europe, where it grows in saline soil and is occasionally cultivated. The root is of the thickness of a quill, long and white. The numerous radical leaves are on long petioles, roundish heart-shaped, or almost reniform, very obtuse and nearly entire; those of the stem are ovate, obtuse, with few angular teeth, the lower ones petiolate, the upper ones clasping. The flowers are white, in terminal racemes, followed by globular ovate ascending pods, which are slightly flattened laterally, pointed by the persistent style, and contain three to five red-brown seeds in each cell. All parts have a pungent, acrid, and bitterish taste.

Constituents.—Winckler obtained tannin and a bitter principle which, with myrosin of white mustard, yielded oil of mustard. O. Geiseler (1859) corroborated the statement that the volatile oil does not pre-exist, but is formed only on maceration with cold water; he found its spec. grav. to be 0.942 and its composition $=(C_3H_5)_2OS$. According to A. W. Hofmann, however, it is butyl-mustard oil, $CSN.C_4H_9$, or sulphocyanide of butyl, boils near 160° C. (320° F.), and yields with ammonia a crystalline compound fusing at 135° C. (275° F.). An oil obtained synthetically from butylamine had the composition of oil of scurvy-grass, but a different odor, and yielded an ammonia compound fusing at 90° C. (192° F.).

Pharmaceutical Uses.—Spiritus cochleariæ, P. G. Macerate 8 parts of bruised fresh flowering scurvy-grass in 3 parts each of alcohol and water, and distil off 4 parts.

Allied Plants.—The following plants of the same natural order and sub-order have been more or less employed:

1. Capsella (Thlaspi, *Linné*) Bursa pastoris, *Moench.*—Shepherd's purse, *E.:* Bourse à pasteur, Molette, *Fr.:* Hirtentäschlein, *G.*—This annual is a native of Europe, but is extensively naturalized in most civilized countries. It has clustered, more or less deeply serrate or pinnatifid root-leaves, a stem about a foot (30 Cm.) or more high, with arrow-shaped sessile leaves and numerous small white flowers in terminal corymbs, which become much elongated. The fruit is a triangular obcordate pouch, which is laterally flattened, has a narrow partition, and contains numerous minute brown seeds. It flowers from early in spring to autumn, and has, particularly in summer, an acrid and bitter taste. Daubrawa (1854) found in the herb, besides the ordinary constituents of herbs, 6 per cent. of soft resin, a little sulphuretted volatile oil, and 9 per cent. of ash. The volatile oil obtained from the seeds was proven by F. Pless (1846) to be identical with oil of mustard. Mulder (1858) obtained from the seeds 28.8 per cent. of fixed oil and 26.5 per cent. of protein compounds.

2. Thlaspi arvense, *Linné*, and Thl. campestris, *Linné.*—Pennycress, Mithridate mustard, *E.:* Thlaspi champêtre, *Fr.;* Bauernsenf, Feldkresse, *G.*—The small, compressed, roughish, brown seeds have an acrid alliaceous taste, and yield a volatile oil which Pless found to be a mixture of the oils of garlic and mustard.

3. Lepidium sativum, *Linné.*—Garden cress, Pepper-grass, *E.:* Cresson alénois, Cresson des jardins, *Fr.:* Gartenkresse, *G.*—This annual is indigenous to Western Asia, and is frequently cultivated for salad. The bitterish and slightly acrid herb and seeds, like those of Lep. ruderale, *Linné*, and Lep. campestre, *Linné*, contain myrosin, but, according to Pless, not myronic acid; they yield, however, a sulphuretted volatile oil which dissolves in sulphuric acid with a red color. Lep. virginicum, *Linné*, and Lep. intermedium, *Gray*, the *wild pepper-grasses* of North America, probably yield a similar volatile oil.

4. Lepidium iberis, *Linné.*—Pepper-grass, *E.;* Passerage iberide, *Fr.:* Iberiskresse, Pfefferkraut, *G.*—This plant is found from Southern Europe to Siberia; has a branching stem about 2 feet high; petiolate, pinnatifid, or incisely serrate radical leaves about 2 inches (5 Cm.) long; smaller linear-lanceolate or linear entire somewhat grass-like stem-leaves, and minute white flowers in racemose cymes; the fruit is small, ovate, and acute. The plant is smooth and rather glaucous, and has a pungent taste, due to a sulphuretted volatile oil. Leroux (1837) obtained from the flowering-tops and seeds an amorphous bitter principle which he named *lepidin.*

The *broad-leaved pepperwort*, Lepidium latifolium, *Linné*, has similar properties.

5. Anastatica hierochuntica, *Linné*, an annual plant of the Levant growing in dry, barren fields, is occasionally seen as a curiosity. After the seeds are ripe the branches become woody and curl inward, forming a kind of a ball, which when soaked in water unfolds like a flower; hence the popular name, *rose of Jericho.*

Medical Action and Uses.—Common scurvy-grass is stimulant, diuretic, and antiscorbutic, in virtue chiefly of its acrid essential oil. Its bitter principle also contributes to its medicinal qualities. When chewed it excites the secretion of saliva, and when swallowed a sense of warmth in the stomach; it also tends to relax the bowels. It is everywhere eaten as a salad, generally mixed with water-cresses, and has great popular reputation as a purifier of the blood. It is justly celebrated for its efficacy in *scurvy*, and is either eaten fresh, which is preferable, or its expressed juice is administered. It has also been used with reputed advantage in *scrofula*, *chronic intermittent fever*, and *dropsy* depending upon the latter disease. Externally, the bruised herb has been applied in poultices to stimulate scrofulous and other atonic *ulcers*; and the juice, diluted with water, has been used as a mouth-wash for *spongy gums* and ulcers of the mouth.

Shepherd's purse is astringent, acrid, and aromatic. The herb and the seeds were anciently employed as stimulants to promote *menstruation*, and more recently in *dysury*, *diarrhœa*, *dysentery*, and *intermittent fever*. It is also credited with hæmostatic powers in *menorrhagia*. It is administered in an infusion made with 1 ounce of the herb in 12 ounces of water (Gm. 32 to Gm. 400), reduced by heat to half a pint. 2 ounces may be given at a dose.

Iberis was known to the ancients, who employed it as a rubefacient in rheumatic and other local affections. Pliny ascribes the discovery of its virtues to a certain physician named Damocrates. Even in recent times its powdered seeds were incorporated in an ointment for purposes like those above mentioned. Internally, it is said to have acted as an irritant, producing nausea and diarrhœa, and to have been useful in *bronchitis*, *dropsy*, *gravel*, squamous *skin diseases*, and *intermittent fever*. Its value, if any, is not determined.

CODEINA, *U. S., Br., F. Cod.*—CODEINE.

Codeinum, P. G.—*Codeia*, E.; *Codéine*, Fr.; *Codein*, *Kodein*, G.
Formula $C_{18}H_{21}NO_3.H_2O$. Molecular weight 317.

An alkaloid prepared from opium.

Origin.—Codeine is one of the constituents of opium, and was discovered by Robiquet in 1832. Grimaux (1881) succeeded in preparing it artificially by heating an alcoholic solution of morphine with soda and methyl iodide, thus showing that codeine is the methyl ether of morphine.

Preparation.—In preparing morphine by Gregory's process (see MORPHINA), after precipitating with calcium chloride the chlorides of morphine and codeine crystallize together, and on redissolving them in water and adding ammonia, morphine alone is precipitated. The ammoniacal filtrate is concentrated, the crystallizing codeine chloride freed from ammonium chloride, then dissolved in hot water, and decomposed by potassa, when a portion of the codeine will crystallize on cooling, but the greater part separate as an oily liquid, which gradually solidifies. The mother-liquor yields a further quantity of the same alkaloid, contaminated with some morphine. The alkaloid is washed with cold water, then dissolved in ether, the ethereal solution mixed with water, and evaporated to crystallize.

Properties.—Codeine is in "white or yellowish-white, more or less translucent, rhombic prisms, somewhat efflorescent in warm air, odorless, having a slightly bitter taste and an alkaline reaction, soluble in 80 parts of water at 15° C. (59° F.) and in 17 parts of boiling water, very soluble in alcohol and in chloroform; also soluble in 6 parts of ether and in 10 parts of benzol, but almost insoluble in benzin. When heated to 120° C. (248° F.) codeine loses its water of crystallization. At about 150° C. (302° F.) it melts, and on ignition it is completely dissipated. Codeine is dissolved by sulphuric acid containing 1 per cent. of molybdate of sodium (*Fröhde's reagent*) to a liquid having at first a dirty-green color, which after a while becomes pure blue, and gradually fades within a few hours to pale-yellow. On dissolving codeine in sulphuric acid a colorless liquid results, which on the addition of a trace of ferric chloride and gentle warming becomes deep-blue. An aqueous solution of codeine added to test solution of mercuric chloride should produce no precipitate, and if codeine be added to nitric acid sp. gr. 1.200 it will dissolve to a yellow liquid which should not become red (difference from and absence of morphine)."—*U. S.* Codeine crystallizes readily from its solutions, the crystals, frequently rhombic octahedrons, being of considerable size when slowly formed. They melt when placed in boiling water, and form transparent oily drops before dissolving. In addition to the solvents mentioned above, the alkaloid dissolves freely in amylic alcohol, methylic alcohol, and carbon bisulphide, and in about 85 parts of ammonia-water, but is nearly insoluble in potassa and soda. Its aqueous solution produces precipitates in solutions of the salts of iron, copper, lead, and other metals. Codeine does not separate iodine from iodic acid, and is not colored blue by ferric chloride (difference from morphine). Its solution in absolutely pure sulphuric acid remains colorless for several days, but on heating to 150° C. (302° F.) becomes brown-green, and after cooling reddish; in the presence of traces of nitric acid or of iron the cold solution gradually changes to green and blue, and deposits a blue precipitate. *Erdmann's reagent*, used for this test, consists of 20 Gm. of pure sulphuric acid and 10 drops of a mixture made with 6 drops of nitric acid spec. grav. 1.25 and 100 Gm. of water. For the testing of alkaloids *Fröhde's reagent* is best prepared by adding 1 Mg. of sodium molybdate to 1 Ccm. of pure sulphuric acid. The yellow solution of codeine in nitric acid when heated contains *nitrocodeine*, $C_{18}H_{20}(NO_2)NO_3$. Codeine yields with chlorine-water a colorless solution, which changes to red-brown on the addition of ammonia.

Physiological Action.—The action of codeine upon animals seems to vary with its dose and mode of administration. 1 grain given to a rabbit hypodermically produced fatal tetanus, while 10 grains in the stomach of a similar animal occasioned only a peaceful and prolonged sleep, from which, however, it was easily aroused. By the former method it was more speedily fatal to these animals than an equal dose of morphia. On their awaking they were neither paralyzed nor dull. It has also induced tetanus in dogs. Given to man in the dose of 1½ grains, it may create marked gastric disturbance, congestion of the head, dulness of the mind, and tremor; but in the dose of ⅓ grain it usually produces calm and refreshing sleep, and does not cause sweating, eruptions on the skin, nausea, vomiting, or constipation. In the case of a child affected with diabetes and albuminuria it occasioned an inert and drowsy condition (*St. Bart's Hosp. Rep.*, xv. 224).

Medical Uses.—Codeine has been chiefly employed to allay *restlessness, cough*, and other symptoms for which opium is generally prescribed and when the latter medicine is not tolerated. In *phthisis* it seems to appease the cough without deranging the digestion. In like manner, it has been found to lessen the irritability of the stomach in cancer of that organ. But it is chiefly in *diabetes* that it has been recommended, especially upon the ground that it does not produce the narcotic effects of opium or morphine (*Edinb. Med. Jour.*, xvii. 461). But it is well known that in that disease narcotism is not produced by those remedies. There is no doubt that under the use of codeine and an appropriate regimen diabetes may be greatly benefited in some instances, but in quite as many it entirely fails. Its power of diminishing the urine and its saccharine contents is sometimes marked (*St. George's Hosp. Rep.*, ix. 679). This alkaloid has been used as an anodyne and antispasmodic in several diseases attended with paroxysmal *pain* or disordered *muscular action*. It is represented by some to be comparable to morphine in its effects when given in a little more than twice the dose, but others declare that its proper hypnotic dose is many times larger than that of morphine. A quarter of a grain may be prescribed, to be repeated if necessary. In a case of diabetes, above referred to, the daily dose varied from 10 to 15 grains. The muriate and the sulphate of codeine may be given in similar doses. One-sixth of a grain has often been administered hypodermically. A phosphate of codeine has been prepared whose solubility and unirritating quality adapt it to hypodermic use. Its dose is said to be about double that of the morphine salts.

COLCHICUM, *U. S., Br., P. G.*—COLCHICUM.

Meadow-saffron, E.; *Colchique, Safran bâtard*, Fr.; *Herbstzeitlose, Wiesensafran*, G.

The tuber and seeds of Colchicum autumnale, *Linné.* Bentley and Trimen, *Med. Plants*, 287.

Nat. Ord.—Melanthaceæ.

Officinal Parts.—1. COLCHICI RADIX, *U. S.;* Colchici cormus, *Br.*; Bulbus, s. Tuber colchici.—Colchicum-root or corm, *E.;* Bulbe de colchique, *Fr.;* Zeitlosenknollen, *G.*

The tuber (corm).

2. COLCHICI SEMEN, *U. S.;* Colchici semina, *Br.;* Semen colchici, *P. G.*—Colchicum-seed, *E.*; Semences de colchique, *Fr.;* Zeitlosensamen, *G.*

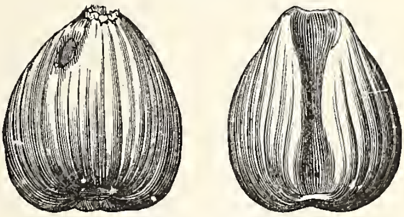
The seeds.

Origin.—The plant is indigenous to Europe, in the southern and central parts of which it is frequently found in pastures and meadows, flowering in September or October and ripening its seeds in June following. In the autumn the subterraneous portion consists of the fully-developed tuber (corm of many writers), bearing at its apex the scar left by the fruit-stem of the preceding summer. A tuft of root-fibres is attached to a lateral projection of the base, above which there is a shallow groove running to the apex of the tuber. In the lower part is a short conical axis with three or four rudimentary leaves, and bearing upon the apex one or more flowers, with the lower part of their long perianth-tubes resting in the groove. The whole is surrounded by a few brown leaves, forming a sheath above. After flowering the tuber gradually diminishes in size, until by the following summer it is completely absorbed and decayed. In the mean time the upper internode of the short conical axis is gradually developed into a stem rising above ground with the capsules, and at the base is enlarged to an ovoid fleshy tuber, as yet without the lateral groove, but showing in the lower axil the bud, which by the following autumn will be developed into a short conical flowering axis, while in the mean time the lateral groove on the fruit-bearing tuber will have been formed. The development and duration of the tuber embrace, accordingly, a period of 2 years, in the first half of which the tuber produces flowers and fruit, and afterward serves for developing and nourishing its successor.

The flowers resemble those of Crocus, have a whitish tube about 5 inches (12.5 Cm.) long, and a six-parted pale lilac or rose-colored border. The ovary remains underground during the winter, and is afterward formed into an obtusely-triangular, oblong-ovate, and inflated capsule, which is three-celled, bears the numerous seeds in the centre, and is surrounded by four or five linear lanceolate leaves. The tubers are collected in July and August, before the appearance of the flowers; but Schroff (1856), and afterward Maclagan, concluded from physiological experiments the proper time for the collection to be the period of flowering and immediately afterward.

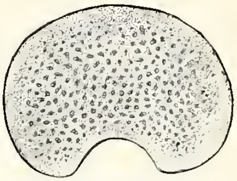
Description.—1. The Tuber. It preserves its properties best if dried entire by exposure to the sun and air, and is then of an ovoid shape, 1 to 1½ inches (25 to 38 Mm.) long, and nearly as thick at the thickest portion, convex on one side, flattened and with a groove on the other. After the removal of the brown membranous teguments the surface is of a brownish or ash color, longitudinally wrinkled and internally white. In our commerce it is usually met with in transverse slices about ⅛ inch (3 Mm.) in thickness, somewhat reniform in shape, and notched on one side, of a white mealy appearance and breaking with a short and mealy fracture. In the fresh state it has a radish-like odor. which is completely lost on drying. The taste is sweetish, then bitter and somewhat acrid. The tissue is formed of regular parenchyma, filled with more or less angular, mostly compound starch-granules, and of rather delicate scattered fibro-vascular bundles with spiral ducts. Colchicum-tubers exhibiting a blackish color upon the recent fracture should be rejected. From the investigations of T. F. Beckert (1877), however, it appears that the amount of colchicine is scarcely influenced by the color, but decreases in old colchicum-root.

Fig. 79.



Tuber of Colchicum.

Fig. 80.

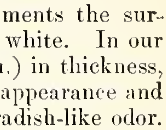


Colchicum: transverse section.

The Oriental *hermodactyls* resemble this tuber, but have a smooth surface, and vary in color between whitish and blackish, and in taste between insipid and bitter. They have been referred to Colch. variegatum, *Linné*, which is found in Southern Europe and Asia Minor, but are probably obtained from different species indigenous to Asia. Orphanides (1875) enumerates not less than forty-three distinct species.

2. The Seeds. They are about $\frac{1}{12}$ inch (2 Mm.) in diameter, nearly spherical, slightly pointed at the hilum by a crest-like appendage, of a dull-brown color, finely pitted, somewhat glutinous when fresh, and with a powdery surface when older. They are entirely inodorous, and have a bitter, acrid taste. The finely-punctate testa adheres closely to the whitish thick horny albumen, which renders the seeds very difficult to powder, and encloses a very small embryo nearly opposite the hilum.

Fig. 81.



Colchicum-seed: *a*, natural size; *b*, section magnified.

The powdering is effected by grinding them in a mill with hardened plates; or if done in a mortar they should be well dried, or else previously soaked in the menstruum to be used for exhaustion, and while still moist crushed beneath the pestle in small quantities. Rosenwasser (1877) proved that unbroken colchicum-seeds yield to solvents less than one-third the amount of colchicine contained in them; Hübler's observation, that *warm* solvents extract all the active principle from the unbroken seed, was corroborated by L. I. Morris (1881) and by Hertel.

Constituents.—The important constituent of the tuber, flowers, and seeds of colchicum is *colchicine*, according to Hübler (1864) of the formula $C_{17}H_{19}NO_5$, and by acids converted into *colchiceïn*. Pelletier and Caventou (1820) supposed it to be veratrine, but Geiger and Hesse (1833) proved it to be distinct. Owing to a case of poisoning by wine of colchicum which occurred in Berlin in 1855, it again attracted attention, and was examined (1857) by Aschoff, Bley, John E. Carter, and others. Oberlin (1856) denied the alkaloidal nature of this body, and regarded (1857) the crystalline *colchicein* as the poisonous principle of colchicum. The majority of investigators, including Ludwig (1862), Diehl (1867), and Hertel (1881), regarded it as a nitrogenated non-alkaloidal bitter principle, which is readily altered by chemical reagents, though it is not a glucoside, as was asserted by Walz. But Carter's colchicine (a specimen of which is in the cabinet of the Philadelphia College of Pharmacy) is unmistakably though feebly alkaline, as we have shown in 1867; it affords also precipitates with the usual reagents for alkaloids. Similar results were obtained by Eberbach (1874), who succeeded in crystallizing it from chloroform in silky needles. Rosenwasser (1877) obtained crystals from benzol, which became amorphous after exposure to the air for several months. According to Hertel, colchicine prepared in the usual manner contains fruit-sugar and other impurities, notably two resins, and also colchicein; these principles are thus characterized: *Colchicine*, $C_{17}H_{23}NO_6$, is colorless or yellow, amorphous, soluble in water, alcohol and chloroform, less soluble in ether, of a saffron-like odor and bitter taste, precipitated by tannin, turns moist litmus-paper slowly blue in consequence of incipient decomposition, with formation of ammonia, and its aqueous solution is colored yellow by hydrochloric acid. *Colchicein*, $C_{17}H_{21}NO_5.2H_2O$, is in white crystals, inodorous, soluble in alcohol, chloroform, and hot water, colored green by ferric chloride, and, after several days' standing, precipitated by tannin; it has a slight acid reaction, and combines with bases, the compounds being mostly insoluble in water, but soluble in alcohol and chloroform. *Colchico-resin*, $C_{51}H_{60}N_2O_{15}$, is brown, amorphous, soluble in chloroform and alcohol, insoluble in ether, and very sparingly soluble in cold water. *Betacolchico-resin*, $C_{34}H_{39}NO_{10}$, is blackish-brown, soluble in strong alcohol and chloroform and insoluble in water and ether. The last two principles are not, or but slightly, affected by tannin, are colored brown-green by ferric chloride, and dissolve in potassa with a brown color. Colchicine and colchicein yield with potassa a yellow solution. The four principles yield with sulphuric acid and potassium nitrate a deep-blue or purplish-blue color, and when this has disappeared concentrated potassa solution produces a more permanent brick-red color. By heating colchicein with hydrochloric acid at 115° C. (239° F.), Zeisel (1883) obtained methyl chloride and *apocolchiceine*, the hot aqueous or dilute alcoholic solutions of which solidify on cooling to a gelatinous mass. Its salts are amorphous; its solutions in acids are intensely yellow, and are precipitated by the group-reagents for alkaloids. Ferric chloride gives a brown-green precipitate soluble with a green color in hydrochloric acid. The behavior to sulphuric acid and potassium nitrate is similar to that described above.

Colchicine is usually prepared by exhausting with alcohol, evaporating, diluting with water, filtering, precipitating coloring matter with subacetate of lead, removing excess of lead by sodium phosphate, and precipitating colchicine with tannin; the washed tannate is digested with lead oxide and dried, when alcohol dissolves the colchicine. Eberbach's process is a modification of that of Geiger and Hesse: he exhausts with alcohol containing ¼ per cent. sulphuric acid; to the tincture calcium hydrate is added, and to the filtrate, if necessary, sulphuric acid, to exact neutralization; the alcohol is distilled off, the residue diluted with water, filtered, the filtrate treated with ammonia, and then agitated with chloroform. Hertel's pure colchicine is made by adding magnesia to the tincture of the unbroken seeds, distilling off the alcohol, diluting the cold residue with water, separating the fat, and extracting the principle with chloroform; the yield is 0.4 per cent.

A. Aschoff (1857) obtained from 1 pound of dry tubers, collected in October, 6.5 grains of colchicine; the amount then decreased, and was in May 0.75 grain, and for the young tuber 6.5 grains. 2 pounds of fresh (=4½ oz. dry) colchicum-flowers yielded 7 grains, but if collected without the underground portion of the tubers, only 2 grains. The flowers, if properly gathered, furnish, therefore, quite an active medicine. 1 pound of seeds yielded 15 to 19 grains; J. E. Carter obtained only 6.7 grains.

The remaining constituents of the tuber are medicinally unimportant; they comprise starch (about 10 per cent.), gum, sugar, tannin, and fatty resinous and coloring matters. The seeds contain much sugar, a little acid reacting like gallic acid, and a fixed oil amounting to between 6 and 8 per cent.

Pharmaceutical Preparations.—ACETUM COLCHICI. Digest for a week 1 part of bruised colchicum-seed in 9 parts of dilute acetic acid and 1 part of alcohol, and filter. —*P. G.* 1872. Colchicum-root 1 part, white wine vinegar 12 parts.—*F. Cod.*

OXYMEL COLCHICI. Mix vinegar of colchicum 1 part and clarified honey 2 parts, and evaporate to 2 parts.—*P. G.* 1872.

Off. Prep.—1. Tuber: Extract. colchici, *Br.;* Extr. colchici rad. fluid., *U. S.;* Extr. colchici aceticum, Vinum colchici radicis, *U. S.*, *Br.*
2. Seed: Extract. colchici seminis fluid., *U. S.;* Tinc. colchici (colchi. sem.), *U. S.*, *Br.;* Vinum colchici seminis, *U. S.*

Physiological Action.—Colchicum and its alkaloids, whether given to certain animals by the mouth or veins or hypodermically, produce essentially the same symptoms. They consist of violent (and even bloody) vomiting and purging, great nervous exhaustion, and signs of extreme suffering. After death intense vascular congestion is found in the gastro-intestinal mucous membrane and in the kidneys: the blood is dark and thick, not only in the veins, but even in the heart and arteries—in consequence, no doubt, of the great loss of its watery element by vomiting and purging. The experiments of Rutherford and Vignal led them to conclude that "colchicum, although it increases the amount of biliary matter excreted by the liver, renders the bile more watery." According to Rossbach, the most characteristic effect of colchicine is complete paralysis of the central and peripheral terminations of the nerves. This effect involves sensibility, motility, and reflex excitability. It is remarkable that the action of the alkaloid is very slowly developed, and that even in experiments causing death the fatal result is delayed for several hours. Upon man the operation of colchicum and its preparations does not differ essentially from that just described. Its topical action is shown by the redness, pricking, and diminished sensibility of the skin produced by the application of the fresh cormus. Applied to the tongue, it occasions an acrid, bitter, and astringent taste, irritation of the fauces with salivation, and a sense of tension and pain, followed by insensibility and rigidity of the organ, and sometimes profuse ptyalism. Medicinal doses, insufficient to produce any gastro-intestinal irritation, diminish the frequency of the pulse and probably increase the proportion of solids in the urine. These statements are not sustained by uniform evidence. According to Dr. Granville Faught (*Inaug. Thesis*, Univ. of Penna., 1879), who studied the action of wine of colchicum-root in his own person, it increases the proportion of water and of free uric acid in the urine, and diminishes that of urea. In studying the action of this drug too little care has been taken to distinguish between cases into which no disturbing element entered, and those in which the emeto-cathartic operation of the drug took place, and in which, therefore, the urinary secretion was necessarily diminished. It is very certain that there is nothing in its eliminative action by the kidneys or by the bowels to explain its curative virtues.

When moderate doses of colchicum have been repeated for several days or a single large dose has been taken, some heat is felt in the epigastrium, with eructations, and perhaps nausea. Under its continued action the appetite fails, the tongue becomes coated, and there is some colic, with gurgling and diarrhœa. In doses of from 1 to 4 drachms within 24 hours it occasions bilious vomiting, with colic and straining, heat in the anus, and bloody and mucous stools. It is said that the abdomen is not tender under pressure, and cases of colchicum-poisoning indicate that the statement is true.

Poisonous doses of colchicum, apart from the symptom just alluded to, occasion all the signs of violent gastro-intestinal irritation, a true cholera morbus, with griping, vomiting, diarrhœa, prostration, and painful spasms of the limbs and trunk, followed by resolution and collapse, in which death occurs without delirium or coma. It probably is due at last to cardiac syncope. After death the most notable changes consist of lividity of the skin in depending parts, engorgement of the veins, with dark pitchy blood in the lungs, brain, and trunk, sometimes a dark-colored injection of the gastro-intestinal mucous membrane and submucous ecchymoses, and more or less shedding of the intestinal epithelium. The kidneys are pale. It is alleged that colchicum or its alkaloid is sometimes used in the manufacture of beer to simulate the bitterness of the hops, which are deficient. A case is recorded in which several persons who each had drunk about a glass of English beer were seized with vomiting and purging, heat of head, etc., and the beer, on examination, was found to contain colchicine.

It may be concluded that colchicum acts chiefly upon the digestive organs and upon the nervous system, and probably favors the elimination of effete matters through the bowels, the kidneys, and, in a slight degree, through the skin.

Medical Uses.—The chief use of colchicum is in the treatment of *gout*, for which disease it was anciently employed, and only fell into neglect through the prevalence of absurd medical theories which condemned it because their authors could not comprehend its operation. Only within the first quarter of the present century was it revived, after the discovery that the virtues of an unquestionably efficient quack-remedy for the cure of gout were due to colchicum. As a general rule, it acts much more favorably upon acute than chronic gout, and upon first attacks than upon those which are frequently repeated; it does not agree with old persons as well as with the young or the middle-aged; and usually, although by no means uniformly, its favorable operation is attended with an increased secretion of bile and urine, free alvine discharges without diarrhœa, and a moist state of the skin. Its curative effects are not to be secured by allowing it to excite vomiting or purging, but are retarded and rendered incomplete by such evacuations. These evils should be avoided by commencing the administration with small doses of the drug. A repetition of the gouty attacks renders larger doses necessary, and in course of time they are apt to resist the medicine completely. Before commencing the use of colchicum in this disease it is profitable to remove the contents of the alimentary canal by means of a purgative. A draught containing sulphate of magnesia, with magnesia or its carbonate, in an aromatic water, is the most appropriate form of prescribing it.

Much has been written of the virtues of colchicum in *rheumatism*, and some reputable physicians have estimated them highly; but a close inquiry leaves no doubt that whatever good may have been achieved was due either to the violent purgative operation of the medicine or to the agents with which it was associated. The recent hypodermic use of colchicine for the same disease is mentioned only to be condemned. The local action of the alkaloid is very irritating. The same remark applies with equal force to the use of the medicine in *cholera*, *tetanus*, *neuralgia*, diseases of the *skin*, etc., but it is possible that it may exert a salutary diuretic action in *dropsy* depending upon congestion or infarction of the kidneys. Its importance in this affection compared with that of digitalis is almost null.

The *dose* of the dried cormus of colchicum may be stated at from 2 to 8 grains (Gm. 0.10–0.50), and , according to some persons, this form of the medicine is the most efficient. But the wines or the extracts are usually preferred.

COLLINSONIA.—Horsebalm.

Richweed, *Stone-root*, *Knob-root*, *Heal-all*, E.; *Guérit-tout*, *Baume de cheval*, Fr.; *Collinsonie*, G.

Collinsonia canadensis, *Linné*. Meehan, *Native Flowers*, ii. 165.
Nat. Ord.—Labiatæ.

Description.—A perennial herb about 3 or 4 feet (.9 or 1.2 M.) high, growing in rich woodlands in North America from South Carolina northward. It has a nearly horizontal and irregularly-branched rhizome, having, together with the branches, a length and width of 3 to 6 inches (7 to 15 Cm.), and on the upper side a very knotty and tuberculated appearance from the numerous short projecting branches and the many shallow concave stem-scars; the lower surface is much less knotty, and bears many thin nearly simple rootlets or their remnants. It is externally of a grayish- or yellowish-brown color, has a very thin bark of a slight nauseous taste, and a very hard, whitish wood. The stem is quadrangular and hairy above; the leaves are opposite, petiolate, 3 to 8 inches (7 to 20 Cm.) long, thin, nearly smooth, ovate, pointed, sometimes rather heart-shaped at the base, coarsely serrate, and somewhat dotted beneath. The flowers are in loose racemes, of a greenish-yellow color, the lower lip of the corolla fringed and with two exserted stamens. The herb has when rubbed a strong and usually disagreeable odor, but occasionally it is more pleasant and anise-like. Its taste is pungent. Like other Labiatæ, it contains a volatile oil, but it has not been chemically examined.

Medical Action and Uses.—From the fact that this plant contains an acrid volatile oil which it loses in drying, and that it has been popularly regarded as a remedy for various forms of debility or oppression, it must be held to possess stimulant virtues. Their special direction appears to be toward the urinary organs, since it is esteemed most in *dropsy*, *gravel*, and *vesical catarrh*; and toward the skin, since it is employed as a diaphoretic in *rheumatism* and *fevers*. Doubtless, the latter object is best secured by a hot, and the former by a cold, infusion of the plant. The essential oil has been used separately, and probably contains all the curative virtues of the herb. The fresh-bruised herb has been employed for the relief of the eruption produced by *poison sumach*, as a vulnerary, and as an anodyne for *colic* and other *local pains*, especially in hot fomentations. Next to the essential oil, an infusion of the bruised fresh plant is to be preferred, which in dropsical affections may be prepared with cider.

COLLODIUM, *U. S., Br., P. G.*—COLLODION.

Collodion, Fr.; *Collodium*, *Kollodium*, G.

Preparation.—Pyroxylin 4 parts (200 grains); Stronger Ether 70 parts (3500 grains or 10⅝ fluidounces); Alcohol 26 parts (1300 grains or 3½ fluidounces), to make 100 parts (5000 grains or 11⅖ oz. av. or 14¼ fluidounces). To the pyroxylin, contained in a tared bottle, add the alcohol, and let it stand for 15 minutes; then add the ether, and shake the mixture until the pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed and transfer it to bottles, which should be securely corked. Keep the collodion in a cool place, remote from lights or fire.—*U. S.*

The British Pharmacopœia directs the dissolution of 1 ounce of pyroxylin in a mixture of 36 fluidounces of ether and 12 fluidounces of rectified spirit. The proportions of the German Pharmacopœia are 1 part of gun-cotton to 21 parts of ether and 3 parts of alcohol. The pharmacopœias order the solution to be poured off from any sediment which may form, and which by the U. S. P. 1870 was ordered to be reincorporated by agitation before using the collodion.

Properties.—If the pyroxylin—or, more correctly, *colloxylin*—has been properly made, there is no difficulty in preparing collodion by simply agitating it occasionally with the liquid. It forms a neutral, nearly clear, or slightly opalescent, either colorless or slightly yellowish, liquid having a syrupy consistence and ethereal odor. On evaporation it forms a colorless, glossy, and contractile film, which is more or less white and opaque if applied with the insoluble sediment.

Pharmaceutical Uses.—Collodion and flexible collodion may be used as an excellent vehicle for the local application of medicinal substances soluble in ether, such as aconitine, atropine, tannin, ferric chloride, carbolic acid, the oleoresins of capsicum, pepper, etc., camphor, corrosive sublimate, red iodide of mercury, etc.

Medical Uses.—These are treated of under COLLODIUM FLEXILE.

COLLODIUM CUM CANTHARIDE, *U. S.*—COLLODION WITH CANTHARIDES.

Collodium cantharidatum, P. G.; *Collodium cantharidale s. vesicans.*—*Cantharidal collodion*, E.; *Collodion vésicant* (*s. cantharidé*, *cantharidal*), Fr.; *Blasenziehendes Collodium*, *Kanthariden-Kollodium*, G.

Preparation.—Cantharides, in No. 60 powder, 60 parts (12 ounces); Flexible Collodion 85 parts (17 ounces); Commercial Chloroform, a sufficient quantity. Pack the cantharides firmly in a cylindrical percolator, and gradually pour commercial chloroform upon them, until 250 parts (50 ounces) of tincture are obtained, or until the cantharides are exhausted. Recover, by distillation on a water-bath, about 200 parts (40 ounces) of the chloroform, and evaporate the residue in a capsule, by means of a water-bath, until it weighs 15 parts (3 ounces). Dissolve this in the flexible collodion, and let it stand at rest for 48 hours. Finally, pour off the clear portion from any sediment which may have been deposited and transfer it to bottles, which should be securely corked. Cantharidal collodion should be kept in a cool place, remote from lights or fire.—*U. S.*

Chloroform is a better solvent for cantharidin or the cantharidin compound contained in old Spanish flies; but if such be used it would seem to be of advantage to treat the powder by Dragendorff's process (see page 376), when cantharidin will be set free, as shown by Fahnestock (1879). Powdered cantharides being much lighter than chloroform, their percolation with this menstruum presents some difficulty unless pressed down by a layer of washed sand. Owing to the volatility of the chloroform, percolation should be performed with an apparatus such as is used for the percolation of ethereal liquids (see OLEORESINÆ), and the greater part of the menstruum remaining absorbed in the powder may be recovered by judicious percolation with water. If the proper precautions be observed in distilling the chloroformic tincture, the loss of chloroform will be insignificant. The present formula is similar to that of Procter (1852), in which, however, ether was used for exhausting the cantharides; the inflammability of this liquid and its vapor requires additional precautions in distilling the tincture.

The U. S. P. 1870 directed the exhaustion of the cantharides by means of ether and alcohol, a portion of the ethereal percolate being preserved, while the remaining percolate was evaporated, the residue mixed with the reserved portion, and the preparation finished by adding the requisite amount of pyroxylin, castor oil, and Canada turpentine. For reasons stated under Cantharides their exhaustion is better accomplished by acetic ether than by ether. Collodium vesicans, *Br.*, is made from blistering liquid 20 fluidounces, and pyroxylin 1 ounce.

The German Pharmacopœia directs this collodion to be made by macerating 50 parts of coarsely-powdered cantharides with 80 parts of ether, and filtering; in the filtrate, which should weigh 42 parts, 2 parts of pyroxylin are to be dissolved, with the addition of 6 parts of alcohol. The process evidently involves a loss of one-half of the active matter.

Properties.—Cantharidal collodion has the same physical properties as flexible collodion, except that it is of a brownish-green color, which becomes yellowish on exposure to light; it is therefore best kept in amber-colored vials. The film left on evaporation has also a greenish color.

Medical Uses.—See the following article.

COLLODIUM FLEXILE, *U. S.*, *Br.*—Flexible Collodion.

Collodium elasticum, P. G.—*Collodium élastique*, Fr.; *Elastisches Collodium*, G.

Preparation.—Collodion 92 parts (11½ oz. av.); Canada Turpentine 5 parts (⅝ oz. av. = 273½ grains); Castor Oil 3 parts (⅜ oz. av. = 163 grains); to make 100 parts (12½ oz. av. or 15¼ fluidounces). Mix them and keep the mixture in a well-corked bottle in a cool place, remote from lights or fire.—*U. S.*

This is nearly identical with the formula of the British Pharmacopœia; the German Pharmacopœia directs the dissolving of 1 part of castor oil in 49 parts of collodion.

Properties.—This preparation has the same appearance as collodion, but on evaporation it forms an elastic and scarcely contractile film.

Medical Action and Uses.—When collodion is spread upon the skin the evaporation of its ether causes its dissolved constituents to solidify and contract. As it then becomes very adhesive, the parts to which it is applied are constringed during the process, and therefore are measurably rendered anæmic, so that congestion, inflammation, and pain in them are prevented or reduced. The film formed by collodion in drying is impermeable to air and water, and therefore protects the parts underneath it, while its transparency permits them to be seen. The adhesive, protective, and contractile powers of collodion have been variously applied. In *wounds* of the scalp it serves to attach to the shaven skin slips of parchment, between whose opposite edges sutures are inserted to draw them together. In other simple incised wounds it is applied while the edges of the wound are kept accurately coaptated, the skin being first made perfectly dry. Collodion is often serviceable as a coating to *ulcers* which will not heal in consequence of the moisture of the locality or its liability to mechanical irritation. Of the former sort are ulcers of the neck of the *uterus;* of the latter, various ulcers of the *skin.* The application should be made first at some distance around the sore, and gradually advance to its centre, which ought to be left open for the escape of the secretions. Its protective and constringing properties are sometimes employed in the treatment of *carbuncles.* As in the case just mentioned, the application should be made widely around the swelling, whose central portion should be left free. The same qualities render it available in preventing and in treating *bed-sores* and *sore nipples.* Its protective action has been employed to prevent *abrasions* and other *wounds* from becoming infected during surgical and obstetrical operations and in *dissections.* Its constringing operation enables it to control *hæmorrhage* from leech-bites and other small wounds, to diminish the inflammation produced by the *stings of insects* and the local phenomena of *erysipelas*, *burns*, and *small-pox*, in the latter of which it is thought to prevent pitting. For the last three purposes it is necessary to modify the action of the collodion so as to render it less rigid when hardened. A mixture of 1 part of castor oil with 15 of collodion is said to have this effect, or the officinal flexible collodion may be used. With a similar object collodion has been applied with more or less success to the treatment of a variety of limited cutaneous eruptions, such as *intertrigo*, *acne*, *eczema*, and *herpes zoster.* In the last-named affection it certainly lessens the pain. In several of these disorders a preparation of collodion has been used containing vegetable and mineral astringents, as tannic acid in the officinal *styptic collodion.* Collodion may be employed to reduce the swelling of gonorrhœal *orchitis*, the skin of the swollen testicle being tensely drawn before the application is made. It has also been used with advantage in the treatment of *varicocele.* In *retracted nipple* a zone of this liquid, applied so as to encircle the nipple at the distance of a quarter of an inch, will sometimes cause it to protrude. Its constringing action and its mechanical support render it efficient in preventing protrusion of the bowel in umbilical *hernia*, and even in some cases of inguinal hernia; and the same is true of its use in cases of *spina bifida*, *vascular nævi.*

and *cephalæmatoma* after puncture. It may be used for a similar purpose in the treatment of *sprains*, its application being renewed as fast as the existing film becomes loose. It has been employed with alleged success to prevent nocturnal *urination* in children, by closing the orifice of the urethra by means of it at bedtime; but this is a clumsy expedient. In applying the *actual cautery* its action may be limited by including the skin about to be burned within a broad and thick circle of collodion.

Various substances of a caustic nature, such as cantharides, croton oil, iodine, corrosive sublimate, iodide of zinc, chromic acid, etc., and certain astringents, such as tannin, the salts of iron and copper, etc., have been associated with collodion for local application. Cantharidal, flexible, and styptic collodions are officinal.

Before applying collodion the skin should be perfectly dried, and, the liquid having been laid on with a soft brush, the first layer should be allowed to harden before a second is applied. For protective purposes a thin film will suffice; for constriction a thicker coating is required. In dressing wounds a piece of patent lint or of linen cambric saturated with the liquid should be laid upon the part after the edges of the wound are accurately coaptated. If a firm dressing without constriction is desired, flexible collodion is to be preferred.

COLLODIUM STYPTICUM, *U. S.*—STYPTIC COLLODION.

Collodium hæmostaticum.—Styptic colloid, *Xylostyptic ether*, E.; *Collodion au tannin*, *Col. styptique*, Fr.; *Tannin-Kollodium*, G.

Preparation.—Tannic Acid 20 parts (80 grains); Alcohol 5 parts (20 grains or 26 minims); Ether 20 parts (80 grains or 116 minims); Collodion 55 parts (220 grains); to make 100 parts (400 grains or about 1 fluidounce). Introduce the tannic acid into a tared bottle, add the alcohol, ether, and collodion, and agitate until the tannic acid is dissolved. Keep the product in well-corked bottles in a cool place, remote from lights or fire.—*U. S.*

This preparation was originally suggested by Dr. Benjamin W. Richardson (1867), who added a small quantity of ticture of benzoin. A somewhat similar but much stronger preparation is the one recommended by Pavesi, consisting of tannin 5 parts, carbolic acid 10 parts, benzoic acid 3 parts, and collodion 100 parts.

Medical Uses.—It is difficult to understand how tannic acid enclosed in an insoluble matrix can operate as an astringent. Such, however, is the purpose supposed be accomplished by this preparation, already referred to under COLLODIUM FLEXILE.

COLOCYNTHIS, *U. S.*—COLOCYNTH.

Poma colocynthidis.—Bitter apple, E.; *Coloquinte*, Fr.; *Koloquinten*, G.

The fruit of Citrullus (Cucumis, *Linné*) Colocynthis, *Schrader*. Woodville, *Med. Bot.*, plate 175; Bentley and Trimen, *Med. Plants*, 114.

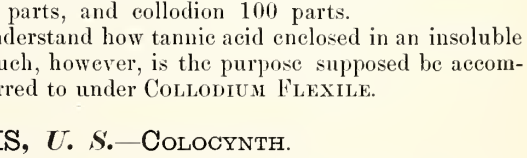
Nat. Ord.—Cucurbitaceæ.

Officinal Parts.—1. COLOCYNTHIS, *U. S.*; Fructus colocynthidis, *P. G.*—Colocynth, *E.*; Coloquintes, *Fr.*; Koloquinten, *G.*—The fruit deprived of its rind.

2. COLOCYNTHIDIS PULPA, *Br.*—Colocynth-pulp, *E.*; Pulpe de coloquinte, *Fr.*; Koloquintenmark, *G.* The decorticated fruit freed from the seeds.

Origin.—The colocynth-plant has a perennial root, an herbaceous, angular, hispid stem, with many-lobed hairy leaves, short branching tendrils, and solitary axillary unisexual flowers with a yellow corolla. It is said to be indigenous to Japan, and is met with abundantly from the sandy lands of Coromandel north-westward to the Caspian Sea, and westward throughout Western Asia to Greece, throughout Northern Africa, and as far south as Nubia, Senegambia, and the Cape of Good Hope. It is cultivated and naturalized in Spain.

FIG. 82.



Peeled Colocynth: longitudinal and transverse section.

Description.—The fruit, called *gourd* or *pepo*, resembles an orange in size and appearance, is globular, 2 to 4 inches (5 to 10 Cm.) in diameter, and covered with a smooth and thin but firm, parchment-like rind of a light brownish-yellow color. The rind is usually removed, sometimes from the fresh, but more frequently from the dried, fruit. In the former case the white or yellowish-white pulp is considerably shrunk, so as to closely envelop the seeds; in the latter case the fruit has retained its original size and shape, but shows upon the surface of the spongy pulp the smooth cuts with a sharp knife. It is destitute of odor, but has an intensely bitter taste, is very light, and divided into three easily separable cells by the parietal placentæ, which project to near the centre, are then branched, turned back toward the rind, and here curved inward again, so that by the development of each placenta three slightly-united wedges are formed, each being again divided into two parts. The naturally one-celled fruit has therefore the appearance of being six-celled, and the seeds being borne on the incurved ends of the placentæ in two, or sometimes three, rows, there are at least four rows of seeds in each wedge or twelve rows in the fruit. The seeds are flat ovate, with a rounded edge, brownish or yellowish, and contain an oily embryo with two thick cotyledons. The pulp consists of roundish, thin-walled, loosely-united parenchyma-cells, containing a little granular matter and becoming larger toward the centre; the thin fibrovascular bundles form in the outer layer an irregular circle and are scattered in the interior. Good colocynth yields from 65 to 72 per cent. of seeds and from 28 to 35 per cent. of pulp, the latter alone being employed in medicine. The oily and slightly bitter seeds, freed from the adhering bitter pulp and from the integuments, are used as food in some parts of Africa. According to Flückiger, the dried pulp yields 11 per cent. of ash, and the seeds 2.7 per cent. of ash and 17 per cent. of fixed oil.

Colocynth reaches commerce from Syria, Egypt, Morocco, and Spain. The Syrian variety is often peeled while fresh, and when dry is of a very shrivelled and unsightly appearance, but is rarely met with in our commerce. 27,555 pounds of colocynth were imported into this country in 1867.

Some other cucurbitaceous fruits have a very bitter taste, and are reputed to be purgative, like Cucumis trigonus, *Roxburgh*, Cuc. Hardwickii, *Royle*, of the East Indies, and Cuc. prophetarum, *Linné*, of Arabia.

Constituents.—Colocynth has been analyzed by Braconnot, Vauquelin, Herberger, Meissner, Bastick, and others. The medicinally unimportant constituents are pectinaceous, mucilaginous, and gummy matter, fixed oil, and salts. Walz (1858) first published a process for obtaining the bitter principle *colocynthin* in a pure state by exhausting the alcoholic extract with cold water, precipitating the filtrate with acetate and subacetate of lead, removing excess of lead with sulphuretted hydrogen, precipitating with tannin, diffusing the precipitate in alcohol, and decomposing with plumbic hydrate. Any lead taken up by the liquid is removed by hydrogen sulphide, the clear liquid evaporated, and the residue washed with ether. The undissolved portion is colocynthin, $C_{56}H_{84}O_{23}$ (?), an amorphous yellow mass which appears to become crystalline on the slow evaporation of its alcoholic solution. On boiling with dilute acids it splits into sugar and resinous *colocynthein*. The portion of the alcoholic extract remaining undissolved by cold water contains a tasteless crystalline principle, *colocynthitin*, which is soluble in ether, alcohol, and hot water. Hübschmann (1858) obtained nearly 3 per cent. of colocynthin by treating the alcoholic extract of colocynth with hot water, concentrating the liquid, precipitating it with excess of potassium carbonate, dissolving the dried precipitate in alcohol, adding 8 volumes of ether, decanting, agitating with animal charcoal, filtering, and evaporating. Henké (1883) prepared apparently a purer colocynthin by precipitating with strong tannin solution and decomposing with lead carbonate; the yield was only 0.6 per cent. of the pulp. It is a pale-yellow uncrystallizable powder, soluble in 20 parts of cold and 16 parts of hot water, readily soluble in alcohol, sparingly soluble in absolute alcohol, and insoluble in ether, chloroform, benzol, benzin, and carbon bisulphide.

Pharmaceutical Uses.—FRUCTUS COLOCYNTHIDIS PRÆPARATI, s. *Trochisci alhandal*, P. G., 1872. It is prepared by triturating 5 parts of colocynth-pulp and 1 part of powdered gum-arabic with sufficient water to form a paste, which is dried and reduced to a fine powder having a yellowish color.

TINCTURA COLOCYNTHIDIS, P. G. Tincture of colocynth is made by macerating for 8 days 1 part of colocynth-fruit, with the seeds, with 10 parts of alcohol sp. gr. 0.832, expressing, and filtering. It is of a yellowish color, very bitter, and becomes opalescent when mixed with water.

For medicinal purposes an *impure colocynthin* has been proposed, to be made by treating the alcoholic tincture with animal charcoal or by mixing the powdered colocynth with and packing it upon some animal charcoal, and then displacing with alcohol; on evaporating, a garnet-colored mass is obtained soluble in water and alcohol and insoluble in ether. It has been used in doses of ¼ to ½ grain.

Off. Prep.—Extract. colocynthidis, *U. S.;* Extr. colocynth. comp., Pilula colocynth. comp., Pil. colocynth. et hyoscyami, *Br.*

Physiological Action.—Unless in very large doses, colocynth acts feebly upon horses, sheep, and swine. It purges dogs and rabbits violently, causing exhaustion, with inflammation of the bowels. The experiments of Rutherford and Vignal led them to the following conclusions: 1. Colocynth is a hepatic stimulant of considerable power; it renders the bile more watery, but increases the secretion of biliary matter. 2. It is also a powerful stimulant of the intestinal glands. In man small doses of it appear to quicken intestinal peristalsis and augment the mucous and biliary secretions. The stools are generally mucous and watery, and are attended with colic. In excessive doses it operates as a violent emeto-cathartic, causing vomiting and serous or bloody stools, severe burning and colicky pains, and muscular spasms, such as are apt to occur in all severe gastro-intestinal irritation. It has been known to cause death with these symptoms or with the addition of peritonitis. Solutions of colocynth applied to the unbroken skin of the abdomen have occasioned purging, and still more readily when the cuticle was removed.

Medical Uses.—Colocynth is used as a purgative when it is intended to produce a copious secretion and rapid evacuation from the bowels, and at the same time a derivative operation upon their mucous integument. Thus, it is employed simply as an *evacuant* when fecal or other accumulations obstruct the intestine, and in this way also it becomes a *vermifuge.* In a similar manner, partly, it is used to promote indirectly the absorption and discharge of *dropsical effusions,* these collections being absorbed in proportion as the blood-vessels lose their watery contents through the bowels. It is one of the drastic cathartics which were anciently employed to cure *melancholia,* and which for this purpose are probably undervalued at the present day. In many cases of the affection the scybalous dejections, muddy skin and eye, foul tongue, tender liver, and loaded urine are speedily modified by active purgation, and with their abatement the mental torpor is removed. In *coma, apoplexy,* and recent *paralysis* of congestive origin colocynth will often prove a valuable revulsive. On the other hand, its irritation of the bowel, by extending to the bladder, urethra, or uterus, sometimes serves to cure *vesical paralysis, chronic urethritis,* and *amenorrhœa* depending upon torpor of the uterine system. Colocynth has been used as a *diuretic* in dropsy, but the proof of its efficacy is insufficient.

Neither colocynth nor its simple extract is, at the present day, often administered alone, but usually in combination with rhubarb, aloes, scammony, and mercurials. As a laxative the *dose* may be stated at from 2 to 5 grains (Gm. 0.10–0.30), and as a drastic purgative at from 5 to 10 grains (Gm. 0.30–0.60) three or four times a day. The tincture (P. G.) is an efficient preparation.

COLUTEA.—BLADDER SENNA.

Baguenaudier, Séné indigène, Fr.; *Falsche Senna,* G.

The leaves of Colutea arborescens, *Linné.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The bladder senna is a South European shrub about 10 feet (3 M.) high, with small racemes of yellow flowers and greenish inflated legumes containing many roundish blackish-brown seeds.

Description.—The leaflets are in four or five pairs, oval or elliptic, obtuse or emarginate at the apex, regular at the base, thin, smooth, and dark-green above, pale-green beneath, and clothed with appressed hairs. They have a feeble odor and a nauseous and bitter taste. They have occasionally been used for adulterating senna-leaves.

Constituents.—Bladder senna has not been analyzed.

Medical Action and Uses.—The leaves and seeds of this plant are slightly purgative, and the latter were formerly regarded as emetic also. It has been used chiefly as a domestic purgative in some parts of Europe, in an infusion prepared with an ounce of the leaves to a pint of water (Gm. 32 to Gm. 500), with the addition of liquorice-root and anise-seed, and taken in divided doses in the morning, fasting. The powder and the extract have also been used, but the former is not tolerated, owing to its offensive taste, and the same objection lies against the infusion. The smoke of the dried leaves is said to act powerfully as an *errhine.* It is employed in the same cases as senna.

COMPTONIA.—Sweet Fern.

Ferngale, Meadowfern, E.

The leaves and tops of Comptonia (Myrica, *Blume*) asplenifolia. *Aiton*, s. Myrica Comptonia, *De Candolle*.

Nat. Ord.—Myricaceæ.

Origin.—Sweet fern is a branching shrub about 3 feet (.9 M.) high, growing in sandy or sterile places in Canada and the United States southward to Virginia, and flowering in April.

Description.—The leaves are scattered, linear-lanceolate, pinnatifid, with alternate, roundish, obtuse lobes, resinous-dotted, thin, and 2 to 4 inches (5 to 10 Cm.) long. They have a peculiar resinous, aromatic odor, and an aromatic and astringent taste.

Constituents.—H. K. Bowman (1869) determined the amount of tannin contained in the leaves to be 8.20 per cent. R. T. Chiles (1873) found in sweet fern a principle analogous to saponin, resin, volatile oil, gallic acid (?), fat, and other common vegetable principles.

Medical Action and Uses.—Sweet fern is stimulant and astringent; it probably owes the former property to its essential oil, which is also the cause of its grateful fragrance, and the latter to gallic acid. A decoction of it is sometimes used to relieve *colic* and check *diarrhœa* and as a fomentation in *rheumatism*.

CONDURANGO CORTEX, *P. G.*—Condurango.

The bark of Gonolobus Cundurango, *Triana*, s. Marsdenia Condurango, *Reichenbach*.

Nat. Ord.—Asclepiadaceæ.

Origin.—The drug which first attracted attention under the above name is known in Peru as *cundurango blanco*, also as *mata perro*, or "dog-killer," and comes from an asclepiadaceous climber, for which Dr. Ruschenberger proposed the name Pseusmagennetus equatoriensis, and which grows in localities from 3000 to 5000 feet above the level of the sea. The shrub is from 10 to 30 feet (3 to 9 M.) high, and has a smooth ash-gray bark, which is more or less mottled with greenish or blackish lichens. The bark is prepared for market by pounding the stem with a mallet to detach it, and then drying it in the sun, generally on skins, during 8 or 10 days.

Description.—Condurango-bark forms quills and semi-cylindrical pieces, which are about 4 inches (10 Cm.) long, $\frac{1}{12}$ to $\frac{1}{4}$ inch (2 to 6 Mm.) thick, but are often much broken; the outer surface is brownish or brown-gray, and somewhat wrinkled and warty; the inner surface is grayish or pale brownish-white; the transverse fracture is granular and slightly fibrous, and shows under the thin brown cork a whitish or yellowish-white amylaceous tissue, which is radially marked by wavy bast-wedges and dotted with numerous brownish or yellow stone-cells. When dry it is without odor; its taste is bitter and somewhat aromatic and acrid.

Constituents.—Dr. Antisell (1871) ascertained the bark to contain, besides 8 per cent. of moisture, 12 of mineral salts and 80 of vegetable matter, the latter consisting of 0.7 fat, 2.7 yellow resin, 0.5 starch, gum, and glucose, and 12.6 tannin, coloring matters, and extractive, the remainder being cellulose; the bitter principle was not isolated.

Other Condurangos.—Dr. Jos. G. Ayers, U. S. N. (1871), ascertained that there are at least ten different shrubby vines designated as cundurango, said to mean *eagle-vine:* of the majority of these he was unable to collect the flowers and fruit. The origin of the following, however, has been determined:

Echites hirsuta, *Ruiz et Pavon*, yields *cundurango de paloma*, from Zaruma. The bark has a soft, pale-yellow, or white corky layer, which is a line or more thick.

Echites acuminata, *Ruiz et Pavon*, yields *cundurango de plátano*. The bark is thin and pale-gray on the outside.

Gonolobus tetragonus, *De Candolle*, yields *cundurango de paloma*, from Malacatos. It is of a dark-gray or brown color, and on the dry stem is slightly wrinkled longitudinally.

(Most of the above facts have been taken from the valuable *Report on the Origin and Therapeutic Properties of Cundurango*, by W. S. W. Ruschenberger, M. D., U. S. N., Washington, 1873.)

Medical Action and Uses.—This plant, which exhibits hardly any active properties, was in 1871–72 proclaimed to be a cure for *cancer*, and for a short time attracted professional notice. It, however, speedily lost its ephemeral reputation when it was proved to possess no medicinal virtues in cancer or in any other disease, except those belonging to various aromatic bitters, such as allaying vomiting and improving the appetite. According to some writers, it has been useful in rheumatism and neuralgia. It may be administered in a decoction made with half an ounce of the bark in a pint of water (Gm. 32 in Gm. 500), reduced to half a pint, of which a tablespoonful is given three or four times a day. The same decoction has been used topically.

CONFECTIONES.—Confections.

(*Conservæ* and *Electuaria*).—*Electuaries*, E.; *Conserves*, *Électuaires*, *Saccharolés mous*, Fr.; *Conserven*, *Latwergen*, G.

These preparations are now but little employed medicinally, compared with the extensive use made of them during the past century, when many medicinal substances were preserved and exhibited in the form of soft solids sweetened by sugar or honey. A distinction was then, and in some countries is still, made between *conserves* and *electuaries*, which in the British and U. S. P. Pharmaeopœias are now comprised under the title of confections.

Conserves were made by covering fresh drugs with a layer of sugar; afterward by beating fresh vegetable substances with sufficient sugar until the whole was converted into a uniform soft mass. As indicated by the name, the primary object in view was to preserve the medicinal virtues of the plants thus treated, and incidentally their administration was rendered more agreeable. Fresh plants not being at all seasons attainable, it became customary to use some in their dried condition, either in the form of powder or unpowdered, and to beat them with the requisite quantity of water and sugar. Medicinal roots not containing enough moisture were usually steeped in hot water before the sugar was added.

Electuaries differ from conserves mainly in being mixtures of powders with pulps, syrups, or honey, and are made by triturating the ingredients together in a mortar. The powders should be very fine; when extracts are to be added they are previously liquefied by trituration with a little water or other suitable menstruum, and gum-resins, if not pulverizable, are best converted into an emulsion to ensure their uniform distribution. Soluble as well as insoluble salts may be given in this form, but of the latter kind only the lighter ones should be used, since heavy insoluble salts are apt to gradually subside in the soft mixture. Of other insoluble substances, volatile oils should first be rubbed with a portion of the sugar or an absorbent powder, and fixed oils are suspended in mucilage before they are incorporated.

If intended to be kept on hand, electuaries are made of such a consistence that they are rather soft, but at the same time firm enough to prevent the separation of the ingredients. For immediate use they are made somewhat softer, so that the mixture, when taken upon a spatula, will gradually drop off; they are then in a condition to be swallowed without mastication, and if partial separation should have occurred on standing, a uniform mixture is readily obtained again by stirring.

If the main excipients of electuaries are pulps and honey, they will for a long time ensure a proper consistence and prevent the preparation from becoming hard and dry. With sugar as the principal constituent, as in the case with conserves, the gradual evaporation of water will often cause it to become hard and the sugar to crystallize; it should then be worked over, if necessary, with the addition of a little water or glycerin, but the substitution of common for refined sugar should not be resorted to.

Two confections only have been admitted in the new U. S. P., and one in the P. G. Formulas for those which have been dismissed will be found under the head of the principal drug contained therein.

CONFECTIO OPII, *Br.*—Confection of Opium.

Electuarium theriaca.—Électuaire opiacé, *Thériaque*, Fr.; *Opiumlatwerge*, *Theriak*, G.

Preparation.—Take of Compound Powder of Opium 100 grains (or 1 part), Syrup 300 grains (or 3 parts). Mix.—*Br.* 39 grains of this confection represent 1 grain of opium. The same quantity is contained in 80 grains of confection made by the French Codex, which orders not less than sixty ingredients. The latter resembles the *Mithridatum* and *Confectio Damocratis* of the past century, which preparations contained about one-fourth of the above proportion of opium. Confection of opium has very properly been dismissed from the new U. S. P. and P. G.

Medical Uses.—Introduced as a substitute for the ancient compound, theriaca, it is peculiarly useful in simple *diarrhœa* affecting persons of a debilitated and especially a gouty habit of body, and feeble digestion associated with flatulent colic, and during the exhausting heats of summer. 1 grain of opium is contained in 36 grains of the mass, and therefore, as the bulk of the medicine may be objectionable where a strong anodyne impression is desired, the proportion of the narcotic may be increased extemporaneously.

CONFECTIO PIPERIS, *Br.*—Confection of Pepper.

Electuarium piperis.—Électuaire (Confection) de poivre, Fr.; *Pfefferlatwerge*, G.

Preparation.—Take of Black Pepper, in fine powder, 2 ounces; Caraway-Fruit, in fine powder, 3 ounces; Clarified Honey, 15 ounces. Rub them well together in a mortar.—*Br.*

Medical Uses.—This confection was prepared in imitation of Ward's paste, which acquired great vogue in the treatment of *hæmorrhoids* with ulceration or a discharge of mucus. A piece of the size of a nutmeg may be taken two or three times a day.

CONFECTIO ROSÆ, *U. S.*—Confection of Rose.

Confectio rosæ gallicæ, Br.; *Conserva rosarum.—Conserve de rose rouge*, Fr.; *Rosenconserve*, G.

Preparation.—Red Rose, in No. 60 powder, 8 parts (2 oz.); Sugar, in fine powder, 64 parts (16 oz.); Clarified Honey 12 parts (3 oz.); Rose-Water 16 parts (4 oz.): to make 100 parts (25 oz.). Rub the red rose with the rose-water heated to 65° C. (150° F.), then gradually add the sugar and honey, and beat the whole together until thoroughly mixed.—*U. S.*

The British Pharmacopœia directs 1 pound of fresh red-rose petals to be beaten in a stone mortar with 3 pounds of sugar.

The formula of the French Codex is similar to the first one, but omits the honey. With a good quality of powdered red-rose petals a very good confection is obtained.

Pharmaceutical Uses.—It is used as an excipient in Pilula aloes barbad., Pil. aloes et assafœtidæ, Pil. aloes et ferri, Pil. aloes et myrrhæ, Pil. aloes socotr., Pil. ferri carbonatis, Pil. hydrargyri, Pil. plumbi cum opio, *Br.*, and is occasionally serviceable for the same purpose in extemporaneous pill-masses.

CONFECTIO ROSÆ CANINÆ, *Br.*—Confection of Hips.

Confectio cynosbati, *Conserva cynorrhodi*, F. Cod.—*Conserve de cynorrhodon*, Fr.; *Hainbutten-Conserve*, G.

Preparation.—Take of Hips, deprived of their seeds, 1 pound; Refined Sugar 2 pounds. Beat the hips to a pulp in a stone mortar, and rub the pulp through a sieve; then add the sugar and rub them well together.—*Br.*

It is used as an excipient in Pilula quiniæ, *Br.*

Medical Uses.—Confection of rose or of hips is used only as an excipient for substances given in pilular form, and which it is desired to have promptly diffused in the stomach.

CONFECTIO SCAMMONII, *Br.*—Confection of Scammony.

Électuaire (Confection) de scammonée, Fr.; *Scammonium-Latwerge*, G.

Preparation.—Take of Scammony, in fine powder, 3 ounces; Ginger, in fine powder, 1½ ounces; Oil of Caraway 1 fluidrachm; Oil of Cloves ½ fluidrachm; Syrup 3 fluidounces; Clarified Honey 1½ ounces. Rub the powders with the syrup and the honey into a uniform mass, then add the oils and mix.—*Br.*

Medical Uses.—This confection is intended, by the stimulants and carminatives which it contains, to moderate the drastic operation of the associated scammony. The dose is from 10 to 30 grains (Gm. 0.60–2.00).

CONFECTIO SENNÆ, *U. S., Br.*—Confection of Senna.

Electuarium e Senna, P. G.; *Electuarium de senna compositum*, *Electuarium lenitivum.—Lenitive electuary*, E.; *Électuaire de séné composé*, *Électuaire lénitif*, Fr.; *Senna-Latwerge*, G.

Preparation.—Senna, in No. 60 powder, 10 parts; Coriander, in No. 60 powder, 6 parts; Cassia Fistula, bruised, 16 parts; Tamarind 10 parts; Prune, sliced, 7 parts; Fig, bruised, 12 parts; Sugar, in fine powder, 50 parts; Water 60 parts; to make 100 parts. Place the Cassia fistula, tamarind, prune, and fig in a close vessel with 45 parts of the water, and digest for 3 hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass first through a coarse hair-sieve, and then through a fine one or through a muslin cloth. Mix the residue with the remainder of the water, and, having digested the mixture for a short time, treat it as before and add the product to the pulpy liquid first obtained. Then by means of a water-bath dissolve the sugar in the pulpy liquid, and evaporate the whole until it weighs 84 parts. Lastly, add the senna and coriander, and incorporate them thoroughly with the other ingredients while yet warm.—*U. S.*

Take of senna, in fine powder, 7 ounces; coriander-fruit, in fine powder, 3 ounces; figs 12 ounces; tamarind 9 ounces; cassia-pulp 9 ounces; prunes 6 ounces; extract of liquorice 1 ounce; refined sugar 30 ounces; distilled water a sufficiency. Boil the figs and prunes gently with 24 ounces of distilled water in a covered vessel for 4 hours; then, having added more distilled water to make up the quantity to its original volume, mix the tamarind- and cassia-pulp, digest for 4 hours, and rub the softened pulp of the fruits through a hair-sieve, rejecting the seeds and other hard parts. To the pulped product add the sugar and extract of liquorice, and dissolve them with a gentle heat; while the mixture is still warm add to it gradually the mixed senna and coriander powders, and mix the whole thoroughly, making the weight of the resulting confection 75 ounces, either by evaporation or by addition of more distilled water.—*Br.*

Mix powdered senna 10 parts; simple syrup 40 parts; purified tamarind-pulp 50 parts, and warm by means of a steam-bath. It is greenish-brown.—*P. G.*

The last formula is the simplest, and yields a less pleasant but equally effectual preparation. That of the French Codex is of more complex composition.

Medical Uses.—This confection forms an eligible basis for various purgative compounds, and is itself a mild and efficient laxative in the *dose* of 120 grains (Gm. 8).

CONFECTIO SULPHURIS, *Br.*—Confection of Sulphur.

Electuarium sulphuris.—Électuaire (Opiat) de soufre, Fr.; *Schwefel-Latwerge*, G.

Preparation.—Take of Sublimed Sulphur 4 ounces; Acid Tartrate of Potassium, in powder, 1 ounce; Syrup of Orange-Peel 4 fluidounces; Tragacanth, in powder, 18 grains. Rub them well together.—*Br.*

Medical Uses.—Like confection of senna, this preparation is well adapted to procure copious semi-solid stools without actively purging or causing irritation of the rectum. These qualities adapt it for use as a laxative in hæmorrhoidal cases. The *dose* is from 1 to 2 drachms (Gm. 4–8).

CONFECTIO TEREBINTHINÆ, *Br.*—Confection of Turpentine.

Electuarium terebinthinatum.—Électuaire (Opiat) térébenthiné, Fr.; *Terpentinöl-Latwerge*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Liquorice-Root, in powder, 1 ounce; Clarified Honey 2 ounces. Rub the oil of turpentine with the liquorice, add the honey, and mix to a uniform consistence.—*Br.*

Medical Uses.—In this mixture the repulsive taste of the oil of turpentine is masked by the liquorice-powder more thoroughly than can be effected in an emulsion. It is used occasionally for passive *hæmorrhage*, *flatulence*, *lumbricoid worms*, *rheumatism*, etc. The dose is 1 or 2 drachms (Gm. 4–8).

CONIUM, *U. S., Br., P. G.*—Conium.

Hemlock, *Poison or spotted hemlock*, E.; *Grande ciguë*, *Ciguë officinale*, Fr.; *Schierling*, *Gefleckter Schierling*, G.

Conium maculatum, *Linné*, s. Cicuta maculata, *Lamarck*. Bentley and Trimen, *Med. Plants*, 118.

Nat. Ord.—Umbelliferæ, Campylospermæ.

Officinal Parts.—1. CONII FOLIA, *Br.;* Herba conii, *P. G.;* Herba cicutæ majoris.—Hemlock-leaves, *E.;* Feuilles de grande ciguë, *Fr.;* Schierlingskraut, Schierlings-Blätter, *G.*

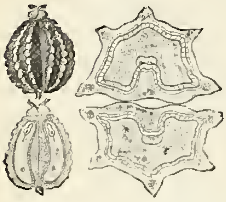
The leaves, also fresh leaves and young branches, *Br.*

2. CONIUM, U. S.; *Conii Fructus*, Br., U. S. 1870.—Hemlock-fruit, *E.;* Fruits de grande ciguë, *Fr.;* Schierlingsfrüchte, *G.*

The full-grown fruit, gathered while yet green.

Origin.—Spotted hemlock is indigenous to the temperate countries of Asia, Europe, and Northern Africa, and has been naturalized in some portions of New England and New York and in South America. It grows in waste places and along streams. It has a biennial, whitish, nearly simple or somewhat branched root, and a round furrowed stem, which is 6 to 8 feet (1.8 to 2.4 M.) high, hollow except at the joints, smooth, glaucous, and covered with numerous brown or brown-red spots. The numerous branches are terminated by umbels of ten to twenty rays, with the one-sided involucels of three or four ovate or lanceolate bracts united at the base, and with small white flowers.

FIG. 83.



Conium: fruit and longitudinal section, magnified 3 diameters; transverse section, magnified 8 diameters.

Description.—1. THE LEAVES. The lower leaves are about 1 foot (30 Cm.) long, upon long, hollow, and sheathing petioles, broadly ovate or triangular in general outline, pinnately decompound, with the pinnæ oblong-lanceolate, pinnatifid, or incised, the upper ones toothed, each lobe or tooth terminating with a small whitish point. The upper leaves are smaller, almost sessile, and less decompound; all are smooth. In the fresh state they are of a dull dark-green color above, paler and somewhat glossy beneath, and acquire on drying a dull grayish-green color and a characteristic odor, which has been likened to that of the urine of mice; their taste is nauseous, saline, somewhat bitter and acrid. They are collected from plants in full bloom when the fruit begins to form; on drying they lose about 85 per cent. in weight.

The leaves of Æthusa Cynapium, *Linné* (Bentley and Trimen, *Med Plants*, 125), Anthriscus sylvestris, *Hoffmann*, and different species of Chærophyllum, have been occasionally collected in place of conium; but the plants have only a superficial resemblance to the latter, and the leaves do not agree with all the characters given above. The first plant is known as Fool's parsley, Small hemlock, *E.;* Éthuse, Petite ciguë, Ache des chiens, *Fr.;* Hundspetersilie, Gartenschierling, *G.* It is indigenous to Europe and Northern Asia, and is somewhat naturalized in North America. The leaves resemble conium-leaves in outline and subdivision, but the secondary pinnæ are rhomboid-ovate and pinnatifid or bipinnatifid, with narrow lanceolate acute segments; they are dark-green above, somewhat paler and glossy beneath, and when bruised have a disagreeable somewhat leek-like odor. The other plants mentioned have pubescent or ciliate leaflets.

2. THE FRUIT. The fruit is about $\frac{1}{8}$ inch (3 Mm.) long, broadly ovate, somewhat compressed at the sides, crowned with the short stylopodium, and readily separating into the two mericarps, each one marked on the back with five wavy crenate ribs, which become nearly smooth in the ripe fruit. The furrows are faintly wrinkled longitudinally, and, like the face, destitute of oil-tubes. The integuments of the fruit are convex upon the face and penetrate into the albumen, which upon a transverse section shows a roundish heart-shaped or reniform outline. The fruit has a green or gray-green color, or is grayish if collected as directed by the British Pharmacopœia. It is nearly inodorous and has but a slight taste; when triturated with an alkali, it evolves the disagreeable odor of the leaves. Conium-fruit has been occasionally observed as an adulteration of anise, to which, when ripe, it bears some resemblance.

Constituents.—The most important constituent of both drugs is the volatile alkaloid coniine, or *conine*, which, according to A. W. Hofmann (1881), has the formula $C_8H_{17}N$. Giseke (1827) obtained it as an impure sulphate; Geiger (1831) prepared it pure. It is contained in the distillate, prepared with an alkali from the drug or its extract, and freed from ammonia by converting it into sulphate and exhausting this with a mixture of strong alcohol and ether, which leaves ammonium sulphate undissolved; coniine may then be liberated by treatment with an alkali and distillation, but, though colorless, is accompanied by *conhydrine* or *conydrine*, and often by methylconiine, the former of which is left in the retort on the careful distillation of the colorless crude coniine. *Conhydrine* forms pearly iridescent laminæ which are easily fusible, sublime above 150° C. (302° F.), and have a slight odor of coniine. It was discovered by Wertheim (1856). Examined by A. W. Hofmann (1882), it was found to melt at 120° C. (248° F.), to boil at 226° C. (439° F.), and to have the composition, $C_8H_{17}NO$, assigned to it by Wertheim; but on treatment with phosphoric anhydride or strong hydrochloric acid it yields an oily distillate of a coniine-like odor, containing several bodies not identical with this base. *Coniine* is a colorless, inflammable, oily liquid, specific gravity 0.88 to 0.89, has a strong alkaline reaction, a penetrating suffocating odor, and when pure the boiling-point 168° to 169° C. (334.4° to 336.2° F.). It dissolves its own weight of cold water, which is separated again on warming; it is soluble in all proportions in alcohol, ether, chloroform, benzol, benzin, and fixed oils, is less freely soluble in carbon bisulphide, and requires 100 parts of cold water for solution. Like ammonia, it forms dense white fumes with volatile acids, combines with acids to salts, precipitates most metallic salts, some of the precipitates, like silver, being soluble in an excess, and it neutralizes acids, forming salts which are freely soluble in water and alcohol, are usually deliquescent, and occasionally uncrystallizable, and are not precipitated by platinic chloride. Its hydrochlorate and hydrobromate are, according to A. W. Hofmann (1881), easily obtained by dissolving coniine in anhydrous ether and passing into the solution dry hydrochloric or hydrobromic acid gas. The salts, being insoluble in ether, are precipitated in a white crystalline form; both are very soluble in water and alcohol, are not deliquescent, and may be dried at 100° C. (212° F.) without decomposition. Coniine deviates polarized light to the right, while *paraconiine*, $C_8H_{15}N$, so called from the supposed identity of its formula with that of coniine, is optically indifferent. This alkaloid was artificially prepared by Schiff (1871).

Conium-fruit contains, besides the usual principles, also a fixed oil, a minute portion of non-poisonous volatile oil having the odor of cumin, and probably malic acid in combination with the alkaloids. The herb contains acetates and malates, and a non-poisonous volatile oil of a disagreeable odor, and yields about 12 per cent. of ash. The amount of alkaloid in the herb is minute, but appears to vary; the mature but still green fruit contains about 0.8 per cent. or less of coniine; conhydrine is always present in very minute proportion.

The herb of fool's parsley was stated by Ficinus to contain a crystallizable poisonous alkaloid, *cynapine*, said to be soluble in water and alcohol, but insoluble in ether. But Walz (1859) and Bernhardt (1880) obtained from the fruit a volatile oily base resembling coniine.

Off. Prep.—1. Of the leaves: Cataplasma conii, Extractum conii, Succus conii, *Br.* 2. Of the fruit: Abstractum conii, Extract. conii alcohol., Extract. conii fluid., *U. S.*; Tinctura conii, *U. S.*, *Br.*

Physiological Action.—*On Animals:* The effects of conium upon various animals accidentally poisoned by it or made the subjects of experiment with its different preparations agree essentially in the occurrence of paralysis, first of the voluntary muscles, and then of the muscles of respiration, and, through the latter operation, in the production of death by asphyxia. Experimenters are not agreed whether it directly slows the heart, or does so indirectly, or, finally, whether it does so at all. Nor is it certain, according to them, whether the toxical and paralyzing operation of the drug proceeds from the spinal centres to the periphery or commences in the terminal nerves, but the latter opinion seems to be the more generally accepted. It is alleged that in either case the muscular contractility is unimpaired. It would seem that if the dose be not directly lethal convulsions may occur before the death of the animal, but otherwise death takes place without spasm. It is not clear that anæsthesia precedes death in animals unless the poisoning be slow. Nor is it quite certain, according to the same anthorities, what influence conium and its alkaloid exert upon the animal temperature; for while it is generally maintained that they diminish it, one writer at least asserts that they decidedly increase the temperature of animals poisoned by them. While one affirms that in poisonous doses they prevent the coagulation of the blood, rendering it dark and fluid, another declares that the blood does not appear to undergo any alteration and that the corpuscles retain their power of absorbing oxygen. One asserts that coniine is not eliminated with the urine, while others have found it in that secretion. These antagonistic results of experiments conducted under determinate conditions illustrate the difficulty of drawing definite conclusions from such data, and the wisdom of preferring clinical bases for clinical rules.

Since the second edition of this work (1879) more thorough investigations of conia and its derivatives have tended to narrow the divergencies of opinion respecting their mode of action. In 1878, Rochefontaine and Tiryakian concluded that coniine is neither a muscular nor a cardiac poison, and that it does not seem to act on the sensitive nerves, but upon the cerebro-spinal centres, increasing reflex excitability, suspending voluntary movement, and producing, in its first degree of action, hurried respiration and disorders of vision, and in its full development loss of reflex excitability, feeble respiration and pulse, and finally collapse (*Archives gén.*, 7ème sér. ii. 244). Precisely similar conclusion were arrived at by Tuloup (*Bull. de thérap.*, c. 286). Meanwhile, more thorough and logical results were obtained by Prévost (*Archives gén.*, 7ème sér. iv. 374). He showed that hydrobromate of coniine is identical in its action with coniine, and that it paralyzes the nerves, and not their central origins. On cutting off all communication of a limb with the body of an animal except through the nerves, and then administering the agent, he found that the limb retained excitability, while all other parts lost it. This result was rendered more distinct when the animal was strychninized. He further found, in poisoning by coniine, that if artificial respiration is maintained the heart is the last organ to die, and that its movements continue longer than those of the normal heart would do after the suspension of artificial respiration. As a necessary induction from these results, he concluded that coniine probably does not act upon the nervous centres, and that the convulsions attending death under its influence are owing to asphyxia produced by paralysis of the respiratory muscles through the pneumogastrics. Prévost found coniine in the urine, the saliva, and the tears. Dolan failed to find it in the milk (*Practit.*, xxvii. 164). Although the general results of Hoffmann's experiments agreed with those just summarized, he nevertheless contended for a powerful action of coniine on the medulla oblongata and spinalis (*Archiv. f. experiment. Pathol. etc.*, xv. 46), and the same conclusion was reached by Boehm (*ibid.*, p. 439). In 1880, Rochefontaine announced that conium contains two principles, one of which paralyzes the central nervous system, while the other, like woorara, paralyzes the nerves themselves. Schulz in 1881 (*Zeitsch. f. klin. Med.*, iii. 21) pointed out in detail the analogies between the two principles, thus: Both act on the extremities of the nerves, and do not affect muscular contractility; are prevented from acting on a muscle by ligating the blood-vessels supplying it; paralyze the vagus sooner than the nerves of the muscles; and both act similarly upon secreting organs. As far as the action of curare upon the brain is known, it resembles that of coniine. Hydrobromate of coniine does not irritate the animal tissues, and is therefore appropriate for hypodermic use.

On Man: There is no apparent relation between the physiological and the toxical effects of conium on the one hand and its medicinal operation on the other, and in this it resembles a very large number of medicines. Supposing a really efficient preparation to be employed, the action of small and continued doses of it is exhibited by an increase of the perspiration and the urine, but the latter does not appear to contain coniine; the appetite, digestion, and defecation are improved, and the strength and flesh are increased. But a very protracted use of the drug produces an opposite condition, with impaired nutrition, which mainly affects the glandular organs, so that the mammæ and testes may undergo atrophy. The analogy of these effects with those of iodine is striking. In large but not toxical doses it renders the pulse somewhat slower and fuller and the temperature slightly lower; it sometimes occasions a papular or erythematous eruption upon the skin, injection of the eyes, a sense of fulness in the head, giddiness, some cloudiness of sight, feebleness of the limbs, and diaphoresis. Still larger doses show their direct operation most evidently upon the muscular system, inducing an impression of excessive fatigue or weariness, and a gradual loss of power, beginning with the hands and feet; the eyelids fall, the eye loses its power of accommodation, and the pupils are dilated; the hearing is dull. There is no mental disorder nor drowsiness, the mind remaining calm but active. Dr. John Harley, who studied this subject with peculiar thoroughness, states the following as the effects of a full dose of conium-juice given to palliate chronic muscular spasm: "The whole muscular system is completely relaxed. The orbicularis is incapable of resistance. The movements of the eyeball are very sluggish, and there is more or less complete ptosis. The muscles of mastication and deglutition are nearly paralyzed. Speech is slow and effected with exertion; the voice is gruff, from relaxation of the laryngeal muscles. Withal, the heart and breathing are normal, sensation and intelligence are perfect, and the mind is calm." Even in fatal cases the pulse and respiration may be natural until the approach of death, which often is preceded by convulsions. The face is apt to be pale, and the hands and feet are cold and either pale or bluish. After death from conium-poisoning no lesions are uniformly found. There is no evidence that conium impairs sensibility when taken internally. The external use of coniine may produce local effects, as where friction with an ointment containing it has temporarily caused paralysis of the fingers that applied it.

Medical Uses.—Conium has had a wide reputation for its virtues in the treatment of *cancer*, and there is no doubt that it has removed tumors supposed to be of this nature, both when used as a dressing and when given internally. That when applied locally it mitigates the pain and improves the condition of sores regarded as open cancer is certain. It is therefore a medicine not to be lightly neglected in cases of this kind. In *scrofulous* glandular sores similar good effects are sometimes observed. Enlargement and induration of the *liver* by simple engorgement or by a degree of hyperplasia, with the attendant symptoms, jaundice and ascites, appear to have been cured by a prolonged use of the medicine. During a like use of it the *mammary gland* has been known to become atrophied and its secretion to have been gradually suspended. Conium plasters were formerly used to *dry up the milk*. Dolan has praised it for chronic inflammation of the womb, and as an "excellent sedative for backache and for the sexual organs." *Cutaneous affections*, especially those of a strumous nature, appear to be favorably modified by this medicine. The reputed benefits of conium in *melancholy* seem to be attributable rather to the associated treatment, except where the mental disorder depended upon one of the visceral infarctions above alluded to. In *mania* its sedative operation has been used to control violence, and in *erotic insanity* it appears to lessen the evidences of sexual excitement. For the latter purpose it was anciently employed. A plaster containing equal proportions of conium and belladonna extracts is an efficient palliative of intercostal *neuralgia* and of *palpitation of the heart*. In various other *neuralgic* affections conium is reputed to be efficacious, but it is probably in those only in which the paroxysm is due to congestion or other pressure upon nervous trunks. The same may be said of its use in *ophthalmia* with *photophobia*, in *toothache*, *whooping cough*, *asthma*, *spasmodic laryngitis*, *laryngismus stridulus*, and *epilepsy* due to congested conditions of the motor centres. Its efficiency in some aggravated cases of *chorea* is still more striking. In this and other spasmodic affections the full development of its physiological operation is essential to the cure. It would seem to be indicated in *puerperal* and *infantile convulsions* and in *tetanus*. In the last-named disease it is said to have effected a cure in four out of six cases (Chew, *Med. Record*, xix. 38). Dr. Harley has called attention to the utility of conium-juice in *trismus*, in *spasm of the orbicularis* and of the *gullet*, in *dislocations of joints* where the action of powerful muscles resists the efforts made to reduce them, and in cases of the *impaction of artificial teeth* in the œsophagus. He dwells upon the important circumstance that patients under its influence are not prevented from assisting the surgeon by their efforts and guiding him by their sensations.

Conium and its preparations are contraindicated in cases of great exhaustion and debility. Diseases interfering with the rhythm of the heart suggest a cautious use of the medicine.

The proper antidotes to conium-poisoning are evacuation of the stomach and the use of alcoholic stimulants, with external warmth.

Administration.—Supposing the preparation to be good—which it seldom is—the extract of conium may be given in doses of 1 grain (Gm. 0.06), repeated at intervals of an hour or more until the physiological operation begins to appear; the dose of the tincture (an ineligible preparation) is $\frac{1}{2}$ fluidrachm (Gm. 2), and of the juice the commencing dose is 1 fluidrachm (Gm. 4). The commencing dose of coniine is stated by different physicians at $\frac{1}{60}$ grain (Gm. 0.001), or even less, and the hypodermic dose of bromohydrate of coniine at $\frac{1}{5}$ grain (Gm. 0.01). According to Tuloup, Audhonin, and others, no smaller amount than 2 grains (Gm. 0.10) of the salt in the 24 hours will have much effect, and this quantity should be used in two doses, and pretty rapidly increased until 5 or 6 grains a day are given. For hypodermic use may be employed a solution of 1 Gm. of bromohydrate of coniine in 19 Gm. of distilled water. Each Gm. will contain 5 Cgm. of the salt, of which $\frac{1}{5}$ may be used for a first injection, but subsequently the quantity may be rapidly increased to 1 Gm., or even 2 or 3 Gm. "The initial dose for hypodermic injections does not differ much from what is necessary by the stomach." By the latter way it is said that if the doses are gradually increased, 5 or even 6 grains of the salt may be given in the course of 24 hours without injury (Tuloup, *Annuaire de thérap.*, 1880, p. 15).

Æthusa cynapium, *fool's parsley*, has generally been alleged to be poisonous, like conium or aconite (Taylor's *Med. Jurisp.*, 1865, p. 351), and Harley collected a number of cases and statements which were supposed to prove its poisonous action; but an extended series of experiments led him to conclude that the plant is not in any degree poisonous (*St. Thomas's Hosp. Rep.*, N. S. iv. 63; x. 257). In 1882 this conclusion was fully confirmed by Tauret, who believes the erroneous statements referred to arose from confounding Æthusa cynapium with Conium maculatum, which it closely resembles in appearance (*Bull. de thérap.*, ciii. 22).

CONTRAYERVA.—CONTRAYERVA.

Contrayerve, Br.; *Bezoarwurzel*, *Giftwurzel*, G.

The root of Dorstenia Contrayerva, *Linné*, and D. brasiliensis, *Lamarck*.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The first species is indigenous to the West Indies, Central America, and southward to Peru; the second, to Brazil and other parts of South America. Both are acaulescent perennials, with a fleshy quadrangular or circular inflorescence, in which the minute nutlets are imbedded.

Description.—The root has one or two short annulate heads, is fusiform, about ½ inch thick, 2 or 3 inches long, and below divided into fine fibres; that of the second species is globular-ovate, about ¾ inch long, annulate, and beset with fine fibres. The color is reddish-brown, internally whitish. The bark is thick, with the inner portion of a punctate appearance, and encloses a brownish-yellow wood which is radiately marked by the medullary rays. The root has a rather unpleasant odor and a bitter and acrid taste.

Dorstenia dracena, *Linné*, D. opifera, *Martius*, D. tubicina, *Ruiz et Pavon*, and perhaps other species yield similar roots.

Constituents.—Geiger obtained from the root some volatile oil, resin, starch, and a bitter amorphous principle.

Medical Action and Uses.—Contrayerva (meaning "antidotal plant") appears to be a stimulant bitter tonic; in its native country it is used in *low fevers*, very much as serpentaria is elsewhere, and also as a remedy, both internal and local, for the *bites of serpents*. The dose of the powdered root is stated to be ½ drachm (Gm. 2).

CONVALLARIA.—LILY OF THE VALLEY.

Lilium convallium.—*Muguet*, Fr.; *Maiblumen*, G.

Convallaria majalis, *Linné*.

Nat. Ord.—Liliaceæ, Asparagineæ.

Description.—This stemless perennial is indigenous to Europe, Northern Asia, and to the Alleghany Mountains of the United States from Virginia southward. It is frequently cultivated in gardens, and has spontaneously appeared in several places. It has a creeping, whitish, much-branching rhizome of the thickness of a quill, two, or occasionally three, elliptic and smooth radical leaves, and a one-sided raceme of about ten nodding white flowers, which are about ¼ inch long, bell-shaped, six-lobed, with the lobes recurved, have six stamens inserted near the base of the perianth, and produce globular, few-seeded red berries. The cultivated flowers are somewhat larger. They are very fragrant and have a bitter and acrid taste. The rhizome and flowers have been used in medicine; the latter, which are still officinal in several pharmacopœias, lose on drying about 85 per cent. of their weight.

Constituents.—The odorous principle of the flowers was obtained by Herberger (1835) in the form of volatile crystals possessing a strong odor, occasioning headache, but very fragrant when largely diluted. The bitter principle of the plant is the glucoside *convallamarin*, $C_{23}H_{44}O_{12}$, which was isolated by Walz (1858) as a white somewhat crystalline powder, has a bitter-sweet taste, is soluble in water, alcohol, and methylic alcohol, and insoluble in ether, chloroform, and amylic alcohol (Sée); but the last two solvents, according to Dragendorff (1871), take it up from the acidulated solution. It dissolves in sulphuric acid with a brown color, and, after previous moistening with water, with a violet color, the solution becoming colorless by more water. Its aqueous solution is precipitated by tannin, but not by lead salts, and when boiled with dilute acids it yields sugar and *convallamaretin*. Sée (1882) obtained the best results with the plant collected in August; on precipitating the alcoholic tincture with basic lead acetate, evaporating, diluting with water, neutralizing with sodium carbonate, precipitating with tannin, dissolving the precipitate in 60 per cent. alcohol, and decomposing with zinc oxide, 0.6 per cent. of convallamarin was obtained. He also isolated the acrid principle *convallarin*, $C_{34}H_{62}O_{11}$, in the form of rectangular prisms, which are soluble in alcohol, insoluble in ether, and sparingly soluble in water, but foaming with it like saponin. On being boiled with dilute acids it is split into sugar and *convallaretin*.

Pharmaceutical Preparation.—EXTRACTUM CONVALLARIÆ. The most efficacious extract is prepared with water from the flowers and scapes, mixed with one-third of their weight of roots and leaves, collected in August (Sée).

Allied Plants.—POLYGONATUM MULTIFLORUM, *Allioni* (Convallaria multiflora, *Linné*), and POL. OFFICINALE, *Allioni* (Conv. Polygonatum, *Linné*).—Solomon's seal, *E.;* Sceau de Salomon, Genouillet, *Fr.;* Weisswurzel. Salomon's Siegel, *G.*—The plants are indigenous to Europe and Northern Asia, and have simple stems with alternate sessile leaves, the axils of which contain one to five cylindrical flowers. The rhizome is horizontal, brownish-yellow, about 6 inches long, nearly cylindrical, jointed, and bears on the upper side of each joint a circular concave stem-scar; internally it is whitish, rather spongy, and has a zone of many scattered wood-bundles near the centre. Walz found in the rhizome and herb convallarin, asparagin, mucilage, sugar, starch, pectin, etc.

POLYGONATUM GIGANTEUM, *Dietrich* (Conv. canaliculata, *Willdenow*), and POL. BIFLORUM, *Elliott* (Conv. biflora, *Walter*), which are North American species, have rhizomes agreeing with the description just given, and are collected here as Solomon's seal.

SMILACINA RACEMOSA, *Desfontaines*, likewise indigenous to North America, has a similar rhizome, but with shorter and thicker joints, and is known as *false Solomon's seal.*

History.—The ancients used Conv. polygonatum as a local stimulant in the treatment of bruises and wounds and for the removal of freckles; and Galen states that owing to its nauseous and astringent taste it is not much employed internally, but adds that it is employed to stimulate uterine contractions. In Russia it is still used locally and internally for toothache (Krebel, *Volksmed., etc. Russlands*). The young sprouts of the same species were eaten in Germany like asparagus. In the commentaries of Mattioli on Dioscorides, which were published in the seventeenth century, we find this statement (liv. iii., chap. cxx.): "According to the Germans, lily of the valley strengthens the heart and brain, and is of use in paralysis, epilepsy, spasms, vertigo, fainting, and palpitation of the heart. They prescribe it also for the stings of insects and the bites of animals, and affirm that it is of singular efficacy in inflammation of the eyes and in difficult parturition. It is used in vinous infusion," etc. The flowers of C. majalis, whose powerful odor when fresh occasions headache and dulness of the senses, were popularly used in the same country, when dried and powdered, as a sternutatory, and the berries in various nervous disorders, including epilepsy. The root and flowers were also employed as purgatives, and their action was compared to that of aloes and scammony. With the dried flowers fomentations were made to remove ecchymoses, and they, as well as the root, were believed to cure worms, epilepsy, and intermittent fever. Cazin took 24 grains of the fresh flowers, producing five copious stools with colic, and gave about thrice that dose to a peasant with intermittent fever, causing eight stools with more or less colic. In 1878 convallaria was pronounced "obsolete" by Bernatzik. In 1882 it was stated by Sée that "from time immemorial the Russian peasants were acquainted with it as a certain cure for dropsy," yet in Krebel's work on the domestic remedies of Russia convallaria does not occur in the long list of anti-hydropics.

Physiological Action.—The experiments of Troitsky, Boioiavlensky, Walz, Sée, and others (*Edinb. Med. Jour.*, xvii. 644, 840, 928; *Bull. de thérap.*, ciii. 51) agree in their results. In frogs convallaria slows the action and increases the energy of the heart, but causes an irregular tonic contraction of the ventricle, which becomes firmer until death. In warm-blooded animals the effects are essentially the same. The dog's heart becomes slower, and then irregularly asystolic, while the inspiratory acts grow fuller and slower. Ultimately, the action of the heart grows exceedingly rapid and feeble, and the inspirations, although deeper than before, finally cease after the heart's arrest. The excito-motor function of the nerves and the reflex activity of the nervous centres remain unimpaired. No diuresis is produced in healthy subjects. Convallaria, therefore, "is a poison which, like digitalis, upas-antiar, erythrophlœum, etc., arrests the heart in systole, and is unlike muscarin, which stops it in diastole" (Sée). According to Dr. I. Ott, convallaria increases the arterial tension and the rate of the heart's movements, but the heart begins to fail before the tension, owing to a direct action of the poison on its muscle. It also causes clonic spasms (*Amer. Jour. of Med. Sci.*, April, 1883, p. 565). It would seem that these results are scarcely in harmony with the others mentioned. The active properties of the plant appear to depend upon the glucosides above mentioned, convallarin and convallamarin, the former of which is stated to act upon animals as a drastic purge in the dose of 5 grains (Gm. 0.30), while the latter is emetic even in smaller doses, and when injected into the veins reduces the pulse-rate. Hypodermically, the thirtieth, and even the sixtieth, of a grain (Gm. 0.002 or 0.001) is fatal to pigeons, arresting the heart in systole and producing convulsions. The slowing of the heart is not attended with diminished power in that organ, but the respiratory movements were quickened (?).

Medical Uses.—The dried flowers of convallaria have been used in powder as a *sternutatory* and errhine, and in fomentations for the removal of *bruises, ecchymoses,* and *freckles,* and they, as well as the root, for the cure of *worms, intermittent fever,* and *epilepsy.* In Russia several species of convallaria are used as local anodynes, and in that country it was first employed for the removal of *dropsy.* The much more thorough and systematic observations of the physicians mentioned above have demonstrated that convallaria as a remedy for dropsy is indicated in the same cases for which digitalis is commonly employed—cases in which the dropsical effusion depends upon a positive or a relative inability of the heart to carry on the circulation of the blood through its own cavities, and which are clinically denoted by its palpitation and arhythmical movements, and by signs of obstruction in other organs, such as dyspnœa, hepatic distension, gastric disorder, a diminished secretion of urine, with an excess of solids, œdema of the feet, etc. The diuretic action of this medicine, affirmed by some and denied by others, can hardly be considered as established. Stiller admits only its occasional, and as it were accidental, occurrence (*Times and Gazette,* Jan. 1883, p. 14); Leyden and Pel both deny it (*Centralbl. f. Therap.,* i. 68, 189), Moutard-Martin could not discern it (*Bull. et Mém. Soc. thér.,* 1882, p. 148); and Beverley Robinson did not find convallaria a renal stimulant (*Boston Med. and Surg. Jour.,* Apr. 1883, p. 374).

It is remarked by Sée that convallaria is not liable to the objections that exist against digitalis, of having an acrid taste, impairing the appetite, and occasioning nausea or vomiting. Nor does it appear to have caused any of those alarming, and even fatal, results which are chargeable to foxglove. On the contrary, it seems to improve the appetite and digestion and render the stools soluble. The *irregularity of the heart,* which it seems especially fitted to correct, arises from mechanical impediments to the circulation, and especially from mitral lesions, more than from tissue-degradation. In these cases it calms the hurry of the heart and renders its movements rhythmical, and sometimes, although less uniformly, reduces the pulse-rate, unless its acceleration has arisen as compensatory for an insufficient supply of blood. In that case the pulse falls to, or even below, its normal standard. In aortic stenosis or insufficiency convallaria, like digitalis, is of less advantage than in mitral disease. The conclusions of Dr. Pel of Amsterdam may here be quoted—viz.: "As a heart tonic (and diuretic) the medicine seems to be inoperative in failure of the left ventricle as it occurs in chronic renal disease; on the other hand, it displays in special cases of organic heart lesion, as mitral insufficiency with imperfect compensatory changes, a power of stimulating the heart, and also of causing diuresis. Nevertheless, digitalis has a more distinct and durable action, and convallaria is not able to rival it." Germain Sée places convallaria and digitalis on nearly the same level, but assigns a superiority to the former, in that it does not suspend the action of the heart like the latter (*Bull. de thérap.,* cv. 489). Gottheil (*Med. Record,* xxiv. 226) used this medicine with, to him, inconclusive results, but it does not appear whether in his cases valvular disease existed or not. It is alleged that even when palpitation is due to other than organic causes irregularity of the heart and its consequences are removed by the medicine; and although the evidence upon this point is incomplete, the statement appears to be sustained. (See case, *Med. Record,* xxiii. 133.) It is also claimed that convallaria has been proved clinically to relieve dyspnœa by deepening the inspiratory act; but in cases of valvular or muscular disease of the heart the action of the medicine upon the heart alone is sufficient to explain the relief felt in breathing. A similar remark may be made concerning its diuretic action. It is altogether secondary, and is manifested only when the dropsy, wherever situated, is of cardiac origin. But in such cases, and especially when the kidneys and the heart-muscle are sound, its influence in removing dropsy by diuresis is at least as salutary as that of digitalis, and does not involve the dangers incident to the use of that drug. As might be expected from its mode of action, the diuresis to which it gives rise does not cease abruptly on the suspension of the medicine, but is maintained for several (from 5 to 9) days longer. It causes no change in the constitution of the urine; a slight cloudiness in it, produced by heat and nitric acid, is due not to albumen, but to the resin of the plant; and, indeed, it affects no other function directly than that of the heart.

Administration.—In the cases which first drew attention to the special virtues of convallaria the Russian physicians employed an infusion of the flowers varying in strength from 10 grains to 2 drachms in 6 ounces of water, which was given in tablespoonful doses twice a day, and also an infusion of the whole plant, made with 1 or 2 drachms in from 4 to 6 ounces of water, of which "3 or 4 spoonfuls" a day were prescribed. Sée found an infusion of the flowers inert. According to him, watery extracts are preferable, the least active being that of the leaves, then the extract of the flowers, and finally the extract made from the flowers, stems, and root. He prescribed for a daily portion from 15 to 20, or even 30, grains of the watery extract of the flowers or of the whole plant, or twice these quantities of extract of the leaves. According to Langlebert and Tanret, the best results are produced by the watery extract of the flowers and stems, along with one-third of their weight of the roots and leaves. Of this preparation the average dose is stated to be 8 grains (Gm. 0.50). It is conveniently given in simple syrup flavored with tincture of orange-peel (*Bull. de thérap.*, ciii. 74, 179). A fluid extract prepared in this country is said to be efficient in doses of from 5 to 12 drops every 4 hours (*Med. Record*, xxii. 281), or, as others say, in doses of not less than 15 or 20 drops. It has been proposed to substitute convallamarin for the preceding preparations, but clinical illustrations of its efficiency are still wanting.

Convallaria polygonatum is represented to be emetic and cathartic, and mildly astringent and stimulant when applied topically. It was formerly used as a vulnerary, and more recently to relieve the irritation of the skin produced by poison-sumach, etc.

COPAIBA, *U. S., Br.*—Copaiva.

Balsamum copaivæ, P. G.—*Balsam copaiva*, *Balsam capivi*, E.; *Copahu*, *Oleo-résine (Baume) de copahu*, Fr.; *Copaivabalsam*, G.

The oleoresin of Copaifera Langsdorffii, *Desfontaines*, and of other species of Copaifera. Bentley and Trimen, *Med. Plants*, 93.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—With the exception of two African species, the genus Copaifera is indigenous to the tropical part of South America, and there consists of ten species, the majority of which are medium-sized or large trees, with mostly abruptly pinnate coriaceous leaves and racemose whitish apetalous flowers, producing coriaceous obliquely elliptical or obovate one-seeded legumes. The following may be enumerated as having been mentioned as sources of copaiva: Cop. officinalis, *Linné* (C. Jacquini, *Desfontaines*), indigenous to Venezuela, New Granada, and some West Indian islands; Cop. guianensis, *Desfontaines*, found in Guiana and in Northern Brazil near the Rio Negro. Cop. Langsdorffii, *Desfontaines*, Cop. coriacea, *Martius*, and others occur in various parts of Brazil. Cop. multijuga, *Hayne*, is a doubtful species; Cop. bijuga, *Hayne*, is probably identical with Cop. guianensis. Copaiva has been medicinally employed in Europe since the beginning of the seventeenth century.

Collection.—In the interior of the stem ducts, sometimes of large dimensions, are formed, in which the oleoresin collects in such quantities that old stems not unfrequently burst from the internal pressure exerted by the liquid. This is gained from bore-holes or incisions made into the trunk near its base, from which the oleoresin exudes at once so abundantly that 12 pounds are sometimes obtained in the space of 3 hours. If, however, no copaiva should flow, the wound is closed with wax or clay and reopened in a fortnight, when an abundant discharge takes place. Old trees occasionally yield it two or three times a year.

Copaiva is imported in barrels principally from Para, to which place it is brought from the northern tributaries of the Amazon. It is, perhaps, in part obtained from C. guianensis. Notable quantities are brought from Maranham, and some from Rio de Janeiro, the latter supposed to be procured from C. Langsdorffii and coriacea. The copaiva exported from Maracaibo and Carthagena appears to be chiefly procured from C. officinalis. 228,159 pounds of copaiva were imported into the United States during the year 1876–77; in the following year only 67,000 pounds; the average for seven years is 138,734 pounds.

Description.—Copaiva is a more or less clear and viscid liquid, varying in color from very light-yellow to brownish-yellow, having a peculiar aromatic odor and a bitterish, persistently acrid, and nauseous taste. Its specific gravity ranges between 0.94 and 0.99; Flückiger gives the limits between .935 and .998; by keeping it becomes thicker and denser. It is mostly transparent, at least in a thin stratum, but occasionally is slightly turbid and faintly fluorescent. Unlike wood-oil, it is not gelatinized on being heated to 130° C. It is insoluble in water, dissolves in three or four times its weight of strong alcohol, and freely in absolute alcohol, bisulphide of carbon, ether, volatile and fixed oils, acetone, and petroleum benzin; the latter solution becomes opalescent on the addition of more (3 to 5 volumes) petroleum benzin, and deposits on standing a little resinous matter, at the same time becoming transparent again. Benzol yields with some varieties a turbid solution. The optical behavior of copaiva varies, as has been shown by Buignet (1861) and Flückiger (1867).

The different kinds are commercially distinguished by their ports of exportation, but even as obtained from the same places are not always identical in every particular. *Para copaiva* is the most limpid and the lightest kind, and frequently contains from 65 to 85 per cent. of volatile oil. *Maranham copaiva* is a little denser, has about the consistence of olive oil, differs somewhat in odor from the preceding, and contains from 40 to 50 per cent. of volatile oil. *Rio Janeiro copaiva* resembles the last. These Brazilian copaivas yield, with one-third to one-half their weight of ammonia, compounds which form perfectly clear solutions in the volatile oils contained in them; a larger quantity of ammonia renders the solution quite milky, but in the presence of a fixed oil clear solutions are not obtained. *Maracaibo copaiva* is the thickest variety, usually of a dark-yellow color and not quite transparent. It contains less volatile oil, and does not always yield a clear mixture with a little ammonia-water; but it solidifies readily with magnesia, and is well adapted for making the officinal Massa copaibæ. According to the German Pharmacopœia, thick copaivas are to be preferred.

Adulterations.—The variable conditions of commercial copaiva, depending on its origin from different species, renders a detection of adulterations by no means an easy task. A copaiva which dissolves clear in strong alcohol, yields with one-third ammonia a transparent mixture, is on heating free from turpentine odor, and on evaporation of the volatile oil from a flat dish (better than distillation, as directed by the U. S. P.) and subsequent cooling leaves a transparent, hard, and brittle resin, may be considered pure. Fixed oils are left behind with the resin, and render it soft and sticky; if other than castor oil is present, neither the copaiva nor the residuary resin will yield a clear solution with alcohol. Castor oil, being nearly insoluble in petroleum benzin, may be detected by shaking the suspected copaiva with 4 to 5, or even 10. volumes of that solvent, when the adulterant will separate, but the volatile oil present exerts a marked solvent power on the castor oil. Flückiger and Hanbury recommend heating the sample of copaiva with 4 parts of 85 per cent. alcohol and allowing the mixture to cool; the upper layer is then evaporated to expel the alcohol and volatile oil, and the remaining castor oil recognized by heating it with caustic soda and lime, when œnanthol will be formed, recognizable by its peculiar smell; even 1 per cent. of castor oil is stated to be thus detected.

When a drop of pure copaiva is evaporated from a piece of filtering-paper, it will leave a sharply-defined transparent spot of resin behind, which, if a fixed oil is present, will be surrounded by a greasy areola. Tomlinson (1864) has recommended the examination of the cohesion-figures produced by a drop upon water, which are said to be quite characteristic for pure copaiva.

The presence of other volatile oils and turpentines usually becomes quite evident by a different odor on slowly heating a little of the copaiva. Turpentine, oil of turpentine, resin, rosin oil, etc. are said to be detected by a test admitted into the P. G.: 1 part of copaiva, on being strongly shaken with 5 parts of water of 50° C. (122° F.), should yield a turbid mixture, and this, on being warmed in a water-bath, should separate again into two clear layers. Copaiva mixed with 10 per cent. of gurjun balsam yields by this treatment a permanent emulsion (Flückiger). The U. S. P. gives the boiling-point of the volatile oil (200° C. = 392° F.) as a test.

The presence of gurjun balsam in copaiva is stated to be detected by shaking together in a test-tube 19 drops of carbon bisulphide and 1 drop of the oleoresin, and adding, with some agitation, 1 drop of a cold mixture of equal parts of concentrated sulphuric and nitric acids; copaiva assumes a faint reddish-brown color and deposits resin on the side of the tube; in the presence of gurjun balsam an intense purplish-red color is produced, changing to violet, the reaction being due to the volatile oil of the adulterant. The oleoresin of Hardwickia pinnata, *Roxburgh*, will under the same circumstances produce a pale greenish-yellow color (*Pharmacographia*).

Constituents.—Copaiva owes its limpidity to the presence of volatile oil (see OLEUM COPAIBÆ), but the acrid and bitter taste is partly due to the brittle resin, partly also to a bitter principle, as shown by Flückiger (*Pharmakognosie*). On boiling copaiva with water, concentrating the aqueous liquid, and filtering from the floccules which are separated, a transparent very bitter solution is obtained, which reddens litmus and yields a copious precipitate with tannin solution. The resin possesses acid properties, and is occasionally deposited from copaiva in a crystalline form, also from a clear mixture of copaiva and ammonia-water when exposed to a low temperature. The crystals are freed from adhering oleoresin by washing with ether, and afterward recrystallized from absolute alcohol, when, according to Schweitzer (1830), *copaivic acid* is obtained free from ammonia. Rush (1879) agitated 1 part of copaiva with 3 parts of solution of soda sp. gr. 1.30; the mixture separates into three layers, consisting of volatile oil, an aqueous alkaline liquid, and the compound of resin; the two upper layers are decanted, the resin compound well washed, dissolved in petroleum benzin, agitated with dilute hydrochloric acid, washed with water, and the benzin solution evaporated. Copaivic acid has the composition $C_{20}H_{32}O_2$, and crystallizes in small soft prisms, which are soluble in alcohol, ether, carbon bisulphide, and in fixed and volatile oils; its salts are uncrystallizable. A deposit from Para copaiva was recognized by Fehling (1841) as distinct from the above, it is *oxycopaivic acid*, $C_{20}H_{28}O_3$. Strauss's (1865) *metacopaivic acid*, $C_{22}H_{34}O_4$, is contained in Maracaibo copaiva, from which it is obtained by agitation with ammonium carbonate and by precipitating the aqueous liquid with hydrochloric acid. When copaiva is kept on hand it gradually becomes thicker, through the alteration of the volatile ail and its conversion into a soft resinous body.

Pharmaceutical Uses and Preparations.—Copaiva is readily emulsified by the aid of yelk of egg or gum-arabic. It is sometimes given in the form of electuary, and requires then some absorbent for the volatile oil, for which purpose powdered marshmallow, liquorice-root, or gum-arabic is adapted; or the copaiva may be preferably fused together with some wax, spermaceti, or cacao-butter, the quantity of which will vary with the amount of volatile oil, between ½ and 1 part. (See also OLEUM COPAIBÆ and MASSA COPAIBÆ.)

Allied Products.—HARDWICKIA PINNATA, *Roxburgh* (nat. ord. Leguminosæ, Cæsalpineæ), is a large East Indian tree, yielding from incisions a thick, dark-brown oleoresin, which in thin layers is greenish or wine-red, transparent, but not fluorescent, and resembles copaiva in both odor and taste. Broughton (1872) obtained from it between 25 and 40 per cent. of volatile oil having the composition $C_{10}H_{16}$, the remainder consisting of several resins, but copaivic acid was not obtained.

DIPTEROCARPUS ALATUS, *Roxburgh*, D. turbinatus, *Gaertner* (s. D. lævis, *Hamilton*), D. incanus, *Roxburgh* (s. D. costatus, *Gaertner*), and several other species of the same genus (nat. ord. Dipterocarpaceæ) which are indigenous to various parts of India, the East Indian and the Philippine islands, yield *gurjun balsam* or *wood-oil*, obtained by cutting large holes into the lower part of the stem and charring the wood, after which the oleoresin flows abundantly. It is a viscid liquid, varying in color from greenish-gray to brownish, opaque in reflected light, but transparent and of a dark brownish or reddish tint when viewed in transmitted light; its odor is similar to but weaker than that of copaiva, and its taste is more bitter and somewhat aromatic, but not acrid. It is freely soluble in chloroform, carbon bisulphide, and volatile oils, but only partly soluble in alcohol, fusel oil, ether, and petroleum benzin. When strongly agitated with water, gradually added until 5 parts have been used, gurjun balsam furnishes a very thick emulsion, which does not become clear on warming, but on the addition of the same bulk of water the balsam separates, and the clear watery liquid has a bitter taste and an acid reaction (Flückiger). When heated in a stoppered vial to near 130° C. (266° F.) it has the curious property of becoming gelatinous, the fluidity not being restored on cooling. The amount of volatile oil present in gurjun balsam varies considerably: Werner (1862) obtained 15 per cent., Flückiger 45.5 per cent., and from one specimen even 72 per cent.; it is strongly levogyre, and has the composition $C_{15}H_{24}$, the density .9044 to .918 at 15° C., and the boiling-point 255° C. (491° F.). The resin left after the distillation of the volatile oils yields to caustic potassa *gurjunic acid*, $C_{22}H_{34}O_4$, which may be obtained pure by adding to the potassa solution an excess of ammonium chloride, filtering, and decomposing with hydrochloric acid. Gurjunic acid dissolves readily in ether and strong alcohol, slowly in benzol, and with difficulty in carbon bisulphide; it melts at 220° C. (418° F.), and congeals again at 180° C. (356° F.). A crystalline neutral resin of gurjun balsam, which had been sold as copaivic acid, was found by Flückiger (1878) to have the composition $C_{28}H_{46}O_2$, to melt at 126° C. (258.8° F.), and to dissolve in sulphuric acid with an orange color.

LAGAM BALSAM, MINJAK-LAGAM, comes from an unknown tree in Sumatra, and closely resembles gurjun balsam. Examined by Haussner (1883), it was dingy-green in reflected and yellowish transparent in transmitted light, had a bitterish and lastingly acrid taste, and was completely soluble in alcohol, ether, benzol, chloroform, and carbon disulphide; it yields about 33 per cent. of levogyre volatile oil of the composition $C_{20}H_{32}$ and boiling at about 250° C. (482° F.). The acid resin is uncrystallizable, and has the composition $C_7H_{14}O_3$; the neutral resin, fused with potassa, yields phenols and formic, acetic, butyric, and aromatic acids.

Physiological Action.—In continued or excessive doses copaiva deranges the digestion, impairs the appetite, and causes eructations, nausea, and diarrhœa. It appears to augment the watery element of the urine, rendering this secretion dark, bitter, and somewhat fragrant, as well as more or less turbid from the resin of copaiva, which also forms an iridescent pellicle upon its surface. The addition of nitric acid to the urine gives a turbid precipitate which, unlike albumen, is soluble in alcohol. Large doses or the long-continued use of copaiva also irritate the bladder, causing micturition and sometimes hæmaturia with feverishness. It appears to be excreted by the pulmonary and the cutaneous surfaces; the former is shown by the odor it gives to the breath, and the latter by the eruptions of roseola, urticaria, etc. which it occasionally excites. A very peculiar eruption has been attributed to copaiva and cubeb taken together (*Amer. Jour. of Med. Sci.*, Jan. 1881, p. 289). Copaiva impregnates the milk of nursing women, so that their infants refuse the breast. In rare instances it seems to have caused convulsions, muscular rigidity, and even paralysis. The cutaneous and nervous symptoms of copaiva are apparently owing to its essential oil, and its modifications of the mucous membranes to the resin and the acid it contains. To the resin especially its diuretic operation is ascribed. Originally suggested by Monro in 1827, the diuretic power of copaiva was again observed (Richter; Dixon), and its reality was confirmed by experiment before 1832 (Wibmer). It was afterward mentioned by systematic writers, as Pereira, Strumpf, and Garrod. From 1869 clinical illustrations of its efficacy began to abound, and were furnished by Duffin, Thompson, Lineing, and others. In 1873, Wilks showed that the resin was even more efficient in this respect than copaiva itself. In 1875, Dixon proved by three cases of dropsy that copaiva acted as a diuretic, increasing the daily quantity of urine from 8½ to 82 ounces, from 15 to 108 ounces, and from 8 to 93 ounces, in several cases. In 1876, Carter published two cases of ascites, independent of cardiac or renal disease, entirely cured by the diuretic operation of the resin of copaiva after the complete failure of other diuretics, purgatives, etc. He tested its action upon a stout man who was suffering from erythema of one leg, but otherwise healthy. It was given three times a day in doses of about 7 grains. In the first 24 hours after the medicine was begun the quantity of urine increased from 22 to 38 ounces, and finally reached 82 ounces; the specific gravity declined from 1019 to 1014; and the total solids increased from 16.25 to 40.48 Gm., of which last amount 18.48 Gm. were organic and 22 inorganic. The total solids had therefore increased fourfold. The urea, however, had increased by only four-fifths, or 18 Gm. These results have been fully confirmed by Frederick Taylor, who administered the resin in more than sixty cases of different forms of dropsy. The diuretic operation failed, however, in cases of renal dropsy depending upon tubular nephritis, acute or chronic—a fact which renders it almost certain that the diuresis produced by copaiva is due to its action upon the secreting elements of the kidneys.

Medical Uses.—The most important uses of copaiva are in the treatment of mucous profluvia, especially of the urinary and the air-passages. There can be no doubt that it acts by modifying the urine in the first, and the bronchial mucous membrane itself in the second, of these cases, and that in both it cures by a substitutive operation. It is well known that copaiva given internally does not often cure vaginal *gonorrhœa*, while it arrests the urethral form of the disease in the female as readily as in the male. It is also known that in hypospadic males affected with gonorrhœa the internal administration of copaiva will arrest the discharge from behind the urethral aperture, but not from that part over which the urine does not flow. Hence an explanation of the clinical rule, to administer as much copaiva as can be taken without disordering the stomach or irritating the urinary organs. In this manner it exerts a stimulant and moderately substitutive action upon the inflamed membrane and causes a diminution of the discharge. According to some, the agent in this operation is exclusively copaivic acid, but, since the resin abundantly appears in the urine, this constituent cannot be denied its share in the cure. It is probable that the essential oil is the most active agent when copaiva cures *bronchitis*, since it is largely eliminated through the bronchia. During the acute stage of gonorrhœa, and also of bronchitis, copaiva is contraindicated, for in the former disease it tends to cause strangury, swelling of the testicle, and other local disturbances, while in bronchitis it is apt to arrest the bronchial secretion and thereby occasion fever and dyspnœa. Besides administering copaiva by the mouth for the cure of gonorrhœa and gleet, it has sometimes been thrown into the rectum—a clumsy, uncertain, and injurious method. It has also been injected as an emulsion into the urethra, but without decided advantage, since the urine remaining unmodified continued to irritate the inflamed mucous membrane. The urine passed by the patient taking copaiva has been used as a urethral injection for the cure of gonorrhœa—an unnecessary and barbarous expedient when so many more appropriate injections are available. *Vesical catarrh* is often greatly benefited, and may sometimes be cured by means of this medicine perseveringly administered in moderate doses. Sometimes an emulsion of it injected into the bladder has been serviceable. It is an efficient remedy in many cases of *irritability of the bladder* depending upon previous gonorrhœa or excessive sexual indulgence. In some cases of *leucorrhœa* it is reputed to have been curative, but there is more evidence of its favorable action in the treatment of inflamed and ulcerated *hæmorrhoids* and chronic *dysentery*. In 1863 it was announced as a specific for *membranous croup*, and even in 1875 the same deceptive statement was repeated. In various inflammations of the *eye* it is reputed to have an almost "specific" influence, especially in *iritis*, *sclerotitis*, and *purulent ophthalmia*. In the two first-named diseases it was given internally in drachm doses, but in the last only applied upon the skin around the orbit. The evidence upon these points is inconclusive. There is more clinical proof of its curative power in *cutaneous scaly diseases*, and its correctness is rendered more probable by the well-known action of the medicine upon the skin. It has even been alleged to be an efficient remedy in *leprosy* (Simmons). Although the ordinary use of copaiva does not denote its action upon the nervous system, yet the occasional effects attributed to it seem to point in that direction. In corroboration of this view it may be mentioned that it has produced cures of *sciatica* even after the failure of numerous other medicines (March, *Times and Gaz.*, Feb. 1881, p. 237). The diuretic operation of copaiva appears to be very decided in certain cases of *dropsy*. This operation has been described in a previous paragraph. A careful examination of the clinical records touching the matter shows that the medicine is of little use in any form of dropsy depending upon renal disease, and least of all in the cases which most require it—viz. those of a scanty secretion of urine due to tubular nephritis. In cardiac dropsy the influence of the medicine is more favorable, but only in proportion as the effusion is due to general causes rather than to mechanical obstruction in the heart. The cases in which copaiva and its resin have produced the most remarkable results are those of hepatic dropsy. In the most successful of them the nature of the hepatic obstruction was only conjectural, but was probably a condition analogous to that of commencing cirrhosis. Certain it is, that in many cases of ascites which improved but slightly, or did not improve at all, under the use of the medicine, and which ultimately proved fatal, advanced cirrhosis of the liver was found after death. The dose of copaiva used in hepatic dropsy is about 20 grains three times a day.

Externally, copaiva, like other terebinthinates, serves to stimulate, and at the same time protect, parts to which it is applied. It forms an excellent dressing for *chilblains*, *sore nipples*, *anal* and other *fissures*, etc.

Administration.—Copaiva is most commonly administered in gelatin capsules, each containing about 10 drops (Gm. 0.60), which is the minimum dose. The maximum dose ordinarily given is about 1 fluidrachm (Gm. 4). Much larger quantities, even as much as an ounce, have been prescribed, but without necessity or advantage. The medicine is sometimes mixed with magnesia, with which it forms a solid and very insoluble mass. Equal quantities of copaiva and liquor potassæ make a perfect solution, which can be diluted and flavored. Next to the capsules, emulsions of copaiva are to be preferred. They are made with the yelk of egg or mucilage and some aromatic water, to which a small proportion of laudanum is usually added. Each tablespoonful should contain from 10 to 40 drops (Gm. 0.60–3.0) of copaiva.

Copal varnish has been recommended to arrest the development of *felons* by applying it previous to the suppurative stage (Isham, *Med. News*, xl. 97). No doubt it acts as other terebinthinates (copaiva, benzoin, oil of turpentine) do in the treatment of frost-bite and various local inflammations, by protecting, and the same time stimulating, the affected part.

GURJUN OIL OR BALSAM, which resembles copaiva closely in its constitution, has, like it, been used for the cure of *gonorrhœa*. In 1873 it was used in one of the British Oriental possessions, the Andaman Islands, in the treatment of *leprosy*. Twenty-four cases were submitted to this method, with the effect of healing the ulcers, while the anæsthesia greatly improved and the tubercles softened and disappeared. It was most efficient when employed externally in the form of an emulsion made with 3 parts of lime-water to 1 of the oil, with which the affected parts were diligently rubbed twice a day, and each time for the space of 2 hours. At the same time the oil was administered internally, in doses varying from 6 to 60 drops (Gm. 0.40–4.0) and finally in tablespoonful doses of an emulsion made of equal parts of the oil and lime-water.

Reports of a later date confirm the statements just made. One comes from India, and summarizes the results of using gurjun oil in leprosy thus: "It rapidly heals chronic leprous ulcers, softens the skin, prevents the collection of flies, and is cheap" (Peters, *Practitioner*, xxiv. 122). The other is by Dr. Milroy, who treated the disease in British

Guiana. "Gurjun oil," he says, "is laxative, diuretic, and alterative, and produces perspiration in the anæsthetic parts, followed by a return of sensation. It softens the tubercles. Internally, it purges and acts on the kidneys and urine like copaiva. Of thirty-two patients under its use, great improvement occurred in sixteen, and nine more were benefited" (*Times and Gazette*, June, 1879, p. 643).

COPTIS.—Gold-Thread.

Coptide, Fr.; *Gelbe* (*Kleinste*) *Niesswurz*, G.

Coptis trifolia, *Salisbury*, s. Helleborus trifolius, *Linné.* Bigelow, *Med. Bot.*, i. t. 5; Bentley and Trimen, *Med. Plants*, 3.

Nat. Ord.—Ranunculaceæ, Aconiteæ.

Origin.—The plant is indigenous to the northern half of this continent, from Pennsylvania northward to Greenland and Labrador, and also from the northern portion of Europe and Siberia to Kamtchatka.

Description.—Gold-thread has a filiform creeping rhizome of a golden-yellow color, with very thin fibrous rootlets. The radical leaves originate from a scaly base, are petiolate and trifoliate; the leaflets are about half an inch (12 Mm.) long, ovate with a wedge-shaped base, obtusely three-lobed, and mucronately crenate; the scape is 2 or 3 inches (50–75 Mm.) long, exceeding the petioles, and bears a single yellowish-white flower producing about seven oblong follicles, which are acuminate with the persistent style and contain a few oblong, black, and glossy seeds. The whole plant is glabrous, without odor, and has a strongly bitter taste.

Constituents.—Mayer (1862) found in gold-thread berberine and a white alkaloid. Analyzed by E. Z. Gross (1873), the absence of tannin and gallic acid was established; besides some sugar, albumen, fat, and resin, two alkaloids were isolated, *berberine* and *coptine;* the latter is colorless, insoluble in alkalies, neutralizes acids, dissolves in strong nitric and hydrochloric acids without change, and produces with warm concentrated sulphuric acid a purplish color, similar to that of hydrastine. The acids naturally combined with the alkaloids have not been ascertained. The herb yielded between 4 and 5 per cent of ash, about one-tenth of which was silica.

Allied Drugs.—Coptis teeta, *Wallich.* The rhizome has the thickness of a quill, contains 8½ per cent. of berberine, and is used in India as a pure bitter tonic.

C. anemonæfolia, *Siebold.* The rhizome of this Japanese plant is about ⅛ inch (3 Mm.) thick, bristly, with short wiry rootlets, externally brown, internally bright-yellow, and has a bitter taste; it probably contains berberine.

Medical Action and Uses.—Coptis has no ascertained virtues beyond those of other simple bitters, for which, if necessary, it may be substituted. An infusion of it may be made with an ounce of the root to a pint of water (Gm. 32 to Gm. 500) and given in the *dose* of 1 or 2 ounces. It is used as a wash for *aphthous sore mouth.* A tincture is made with alcohol, a pint to an ounce of the bruised root. *Dose*, a fluidrachm (Gm. 4).

CORALLORRHIZA.—Coral-Root.

The rhizome of Corallorrhiza odontorrhiza, *Nuttall.*

Nat. Ord.—Orchidaceæ.

Origin.—The plant is a parasite, of a purplish-brown color, has a slender stem about 10 inches (25 Cm.) high, and bears from eight to twenty flowers, with their lips nearly entire. It is indigenous to North America east of the Mississippi. It is not unlikely that the more common Corallorrhiza multiflora, *Nuttall*, may furnish some of the commercial coral-root; it is stouter, and has from fifteen to thirty flowers, which are spurred at the base and have the lip deeply three-lobed. It is found westward to the Rocky Mountains.

Description.—Coral-root consists of numerous small fleshy tubers, which are united by their broader sides and form many branches of different length, but of the same articulated appearance, resembling coral in arrangement. It is of a brown color externally, whitish within, and has, particularly in the fresh state, a peculiar odor and a bitterish and astringent taste. Its proximate constituents have not been ascertained.

Medical Uses.—There appears to be nothing to be added to the stereotyped account of this plant, to the effect that it is an active diaphoretic and useful in fevers and inflammations. It is administered in powder in the dose of 30 grains (Gm. 2) every 2 hours

CORIANDRUM, *U. S.*—CORIANDER.

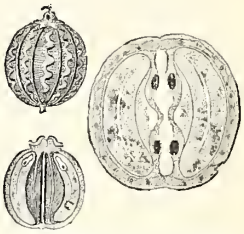
Coriandri fructus, Br.—*Coriander-fruit*, E.; *Coriandre*, Fr.; *Koriander*, G.

The fruit of Coriandrum sativum, *Linné*.

Nat. Ord.—Umbelliferæ, Cœlospermæ.

Origin.—The plant is probably indigenous to China and to the eastern portion of the northern shore of the Mediterranean, but is now extensively naturalized in the fields of temperate Asia and Europe, where it is also cultivated. It is occasionally cultivated in the United States and in some parts of South America. It is a smooth annual about 2 feet (60 Cm.) high and of a very offensive odor, somewhat like that of bed-bugs. The leaves are decompound, the segments of the lower ones broadly cuneate, and of the upper ones narrow and linear; the umbels are three- to five-rayed, without involucre; the umbellets six- to fifteen-rayed, with an involucel of three linear bracts. The flowers are white or rose-colored. 49,133 pounds of coriander were imported in 1866–67; in the recent returns coriander is included with caraway.

Fig. 84.



Coriandrum: fruit and longitudinal section, magnified 3 diameters; transverse section; magnified 8 diameters.

Description.—The cremocarp of coriander is nearly globular, about ⅙ inch (4 Mm.) in diameter, smooth, crowned with the unequal calyx-teeth and stylopodium, and of a buff or pale brownish-yellow color. Each of the two mericarps forms a thin hemispherical shell, the two being united at the edge by the thin pericarp, thus enclosing a flattish lenticular cavity and separating only by slight pressure. The five primary ribs of each half-fruit are obsolete, forming merely raised wavy lines; the four secondary ribs are more prominent as straight ridges, and similar ridges are formed at the junction of the mericarps. The longitudinal and transverse sections of each mericarp show the albumen to be of a semilunar shape; upon the latter two oil-tubes are seen on the face and none on the back. On ripening the fruit becomes gratefully aromatic.

Constituents.—Trommsdorff obtained from coriander nearly one-half of 1 per cent. of volatile oil (see OLEUM CORIANDRI) and 13 per cent. of fatty matter, besides a small amount of mucilage, malic acid, and traces of tannin.

Off. Prep.—Coriander-fruit is used in preparing Confectio sennæ, *U. S.*, *Br.*; Mistura gentianæ comp., Syrupus rhei, Tinct. rhei, Tinct. sennæ, *Br.*

Medical Action and Uses.—Coriander is aromatic and stimulant, and is chiefly employed to promote the *digestion* of certain kinds of pastry, and in medicine to correct or assist the action of purgatives, such as rhubarb, senna, and jalap.

CORIARIA.—CURRIER'S SUMACH.

Redoul, *Sumac des corroyeurs*, Fr.; *Gerberstrauch*, G.

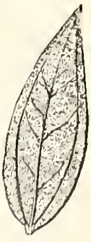
Coriaria myrtifolia, *Linné*.

Nat. Ord.—Coriariaceæ.

Origin.—It is a shrub about 6 feet (1.8 M.) high, growing in Southern Europe and Northern Africa.

Description.—The branches are quadrangular; the leaves opposite, 1 to 1½ inches (25 to 38 Mm.) long, on short petioles, ovate-lanceolate, acute, entire, even at the base, smooth, bluish-green, and shining above, pale-green beneath, with a strong midrib and two lateral nerves running to near the apex. The flowers are in small terminal racemes, have a bell-shaped calyx, five fleshy, scale-like petals, five long linear stigmas, and produce each five blackish-brown obliquely ovate nutlets, which are surrounded by the enlarged scales and have a berry-like appearance. The leaves have a strongly astringent, bitter, and somewhat acrid taste.

Fig. 85.



Coriaria-leaf.

Constituents.—The leaves contain tannin, which produces blue-black precipitates with salts of iron. The poisonous principle *coriamyrtin* has been isolated and studied by Riban (1864–66), who precipitates the decoction with subacetate of lead, removes the lead from the filtrate, and evaporates to a syrupy consistence; from this residue the principle is dissolved by ether. It is in white or colorless very bitter prisms, which dissolve in 70 parts of water, in 50 of alcohol, and in less ether, chloroform, and benzol. Its composition is $C_{30}H_{36}O_{10}$. It is rendered brown by alkalies, and on being boiled with dilute hydrochloric acid yields a body which reduces Fehling's solution, but differs from sugar.

Physiological Action.—Accidental poisoning has occurred by mistaking the leaves of this plant for senna and the fruit for blackberries. Snails that lived on its leaves have poisoned those who ate them. The toxical phenomena generally consisted of nausea, vomiting, colic, trismus, and general convulsions, ending fatally in some cases within 24 hours. Experiments upon various animals gave the same general results, but rabbits were usually unaffected. But the latter animals were destroyed by coriamyrtin in the dose of $1\frac{1}{2}$ grains (Gm. 0.10) given internally, and $\frac{1}{8}$ grain (Gm. 0.008) administered hypodermically. 3 grains (Gm. 0.20) of this substance sufficed to bring on fatal convulsions in dogs in periods varying from 20 to 75 minutes. The phenomena of poisoning by the plant and its extract resemble those induced by picrotoxin, including spasm, frothing at the mouth, and contraction of the pupils; and the lesions after death present a similar analogy, for they consist of a normal appearance of the gastro-intestinal mucous membrane, congestion of the meninges, rapid occurrence of rigor mortis, distension of the heart with dark blood, and ecchymoses in the lungs. The toot poison of New Zealand has been proved to be furnished by one or more species of Coriaria.

CORNUS, *U. S.*—Cornus.

Dogwood-bark, E.; *Écorce de cornouiller à grandes fleurs*. Fr.; *Grossblüthige Kornelrinde*, *Hornbaumrinde*, G.

The bark of the root of Cornus florida, *Linné*. Bigelow, *Med. Flora*, t. 28; Bentley and Trimen, *Med. Plants*, 136.

Nat. Ord.—Cornaceæ.

Origin.—The tree is found in woodlands from Canada southward throughout the United States east of the Mississippi; it is usually from 15 to 20 feet (4.5 to 6 M.) high, and in favorable localities attains double that height. The opposite leaves are ovate, pointed, about 4 inches (10 Cm.) long, and become crimson in autumn; the small greenish flowers are in capitate clusters surrounded by four large involucral leaves, which are notched at the apex, of a white color, sometimes tinged with purple, and quite showy. The drupaceous fruit is bright red.

Description.—The bark of the root, which is preferred, is usually met with in commerce, and is in broken somewhat curved pieces, about $\frac{1}{8}$ inch (3 Mm.) thick and rarely over 2 inches (5 Cm.) long and wide. The furrowed corky layer is dark ash-colored or brown-gray, in the young bark smooth and marked with small oblong white spots. The Pharmacopœia directs the corky layer to be removed, when the outer surface is of a pale reddish- or light reddish-brown color, and rather darker than the inner surface, which is of a rusty rose-color and striate; the longitudinal as well as the transverse fracture is short, of a whitish color, and with brown-yellow striæ of stone-cells. It is almost without odor and has an astringent and bitter taste.

Constituents.—Geiger (1836) separated the bitter principle, *cornin* or *cornic acid*, by treating the cold infusion with plumbic hydrate, evaporating the filtrate, treating the extract with absolute alcohol, adding ether, and crystallizing. Frey (1879) found it difficult to obtain the principle pure without loss. It is in white, silky bitter needles, readily soluble in water and alcohol, slightly soluble in ether, colored dark by alkalies, and precipitated by silver nitrate and basic lead acetate, but not by other normal salts. We observed (1859) that the bitter principle when in aqueous solution containing a little ammonia is altered and destroyed by exposure to air and heat. Geiger separated also a tasteless resinous body crystallizing in shining needles. Cockburn (1835), besides some unimportant principles, recognized the presence of gallic acid and tannin, producing a bluish-black color with iron. Bowman (1869) obtained only 3 per cent. of tannin. Frey, in addition to these principles, isolated a bland inodorous orange-colored fixed oil, and ascertained that the resin dissolves with an orange color in cold sulphuric acid.

Off. Prep.—Extr. cornus floridæ fluid., *U. S.*

Allied Plants.—1. Cornus circinata, *L'Heritier.*—Round-leaved dogwood, *E.;* Cornouiller à feuilles arrondies, *Fr.;* Canadischer (Rundblätteriger) Kornel, *G.*—This shrub is met with in Canada, and in the United States as far south as Virginia and west to Indiana, growing in copses in rich soil. It attains a height of 6 to 8 feet (1.8 to 2.4 M.), has greenish warty dotted branches and orbicular or broadly ovate opposite leaves, which are 5 inches (12 Cm.) or less long, abruptly pointed and white woolly beneath. The white flowers are in flat cymes; the fruit is drupaceous, light blue. The bark is in thin, irregular pieces or short quills, which are externally greenish and warty when from young branches, or from older branches of a brownish-gray color, with the warts confluent in slightly-raised longitudinal lines of a glossy brown. The inner surface is cinnamon-brown, even, and very finely striate. The bark breaks with an even scarcely fibrous fracture through the pale-reddish inner layer. The odor is slight; the taste not unpleasant, somewhat astringent, and bitter. Rob. Gibson (1880) found it to agree in composition with the officinal bark.

2. Cornus sericea, *Linné.*—Swamp dogwood, Silky cornel, Red hosier, Kinnikinnick, *E.;* Cornouiller soyeux, *Fr.;* Sumpfkornel, *G.*—This common shrub is found in moist woods, on the margins of streams and swamps, from Canada south to the mountains of South Carolina. It is 6 to 10 feet (1.8 to 3 M.) high, has purplish branches and opposite, elliptic-ovate, and pointed leaves, which are covered underneath with rust-colored silky down. The yellowish-white flowers are in close, flat, and woolly pubescent cymes, followed by pale-blue fruits. The bark is usually in much broken pieces, resembling the preceding, but having a distinct purple tint and being less warty. Its constituents are probably the same.

3. Cornus mascula, *Linné.*—Cornelian cherry, *E.;* Cornouille, *Fr.;* Kornelkirsche, Dürlitze, Herlitze, *G.*—A shrub or small tree indigenous to Southern and Central Europe, and somewhat cultivated in the United States for ornament. It is 10 to 20 feet (3 to 6 M.) high, and produces, preceding the leaves, capitate umbels of yellow flowers surrounded by a four-leaved dingy-yellow or greenish involucre. The bright-red glossy elliptic drupe is about ⅘ inch (2 Cm.) long, in the green state strongly astringent, but when ripe of an acidulous sweet and slightly astringent taste, and edible.

Medical Action and Uses.—Dogwood is tonic, astringent, and slightly stimulant, and in the recent state is apt to produce nausea. Like other vegetable bitters, it has been popularly used as a remedy for *intermittent fever.* Its virtues as a stomachic *tonic* are more demonstrable. The dose of the powdered bark as a tonic is about 20 grains (Gm. 1.30), and three times that quantity, repeated six or seven times during the apyrexia, may be given in intermittent fever. A decoction or the officinal fluid extract is to be preferred.

Swamp dogwood (C. sericea) is less, and round-leaved dogwood (C. circinata) more, bitter than this species, while the first-named excels in astringency.

CORYDALIS.—Turkey Corn.

Squirrel corn, Turkey pea, E.

The tubers of Dicentra canadensis, *De Candolle*, s. Dielytra eximia, *Pursh.*

Nat. Ord.—Fumariaceæ.

Origin.—The plant is a perennial, has bi-ternate somewhat glaucous radical leaves, with the leaflets dissected into linear-oblong segments and several scapes bearing about four greenish-white flowers, which are tinged with purple, nearly ½ inch (12 Mm.) long, heart-shaped, and have two short and rounded spurs. It grows in rich rocky woods as far south as Kentucky, but is more frequent farther north and in Canada.

Description.—The thin subterranean shoots bear small tubers, which are collected. They are depressed globose, ¼ to ⅜ inch (6 to 10 Mm.) thick, of a tawny-yellow color, nearly smooth, with a scar on each of the depressed sides, internally yellow or yellowish-white. The tuber breaks with a somewhat horny or slightly mealy fracture, is nearly inodorous, and has a bitterish and rather persistent taste.

Constituents.—W. T. Wenzell (1855) obtained from it corydaline, fumaric acid, yellow bitter extractive, an acrid resin, starch, and other common principles of plants. The alkaloid was obtained by evaporating the tincture, separating the resin by filtration, precipitating the filtrate with ammonia, and exhausting the precipitate with alcohol. This solution was evaporated, the residue treated with dilute hydrochloric acid, the salt thus formed again precipitated by ammonia, and the alkaloid purified by repeated crystallization. *Corydaline* was discovered by Wackenroder (1826) in the tubers of Corydalis tuberosa and fabacea. It is a white amorphous powder, crystallizing from alcohol in colorless prisms and scales, its solution having a very bitter taste. It is soluble in alcohol, ether, chloroform, and in the fixed and volatile oils, fuses at about 70° C. (158° F.), yields mostly amorphous salts, and is colored dark-red by sulphuric acid and yellow by nitric acid, or, if it contains resin, blood-red by the last-named agent.

Allied Plants.—Corydalis tuberosa, *De Candolle.*—Fumeterre bulbeuse, *Fr.;* Hohlwurzel, Helmwurzel, *G.*—It is indigenous to the hilly woodlands of Europe. The tubers vary from ½ to 3 inches (1 to 4 Cm.) in thickness, are roundish, gray-brown, internally greenish-yellow or whitish, firm; when old, hollow and frequently lobed.

Cor. fabacea, *Persoon*, another European plant, has small tubers which are never hollow.

Dicentra eximia, *De Candolle*, s. Corydalis formosa, *Pursh*, indigenous to the United States, has a scaly rhizome and a compound raceme of oblong purplish flowers, which are about ¾ inch (18 Mm.) long and have two very short saccate spurs.

Medical Uses.—As long ago as 1855 it was stated that "the root of C. formosa is supposed to be tonic, diuretic, and alterative, and is given in syphilitic, scrofulous, and cutaneous affections in the dose of from 10 to 30 grains." Since then there appears to have been nothing more definite made known respecting the virtues of this plant. The resin which it contains, and on which depend whatever virtues it may possess, is probably worthy of being suitably tested. Numerous species of Corydalis occur in Europe, from one of which a resin is obtained, by precipitation from a tincture, which is alleged to have cured *intermittent fever;* and another, C. tuberosa, is regarded as emmenagogue, anthelmintic, etc.

CORYLUS.—HAZEL.

Noisetier, Fr.; *Hasel*, G.

Nat. Ord.—Cupuliferæ.

Description.—The following species have been used:

CORYLUS AVELLANA, *Linné*, is a shrub 10 to 15 feet (3 to 4.5 M.) high, common in woodlands and thickets in Europe and Northern Asia, and cultivated to some extent in the United States. It has somewhat hairy, roundish-ovate, and pointed leaves, with a heart-shaped base, flowers in March, and ripens its fruit in autumn. It has bony nuts, which are enclosed in a bell-shaped involucre, are nearly an inch (25 Mm.) long, and have a smooth, light-brown, woody shell enclosing a white, oily, and sweetish kernel. The nut is known as *filbert.* The seeds contain over 50 per cent. of fixed oil. *Hazelnut oil* is pale-yellow, inodorous, has a mild nutty taste, and congeals at about —17.8° C. (0° F.): it consists of olein, arachin, palmitin, and stearin. By nitric acid it becomes greenish, and by sulphuric acid bluish-green and gray.

CORYLUS AMERICANA, *Walter*, is common in thickets in North America, has obovate-cordate and acuminate leaves, and yields a fruit about ½ inch (13 Mm.) long and wide, which is enclosed in an open involucre of about twice the length of the fruit.

CORYLUS ROSTRATA, *Aiton*, grows in Canada, in the northern part of the United States, and along the Alleghanies, and is about 2 to 5 feet (0.6 to 1.5 M.) high. The leaves are oblong-ovate, pointed, and somewhat heart-shaped. The fruit is enclosed in a long hirsute involucre, which above is contracted into a long tubular beak.

Medical Uses.—The spiculæ which cover the involucre of the last-named species have been used with alleged effect as a substitute for those of Mucuna in the treatment of *intestinal worms.*

COTULA.—MAY-WEED.

Herba chamomillæ fœtidæ.—*Wild chamomile, Dog chamomile*, E.; *Herbe de chamomille puante, Herbe de maroute*, Fr.; *Hundskamillen-Kraut*, G.

The herb of Maruta Cotula, *De Candolle*, s. Maruta fœtida, *Cassini*, s. Anthemis Cotula, *Linné.*

Nat. Ord.—Compositæ, Anthemideæ.

Description.—This nearly smooth annual is originally indigenous to Europe, but is now a very common weed in many parts of North America, growing along roadsides, in neglected fields, and in waste places. The stem is about a foot (30 Cm.) high, with ascending branches from the base, cylindrical, furrowed, somewhat hairy above. The sessile leaves are obovate in outline, thrice pinnately divided, with linear subulate lobes, pale-green, and slightly hairy beneath. The flower-heads terminate the branches upon soft hairy peduncles. The numerous involucral scales are somewhat imbricate, ovate, with whitish scarious margins. The receptacle is conical, not hollow; chaff nearly subulate, shorter than the florets; ray-florets white, ligulate, three-toothed, neutral; disk-florets tubular, yellow; akenes obovoid, ribbed, and without pappus. The plant begins to flower in June, and has an unpleasant aromatic odor and a bitterish acrid taste.

Constituents.—The flowers were analyzed by Wm. H. Warner (1858), and found to contain a little volatile oil, some tannin, valerianic and oxalic acids, an acrid fatty substance, bitter extractive, etc. Pattone (1859) announced the discovery of an alkaloid, *anthemidine*, and of a crystallizable bitter acid, *anthemidic acid*, the latter of which is dissolved from the aqueous extract by alcohol and is also soluble in ether. The undissolved portion of the extract, taken up with water and treated with ammonia, is said to yield the alkaloid, which, however, has not been obtained since.

Medical Action and Uses.—May-weed, or wild chamomile, resembles officinal chamomile in most of its qualities and uses, but its smell is different in being fetid, and its juice is capable of blistering the skin. Its rank odor and acrid qualities probably led to its being used as a nervous stimulant in such cases as those for which valerian is usually employed, and especially for the relief of flatulent *colic* and *dysmenorrhœa*. Its excitant properties adapted it to popular use as a sudorific and anti-spasmodic. The leaves are commonly applied externally, but an infusion of the flowers is preferable for internal use.

COTYLEDON.—NAVELWORT.

Pennywort, E.; *Cotylet*, *Nombril de Vénus*, Fr.; *Nabelkraut*, G.

Cotyledon Umbilicus, *Linné*, s. Umbilicus pendulinus, *De Candolle*.
Nat. Ord.—Crassulaceæ.

Description.—A perennial herb of Southern and Western Europe, growing on rocks and old walls. It has a fleshy tuberous root and an erect stem about 6 inches (15 Cm.) high. The leaves are smooth, fleshy, peltate, concave, roundish, and repand-crenate, about 1 inch (25 Mm.) broad, the upper ones smaller, roundish, wedge-shaped, and on shorter petioles. The numerous small flowers are greenish-yellow and tubular, bell-shaped, with a five-parted corolla, ten stamens, and five many-ovuled ovaries. The dry plant is inodorous and has a mucilaginous taste.

Constituents.—Navelwort was analyzed by Hétet (1864) with the following results: The fresh plant contains 95 per cent. of water, 0.001 per cent. of salt of *trimethylamine*, the same quantity of ammonia salt, 0.9 per cent. nitrate of potassium, 2.063 per cent. of other salts, the remaining 2.035 per cent. being sugar, mucilage, starch, cellulose, etc.

Medical Action and Uses.—Between 1849 and 1855 several English practitioners abounded in eulogies of this plant as a remedy for *epilepsy*. They were, for the most part, gentlemen of good, and even of eminent, professional standing, and their opinions for a time led physicians astray; but when the medicine had been tried by experts both in England and upon the Continent, it was adjudged to be utterly worthless. Against this sentence there has been no appeal. Formerly the mucilaginous leaves of the plant were applied to *contusions*.

CREASOTUM, *U. S., Br.*—CREASOTE.

Kreosotum, P. G.; *Créosote*, Fr.; *Kreosot*, G.

A product of the distillation of wood-tar.

Origin and Preparation.—Creasote, which was discovered by Reichenbach (1830), is one of the numerous products resulting from the dry distillation of wood. According to Voelckel, it is not produced from cellulose, but rather from the incrusting layers of the wood-cells. Crude wood vinegar is stated to contain about 1 per cent., but beech-wood tar occasionally 25 per cent. of it; the latter is therefore the best material for its preparation. To obtain it the tar is distilled until about one-half is passed over and dense vapors of paraffin, etc. make their appearance. The distillate separates into a heavy and light oily layer, with an intervening aqueous stratum of an acid reaction. The light oil contains *eupion*. The heavy oil is treated with a concentrated solution of sodium carbonate, and the separated oily liquid is distilled, that portion of the distillate only being collected which is heavier than water. This distillate is treated with potassa solution spec. grav. 1.12, whereby the creasote is dissolved and *eupion* separated. The potassa solution is now supersaturated with sulphuric acid, and the precipitated creasote well washed with water and rectified, the product distilling at and above 203° C. (397° F.) being collected. The treatment with potassa and sulphuric acid is repeated until the potassium creasote solution does not turn brown on being heated in the air.

To obtain it from crude pyroligneous acid the oily constituents are first separated by saturating the crude acid with sodium sulphate at about 70° C. (158° F.), and while warm skimming off the supernatant layer. The cold thick oil is distilled, treated with sodium carbonate, and further purified as above.

Properties.—Creasote is a colorless oily liquid; age renders it slightly yellowish, but even exposure to direct sunlight should scarcely render it brown (*P. G.*); but the U. S. P. permits it to turn reddish-yellow or brown by exposure to light from the presence of tar-oils. It is very refractive to light, neutral to test-paper, of a peculiar penetrating smoky odor and of a caustic and burning taste. Its specific gravity is 1.035 to 1.085, *U. S.*, *P. G.*; 1.071 *Br.* It volatilizes without leaving any residue, begins to boil at about 200° C. (392° F.), *U. S.*, and most of it distils between 205° and 220° C. (401° and 428° F.). When cooled to − 27° C. (− 17° F.) (− 20° C. = − 4° F., *U. S.*, *P. G.*), it becomes thick, but does not solidify. It is inflammable and burns with a luminous and very sooty flame. With 120 parts of hot water it yields a clear solution, which on cooling becomes turbid and afterward clear again; with less water (80 parts of cold and 12 of boiling water, *U. S.*) turbid mixtures are obtained. The clear watery solution yields with bromine-water a red-brown resinous precipitate, and with a little ferric chloride a gray-green or transient blue color, which rapidly changes to dingy brown, the liquid becoming turbid and separating a flocculent precipitate (difference from carbolic acid). It takes up 50 per cent. of glycerin or 15 per cent. of ammonia sp. gr. 0.940, and is freely soluble in alcohol, ether, carbon bisulphide, glacial acetic acid, fixed and volatile oils. When agitated with an equal bulk of ammonia-water it separates unchanged on standing, but it dissolves in potassa solution, the liquid giving off creasote when heated to boiling. It causes precipitates with solutions of gum and albumen, but not with gelatin, and does not render collodion gelatinous (difference from carbolic acid). It preserves meat, probably in consequence of its behavior with albumen, and is present in the smoke of burning wood. Creasote is decomposed by strong nitric and sulphuric acids, and in contact with silver nitrate the latter is reduced.

Composition.—That creasote is a mixture of a number of different compounds has been long known, but their isolation has been a matter of great difficulty. In 1867, Gorup-Besanez recognized the presence of *guaiacol*, $C_7H_8O_2$, and *creosol*, $C_8H_{10}O_2$, in beechwood tar creasote; both are oily liquids of the general properties of creasote, the former boiling at 200° C. (392° F.), the latter between 220° and 224° C. (428° and 435° F.) (Tiemann and Koppe, 1881). Heated with hydriodic acid, both yield methyl iodide, and in addition thereto *pyrocatechin*, $C_6H_6O_2$, is produced by the former, and by the latter a non-crystallizing body isomeric with orcin, $C_7H_8O_2$. Tiemann and Mendelssohn (1876) proved also the presence of *phlorol*, $C_8H_{10}O$, which had been previously supposed to exist in it and in impure carbolic acid, the so-called *coal-tar creasote*. They dissolved the portion obtained by fractional distillation near 220° C. (428° F.) in ether, and added concentrated potassa solution, whereby its compound with creosol was separated, while the phlorol remained in the mother-liquor. Reimer observed (1876) that guaiacol, treated with chloroform and soda and afterward with an acid, is converted into *vanillin*, the aldehyd of *vanillic acid*, which latter was obtained from creosol by converting it first into acetyl-creosol and oxidizing this with potassium permanganate (Tiemann and Mendelssohn, 1877).

Besides the three principles named, others are likely to be present in creasote from different sources, such as *methyl-creosol*, $C_9H_{12}O$ (boiling-point 215° C. = 419° F.), and *methyl-guaiacol*, $C_8H_{10}O_2$ (boiling-point 205° C. = 401° F.). The cresols and phenols boiling below 200° C. (392° F.) should be absent (see pages 40, 42).

Tests.—For *distinguishing* between creasote and carbolic acid their behavior in aqueous solution to ferric chloride is decisive or their alcoholic solutions may be tested. On adding a strong solution of ferric chloride to a strong alcoholic solution of creasote, a blue and then a green color is produced; with a similar solution of carbolic acid the coloration will be at first blue, then brown, or, in certain proportions, green; if now six or eight times the bulk of water be added, the creasote mixture will become dingy-brown, with the separation of minute oily drops, but the carbolic acid mixture will remain perfectly transparent and acquire a beautiful blue color. J. Williams (1872) did not succeed in detecting with these reactions adulterations of creasote with carbolic acid. It is obvious that unfailing tests can hardly be expected for a variable mixture of compounds, some of which are still unknown; yet since guaiacol is the principal constituent of creasote, the tests for this principle are generally applicable, or rather the absence of the impurities which are likely to be present may be proven by the non-appearance of their characteristic reactions. Thus, the absence of *fixed oils* is shown by the complete volatility of the sample; a drop may be put upon bibulous paper, and this exposed to a temperature near 100° C. (212° F.), when the greasy stain should gradually completely disappear. "The absence of *tar-oils* is shown by caustic soda. If 1 part of creasote be agitated with 1 part of soda solution sp. gr. 1.16, a clear solution should result, which does not acquire a dark color, and on being largely diluted with water does not separate fetid tarry products (cresol, toluol, etc.)."—*P. G.* For the absence of *carbolic acid* the U. S. P. offers two tests: 1, that it should not coagulate collodion; and 2, the glycerin test. The first test will not detect small quantities (5 to 10 per cent.) of carbolic acid. Morson (1872) proposed as a test for pure creasote its insolubility in glycerin, in which it becomes readily soluble on the addition of carbolic acid. The test was, however, soon proven to be unreliable for German beech-wood tar creasote, and to be applicable only to English pine-wood (Norway) tar creasote; and the cause was explained by Graetzel (1877) to be the presence in the latter of oil of turpentine derived from the tar; he suggests the approximate determination of the quantity of carbolic acid by the fractional distillation of the suspected creasote, or by combining it with saturated potassa solution and crystallizing from ether, when carbolic acid will be liberated from the mother-liquor by acidulating with sulphuric acid and distilling. A. H. Allen (1878) corroborated the insolubility in glycerin of Morson's creasote, which boiled at 217° C. (422.6° F.), and must therefore have been free from oil of turpentine; he regards the tests with glycerin and collodion as the only ones of service with mixtures of carbolic acid and creasote. The glycerin test is now formulated thus: "If 1 volume of creasote be mixed with 1 volume of glycerin, a clear mixture will result, from which the creasote will be separated by the addition of 3 or more volumes of water."—*U. S.* "Creasote should be almost insoluble in three times its volume of a mixture of 3 parts of glycerin and 1 part of water."—*P. G.* The last authority adds another test: "If 2 volumes of creasote be agitated with 20 volumes of ammonia-water, after separation of the mixture the creasote should measure not less than 1½ volumes." Carbolic acid is completely soluble in 10 parts of ammonia, while creasote requires not less than 40 volumes for solution.

Fröhde's reagent, prepared by dissolving 1 part of molybdic acid in 100 parts of sulphuric acid, has been found by E. W. Davy (1878) to be a reliable test for detecting an admixture of carbolic acid in creasote, the former producing with the reagent a yellowish or brownish tint, passing into maroon or reddish-brown, and finally into beautiful purple; the latter causes a brown or reddish-brown color, which becomes fainter, and finally light yellowish-brown. The test is applied by adding 1 or 2 drops of the aqueous solution of the substance to 3 or 4 drops of the reagent; warming the mixture gently will hasten the production of the final coloration. If the creasote contains but a small quantity of carbolic acid, 10 drops of it are dissolved in ½ ounce of water and the solution distilled. The first portion of the distillate will give the creasote reaction, and the last portions that of carbolic acid.

It should be stated that much of the commercial creasote is coal-tar creasote, and readily recognizable as such by its behavior to ferric chloride.

Off. Prep.—Aqua creasoti, *U. S.;* Mistura creasoti, Unguentum creasoti, Vapor creasoti, *Br.*

Physiological Action.*—*On Animals:* A small proportion of creasote is sufficient to cause plants to fade and wither, and it is equally fatal to the insect tribes. Given to animals, it excites inflammation of the stomach, pain, vomiting, salivation, laborious breathing, convulsions, and death. Injected into the veins, according to the dose and degree of its concentration it causes death by arresting the heart, or this result follows previous embarrassment of the breathing. These effects are due to its coagulating action on the blood.

On Man: Applied pure to a mucous membrane or to the raw cutis, it excites severe burning pain, coagulates the albumen of the secretion, and may even produce ulceration. Its taste is very penetrating and peculiar, and may be detected in a solution of 1 part of creasote in 1000 of water. In doses of 1 or 2 drops it causes burning in the throat and œsophagus. Larger medicinal doses, if continued, are apt to occasion a sort of intoxication, with giddiness, dulness, debility, frequent pulse, and dyspnœa. The urine is increased and blackened, and exhales the odor of the medicine; sometimes there is strangury. The vapor, when inhaled, is soporific. Applied externally to an ulcer, creasote has occasioned faintness, palpitation, etc. Excessive doses may cause severe abdominal pain and bloody stools. A case in which 2 drachms were taken ended fatally. Another case is reported in which an infant a year old is said to have taken a teaspoonful of creasote, and recovered after having exhibited great debility, pallor, a hoarse croupy cough, and stertorous breathing (Grinnell, *Med. News*, xl. 344). A fatal case occurring in an infant was remarkable for the severe lesions of the mouth, throat, etc. (*Edinb. Med. Jour.*, xxviii. 655).

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* The almost complete substitution in commerce of carbolic acid for creasote, and the very close analogy in their operation, render a more detailed account of the latter unnecessary.

Medical Uses.—The first medicinal use of creasote was to check *vomiting* in cholera, and subsequently it was found to relieve this symptom produced by reflex irritation, by exhaustion in alcoholism, by sea-sickness, by Bright's disease, by malignant disease of the stomach, and by certain forms of dyspepsia, probably of the fermentative sort. Its manifest hæmostatic powers in external *hæmorrhage* led to its use in bleeding from the lungs, stomach, bowels, kidneys, bladder, and uterus, and its analogous operation was employed to correct excessive secretion in *diabetes*, *polyuria*, and *bronchorrhœa*. When creasote was first introduced it was vaunted as a remedy for pulmonary *phthisis*, but naturally fell into the same discredit as all other medicines for which this claim is made. It is, however, true that both by inhalation and by its internal administration it tends to reduce excessive bronchial secretion, and thereby prolong life, just as many other medicines and dietetic agents are known to do. If a solution of 2 or 3 drops of creasote in a fluidrachm of alcohol is diluted with 6 fluidrachms of water, it forms, when atomized, one of the best remedies for the symptoms in question. Administered by the stomach, it is less efficient, but still useful. It may be given with cod-liver oil in the dose of about 1 drop. Some have preferred it associated with tolu in lozenges (Reuss); others prescribe it simply dissolved in alcohol. The preceding remarks are equally applicable to *chronic bronchitis* and *laryngitis;* and, indeed, in pulmonary consumption the medicine can reach only the effects of the disease, not the essential organic cause of those effects. There is no better agent for the relief of *toothache* due to caries and inflammation of the dental pulp. For this purpose it should be applied upon a small and dense wad of cotton or lint. Creasote-water is sometimes used as an injection to cure *leucorrhœa* and *gleet;* it is an excellent application to *burns* and *chilblains* and to all forms of *ulcers* requiring stimulation, but especially to such as present flabby and bloody granulations and a fetid discharge, as in *cancer*, *gangrene*, mercurial *stomatitis*, chronic *glanders*, *ozæna*, etc. It is a useful stimulant in certain cases of *deafness* due to dryness of the external auditory canal. The anti-putrescent power of this substance has caused it to be used to preserve dead animal matter for *dissection*, etc. Creasote has been given, like carbolic acid, for its anti-zymotic virtues in the treatment of *typhoid fever*, but, however it may seem to be theoretically fitted for the cure of that disease, its efficacy has not been generally admitted. Indeed, if it act in the manner supposed, its advantages are not very explicable when it is administered by enema, as Dujardin-Beaumetz advises. If given at all, it should be in the form of creasote-water, and by the mouth in the dose of a fluidrachm. It has been applied as a means of allaying *itching* in numerous diseases of the skin, but in a concentrated form it is more efficient in causing the shrivelling and destruction of *warts*, *condylomata*, and *nævi materni*. If carbolic acid were not so universally used instead of creasote, it would still be preferable as having a less persistent and disagreeable smell. This may be removed from the body or clothing by chlorinated lotions. The poisonous effects of creasote may be combated with wine, coffee, and other stimulants.

The *dose* of creasote is 1 or 2 drops (Gm. 0.05–0.10). It may be given in pill or emulsion or in the form of creasote-water. It is rendered more miscible with water by the addition of an equal quantity of solution of potassa. Its taste may be disguised by aromatic waters. It may also be used by inhalation, dissolved in from 1 to 3 parts of rectified spirit.

CRETA PRÆPARATA, *U. S., Br.*—Prepared Chalk.

Creta lævigata.—*Craie préparée*, *Craie lavée*, Fr.; *Präparirte Kreide*, *Schlämmkreide*, G.
Formula $CaCO_3$. Molecular weight 100.

Native friable carbonate of calcium freed from most impurities by elutriation.

Origin.—Neither the U. S. nor the Br. Pharmacopœia now gives a process for the preparation of prepared chalk, but the last-named authority adds to the above definition that it is "afterward dried in small masses, which are usually of a conical form," and, mainly for the purpose of producing carbonic acid gas, recognizes

Creta, *Br.*; Chalk, *E.*; Crai, *Fr.*; Kreide, *G.*

Chalk is a mineral found in many parts of the world and very abundantly on the coasts of the English Channel. It consists mainly of the microscopic shells of Foraminifera, and, chemically, is carbonate of calcium, generally containing a little silica, aluminium, iron, magnesium, and organic matter. It is usually soft and earthy, but occasionally compact and rather hard, often of a yellowish-white, or even red, color, due to ferric oxide; as met with in commerce it is nearly white. Its specific gravity is about 2.5. It is much used for making marks which are readily effaced. Freed from the hard, silicious portions by pulverization and diffusion in water, it constitutes *whiting*, and if prepared from very white and soft chalk it is known as *Spanish* or *Paris white* (Blanc d'Espagne, Blanc de Troyes, *Fr.*). The latter, mixed with coloring matters and moulded into pencils, forms the main ingredient in *pastil* colors. Being very rapidly and almost completely dissolved by hydrochloric acid, chalk is not adapted for generating a continuous stream of carbonic acid gas. To be suitable for medicinal purposes it requires to be purified or *prepared*.

Preparation.—"Take of chalk a convenient quantity. Add a little water to the chalk and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and after a short interval decant into another vessel the supernatant liquid while yet turbid. Treat the coarser particles of chalk remaining in the first vessel in a similar manner, and add the turbid liquid to that previously decanted. Lastly, let the powder subside, and, having poured off the water, dry it."—*U. S.* 1870.

The directions given here explain the *process of elutriation*, which consists in separating the finer and lighter from the coarser and heavier particles by suspending them in water, and, after the latter have subsided, pouring off the water, holding the former still in suspension, which are then allowed to subside. The powder, while still moist, is then often dried in the form of small nodules, which are usually made by putting the sediment, still moist, into a funnel-shaped vessel and depositing it in small quantities upon the surface prepared for it, either by striking the lower end of the funnel against it or by pushing the soft mass through the funnel-tube by the aid of a suitable rod. The surface used for drying is either glass or a smooth calcareous stone, the latter serving for the rapid absorption of the moisture; the dry powder adheres loosely in the form of small cones. The heavy portion, which subsided first, is again triturated, *levigated* with some water, and again subjected to elutriation.

Bismuth subcarbonate and subnitrate and other pulverulent mineral salts are sometimes dried in the same manner.

Properties and Tests.—Prepared chalk is in conical nodules, forming a white, amorphous, insipid powder, and, being nearly pure calcium carbonate, has all the physical properties of that compound (see page 350), except that the color is usually of a less bright tint, and that, viewed under the microscope, the particles do not present a crystalline appearance. The chemical behavior is likewise the same, except that on dissolving prepared chalk in diluted hydrochloric, nitric, or acetic acid a trifling insoluble residue is usually left, and that the rapid and copious effervescence of carbonic acid gas produces a more permanent foam. The solution should assume only a faint blue color on the addition of potassium ferrocyanide (iron), and when completely precipitated by ammonium carbonate the filtrate generally gives a turbidity on the addition of ammonium phosphate (magnesia). The Pharmacopœia also adds, for no obvious reasons, a test for the absence of strontium and barium (the acetic acid solution is not precipitated by calcium sulphate), but omits tests for other white mineral substances.

Substitution.—*Powdered gypsum*, calcium sulphate, has been during the past thirty years repeatedly sold in place of prepared chalk. It is of a whiter color, does not effervesce with acids, and yields with a large quantity of distilled water a neutral solution giving white precipitates with barium chloride and ammonium oxalate, the latter being soluble in diluted hydrochloric acid.

Off. Prep.—Hydrarg. cum cretâ, Mistura cretæ, *U. S.*, *Br.*; Pulvis cretæ aromaticus, Pulv. cretæ arom. cum opio, *Br.*; Trochisci cretæ, *U. S.*

Allied Drugs.—1. Corallium.—Coral, *E.*; Corail, *F.*; Koralle, *G.*—Oculina virginea, *Lamarck*, and Corallium rubrum, *Lamarck* (s. Isis nobilis, *Pallas*). Class, Polypiphera.—Corals are polypipherous animals inhabiting the sea, and consisting of a skeleton and a fleshy portion. Those which were formerly, and are still occasionally, employed in medicine have a calcareous skeleton which branches considerably, assuming the form of a tree or shrub, on the branches of which the individual animals are located in tube-like apertures. Of the numerous species which have been distinguished the skeletons of only two have been used. The first one mentioned above has a milk-white color, the second is of a dull-red. Besides a small quantity of organic matter, coral consists almost exclusively of carbonate of calcium, with a little carbonate of magnesium. The color of red coral is due to about 4.25 per cent. of ferric oxide.

2. Lapides (s. Oculi, s. Calculi, s. Lapilli) cancrorum.—Crabs' eyes, Crabs' stones, *E.*; Yeux (Pierres) d'écrevisses, *Fr.*; Krebsaugen, Krebssteine, *G.*—They are concretions contained in the stomach of the *crawfish*, Astacus fluviatilis, *Fabricius*, class Crustacea, and are obtained in Russia by allowing the animals to putrefy and washing the mass with water. They are circular, $\frac{1}{8}$ to $\frac{3}{8}$ inch (3 to 9 Mm.) in diameter, plano-convex, with a concentric groove on the flat side, consist of several layers, acquire in boiling water a rose-red color, and dissolve partly with

effervescence in hydrochloric acid, leaving a cartilaginous mass of the shape of the crabs' stones. They contain about 63 per cent. of calcium carbonate and 17 per cent. of calcium phosphate, the remainder being various animal matters with small quantities of other salts. Factitious crabs' stones, which are sometimes met with, are completely dissolved or disintegrated by hydrochloric acid.

3. Os sepiæ.—Cuttlefish-bone, *E.;* Os de sèche, *Fr.;* Sepie, Weisses Fischbein, *G.*—It comes chiefly from the Mediterranean, from Sepia officinalis, *Linné*, class Cephalopoda, and is the calcareous bone contained in the mantle of the animal. It is oval-oblong in shape, both sides slightly convex, the rear surface being smooth, hard, and glossy, the remainder porous in texture and friable. It is of a white color, and consists of 80 to 85 per cent. of calcium carbonate, with traces of phosphates, 12 to 16 per cent. of animal matter, and about 4 per cent. of moisture.

4. Testa præparata, *U. S.* 1870; Conchæ præparatæ, *P. G.* 1872.—Prepared oyster-shell, *E.;* Magistère de coquilles (d'écailles) d'hûitres, *Fr.;* Präparirte Austerschalen, *G.*—From the shell of Ostrea edulis, *Linné.* Class Acephala (Conchifera), ord. Lamellibranchia, Fam. Ostracea.—The oyster inhabits the Atlantic and Indian Oceans and adjacent seas in the neighborhood of the coasts, and is abundant in the bays and on the coast of North America. It consists of a soft, fleshy, suborbicular body, which is enclosed in a calcareous shell opening by two valves, the deeper one being adherent to the rock. Oysters are caught by dredging, and are often planted in creeks and rivers near the sea-shore. The flesh is a nutritious article of food, but the officinal parts of oysters are the shells. Oyster-shells are of an irregular shape, and vary between roundish, obovate, and oblong in outline. The lower valve is deeper than the upper one, which is nearly flat, the two being united by a toothless hinge. The shells are composed of imbricate foliaceous layers, are externally rough, uneven, and of a gray or brownish color, and have their internal surface smooth and white. The principal constituent of oyster-shells is carbonate of calcium, which, according to Schlossberger, varies in the different layers between 88 and 98 per cent., the pearly inner layer containing the largest quantity. The analyses of Bucholz and Brandes, Phipson (1860), How (1866), and others indicate that the organic matter present in oyster-shells may vary between 0.5 and 4.5 per cent. The remaining inorganic constituents are, small amounts of phosphate and sulphate of calcium, magnesium, silica, oxide of iron, and alumina.

For medicinal use oyster-shell is freed from extraneous matter by washing it with boiling water, removing the colored external layer with a knife, and rubbing the clean white inner layer into a powder, either in a mortar or upon a slab by means of a muller; the finest powder is then separated from the coarser particles by elutriation, and dried like prepared chalk. It has a close resemblance to the latter, but is rather rough as compared with it when taken between the teeth, and under the microscope is seen to consist of minute irregular and angular but not crystalline fragments.

Coral, crabs' eyes, crabs' claws, etc. consist essentially of chalk or carbonate of lime, but their action is modified, and perhaps rendered somewhat gentler, by the animal matter which they contain. Powdered cuttlefish-bone is used as an ingredient of dentifrices on account of its hardness.

Medical Action and Uses.—These medicines are antacid and absorbent, and thereby astringent. Externally, they are applied as dusting powders to absorb and neutralize the *cutaneous secretions* and those of *superficial ulcers*, and to protect *erythematous inflammations*. An ointment made with chalk is sometimes used, but the combination in some degree defeats the purpose of the chalk. Internally, prepared chalk is in common use, and is a most valuable remedy for the cure or palliation of almost every form of *diarrhœa*, but especially of those forms in which the intestinal discharges are acid. As a rule, its use in these cases should be preceded by an evacuant to remove undigested food or other irritating substances. There is no better remedy for the premonitory diarrhœa of *cholera* than this simple preparation. It is usual to associate chalk with opiates and astringents; thus, to chalk mixture (*Mistura cretæ*) are added the tinctures of opium, kino, catechu, etc. Richter, in noticing the general substitution of mineral for animal preparations of lime, expresses a doubt of its expediency. Prepared chalk, he remarks, is by no means a substitute for cretaceous preparations derived from the animal kingdom, which contain phosphate as well as carbonate of lime, are more acceptable to the stomach in moderate doses, constipate less, and are more readily absorbed into the system. This writer ascribes a diaphoretic virtue to crabs' eyes, and alleges that they may produce urticaria, and that they tend to excite hæmorrhage. The latter qualities may perhaps be hypothetical, but the belief that the animal carbonates in general derange the stomach less than other cretaceous medicines, and are on that account preferable for infants and delicate persons generally, cannot, it is believed, be successfully controverted.

The *dose* of prepared chalk or of prepared oyster-shell is from 5 to 60 grains (Gm. 0.30–4.00), according as its antacid or its astringent operation is chiefly sought.

CROCUS, *U. S.*, *Br.*, *P. G.*—SAFFRON.

Stigmata croci.—*Safran*, Fr., G.

The stigmas (and top of the style, *Br.*) of Crocus sativus, *Linné.* Bentley and Trimen, *Med. Plants*, 274.

Nat. Ord.—Iridaceæ.

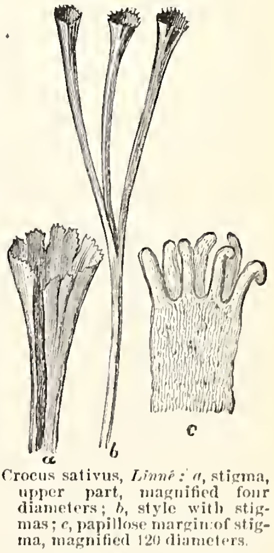
Origin.—The saffron-plant is indigenous to Oriental countries, probably from Greece and Asia Minor eastward to Persia; it has been cultivated from an early period, and grows spontaneously in some parts of Southern Europe. At the present time commerce is supplied with saffron chiefly from Spain (Alicante and Valencia) and France (Gatinais). It is also grown in Austria, and to a limited extent in some of the south-eastern counties of Pennsylvania. Asia Minor, Persia, Cashmere, and China are the principal countries which supply the Oriental regions with it. The plant has a depressed tuberous bulb or corm, which, in the latter part of summer or early in autumn, produces about nine grass-like, keeled, and dark-green leaves, and afterward a few pale-purplish, red-veined, six-lobed flowers with three stamens and a filiform style, which is whitish below, yellow above, and divided into three orange-red stigmas. In the year 1876–77, 17,006 pounds, and in the following year nearly 3000 pounds, of saffron were imported into the United States; the average for seven years is 7900 pounds.

Description.—Each stigma is 1 to 1¼ inches (25 to 31 Mm.) long, flattish-tubular, almost filiform below, gradually enlarged above, slit on the inner side, and with several roundish teeth on the edge. The three stigmas are usually united, and occasionally are collected with a considerable portion of the yellow style. Dried saffron is flexible and tough, of a brownish-red or orange-brown color, somewhat unctuous to the touch, of a peculiar aromatic odor and a bitter, aromatic, and warm taste. It retains about 12½ per cent. of moisture, and after this is expelled becomes friable and more readily pulverizable. When chewed it tinges the saliva deep orange-yellow.

Cake-saffron is now not met with in commerce. In its loose condition it is sometimes called *hay-saffron.* Several varieties are distinguished. *Spanish saffron* is usually collected with considerable portions of the styles, which are easily distinguished by their yellow color. *French* or *Gatinais saffron* is mostly of a better quality. The handsome saffron collected in Austria is rarely if ever seen in our markets. The excellent saffron collected in Eastern Pennsylvania is known there as *American saffron*—a term which in other parts of the United States is used to designate the florets of Carthamus tinctorius. Heinitsh (1866) calculated that 33 to 36 pounds of saffron may be raised to an acre, and found 300 stigmas to weigh 13 to 14 grains, which requires over 50,000 flowers to obtain a pound.

Constituents.—Saffron contains gum, albumen, wax, fat, about 1 per cent. of volatile oil, and coloring matter, called *polychroit*, or by some authors *crocin.* Weiss (1867) prepared polychroit, $C_{48}H_{60}O_{18}$, by exhausting saffron first with ether, afterward with water. The infusion is precipitated by strong alcohol, and the filtrate by ether. The precipitate contains a little sugar, is very deliquescent, and dries over sulphuric acid to a hard ruby-colored mass, which is inodorous, of a sweetish taste, readily soluble in water and dilute alcohol, slightly in absolute alcohol, and insoluble in ether and benzol. On being treated with dilute sulphuric acid in an atmosphere of hydrogen, polychroit is decomposed into a volatile oil having the composition of carvol, $C_{10}H_{14}O$, sugar, $C_6H_{12}O_6$, and *crocin*, $C_{16}H_{18}O_6$. The latter is a red powder insoluble in ether, scarcely soluble in water, and freely soluble in alcohol and diluted alkalies. Warm concentrated potassa evolves from it vapors of a pungent odor; concentrated sulphuric acid produces a deep-blue color, changing to violet and brown; nitric acid colors it green, then yellow and brown. The same colors are produced by sulphuric and nitric acids with polychroit. The volatile oil obtained by the decomposition of polychroit has the odor and general properties of the volatile oil obtained from saffron by distillation with water. Quadrat (1851) observed that polychroit (his crocin) yielded with concentrated solution of alkalies a neutral volatile oil which was lighter than water and had an odor distinct from saffron. Lagrange and Vogel (1811) obtained from saffron 7.5 (Aschoff (1818) 1.4 and Hagan 1.25) per cent. of

FIG. 86.



Crocus sativus, *Linné*: *a*, stigma, upper part, magnified four diameters; *b*, style with stigmas; *c*, papillose margin of stigma, magnified 120 diameters.

volatile oil; the first result must have been mostly the volatile oil formed from the polychroit. Saffron yields about 5 per cent. of ash.

Adulterations.—The occasional admixture in true saffron of considerable portions of the yellow style has been noticed above. The appearance of inferior saffron is sometimes improved by oil or by glycerin; it then leaves a greasy stain on being slightly pressed between paper. Partially exhausted (mixed with good) saffron is recognized by the lighter and more uniform color of the stigmas. The tubular florets of Carthamus are easily distinguished by their five-toothed corolla and the projecting anthers with style. The styles of crocus, suitably dyed, have appeared in commerce as *feminelle*, a name also given to the dyed ligulate florets of Calendula officinalis, *Linné;* the latter are strap-shaped, with a three-toothed margin, and are easily distinguished from true saffron after soaking in water, or in dilute ammonia should the coloring matter of the dye be insoluble in water. The cut petals of the pomegranate, and the stamens of crocus and perhaps other flowers, are by the same means easily recognized from their different shape. About 1860, and again since 1870, Spanish (Alicante) saffron has often appeared adulterated with chalk, gypsum, or heavy spar, the powders having been rendered glutinous by some honey and mixed with the saffron; they then become yellowish and of the appearance of pollen. Powdered emery is said to be used in the same manner. The amount of such adulteration is sometimes 20 per cent., and may be estimated by incineration. The adulteration is detected without difficulty by throwing a pinch upon water, when the mineral matter will subside, and may be identified by appropriate tests. "If 1 part of saffron be macerated in 10 parts of water, a yellow-red liquid is obtained free from sweet taste, and which, diluted with 10,000 parts of water, has a distinct yellow color. Saffron on being dried at 100° C. (212° F.) should lose less than 14 per cent. of moisture, and on being now incinerated should leave not over 8 per cent. of ash."—*P. G.* These two tests will probably answer for determining the genuineness of saffron. The first, based on its tinctorial power, requires that 22 fluidounces of water be colored yellow by 1 grain of saffron; a single grain of saffron rubbed to a fine powder with sugar will impart a distinct tint of yellow to 700,000 grains (10 galls., *Br.*, or 12 galls., *U. S.*) of water (*Pharmacographia*).

An article has sometimes (1872) been offered as *African saffron;* it is mostly safflower, but occasionally it consisted of the corolla of Lyperia crocea, *Ecklon*, a scrophulariaceous plant indigenous to Southern Africa.

Pharmaceutical Preparations.—SYRUPUS CROCI.—Syrup of saffron.—25 parts of saffron are exhausted with sufficient Malaga wine to obtain 440 parts of tincture in which 560 parts of sugar are dissolved.—*F. Cod.*

Saffron is used only for Tinctura croci, *U. S.*, but enters into the composition of the following: Decoct. aloes comp., Pil. aloes et myrrhæ, Pulv. cretæ arom., Tinct. cinchonæ comp., Tinct. croci, Tinct. opii ammon., Tinct. rhei, *Br.*

Allied Drugs.—GARDENIA GRANDIFLORA, *Loureiro*, G. FLORIDA, *Linné*, and G. RADICANS, *Thunberg.*—Nat. ord. Rubiaceæ.—These shrubs are indigenous to Eastern and Southern Asia, and produce obconical four- or six-sided somewhat winged berries, which attain a length of 1⅗ inches (4 Cm.) and contain numerous flat and finely-pitted seeds imbedded in a red pulp. The coloring matter of the latter, according to Rochleder and L. Mayer (1858), is identical with that of crocus. The fruits are regarded as possessing demulcent and refrigerant properties, and are largely used in the East for dyeing yellow.

Medical Action and Uses.—Saffron is generally regarded as a stimulant aromatic. Like other powerfully odorous vegetable substances, its emanations occasion headache, sleep, stupor, and even death. It also displays anodyne and anti-spasmodic properties. Its aromatic quality is exhibited in its general use as a condiment in tropical countries, where the heat enfeebles digestion and vegetable food is chiefly used. Like other agents of its class, it sometimes appears to stimulate the pelvic organs, as shown by its employment from remote periods as an emmenagogue and also as an aphrodisiac. During its use the urine is colored yellow.

As just indicated, it is most commonly employed to prevent or relieve flatulent *dyspepsia* and its accompanying *colic*, for by expelling the gaseous contents of the digestive canal it enables that organ to perform its functions more perfectly. It may be prescribed, like other aromatics, to allay the pain of *dysmenorrhœa.* Hot infusions of saffron are sometimes given to promote *exanthematous eruptions.* It has long been reported to be efficacious in spasmodic *coughs* and *asthma*, but its value in these affections is very slight. Yet the preparations of saffron may be conveniently employed as vehicles for more powerful drugs. Like the flowers of other plants containing a volatile oil, those of saffron have long entered into various compounds in popular use to relieve *rheumatic* and *neuralgic pains*, to remove the soreness and discoloration of *bruises*, and to promote the healing of *abrasions* and superficial *sores.* A collyrium of saffron has been employed in subacute and chronic inflammations of the *conjunctiva*, and saffron ointment has been reputed to be an excellent palliative of *hæmorrhoids.* A strong infusion of saffron applied to the gums is said to allay the pain of *dentition.*

Saffron has been omitted from most of the officinal preparations into which it formerly entered—a change justifiable, if at all, upon economical rather than upon medical grounds.

The *dose* of saffron is from 5 to 30 grains (Gm. 0.30–2.00), the former quantity sufficing as a gastric, the latter as a general, stimulant. But the dose should be repeated at short intervals. Only pure and well-preserved specimens can be depended upon. An infusion may be made with 2 drachms (Gm. 8) of saffron to a pint of boiling water, of which 4 ounces may be given at intervals of half an hour or an hour.

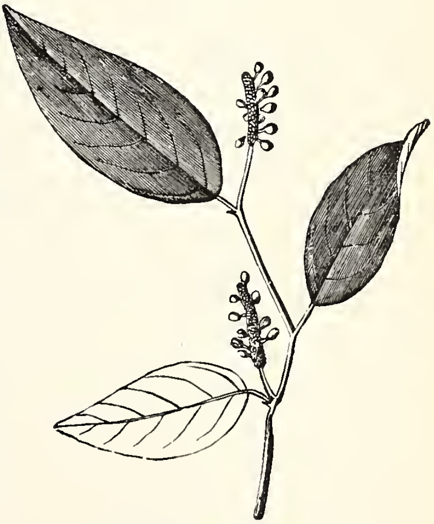
CUBEBA, *U. S., Br.*—Cubeb.

Cubebæ, P. G.; *Fructus* (*s. Baccæ*) *cubebæ*, *Piper caudatum.*—*Cubebs*, E.; *Cubèbe*, *Poivre à queue*, Fr.; *Kubeben*, G.

The unripe fruit of Cubeba officinalis, *Miquel*, s. Piper Cubeba, *Linné filius.* Steph. and Church, *Med. Bot.*, plate 175; Bentley and Trimen, *Med. Plants*, 243.

Nat. Ord. Piperaceæ.

Fig. 87.



Cubeba officinalis, *Miquel.*

Origin.—The cubeb-plant, which is indigenous to Java and some of the adjacent islands, is a climbing diœcious shrub about 20 feet (6 M.) high, with ovate or ovate-lanceolate, leathery, and shining leaves upon short petioles about as long as the peduncles of the spikes. The pistillate spikes are about $1\frac{3}{5}$ inches (4 Cm.) long, cylindrical, with the fruit at first sessile, afterward stalked. The plant is cultivated chiefly in coffee-plantations, and the fruit collected before it is ripe. The importation of cubebs into the United States amounted in 1878 to 7045 pounds, reached 277,422 pounds in 1879, and averaged in 1882, for seven years, 167,290 pounds.

Description.—Cubebs are of the size and general appearance of black pepper, about $\frac{1}{6}$ or $\frac{1}{5}$ inch (4 or 5 Mm.) in diameter, at the base contracted into a kind of stalk $\frac{1}{3}$ or $\frac{2}{5}$ inch (8 or 10 Mm.) long, very slightly pointed at the apex from the remnants of the stigmas, of a brown-gray to blackish-gray color, and a reticulately wrinkled surface. The integuments of the fruit consist of a thin, dried, fleshy layer and a smooth lighter-colored shell, surrounding a globular cavity with an undeveloped whitish seed at the base. The epicarp and endocarp consist of stone-cells, those of the former being cubical in one interrupted row, those of the latter radially elongated and in two or three rows. The mesocarp is formed of thin-walled parenchyma and larger oil-cells, both containing crystals of cubebin, the former also starch-granules in the outer layer. The fruit has a strong spicy odor and a pungent aromatic and bitterish taste, is frequently mixed with, and should be freed from, the nearly inodorous rachis or common axis, which is from 1 to $1\frac{3}{5}$ inches (25 to 40 Mm.) long and has a pitted surface.

Constituents.—Cubebs contain from 5 to 15 per cent. of volatile oil (see Oleum Cubebæ), fixed oil, waxy matter, resin, cubebin, gum, malates, etc. The medicinally most important constituents are the *indifferent resin* and *cubebic acid;* they were isolated by Bernatzik (1863), and further examined by E. A. Schmidt (1870, 1873). *Cubeb resin* is slightly soluble in ether, carbon bisulphide, or chloroform, but dissolves freely in caustic alkalies and alcohol; it is not precipitated from the spirituous solution by acetate of lead. *Cubebic acid*, $C_{14}H_{16}O_4$, is an amorphous yellowish mass, soluble in ether, chloroform, carbon bisulphide, benzol, and petroleum benzin, and is precipitated from its alcoholic solution by lead acetate; its sodium salt crystallizes from hot alkaline liquids and from alcohol. Both resinous compounds are colored red by sulphuric acid. The indifferent resin has been obtained in quantities of 2.5 to 3.5 per cent., and the cubebic acid in amounts of 0.96 to 3.4 per cent.

Cubebin, $C_{10}H_{10}H_3$, according to Weidel (1877), was first obtained pure by Soubeiran and Capitaine (1839), and forms the principal portion of the deposit in the ethereal extract. It crystallizes in tasteless and inodorous white needles or pearly scales, which melt at 128° C. (257° F.), are colored red by sulphuric acid, and dissolve in 26.6 parts of ether, readily in benzol and in chloroform, and in 30 parts of cold and in 10 parts of boiling alcohol; the alcoholic solution has a bitter taste. By melted potassa cubebin yields carbonic, acetic, and protocatechuic acids. Medicinally, it appears to be inactive; its percentage varies between 0.4 and 2.5.

Potassium chloride has been found among the saline constituents of cubebs.

Impurities and Substitutions.—The presence of cubeb-stems (the rachis) has been alluded to before. Black pepper and other piperaceous fruits occur sometimes as accidental, rarely if ever as intentional, impurities. The fruit of Rhamnus catharticus has only a very superficial resemblance, and is at once distinguished by the true pedicel and its four seeds. Allspice is much larger, has no pedicel, contains two seeds, and is crowned with the calyx limb.

The following two species are mentioned in *Pharmacographia* as yielding fruits extremely cubeb-like: Cubeba Lowong, *Miquel* (Piper Lowong, *Blume*), and Cub. Wallichii, *Miquel* (Pip. ribesioides, *Wallich*). The fruit of Cub. canina, *Miquel* (Pip. caninum, *Dietrich*), is smaller than cubeb, and contracted below into a stalk of only half the length of the globular portion. In 1863 a fruit was sold as cubeb which by Grœnewegen was referred to Piper anisatum, *Humboldt et Bonpland;* it is probably the same which Flückiger and Hanbury refer to Cubeba crassipes, *Miquel* (Pip. crassipes, *Korthals*). The fruit of Cub. Clusii, *Miquel*, of Western Africa, resembles cubeb, but, according to Stenhouse (1855), it contains piperine instead of cubebin.

Off. Prep.—Cubebs are used for the distillation of Oleum cubebæ, and for the preparation of Extract. cubebæ fluid., Oleoresina cubebæ, *U. S.*, and Tinctura cubebæ, *U. S.*, *Br.*

Physiological Action.—Cubeb is a local irritant. Taken into the stomach, it stimulates the whole intestinal tract, after the manner of black pepper, thereby exciting more or less irritation of the rectum and other pelvic organs. At the same time, its active principle is absorbed, causing flushing of the face and diffused warmth, and increasing the urinary secretion as well as giving it a peculiar odor. It does not derange the digestion like copaiva. Its direct and indirect operation upon the genito-urinary apparatus may be attended with painful irritation of those parts if the medicine is given when they are actively inflamed. Excessive doses may occasion vomiting, gastro-intestinal irritation, and a general feverish condition. Cubeb sometimes produces an erythematous eruption on the skin.

Medical Uses.—The chief medicinal application of cubeb is to relieve inflammation of the urinary passages. It has long been used for the cure of *gonorrhœa*, but at present, like copaiva, it is in a great degree superseded by the local treatment of that affection. In efficacy it is inferior to copaiva, but it is more readily tolerated by the digestive organs. The cases of gonorrhœa to which it is most appropriate are those in which the attack is recent and the inflammation moderate, but more inflammatory conditions, accompanied by chordee, scalding urine, and even swelled testicle, do not contraindicate the medicine, although they call for caution in its use—that is to say, for the administration of small rather than large doses. The former may be represented by about 15 grains (Gm. 1) three times a day; the latter, which usually should be reached by gradual increase, may be stated to be ½ drachm (Gm. 2) or more. Few persons can long tolerate so large a dose, which is apt to cause vomiting and diarrhœa, besides inspiring invincible disgust. It should not be continued longer than a week or ten days, unless the gonorrhœal discharge declines, in which case the dose should be gradually reduced. It is asserted that the efficient element of cubeb in the cure of gonorrhea is cubebic acid, which appears capable of curing the acute affection when given in doses of 2 or 3 grains (Gm. 0.10–0.15) every 2 or 3 hours; but, on the whole, it seems to be less successful than cubeb itself.

Irritability of the urethra in females, with accompanying vesical tenesmus and scalding of the urine—a condition often associated with catamenial congestion—is apt to be mitigated by cubeb in doses of from 20 to 30 grains two or three times a day. *Vesical irritability* and *tenesmus* produced by cold or by cantharidal irritation, and nocturnal *inconti-*

nence of urine, may often be cured in the same manner. Chronic *cystitis* and *vaginal discharges* are favorably influenced by cubeb, and, like copaiva, but less surely, this medicine may be of use in *chronic bronchitis*. Its local stimulant action seems to have been advantageous in certain cases of *pseudo-membranous angina*, when cubeb was given finely powdered in the dose of 2 or 3 drachms (Gm. 8–12), mixed with syrup. It was also administered with powdered sugar, which itself was probably not without influence on the result. But, while stimulating the fauces and the system generally, it also prevented the meddlesome medication which has not a little to answer for in this disease. Cubeb has been thought to be efficacious in certain nervous disorders, comprising *headache*, *vertigo*, *fainting*, *impaired memory*, and even *paralysis;* doubtless, such symptoms, depending upon exhaustion of the nervous centres, may be ameliorated by whatever stimulates them primarily, while it secondarily improves the digestion, and therefore the composition of the blood.

Cubeb is administered in *doses* of 10 grains (Gm. 0.60) and upward, either mixed with water or with powdered sugar or enclosed in wafers. In the last case it should be followed by a mouthful of water.

CUCUMIS.—Cucumber.

Concombre, Fr.; *Gurke*, G.

The fruit and seed of Cucumis sativus, *Linné*.

Nat. Ord.—Cucurbitaceæ.

Origin.—The cucumber is indigenous to Southern and Central Asia, but is now extensively cultivated in most civilized countries. It has a roundish hispid stem, climbing by simple tendrils, alternate, heart-shaped, and somewhat five-lobed rough leaves, and unisexual yellow flowers.

Description.—The fruit is at first rough and somewhat verrucose, but becomes smooth on ripening. It is cylindrical-oblong, somewhat triangular, obtuse at both ends, sometimes curved, and varies considerably in size and color. It has a slight but quite characteristic odor and a slightly saline and rather harsh taste.

The seeds are about ⅓ inch (8 Mm.) long, oblong-ovate, flat, rather acute on the edge, and with a short point above. They are white, inodorous, and of an oily taste. The embryo is of the shape of the seed, and consists of two plano-convex white cotyledons, with a short radicle in the pointed end. The seeds contain about 30 per cent. of a bland light-yellow fixed oil.

Pharmaceutical Uses.—Prof. Procter (1853) gave a formula for *cucumber ointment*, which is prepared by grating 7 pounds of green cucumbers, expressing the juice, and incorporating it, about one-third at a time, with 15 ounces of suet and 24 ounces of lard, the fats having been previously fused together and allowed to cool until the mixture commences to thicken. After all the juice has been in contact with the fat, the latter is melted, strained, and preserved in glass jars covered with a layer of rose-water; the jars should be well closed. When intended for use a portion of the ointment is triturated with a little rose-water until it becomes white and creamy.

Allied Plants.—The following plants are indigenous to Southern Asia, and at present cultivated in many warm countries:

Cucumis Melo, *Linné*.—Muskmelon.—The seeds resemble cucumber-seeds, but are somewhat larger and rather more blunt on the edge; they contain an inodorous yellowish fixed oil.

Cucumis (Cucurbita, *Linné*) Citrullus, *Séringe*, s. Citrullus vulgaris, *Schrader*.—Watermelon.—The seeds are about ½ inch (12 Mm.) long, blackish or brown and marbled, broadly ovate, flat, blunt on the edge, near the pointed end with two thin converging ridges. They yield by pressure about 30 per cent. of a thin light yellow bland oil.

Lagenaria vulgaris, *Séringe*, s. Cucurbita Lagenaria, *Linné*.—Gourd.—The seeds are ¾ inch (18 Mm.) long, oblong, obtuse at both ends, thickened and with two furrows near the margin, the surface yellowish-white and soft felt-like.

Momordica balsamina, *Linné*.—Balsam-apple.—The fruit is ovate in shape, narrowed at both ends, somewhat angular, warty, bright-red or orange-colored, and separating laterally. It contains numerous flat, oval, and wrinkled brownish seeds, which are surrounded with a fleshy red arillus.

Medical Action and Uses.—The ointment prepared with cucumber-juice is supposed to be peculiarly mild, emollient, and healing when freshly made and applied to *abrasions* and other analogous lesions.

The juice of the watermelon increases somewhat the secretion of urine—an effect which is perhaps due to the sugar it contains. An infusion of the whole seeds is decidedly diuretic, and that of the bruised seeds is also demulcent. No better drink than the latter infusion can be used in all cases of irritation of the *kidneys* or *bladder*, and especially in those of *retention of urine* produced by cold.

The root as well as the fruit of *balsam-apple* is an active purgative. 2 drachms of the latter given to a dog are said to have killed it within 16 hours. In the Philippine Islands a decoction of it is employed as an emetic. An infusion of the seeds in olive or almond oil has been used as a vulnerary and also to relieve hæmoptysis (Strumpf, *Handbuch*, ii. 214).

CUMINUM.—CUMIN.

Fructus cumini s. cymini.—Cumin, Fr.; *Kreuzkümmel, Mutterkümmel, Römischer (langer, scharfer) Kümmel*, G.

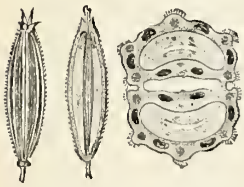
The fruit of Cuminum Cyminum, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The cumin-plant is indigenous to Egypt and other parts of Africa, and is cultivated in various parts of Asia and Europe, in the latter continent chiefly in Southern Italy and the neighboring islands. It is an annual about 1 foot (30 Cm.) high; the leaves are divided into narrow linear segments; the umbels are small, and the umbellets have about five white or purplish flowers. 20,874 pounds of cumin-fruit were imported into the United States in the year 1866–67.

Description.—The fruit is about ¼ inch (6 Mm.) long, oblong, narrowed at both ends, slightly compressed laterally, and of a yellowish-brown color. The two mericarps are usually united; each has five light-colored filiform ribs, which are beset with soft short hairs and are separated by broad brown furrows, each containing a pale-brown rather broad, rough, hairy, secondary rib and covering one oil-tube. Two oil-tubes (vittæ) are contained on the face or six in each mericarp. The strong aromatic odor and taste somewhat resemble those of caraway. Cumin is very prone to the attacks of insects, which eat the entire seed, leaving only the fruit-shell.

FIG. 88.



Cumin: fruit and longitudinal section, 3 diameters; transverse section, 8 diameters.

Constituents.—Examined by Bley (1829), cumin was found to contain 7.7 per cent. of fat, 13.5 of resin, 15.5 of protein compounds, 8 of gum, and only 0.24 of volatile oil, the remainder being extractive, salts (mainly malates), cellulose, and 9 per cent. of moisture. Raybaud obtained nearly 3 per cent. of volatile oil. The latter consists of several hydrocarbons—one having the composition $C_{10}H_{16}$, another being *cymol* or *cymene*, $C_{10}H_{14}$, which at 15° C. (59° F.) has the specific gravity 0.860, boils at 175° C. (347° F.), and has a lemon-like odor (Gerhardt and Cahours)—and of an oxygenated body, *cuminol* or *cumin-aldehyd*, $C_{10}H_{12}O$, which has the density 0.972, boils at about 230° C. (446° F.), has a caraway-like odor, and yields with nitric acid crystallizable *cuminic acid*, $C_{10}H_{12}O_2$. Volatile oils identical with *oil of cumin* have been obtained by Trapp (1858) from the fruit of Cicuta virosa, *Linné*, and by Haines (1856) from the fruit of Ptychotis (Carum, *Bentley*) Ajowan, *De Candolle*; the latter, however, was shown by Stenhouse to contain thymol.

The *ajowan* (Bentley and Trimen, *Med. Plants*, 120) is largely cultivated in Oriental countries; the fruit is about $\frac{1}{16}$ inch (1.5 Mm.) long, ovate, laterally flattened, rough, gray-brown, has broad ribs, and in each mericarp six oil-tubes.

Medical Action and Uses.—Cumin is mildly stimulant and carminative, in the same manner as anise and caraway, and may be used for the same purposes. It has been regarded as a galactagogue, but Dolan failed to detect any such action in it (*Practitioner*, xxvii. 164). It is, however, very seldom employed. The *dose* may be stated at from 15 to 30 grains (Gm. 1–2).

CUPRI ACETAS, *U. S.*—ACETATE OF COPPER.

Cuprum aceticum, Acetas cupricus, Ærugo crystallisata s. destillata, Flores virides aëris.—Copper verditer, Crystallized verdigris, E.; *Acétate de cuivre, Verdet crystallisé, Crystaux de Vénus*, Fr.; *Kupferacetat, Gereinigter (krystallisirter, destillirter) Grünspan*, G.

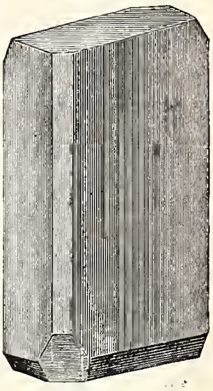
Formula $Cu(C_2H_3O_2)_2.H_2O$. Molecular weight 199.2.

Origin.—Verdigris was already known to Theophrastus about 300 B. C., when it was prepared from copper and various refuse products obtained in making wine. Crystallized copper acetate was probably first prepared by the Arabian chemists in the eighth century by dissolving verdigris in vinegar. At present it is manufactured in the same manner, or from copper sulphate and lead or calcium acetate. The average annual importation of this salt into the United States was 592 pounds up to 1881.

Preparation.—Verdigris is dissolved in about 4 parts of warm wood vinegar; the clear decanted liquid is concentrated by evaporation in copper vessels and allowed to crystallize in wooden tanks; or, solutions of 2 parts of copper sulphate and 3 parts of lead acetate are mixed, the liquid decanted from the insoluble lead sulphate, acidulated with a little acetic acid, and evaporated to crystallize.

Properties.—This salt is met with in deep blue-green rhombic prisms, which are nearly opaque or somewhat translucent, glossy, superficially efflorescent on exposure to the atmosphere, and have the spec. grav. 1.914, an acetous odor, and a disagreeable metallic taste. The effloresced surface is dull and of a light bluish-green color, the powdered crystals of a bright blue-green, resembling verdigris. When kept over sulphuric acid the crystals turn white from the loss of water, but become blue-green again in the air. On the application of heat water is given off, and at 110° C. (230° F.) also traces of acetic acid, the loss in weight up to 140° C. (284° F.) amounting to about 10 per cent.; the water of crystallization is 9.04 per cent. The residue left is of a blue-green color, soluble in water, and on being heated to between 240° and 260° C. (464° and 500° F.) yields about 36 per cent. of glacial acetic acid, and above 270° C. (518° F.) acetone, carbonic acid gas, and other products of decomposition, while chiefly metallic copper is left behind. The salt dissolves at 15° C. (59° F.) in 13.4 parts (15 parts, *U. S.*) of water and in 135 parts of alcohol, and at the boiling temperature in 5 parts of water and in 14 parts of alcohol. The aqueous solution is blue-green, gives off acetic acid on boiling, depositing at the same time a basic salt, and changes to a deep-blue color with excess of ammonia or ammonium carbonate. Sulphuric and other strong acids decompose the salt, liberating acetic acid.

FIG. 89.



Crystal of Copper Acetate.

Tests.—The salt should be completely soluble in excess of solution of ammonium carbonate (absence of lead, calcium, etc.). If dissolved in diluted nitric acid, no precipitate should be produced with silver nitrate or barium nitrate (absence of chloride and sulphate). "If the aqueous solution of the salt be treated with hydrosulphuric acid until all the copper is precipitated, the filtrate should leave no residue on evaporation (alkalies, alkaline earths, and iron). If the aqueous solution be heated to boiling with solution of soda in excess, it yields a filtrate which should not be clouded by hydrosulphuric acid (absence of lead, zinc)."—*U. S.*

Pharmaceutical Preparation.—TINCTURA CUPRI ACETICI RADEMACHERI. Dissolve 1 part of acetate of copper in 10 parts of warm water, and add 8 parts of alcohol.

Allied Salt.—CUPRI SUBACETAS, *U. S.* (1870); Ærugo, Viride aëris, Subacetas cupricus.—Verdigris, Subacetate of copper, *E.;* Acétate basique de cuivre, Vert-de-gris, Verdet gris, *Fr.;* Grünspan, Spangrün, Basischessigsaures Kupfer (Kupferoxyd), *G.*—Formula of pure verdigris $(Cu_2O)2C_2H_3O_2$. Molecular weight 261.—In the wine districts of Southern Europe, and particularly in the neighborhood of Montpellier, verdigris is prepared by the aid of the marc of the wine-press. These grape-husks are allowed to undergo the acetic fermentation, and are then stratified in earthen vessels with sheets of copper, which, if new, have been previously superficially corroded by a solution of acetate of copper. After having been thus kept at a temperature of 8° or 10° C. (46° or 50° F.) for 3 or 4 weeks, the plates are removed, placed upright to dry, and for the following 6 or 8 weeks are occasionally dipped into water and exposed, until the neutral acetate at first formed has been converted into a thick layer of verdigris, which is scraped off. The sheets are then replaced in the grape-husks, and the process repeated until the copper has been completely corroded. The scrapings are formed with water into cakes of convenient size and dried. Verdigris of inferior quality is said to be made in the cider districts of England in a similar manner from pommage or apple-marc, and in some places it is obtained by exposing the copper to the vapors of vinegar or pyroligneous acid or by treating impure cupric oxide with the latter. The annual importation of verdigris into the United States during seven years averages about 203,902 pounds; in 1880 it reached 305,792 pounds. Verdigris is met with in commerce in heavy and hard bluish-green masses containing a considerable number of small crystals and breaking with an earthy somewhat crystalline fracture. It varies in composition, but always consists mainly of hydrated oxyacetate of copper, and contains between 45 and 50 per cent. of cupric oxide. It is decomposed by, and but partially soluble in, water, insoluble in alcohol, but completely soluble, the impurities excepted, in ammonia and dilute sulphuric, acetic, and hydrochloric acids. Acids should produce but little effervescence, showing the absence of carbonate. The presence of chalk as an impurity is determined by the copious effervescence when dissolving a sample in warm acetic acid, and by the precipitate occurring in the solution on the addition of ammonium oxalate.

Cupri nitras, *Br.*, $Cu(NO_3)_2.3H_2O$, a deep-blue deliquescent salt, is made by dissolving copper in diluted nitric acid.

Medical Uses.—Acetate of copper has been used in collyria and in lotions for various local inflammations, including *gonorrhœa*, in solutions of $\frac{1}{4}$ to 1 per cent., and internally, in pill or potion in doses of $\frac{1}{5}$ to 1 grain, in several chronic *skin diseases*, *intermittent fever*, and *epilepsy;* but in the latter affection it is now quite obsolete, and in the former is superseded by the sulphate. Acetate of copper has been employed, like acetate of zinc, in collyria and for stimulating aphthous ulcers of the mouth.

Subacetate of copper is very rarely used internally, and seldom as a local application. Its stimulant or escharotic action, according to the strength of the solution employed, is sometimes taken advantage of in the treatment of indolent *ulcers* and chronic tuberculated affections of the *skin*, and to remove condylomata and *warts*, especially the soft warts due to *syphilis*. These excrescences, and also condylomata, may be destroyed by a mixture of equal parts of verdigris and powdered savine.

CUPRI SULPHAS, *U. S., Br.*—Sulphate of Copper.

Cuprum sulfuricum, P. G.; *Sulfas cupricus*, *Cuprum vitriolatum.*—*Blue vitriol*, *Bluestone*, E.; *Vitriol bleu*, *Sulfate de cuivre*, Fr.; *Kupfervitriol*, *Blauer Vitriol*, *Schwefelsaures Kupfer* (*Kupferoxyd*), G.

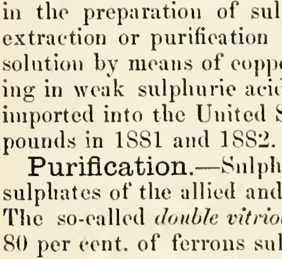
Formula $CuSO_4.5H_2O$. Molecular weight 249.2.

Preparation.—Blue vitriol is obtained on a large scale from the native (*copper pyrites*) or artificially-prepared sulphide by converting it through oxidation into the sulphate; for this purpose the sulphide is obtained by heating sheet copper to redness and throwing sulphur upon it. The water accumulating in copper-mines contains the sulphate in solution, formed by the oxidation of the native sulphide. The iron contained in this is removed either by digesting with oxide or carbonate of copper or by evaporating to dryness and heating until the iron salt is decomposed. The same salt is also formed in the preparation of sulphurous acid from copper and hot oil of vitriol, and in the extraction or purification of silver by precipitating this metal from its sulphuric acid solution by means of copper; also by dissolving the black scales obtained in coppersmithing in weak sulphuric acid (chamber acid). 190,657 pounds of sulphate of copper were imported into the United States in 1876–77; this amount has gradually decreased to 20 pounds in 1881 and 1882.

Purification.—Sulphate of copper cannot by recrystallization be separated from the sulphates of the allied and of the alkaline metals, owing to the formation of double salts. The so-called *double vitriol* (vitriol de Salzbourg, *Fr.;* Doppelvitriol, *G.*) contains 70 to 80 per cent. of ferrous sulphate, and the *vitriol mixte de Chypre* contains zinc sulphate; these were formerly, but now are rarely, employed in the arts. If iron alone is present, it may be conveniently removed by oxidizing with nitric acid and digesting the solution with barium carbonate; ferric hydrate and barium sulphate will be precipitated with the excess of the carbonate, and the filtrate will yield pure crystals. If contaminated with other metals its purification will be difficult, and it is more convenient to prepare the salt directly by heating 3 parts of copper with 10 parts of sulphuric acid, or with 5 parts of sulphuric acid, 50 of water, and 4 or 5 of nitric acid.

Properties.—Sulphate of copper crystallizes in transparent azure-blue oblique triclinic short prisms, which are without odor, and have a disagreeable styptic metallic taste, the specific gravity 2.274, and an acid reaction. On trituration they yield a whitish-blue powder; on exposure to a dry atmosphere they effloresce superficially, gradually part with $4H_2O$, or 28.86 per cent. of water, at a temperature of 100° C. (212° F.), and when heated to between 220° and 240° C. (428° and 464° F.) lose all their water of crystallization, amounting to 36.07 per cent., leaving a whitish, friable mass of the anhydrous salt, which in a damp atmosphere again combines with water and becomes blue and crystalline, but at a strong red heat is decomposed into oxygen, sulphurous and sulphuric anhydrides, and black cupric oxide. The salt is insoluble in alcohol, but dissolves in 400 parts of diluted alcohol sp. grav. .940. 1 part of the crystallized salt dissolves

Fig. 90.



Crystal of Copper Sulphate.

At 10°	20°	30°	40°	60°	80°	100°	104° C.
in 2.71	2.36	2.07	1.76	1.29	.85	.55	.47 parts water.

The solution has a pale-blue color, which is changed to green on the addition of a soluble chloride, and yields a white precipitate with barium chloride and a blue one with ammonia-water, soluble in excess of the latter. Commercial blue vitriol (Cuprum sulfuricum crudum, *P. G.*) is sometimes quite impure, but there is no difficulty in finding in our market very good and pure sulphate of copper.

Tests.—For detecting a small quantity of ferrous salt, this should be oxidized by chlorine; if now ammonia-water be added in excess, all the iron will precipitate as ferric hydrate, while the copper will form a deep-blue solution. The presence of zinc and earthy or alkaline sulphates is most conveniently detected by precipitating the solution completely with hydrosulphuric acid gas and evaporating the filtrate to dryness, when, in case a residue should have been left, its nature may be ascertained by the appropriate tests.

Pharmaceutical Preparations.—CUPRUM ALUMINATUM, *s. Lapis divinus*, is the name of an old preparation used in eye-waters which is still recognized in Europe. It is prepared by powdering 16 parts each of pure cupric sulphate, potassium nitrate, and alum, fusing the mixture in a porcelain capsule at a moderate heat, adding a previously-prepared mixture of finely-powdered camphor and alum each 1 part, stirring well, and immediately pouring upon a porcelain slab or plate to cool and harden, when it is broken into pieces and preserved in well-stopped bottles. The *pierre divine* or *pierre ophthalmique* of the French Codex contains a trifle less of camphor. In dispensing the *aluminated copper* it should be well triturated in a mortar with a few drops of water before the remaining ingredients are added, to facilitate the solution of the camphor. A collyrium, *Collyre de pierre divine* (*F. Cod.*), is made by dissolving 4 parts of aluminated copper in 1000 parts of water, and filtering.

Off. Prep.—Cuprum ammoniatum, *U. S.*

Allied Compounds.—CUPRUM AMMONIATUM, Cuprum sulfuricum ammoniatum.—Ammoniated copper, Ammonio-sulphate of copper, *E.;* Sulfate de cuivre ammoniacal, Cuivre ammoniacal, *Fr.;* Schwefelsaures Kupferoxyd-Ammoniak (Kupfer-Ammonium, Cuprammonium), *G.*—Formula of crystals $Cu(NH_3)_4SO_4.H_2O$; molecular weight 245.2.—Rub together in a glass mortar copper sulphate 4 parts and ammonium carbonate 3 parts until effervescence ceases; wrap the product in bibulous paper, dry it with a gentle heat, and keep it in a well-stopped bottle.—*U. S.* 1870. This preparation contains an excess of ammonium carbonate. It is obtained pure and in crystals by dissolving copper sulphate 1 part in ammonia-water 3 parts, filtering, and pouring upon the solution 6 parts of alcohol; in proportion as the latter abstracts the water from the solution prismatic crystals will be deposited. The salt will be at once separated as a crystalline powder on mixing the alcohol with the aqueous solution. Ammonio-sulphate of copper has a deep azure-blue color and an ammoniacal odor; exposed to the air, it loses ammonia and gradually changes to light-blue. It dissolves in 1½ parts of cold water; the solution has an alkaline reaction and metallic taste, and on the addition of more water becomes turbid and produces a sediment. With a solution of arsenious acid a green precipitate (Scheele's green) is produced. When the salt is heated to 150° C. (302° F.) ammonia and water are given off, and an apple-green powder remains having the composition $Cu(NH_3)_2SO_4$, being a cupro-diammonium sulphate, while the medicinal salt is a cupro-tetrammonium sulphate; this contains 27.10 per cent. of ammonia and 32.38 oxide of copper. Berzelius obtained 26.40 and 34.0 per cent.

CUPRI OXIDUM, Cuprum oxydatum, *P. G.*—Oxide of copper, *E.;* Oxyde de cuivre, Safran de Vênus, *Fr.;* Kupferoxyd, *G.*—CuO; mol. weight 79.2.—Dissolve copper sulphate 10 parts and sodium carbonate 15 parts each in hot water 50 parts; mix the solutions, and continue the heat until the voluminous precipitate becomes dense; collect this, wash it well, and expose it to a moderate red heat.—*P. G.* It is a soft, black, amorphous, heavy powder, which dissolves in dilute nitric acid without effervescence (absence of carbonate); this blue solution may be tested for iron and other metals by ammonia and hydrosulphuric acid in the same manner as copper sulphate. If to 1 Gm. of copper oxide be added 1 Ccm. of solution of ferrous sulphate, and afterward, without mixing, 1 Ccm. of strong sulphuric acid, a brown color should not be produced between the liquids (absence of nitrate). By precipitating a solution of copper sulphate with an excess of potassa or soda, and boiling, a brownish-black powder is obtained having the composition $3CuO.H_2O$ (molecular weight 255.6); by red heat it is converted into anhydrous oxide, CuO.

Physiological Action.—Given to animals, sulphate of copper excites violent vomiting, and, if this is prevented by tying the œsophagus, insensibility, convulsions, and paralysis ensue. 60 grains of the salt thoroughly dissolved in water and injected under the skin of a dog destroy the animal in 24 hours, death following contraction of the pupils, paralysis of the hind legs, and a rapid pulse and respiration. The lungs, liver, and kidneys are gorged with dark blood, and the gastric mucous membrane is inflamed. This change in the blood, which becomes dark as well as thick and sticky, is considered by Laborde to be a primary effect of the poison. These results, however, are not confirmed by more recent experimenters. Levi and Barduzzi gave a horse 15 grains of sulphate of copper daily for 30 days without injury, and, indeed, with manifest improvement of the animal's health, and when it was sacrificed no traces of a toxical operation could be found. Similar results were obtained by subjecting an ass to the same treatment. Galippe, following previous observers, found that dogs may be fed for a considerable period on food contaminated with copper without harm. The sulphate (and also the acetate, lactate, and citrate) of copper only caused vomiting, while small doses, gradually increased, were productive of no inconvenience.

Taken in small doses by man, sulphate of copper may be regarded as astringent and tonic. It does not act on healthy tissue as a caustic. In emetic doses its action is prompt and rapid, and it leaves no nausea or depression behind it. Even in very large (and in what may be called poisonous) doses it is rarely fatal to life, and recovery is usually rapid and complete, although in some cases derangement of the digestive function, with diarrhœa, may for a time continue. The symptoms of acute poisoning by this substance are headache, convulsions, colic, vomiting, collapse, suppression of urine, and sometimes jaundice. In the rare cases of death following directly upon poisoning by sulphate of copper congestion of the gastro-intestinal mucous membrane was the only discoverable lesion; in some instances of death occurring at a later period ulceration, and even sloughing and perforation, of the bowel have been found. In 1882, Dr. M. A. Starr reported the case of a woman who was fatally poisoned by an ounce of sulphate of copper (*Med. Record*, xxi. 564). She experienced burning pain and cramps in the abdomen, faintness, cramps in the legs, vomiting, and diarrhœa. On the third day she had headache, abdominal pain, micturition, and copious, inky urine containing albumen and hæmoglobin, but no red corpuscles; on the fourth day she grew yellow, and on the fifth fell into a comatose state, in which she died. The tissues were everywhere grayish-yellow and the blood was firmly clotted in the veins. There was no serious lesion of the stomach, but there was extensive ulceration of the lower end of the ileum, not confined to the glands. The liver was soft and somewhat fatty. The kidneys showed obstruction of the tubules with granular matter, and minute erosions of the membrane lining their pelves. Three cases of criminal poisoning by sulphate of copper, all of which terminated fatally, are cited by Rey (*Thèse*, Paris, 1879).

Medical Uses.—The emetic operation of sulphate of copper is peculiarly appropriate to the treatment of pseudo-membranous *croup*, on account of its sustained mechanical and expulsive action, unaccompanied by nausea or other cause of depression. It has no specific operation whatever upon the seat of the plastic exudation, and therefore it can only be useful when the membrane has become spontaneously loose or been loosened by other agents—such, for instance, as mercury, inhaled lime-water or lactic acid, and possibly in some cases by depletion. In *malignant sore throat* a solution of 2 grains to the ounce has been given in tablespoonful doses every 10 or 15 minutes with alleged success. It is probable that the local application by means of a sponge of this or of a stronger solution would be, at the least, as efficient. There is some reason to think that *quartan agues* have been cured by sulphate of copper in doses of $\frac{1}{4}$ grain three times a day. It has been alleged that sulphate of copper is a more certain remedy than mercury for constitutional *syphilis*, but this claim of Martin and Oberlin does not appear to have been confirmed. Solutions of the salt form efficient injections for *gleet* and *leucorrhœa*. They should have a strength of 1 or 2 grains to the ounce. In leucorrhœa they may be applied on tampons. *Dysentery* and *diarrhœa* in their chronic forms, but especially the former disease, are often materially benefited by enemas of a pint of tepid water holding in solution from 10 to 20 grains of sulphate of copper. All forms of *ulcers* are very advantageously modified by it, as ulcers of the cornea, nostrils, mouth, vagina, and general surface, especially when they present an indolent aspect or arise in vitiated states of the system; for example, in ulcerative *stomatitis*, gangrene of the *pharynx*, *mercurial sore mouth*, etc. In *conjunctivitis*, especially of the chronic, and most of all of the granular, form, this salt is of great service. When the granulations are large a crystal of sulphate of copper should be used. The same agent will sometimes suffice to arrest *hæmorrhage* from bleeding surfaces; for this purpose also it is sometimes used in the form of a powder, which may be mixed with an equal quantity of powdered gum-arabic. The stimulant and astringent action of the salt has been applied to the cure of various local affections of the skin, such as *acne rosacea*, *ichthyosis*, *alopecia*, etc. In 1866, Bamberger proposed sulphate of copper as an antidote to *acute poisoning by phosphorus*, upon the ground that the phosphorus reduces the metal, which coats the remaining phosphorus and renders it innocuous. He recommended that sulphate of copper should be given first in an emetic dose, and then continued in smaller quantities. A critic of this method (1872) remarked that it was certainly very ingenious, but that there was no proof of its efficiency; and Eulenberg and Landois, who used carbonate of copper for the same purpose in experiments upon animals, found that the alleged antidote delayed their death, but did not prevent it.

Sulphate of copper is the basis of the most usual and convenient tests for *diabetic* sugar. They all essentially consist of oxide of copper, held in solution by an alkali through the medium of organic matter which, unlike sugar, has not the property of deoxidizing copper salts during ebullition (Pavy). The most usual form of the solution is as follows: Sulphate of copper 320 gr.; neutral tartrate of potash 640 gr.; caustic potash or soda 1280 gr.; distilled water 20 f℥. Dissolve the sulphate of copper in 10 ounces of the water, and the tartrate of potash and the caustic potash or soda in the remainder. If on being boiled any deposit occurs a little excess of potash or soda must be added. When this solution is heated in a test-tube and a drop or two of diabetic urine is added, a more or less copious deposit of suboxide of copper forms as a yellow, orange-yellow, orange-red, or brownish-red precipitate. It is said that 1 grain of sulphate of copper dissolved in an ounce of glycerin forms a solution of which 1 drachm will reduce 1 grain of grape-sugar in a caustic alkali. 2 or 3 drops of the mixture are put into a test-tube and half an ounce of liquor potassæ added; the whole is then boiled, a few drops of urine added, and the whole boiled again" (Oppenheimer, *Med. Record*, xix. 27).

Ammoniated copper in medicinal doses does not produce any immediately sensible effects upon the healthy system, but in large doses it occasions nausea, giddiness, confusion or dimness of sight, vomiting, colic, constipation or diarrhœa, and, if persisted in, is said to cause muscular spasms or paralysis, wasting of the body, and death. It was once reputed to be an efficient remedy for *epilepsy*, but more accurate and continued observation has not sustained its character. It is one of the many medicines to which cures of *chorea* have been ascribed, and sometimes with such emphasis and detailed proofs that some faith in its efficacy cannot easily be withheld. If employed in this disease, it should be given at first in doses of ½ grain (Gm. 0.03) three or four times a day in an aromatic vehicle, with a small proportion of laudanum, and rapidly but gradually increased until it begins to disturb the stomach. It should be administered when the stomach contains food. It is stated by Féréol to have cured trigeminal neuralgia that had resisted all the most accredited medicines. The medium dose employed by him was about 2 grains, and was given after meals for 10 or 15 days (*Monthly Abstract*, Aug. 1879, p. 349). Locally, it has been employed for the same purposes as sulphate of copper in solution and in ointments.

Administration.—As an emetic, sulphate of copper may be given in doses of from 2 to 10 grains (Gm. 0.10–0.60) of the powdered salt mixed with pulverized sugar, and repeated every 10 or 15 minutes if necessary. As a tonic or astringent, the dose is from ¼ grain to 2 or more grains (Gm. 0.016–0.12) in pill. For local application, solutions containing from 1 to 10 or more grains (Gm. 0.6–0.60) to the ounce of water may be used. Pencils of sulphate of copper are made by fusing together 2 parts of this salt with 1 of alum. They are also produced by first depriving the sulphate of its water of crystallization, reducing it to a fine powder, and then, after placing it in paper moulds, surrounding them with wet cloths, which restores the water of crystallization.

CUPRUM, *Br.*—COPPER.

Cupreum filum.—Copper wire, E.; *Cuivre, Fil de cuivre*, Fr.; *Kupfer, Kupferdraht*, G.
Symbol Cu. Atomicity bivalent. Atomic weight 63.2.

Fine copper wire, about No. 25.

Origin.—Copper, which has been known from the earliest times, is often found in the metallic state as native copper, notably near Lake Superior; occasionally it is met with in the oxidized state as black and red copper ore or as a carbonate in malachite, and frequently as sulphuret in copper pyrites, copper glance, and gray copper ore, etc. It is a natural constituent in minute quantities of some mineral springs and of many vegetable and animal organisms. The smelting process is rather complicated for many ores, and depends mainly upon the oxidation of the sulphurets by roasting and the reduction of the metal by means of charcoal or by fusing a mixture of oxide and sulphide of copper. Arsenic and antimony, which are often present, are expelled by the repeated roastings, together with the sulphur, and the iron is made to enter the slag.

Properties.—Copper is a very sonorous, malleable, and ductile metal of a reddish color, having the specific gravity 8.92 or when hammered 8.95. It melts at a bright-red heat, first becoming brittle, and expands in volume on congealing. It is inferior to iron in tenacity or strength and in hardness, but superior to it as a conductor of electricity and heat and in resisting the chemical action of moist air. Copper is not acted upon by cold concentrated or hot dilute sulphuric acid, but it dissolves readily in nitric acid. The most important of the numerous alloys of copper are *brass*, containing about 28 to 36 per cent. of zinc; *bronze*, containing 8 to 12 per cent of tin, and sometimes a little zinc and lead; *bell-metal*, containing 20 to 25 per cent. of tin; and *German silver*, composed of 8 copper, 3½ zinc, and 3 or 4 nickel.

Chemical Characteristics.—Copper forms two series of salts—*cuprous* and *cupric*, the former of which are of little importance. The anhydrous cupric salts are usually white, the hydrated green or blue; the soluble ones have an acid reaction, and their solutions are decomposed by iron, zinc, and the earth metals, with the precipitation of copper. Potassa precipitates a greenish-blue basic salt or blue hydrate, which when heated turns to black $(CuO)_3H_2O$ or CuO. Potassium carbonate precipitates green oxycarbonate of copper, the precipitate turning black on boiling. Ammonia-water and ammonium carbonate occasion bluish-green precipitates which dissolve in an excess, forming deep azure-blue solutions. Ferrocyanide of potassium yields a brown-red precipitate, which is insoluble in dilute acids. Sulphuretted hydrogen separates from acid solutions brown-black sulphide of copper. Potassium iodide produces a grayish-white precipitate of cuprous iodide, one-half of the iodine being at the same time liberated.

Pharmaceutical Uses.—Copper wire is employed in the preparation of Spiritus ætheris nitrosi for generating nitrous acid.

Copper Pigments.—Bremen blue or Bremen green is cupric hydrate, prepared by precipitating a copper salt with an alkali and drying the precipitate below 40° C. (104° F.). Used as a water-color, it remains blue, but if used as an oil-color it becomes green from the formation of a copper soap. Basic cupric carbonate is sometimes sold under the same name.

Brunswick green is either oxycarbonate or oxychloride of copper.

Mountain green or Mineral green is powdered green malachite or artificially-prepared oxycarbonate of copper.

Scheele's green. Copper sulphate is precipitated by a solution of arsenious acid in sodium carbonate; its composition, according to Sharples (1877), is $Cu_3As_2O_6.2H_2O$.

Schweinfurt green or Paris green is aceto-arsenite of copper, prepared by boiling the mixed hot solutions of cupric acetate and arsenious acid.

Most of these pigments are also sold under other names than those given above. As met with in commerce, they are frequently mixed with alumina or calcium and barium compounds, and thus constitute lower grades. Mixtures of chrome-yellow and Prussian blue are likewise sold under several of the above names.

Physiological Action.—Copper in the metallic state is not known to exercise any specific action upon the economy. Workers in the metal, although constantly covered with its dust and receiving such large quantities of it into the system through the lungs and digestive apparatus that it is readily detected in the urine, do not appear to be liable to any special diseases, although they have a more or less anæmic appearance and are subject to giddiness, lassitude, and dyspepsia. They are apt to lose their teeth early, and their gums present a green or olive-colored line, and the teeth are discolored in the same manner. In 1869, Dr. Clapton pointed out the absolute freedom of the workmen in copper from cholera or choleraic diarrhœa (*Trans. Clin. Soc.*, iii. 7). And in 1880, Dr. Burq (*Bull. de thérap.*, xcviii. 330) not only maintained this opinion, but also alleged that these workmen are equally insusceptible of contracting typhoid fever, and that musicians who play on brass instruments are not liable to either disease. On the other hand, there can be no doubt that persons who work at trades in which copper-leaf is employed in the form of "bronze powder" may suffer from its poisonous effects. The symptoms do not seem to be uniformly alike, for diarrhœa or constipation may exist; but in all cases there is abdominal pain and tenderness, nausea and vomiting, an anæmic appearance of the skin, and a purplish discoloration of the gums. Copper has been found in the feces. In one case death was ascribed to peritonitis. The treatment of such poisoning should be by gentle but repeated purgation with salines, warm baths, and a milk diet (*British Med. Jour.*, July 24, 1880; *Phila. Med. Times*, xi. 457).

CURARE.

Urari, Wourari, Wourali, Woorara.

Preparation.—The latest information concerning the preparation of this South American arrow-poison is from Dr. Jobert (1878), who, writing from Belen de Para to the French Academy, made the following statements: The principal ingredients are *urari uva* (probably Strychnos Castelnanæna, *Weddell*) and *eko*, also called *pani du maharão* (probably Cocculus toxiferus, *Weddell*). The young bark of these plants is well scraped, and the scrapings are mixed in the proportion of 4 parts of the former and 1 part of the latter; the mixture is well kneaded with the hands, and, in a funnel made of palm leaf, exhausted with cold water, the liquid being returned seven or eight times. The red infusion is boiled with fragments of *taja* (an Aroidea) and *mucura-ea-ha* or *cone* (probably Didelphys cancrivora). After about 6 hours the liquid has acquired a thick consistence, and is mixed with the scrapings of three species of pepper (Artanthe?) and *tauma-gere*, and again boiled and allowed to cool, when it will have the the consistence of a thick paste.

Dr. Richard Schomburgk (1879) observed the following ingredients to be used in the preparation of *urari* or *urati* in British Guiana: Bark of Strychnos toxifera, *Schomburgk*, 2 pounds; Str. Schomburgkii, *Klotzsch*, Str. cogens, *Bentham* (*arimaru*), and *wakarimo*, of each $\frac{1}{4}$ pound; roots of *tarvieng* and *tararemu*, of each $\frac{1}{2}$ ounce; four small pieces of wood of a species of Xanthoxyleæ called *manuca*. An extract is made by boiling these articles with water, straining, and adding to the thick liquid the slimy juice pressed out of the fleshy root of a species of Cissus, called *muramu;* the mixture is further evaporated by exposing it to the sun.

Planchon (1879) added to the above-named species Strychnos Gubleri, *Planchon*, which is used on the Rio Negro; Str. Crevauxii, *Planchon*, in Upper French Guiana; and Str. Yapurensis, *Planchon*, on the Yapura River. In addition to these, Rouhamon (Strychnos, *Martius*) guianensis, *Aublet*, Str. cogens, *Bentham*, Paullinia Cururu, *Linné*, and other plants have been named as being used in the preparation of this poison in different parts of South America.

Properties.—Curare is a blackish-brown extract, brittle or hygroscopic, and of a very bitter taste; cold water dissolves about 75 per cent.; this portion contains the poisonous alkaloids, and is insoluble in ether and very sparingly soluble in absolute alcohol.

Constituents.—Boussingault and Roulin (1828) separated from curare some fat, brown resin, red coloring matter, gum, clay, and the alkaloid *curarine*, which was previously discovered by A. Buchner (1827). In its pure state the alkaloid forms colorless prisms which have a very bitter taste, but less persistent than strychnine. It has a slight alkaline reaction, is deliquescent in moist air, freely soluble in alcohol, sparingly so in chloroform and amylic alcohol, and insoluble in absolute ether, carbon bisulphide, and benzol. It is colored deep-red by nitric acid, and by concentrated sulphuric acid acquires a carmine-red color, which on the addition of bichromate of potassium, becomes violet, the reaction being very similar to that produced by strychnine under the same treatment, but the coloration is more permanent. Sachs (1878) gives it the formula $NC_{18}H_{35}$, and states that it exists in curare as sulphate, and that Preyer's alkaloid, which was colored blue by sulphuric acid, consisted mainly of calcium phosphate and coloring matter. The alkaloid yields white, yellow, or brownish precipitates with all the group-reagents for alkaloids, and is precipitated yellow by potassium ferricyanide, and white by potassium ferrocyanide, sulphocyanide, and iodate and by sodium phosphate and arsenate.

Physiological Action.—*On Animals:* The observations made more than half a century ago by Fontana, Brodie, Emmert, and others agree essentially with the results of recent experiments as to the action of this substance. They found that it acted much more energetically upon birds than upon quadrupeds—a peculiarity which is now known to depend upon its very slow elimination with the urine in the former, and its rapid discharge with the same excretion in the latter class of animals. So complete is this elimination that the urine of an animal poisoned by curare is itself actively poisonous. The most conspicuous phenomena observed when a solution of the poison is injected into the blood or hypodermically are the following: According to Couty, the primary effect of very small doses is stimulant, the animal becoming agitated and excited, the pupils alternately contracting and dilating, while the nervous excitability is augmented. A general muscular paralysis, voluntary and reflex, ensues, including that of the muscles of respiration, which first affects the hinder limbs of quadrupeds, but ultimately involves all of the voluntary muscles, so that if the dose be duly proportioned the animal may remain for hours alive, but entirely motionless. The movements of the muscles of organic life are less promptly and deeply affected than the voluntary muscles. Occasionally, when death is rapid, convulsions occur, which are occasioned by asphyxia due to respiratory paralysis, but the heart continues to beat after other signs of life become extinct, and sometimes even then the poisoned animal may be revived by artificial respiration.

On Man: The original experiments upon animals agree with those subsequently made upon man, in showing that curare is rarely poisonous when taken into the stomach. Locally, however, it acts as an irritant to the denuded cutis, causing severe pain and subsequently inflammation; when used hypodermically, it is apt to produce obstinate and painful ulcers: its powder irritates the mucous membranes, exciting lachrymation and a copious nasal and salivary flux. Internally, it is a diaphoretic, and in some cases it is said to have rendered the urine saccharine. It does not seem to influence the pulse or the temperature. In large doses, given hypodermically or by the stomach, it sometimes causes chilliness, followed by fever and sweating, but more usually its effects are exhibited by the voluntary muscular system, which is in every part relaxed. This action upon the muscles of the face produces an apathetic, dull expression, especially when the upper eyelids fall, covering the eyeball; and, as the patient is unable to open his eyes, he is apt to believe himself stricken with blindness. In other cases the muscles of the eyeball are affected, and mydriasis, diplopia, strabismus, and ptosis occur. The lower limbs are first and chiefly affected with loss of muscular power, so that the gait is staggering. These phenomena are variously explained by different observers and experimenters according to their several theories of the nervous functions. The greater number agree that the primary operation of curare is upon the terminations of the nerves, and not upon their central origins; but Dr. Poole (*Med. Record*, xix. 597) infers from the reported facts that the ordinary effect of curare is to paralyze the motor nervous trunks.

Medical Uses.—Curare has been employed chiefly in the treatment of several grave diseases attended with nervous spasm, and especially tetanus, epilepsy, chorea, and hydrophobia. It is well known that *tetanus*, even of the traumatic form, has been treated successfully with various medicines which control muscular action, and this one is reported to have cured thirteen out of thirty-three cases (Demme; Busch). Other persons have published similar results, but in isolated cases. There can be no doubt that, appropriately administered, it effectually controls the spasms, probably by its direct action upon the muscles, and thereby spares the patient the exhaustion which the spasms produce. Practically, however, curare is seldom employed in the treatment of tetanus. Vulpian even comes to the conclusion that it does not favorably influence the termination of that disease (*Leçons sur les Substances toxiques*, p. 396). In *epilepsy* Kunze claims to have cured nine out of thirty-five cases by this medicine, but in a later report only six cases out of eighty (*Med. Times and Gaz.*, Nov. 1878, p. 523); and Eddlefsen three out of thirteen cases, using hypodermic injections with a primary dose of $\frac{1}{3}$ grain (*Edinb. Med. Jour.*, xxvii. 842). In *chorea* it appears to be useless. It has also been tried in *rabies*, uniformly with the result of appeasing or suspending the spasms, and in at least three cases it is said to have cured the disease. A critical examination of these cases leaves an impression of doubt as to their nature. The reporters do not always seem to have been aware of the distinction between rabies canina and hydrophobia, nor of the alleged cure of the disease by various remedies, such as Xanthium spinosum, the hot vapor-bath, oxygen, etc. It should also be noted that in several cases the medicine appears to have been thoroughly employed without the least advantage. At the same time, its possible inertness in these instances should not be lost sight of, and in no case should any of it be used that has not first been tested upon an animal. Curare is best administered hypodermically in a filtered watery solution of the strength of 1 per cent., each injection containing about $\frac{1}{10}$ grain (Gm. 0.006). But in a remarkable case of cure (Offenburg, 1877) about $\frac{1}{3}$ grain (Gm. 0.02) was administered as often as the spasms threatened to return. Within 4 hours seven injections, amounting to Gm. 0.19, or $2\frac{1}{2}$ gr., were given hypodermically in a 5 per cent. solution (*Arch. f. Exp. Pathol.*, xi. 308). In all cases it must be repeated so as to maintain complete muscular relaxation. It has also been used endermically and by the rectum. Curarin has been employed as a sulphate in from one-twentieth to one-tenth of the dose of curare, but Sachs has shown that this pretended *curarin* is really phosphate of lime.

CURCAS.—PURGING-NUT.

Semen ricini majoris.—Physic-nut, Barbadoes-nut, E.; *Pignon d'Inde (des Barbades), Semence du médicinier*, Fr.; *Purgirnuss, Schwarze Brechnuss*, G.

The seed of Curcas purgans, *Adanson*, s. Jatropha Curcas, *Linné*.

Nat. Ord.—Euphorbiaceæ.

Origin.—A medium-sized monœcious shrub indigenous to the West Indies and South America, but naturalized in other tropical countries. It has smooth, angularly three- or five-lobed, cordate leaves, paniculate cymes of greenish-yellow bell-shaped flowers, the pistillate ones few and largest, and tricoccous, obtusely triangular, and blackish capsules, each cell containing one seed.

Description.—The seeds are about $\frac{4}{5}$ inch (2 Cm.) long, ovate-oblong, flattened from the back, with a broad whitish hilum and caruncle at one end, black, not glossy, somewhat rough, and marked with numerous small cracks. The kernel has the shape of the seed, and consists of an oily albumen which encloses the embryo. The seeds are inodorous; the kernels have a sweetish and oily taste, which gradually becomes acrid and burning.

Constituents.—The principal constituent is the fixed oil, of which Arnaudon and Ubaldini (1858) obtained 37.5 per cent. It is light yellow or colorless, of spec. grav. 0.92, congealing to a butyraceous mass at $-8°$ C. (17.6° F.), inodorous, and nearly insoluble in alcohol. When distilled with potassa, caprylic alcohol is obtained. Bouis (1854) separated a liquid and solid fatty acid, and named the latter *isocetic acid*, $C_{15}H_{30}O_2$. Cadet de Gassicourt (1824) found in the seeds also an acrid resin.

Allied Seeds.—Anda Gomesii, *Jussieu*, s. Anda brasiliensis, *Raddi*, s. Joannesia principis, *Vellozo*. A large tree of Brazil, known there as *anda-assú*, bearing a heart-shaped, obtusely quadrangular drupe, the seeds with a white fleshy arillus. The seeds resemble chestnuts, are somewhat reniform, dark-brown, and of an almond-like taste; they yield about 50 per cent. of a reddish inodorous crude drying oil, which is an active purgative in doses of 10 Gm., and is more limpid than, and free from the mawkish odor and unpleasant taste of, castor oil. One or two seeds act as a violent cathartic, often also as an emetic.

Curcas multifidus, *Endlicher*, s. Jatropha multifida, *Linné*, is a South American shrub, the seeds of which resemble the purging-nut, but are smoother and brown. According to Soubeiran, the oil of these seeds is very similar to, if not identical with, that of the latter.

Euphorbia lathyris, *Linne*, s. Tithymalus Lathyris, *Scopoli*.—Caper spurge, Garden spurge, *E.;* Epurge, Catapuce, *Fr.;* Wolfsmilch, Springkraut, *G.*—A South European herb, cultivated in gardens and somewhat naturalized in North America, the seeds of which were formerly officinal as *semen cataputiæ minoris*. They are about $\frac{1}{8}$ inch (3 Mm.) long, oval, obtuse, on one end with the hilum and caruncle, brown, marbled with gray, and rugose. The oil separates a crystalline mass on standing.

Physiological Action.—It is said that the expressed oil of curcas-seeds acts chiefly as a purgative, and that in the dose of about 12 drops it produces effects like those of an ounce of castor oil. It is more like croton oil in its operation. The acrid emetic principle resides chiefly in the embryo. It is stated that if the embryo is wholly removed four or five of the seeds may be used as a purgative without producing either vomiting or griping. This opinion is supported by experiments upon dogs. A number of cases have occurred of poisoning by eating the seeds entire. In one case a man who had eaten five of them soon complained of burning in the mouth and throat, and the whole abdomen felt distended and sore. In a few minutes vomiting occurred, and was repeated five times in the course of an hour, accompanied with active purging. The pain continued; the patient complained of feeling hot and giddy; he then became delirious, and afterward insensible. On regaining consciousness several hours later his face was pale, his hands cool, the pulse 110 and weak. He recovered. In 1854, at Birmingham, Eng., more than thirty boys were poisoned by eating these seeds. In some of them, besides the symptoms just mentioned, there was a hot skin and an appearance of drowsiness, which may, however, have been due to exhaustion produced by the evacuations. They all made good recoveries. The oil applied to the skin irritates it.

Medical Uses.—In the East Indies the juice of the plant and the oil are said to be used locally in the treatment of *cutaneous eruptions*, *rheumatism*, and *hæmorrhoids*, and, in liniments to stimulate the secretion of *milk*. The oil has been employed internally in *constipation*, *dropsy*, *worms*, etc., and externally in the diseases mentioned, and also in *paralyses*, pain in the *ears*, *deafness*, etc. In a word, it has, in a less degree, the qualities and medical virtues of croton oil, and appears to be purgative in about the same dose.

The uses of the oil of *Anda Gomesii* are stated under Oleum Ricini. The oil obtained by expression from Euphorbia Lathyris, and the seeds themselves, were formerly used in the south of France and in Italy as purgatives. Five seeds caused vomiting and diarrhœa in one experiment, but ten were required to produce a like effect in another. The expressed oil acted purgatively, and the seeds which furnished it were no longer purgative in the same degree as at first (Husemann, *Toxikologie*, p. 447).

CURCUMA.—Turmeric.

Rhizoma curcumæ.—Curcuma, Souchet des Indes, Fr.; *Kurkuma, Gelbwurz*, G.

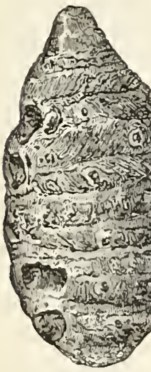
The rhizoma of Curcuma longa, *Linné*, s. Amomum Curcuma, *Jacquin*, s. Curcuma rotunda, *Linné*. Woodville, *Med. Bot.* 252; Bentley and Trimen, *Med. Plants*, 269.

Nat. Ord.—Zingiberaceæ.

Origin.—The plant yielding turmeric is a perennial indigenous to India, and is extensively cultivated throughout Southern Asia and in many islands of the Indian Ocean. It produces a tuft of radical leaves, which are about 3 feet (90 Cm.) long and have a prominent midrib; the scape bears a few sheathing bracts below, and terminates with a spike of 6 inches (15 Cm.) bearing orange-colored flowers in pairs from the axils of spreading bracts. The United States import annually about 1,000,000 pounds of turmeric.

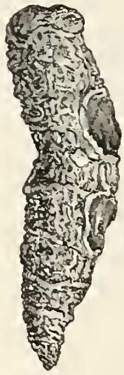
Description.—The central portion of the rhizome of the different species of curcuma is tuberous, and sends out nearly cylindrical branches, some of which become fusiformly thickened toward their ends, and then contain a very pure starch. Aside from these spindle-shaped, amylaceous tubers, the subterraneous stem is of two forms, and the commercial turmeric must vary as one or the other or both forms are collected, which were formerly supposed to have been produced by two distinct species.

Fig. 91.



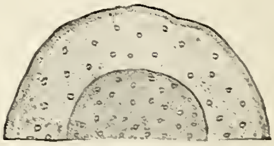
Round Turmeric.

Fig 92.



Long Turmeric.

Fig. 93.



Curcuma: transverse section, magnified 3 diam.

Curcuma rotunda, or round turmeric, attains a length of $1\frac{1}{2}$ to 2 inches (38 to 50 Mm.) with a diameter of 1 inch (25 Mm.) or more; it varies in shape between globular, oblong, and pyriform, has annular marks from the scars of the leaf-sheaths, and is beset with root-scars and a few fibres or their remnants. Curcuma longa, or long turmeric, is 1 to 2 inches (25 to 50 Mm.) long, $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 12 Mm.) thick, straight or curved, mostly simple, nearly cylindrical, and somewhat annulated by the leaf-scars. The two varieties are externally covered with a yellowish-gray, soft, and friable corky layer, and break with a short and smooth fracture of a horny or resinous lustre. The interior is of a gamboge- to brown-yellow color, the centre usually of a deeper tint, and separated from the outer portion by a circular line, indicating the nucleus-sheath. The fibro-vascular bundles are scattered throughout the entire rhizome, and are more numerous near the nucleus-sheath; the polyhedric parenchyma-cells of the cortical and inner layer contain starch, resin, and drops of volatile oil. The nearly uniform color and glossy appearance of the interior are due to the scalding of the rhizomes previous to drying, whereby the starch has been converted into a pasty mass. The quality of turmeric is approximately judged by the brightness of the tint and the degree of lustre upon the fracture. Turmeric has a peculiar aromatic odor and a warm, aromatic, and bitterish taste.

The principal commercial varieties are—*Chinese turmeric*, which consists of many central rhizomes with well-developed branches; *Bengal turmeric*, mostly in slender branches of a deep reddish tint; *Madras turmeric*, in thick lateral branches, mixed with transversely-cut tubers of a gamboge tint; *Java turmeric*, which consists of rather small tubers and branches that are often transversely and longitudinally cut; and *Cochin turmeric*, in sections or slices of a larger tuber, some being marked with rather large depressed stem-scars; they are probably derived from another unknown species.

Constituents.—The investigations of Bolley, Suida, Lange (1868), Gajewsky (1870, 1872), Kachler (1870), and Flückiger (1876) have been supplemented and partly modified by C. L. Jackson and A. E. Menke (*Am. Chem. Jour.*, 1882–83, iv.). By distillation with water about 1 per cent. of volatile oil is obtained. Treatment with cold ligroin yields 11 per cent. of viscid oil, a small portion of which distils, under diminished pressure of 60 Mm., under 193° C., and a second portion, *turmerol*, $C_{19}H_{28}O$, between 193° and 198° C. (379° and 388° F.), leaving a viscous body. Turmerol is pale-yellow, agreeably aromatic, dextrogyre, of the density .9016 at 17° C., and boils under ordinary pressure at 285°–290° C. (545°–554° F.), with partial decomposition. The *curcumol* of other chemists was stated to have the formula $C_{10}H_{14}O$ and the boiling-point 245° C. (473° F.).

The coloring matter, *curcumin*, is best obtained pure after removing the oil by exhausting the powder with ether and recrystallizing from alcohol; the yield, involving much loss, was only 0.3 per cent. The yellow crystals, $C_{14}H_{14}O_4$, have a vanilla-like odor, fuse at 165° C. (329° F.), are readily soluble in alcohol, chloroform, and ether, very little in cold benzol and benzin, and freely and with a red-brown color in alkalies. Oxidation by potassium permanganate or other weak oxidizing agents yields vanillin (melting-point 79° C.); by chromic acid the products are carbonic and acetic acids; and with nitric acid oxalic acid is obtained. The carmine-colored potassium compound is insoluble in strong alcohol and ether; the zinc compound is soluble in water; the insoluble lead and silver compounds are easily altered. By boiling an alcoholic solution of curcumin with boric acid and decomposing the compound with hot water, Schomberger (1866) obtained yellow *pseudo-curcumin*, which is not reddened by boric acid, and is soluble in alkalies with a greenish-gray color. Boiling as before, but in the presence of sulphuric acid, *rosocyanin* is formed, which is crystalline, insoluble in water, benzol, and ether, and soluble with a beautiful red color in alcohol. Alkalies color it blue; the solution on boiling turns blood-red, then yellow, and now contains pseudo-curcumin.

The other constituents of turmeric are starch, gum, resin, and others of no medicinal importance. Kaehler (1870) separated from the infusion a notable quantity of *acid potassium oxalate.* Tincture of turmeric shows a blue fluorescence, due to curcumin.

Pharmaceutical Uses.—Turmeric is employed for the detection of alkalies and of borates. Paper saturated with the tincture is colored brown-red by alkalies, the yellow color being restored by acids. Soluble borates likewise produce a brown-red color, which is not altered on the addition of dilute acids. It is occasionally employed for coloring pomades and ointments, as in the *Unguentum flavum s. Ung. althææ* (P. G. 1872), which is made by digesting for half an hour 1 part of turmeric with 50 parts of lard, fusing together with yellow wax and Burgundy pitch, each 3 parts, and straining.

Medical Uses.—Turmeric has no medicinal properties that require notice. Its sole use is to prepare a test-paper. In India and China it is employed as a condiment.

CYCLAMEN.—Cyclamen.

Sow-bread, E.; *Arthanite*, *Pain de pourceau*, Fr.; *Erdscheibe*, *Erdbrot*, *Schweinebrot*, G.

The tuber of Cyclamen europæum, *Linné.*

Nat. Ord.—Primulaceæ.

Origin.—The species grows in shady places and rocky woodlands of Southern Europe, and is met with in cultivation. It has a few roundish, heart-shaped leaves of a dark-green color, marked with white above and purplish beneath, and several stalks, each bearing a nodding, fragrant, pink-colored flower, and coiling up after flowering so as to bring the capsule to the ground.

Description.—The tuber is 1 to 2 inches thick, flattish-circular or depressed globose, dark-brown externally, internally white, mealy, with a rather thin bark and with narrow and short fibro-vascular bundles loosely arranged in irregular circles. In the fresh state it has a burning, acrid taste; after drying this is milder.

The similar tubers of Cyclamen hederæfolium, *Aiton*, and C. persicum, *Miller* (s. C. latifolium, *Sibthorp*), which are indigenous to Southern Europe and the Levant, have similar properties; these plants are also cultivated for ornament.

The pyriform or spindle-shaped tubers of Lathyrus tuberosus, *Linné*, which are of the size of a walnut, are said to be occasionally substituted for those of cyclamen; they have a mucilaginous taste.

Constituents.—Aside from starch, gum, pectin, and other common principles, Saladin (1830) isolated *cyclamin* or *arthanitin*, $C_{20}H_{24}O_{10}$. It is white, amorphous or in minute crystals, of a bitter and acrid taste, soluble in bisulphide of carbon, chloroform, alcohol, and in water, and insoluble in ether and fixed and volatile oils. Its aqueous solution foams like soap-water, is precipitated by tannin, and when boiled with dilute acids yields glucose and resinous *cyclamiretin.*

Physiological Action and Medical Uses.—Experiments made by Claude Bernard led him to the conclusion that cyclamin resembles curare in its action, but as he injected a large amount of liquid in which the cyclamin was dissolved into the trachea of animals, it is evident that they may have died of asphyxia, and not of cyclamin. While pigs can eat any quantity of cyclamen-root without harm, fish are poisoned by its juice as well as by cyclamin. The former is said to be used in Sicily and Italy for catching fish. They are not affected tetanically, as by cocculus, but die asphyxiated through imperfect respiration. Small fish die in water containing the $\frac{1}{3000}$ part of the juice of cyclamen-root. According to Schroff—1, cyclamin does not act upon the sound skin; 2, in the mouth it produces a very unpleasant sensation and taste, and excites salivation; 3, in the stomach it causes burning, oppression, nausea, and vomiting, and in this organ, as in the intestine, it occasions inflammation; 4, in the connective tissue it excites inflammation, which may be followed by gangrene; 5, it does not affect the brain, spinal marrow, or nerves; 6, it salivates men when not taken by the mouth, but by the veins; 7, its action is analogous to that of smilacin, senegin, and saponin. It has been stated by Vulpian that when cyclamin is given to frogs the animals sicken, and after a few days die. Their blood is found to contain a multitude of vibrios, some of which are seen even in the interior of the red corpuscles.

Cyclamen-root loses much of its acrimony by keeping, and has been recommended under such circumstances as a purgative in the dose of 10 grains (Gm. 0.60) triturated with powdered gum. On the other hand, the fresh root has sometimes occasioned alarming effects. Bulliard states that "in the north of France, where it is much used as a purgative, it often produces violent vomiting, followed by cold sweats, vertigo, ringing in the ears, and gyratory or convulsive movements; often blood is ejected by vomiting or purging, and sometimes there is even fatal hypercatharsis." Formerly it entered, with other drastic purgatives, into a liniment which caused purgation when applied to the abdomen in cases of *worms* and of *dropsy*. Externally, the fresh tuber has been proposed as a stimulating cataplasm for *carbuncles*, *abscesses*, enlarged *glands*, etc. Dose, 5 grains (Gm. 0.30). A decoction is prepared with from 1 to 3 drachms (Gm. 4–12) in a pint (Gm. 500) of water.

CYDONIUM, *U. S.*—CYDONIUM.

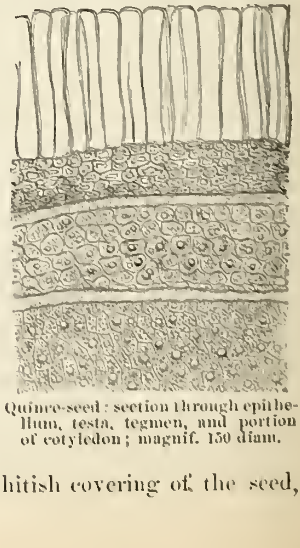
Semen cydoniæ.—*Quince-seed*, E.; *Semences* (*Pépins*) *de coing*, Fr.; *Quittensamen*, *Quittenkerne*, G.

The seed of Cydonia vulgaris, *Persoon*, s. Cyd. europæa, *Savi*, s. Pyrus Cydonia, *Linné*, s. Sorbus Cydonia, *Crantz.* Woodville, *Med. Bot.*, 182; Bentley and Trimen, *Med. Plants*, 106.

Nat. Ord.—Rosaceæ, Pomeæ.

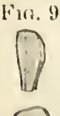
Origin.—The quince tree, which attains a height of 20 feet (6 M.) or remains shrubby, is probably indigenous to Asia Minor and Persia, but was anciently cultivated, and is now naturalized, in the Mediterranean basin and cultivated in the temperate parts of Asia, Africa, Europe, and America. It has shortly petiolate, entire, ovate or obovate leaves, which are woolly beneath; ovate, glandular, and denticulate stipules; handsome, pale rose-colored flowers; and a pyriform or subglobular golden-yellow fragrant fruit, with five cells, each containing about twelve closely-packed seeds.

FIG. 95.



Quince-seed: section through epithelium, testa, tegmen, and portion of cotyledon; magnif. 150 diam.

FIG. 94.



Quince-seed and section.

Description.—The seeds are ¼ or ⅜ inch (6 to 10 Mm.) long, of an oblong or oval shape, but flattened and three-sided by mutual pressure; the somewhat pointed hilum at the narrow end is connected by the ridge-like raphe along the sharper edge with the chalaza at the other slightly-beaked end. The testa is of a brown color, covered with a mucilaginous epithelium, by which the seeds of one cell are united into a mass. The embryo is of the size and shape of the seed, consists of two plano-convex oily cotyledons, with a thick straight radicle pointing toward the hilum, and possesses the taste of bitter almonds. The unbroken seeds are mucilaginous. The mucilage is contained in the epithelial cells, which form the grayish or whitish covering of the seed, and when immersed in water swell up considerably, forming a thick jelly-like mass with 40 parts of water to 1 of seeds.

Constituents.—Quince-seeds yield about 20 per cent. of dry mucilage, which has the composition $C_{12}H_{20}O_{10}$ and contains some calcium salts and albumen. Treated with nitric acid, it yields oxalic acid. The mucilage has little adhesive power, is not affected by solution of borax, and is precipitated by alcohol and by metallic salts.

Off. Prep.—Mucilago cydonii, *U. S.*

Allied Plant.—CYDONIA (PYRUS, *Thunberg*) JAPONICA, *Persoon.* This frequently-cultivated ornamental shrub is smooth throughout, has oval serrate leaves and bright-red flowers, and bears globular fruits of an aromatic acidulous taste.

Medical Uses.—The pulp, and especially the rind, of the fruit have a certain astringency which has caused them to be used in cases of *mucous profluvia* and passive *hæmorrhages*, but particularly in *leucorrhœa* and *uterine* hæmorrhage, and also in *diarrhœa.* They are rather domestic than officinal medicines.

CYNANCHUM.—SWALLOW-WORT.

Dompte-venin, *Hirundinaria*, Fr.; *Schwalbenwurz*, *Giftwende*, G.

The root of Cynanchum (Asclepias, *Linné*) Vincetoxicum, *Persoon*, s. Vincetoxicum officinale, *Moench.*

Nat. Ord.—Asclepiadaceæ.

Origin.—This plant grows in rocky places throughout the greater part of Europe. It is about 2 feet (60 Cm.) high, and has nearly sessile cordate-ovate and acuminate leaves, the axils of which bear the small umbels of about nine flowers, having a white corolla and yellowish crown.

Description.—The subterraneous portion consists of a very knotty, many-headed horizontal root-stock, with cup-shaped stem-scars, and with numerous nearly simple rootlets, which are about 6 inches (15 Cm.) long, longitudinally wrinkled, pale-brownish externally, and showing upon the transverse fracture a rather thick brownish bark with white dots and a finely porous yellowish meditullium. The peculiar odor of the fresh root, which resembles that of valerian, disappears nearly altogether on drying; the taste is sweet, bitterish, and acrid.

Constituents.—Feneulle (1825) submitted the root to analysis, but did not succeed in isolating the emetic principle. He determined the presence of pectin, fat, volatile oil, etc.

Medical Action and Uses.—This plant and the bitter principle derived from it are extremely irritating, and, taken internally, occasion nausea, vomiting, and purging, depending upon an active irritation of the gastro-intestinal mucous membrane, as experiments on animals show. Its action has been compared to that of scammony, for which it has been proposed as a substitute in France. Occasionally it has been used in *dropsy* and *diseases of the skin.* Its fresh juice is purgative in the dose of about 15 grains (Gm. 1).

CYPRIPEDIUM, *U. S.*—CYPRIPEDIUM.

Rhizoma cypripedii.—*Ladies'-slipper root*, E.; *Racine de cypripède jaune*, *Valériane americaine*, Fr.; *Gelbfrauenschuh-Wurzel*, G.

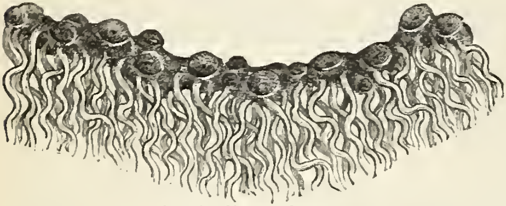
The rhizome and rootlets of Cypripedium pubescens, *Willdenow*, and of Cypripedium parviflorum, *Salisbury.*

Nat. Ord.—Orchidaceæ.

Origin.—These herbaceous plants are indigenous to Canada, and to the United States as far south as North Carolina; they grow in low woodlands and boggy localities and flower in May and June. The two plants are distinguished from each other by their size, Cypr. pubescens being the taller, growing about 2 feet (60 Cm.) high, and by their flowers, which in the species named have lanceolate sepals and a laterally-flattened lip which is arched above, while the flowers of Cypr. parviflorum are smaller, with lance-ovate sepals and the lip flattened from above. In both species the lip of the yellow flowers forms an inflated obtuse sac which is likened to a slipper.

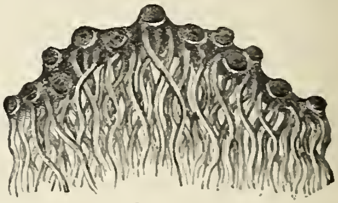
Description.—The rhizomes are horizontal, bent up and down, nearly cylindrical, about ⅛ inch (3 Mm.) in diameter, nearly 4 inches (10 Cm.) long, above beset with broad circular cup-shaped scars of the overground stems, the more recent ones with fibrous tufts of ligneous tissue; the numerous simple rootlets are mainly attached on the lower half of the rhizome, attain a length of 6 to 8, occasionally even 18 or 20 inches (15 to 20, even 45 or 50, Cm.). The rhizomes and rootlets of Cypr. parviflorum are rather slender and shorter, and after drying of an orange-brown color, while the coarser parts of Cypr. pubescens dry of a black-brown. Both break with a short fracture, which is white with scattered wood-bundles, have a peculiar slight but heavy odor, and a sweetish, bitter, and pungent taste.

Fig. 96.



Cypripedium pubescens.

Fig. 97.



Cypripedium parviflorum.

Portion of rhizome and rootlets, natural size.

The rhizome of Hydrastis canadensis is not unfrequently mixed with the commercial cypripedium; it is readily distinguished by its different shape, its yellowish-gray color externally, and by its transverse section, which is bright-yellow and shows a circular arrangement of the wood-wedges.

Constituents.—Cypripedium was analyzed by H. C. Blair (1866), who found a minute quantity of volatile oil, a volatile acid, two resins, tannin, starch, etc. The rhizomes of both species deserve to be again carefully analyzed.

Medical Action and Uses.—Cypripedium was among the medicinal plants used by the aborigines of this country, and subsequently it was resorted to by the country-people for the relief of nervous affections, such as *chorea* and *hysteria*. It is one of the numberless agents said to cure *epilepsy*. In its action and uses it is generally supposed to resemble valerian. The *dose* is stated to be 15 grains (Gm. 1) of the powdered root, or the equivalent of that quantity in tincture or infusion, three times a day. The oleoresin precipitated from the tincture by water may be prescribed in doses of 1 or more grains (Gm. 0.06).

DAMIANA.—Damiana.

Origin and Description.—Since 1874 the leaves of two or three Mexican plants have appeared in commerce under the above name, attention to the difference being called by Wellcome (1875). According to E. M. Holmes (1876), they come from the following species:

Turnera microphylla, *De Candolle* (Fig. 99). Nat. Ord. Turneraceæ. The leaves are alternate, obovate, entire at the base, and above on each side with three or four teeth, light-green, rather rough, and nearly smooth, or along the midrib covered with short whitish hairs. They readily fall off the much-branched stems, which, if present, have some resemblance to broom-tops. The calyx of the flowers has five three-nerved lobes, and bears in the throat five yellow obovate sepals and five stamens; the ovary has three styles, and ripens to a globular or oval one-celled and many-seeded capsule. The leaves have an aromatic taste, suggesting that of confection of senna. Leaves of the shape seen in Fig. 98 belong either to a variety of the same or to a closely-allied species. They are usually of a darker green, smooth, and have a somewhat mint-like flavor. Turnera aphrodisiaca, *Ward*, is the name given to the plant, in allusion to its asserted properties. Turnera diffusa, *Ward*, has rather shorter leaves, which are finely hairy above and tomentose beneath.

Fig. 98.

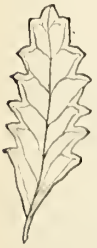


Fig. 99.

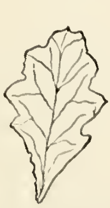
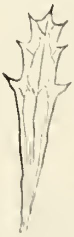


Fig. 100.



Damiana, natural size.

Aplopappus (Haplopappus) discoideus, *De Candolle*. Nat. Ord. Compositæ. The leaves are lanceolate, above with about three sharp teeth on each side, the lower half entire, rather coriaceous, roughish on the surface, light-green, with occasional black dots, and with minute resin-like granules or scales. The flowers, which are usually present, have an imbricated involucre, yellow florets, and a white hairy pappus. The drug has a distinct balsamic odor and taste. Dr. Rothrock (1876) gives the following synonyms for this plant: Linosyris mexicana, *Schlechtendal;* Baccharis veneta, *Kunth;* and Bigelovia veneta, *Gray.*

The two genera mentioned above belong to Western North America and parts of South America. A species of Turnera, T. ulmifolia, *Linné,* grows in the West Indies, where its aromatic leaves and flowers have been used for their tonic properties.

Constituents.—Turnera damiana yielded to H. B. Parsons 8 per cent. of volatile oil, with soft resin and chlorophyll, 7 per cent. of a bitter substance, 6.4 per cent. of hard resin, and 3.5 per cent. of tannin, the remainder being sugar, gum, albuminoids, etc., with 8.4 per cent. of ash. In making a fluid extract of the Aplopappus damiana, and using 76 per cent. alcohol, crystals of chloride of potassium were obtained by Prof. Wayne (1876).

Medical Action and Uses.—Damiana appears to have stimulant, tonic, and laxative properties, and has been supposed especially to stimulate the pelvic organs. It has been widely and boldly advertised as a remedy for *sexual impotence* or indifference in either sex, but there is not the slightest reason for confiding in this statement of its virtues. Still less can it be credited with the restoration of an atrophied testis to its normal size and function, which has been set to its account. It is best administered in a fluid extract, of which the average dose is ½ fluidrachm (Gm. 2).

DECOCTA, *U. S., P. G.*

Decoctions, E.; *Décoctés, Tisanes par décoctions,* Fr.; *Abkochungen,* G.

When the active principles of vegetable drugs are exhausted by boiling with water decoctions are obtained. Such preparations are obviously not adapted to drugs the activity of which depends upon principles of a resinous nature which are insoluble in water, nor to such as contain volatile oils or other volatile substances which would be dissipated with the vapor of water. Formerly, decoctions were usually made by using a large quantity of water and boiling it down to one-half or even to a less amount. No obvious advantage was gained by this method, and in many instances it proved to be decidedly disadvantageous, owing to the alteration and darkening of the extractive matters, and in some cases to changing the nature of the active principles. The pharmacopœias have very properly, in nearly all cases, reduced the time of boiling to 10 or 15 minutes, the general directions given by the present U. S. P. being as follows: "An ordinary decoction, the strength of which is not directed by the physician nor specified by the pharmacopœia, shall be prepared by the following formula: Take of the substance, coarsely comminuted, 10 parts (360 grains or 24 Gm.); water a sufficient quantity, to make 100 parts (3600 grains or 240 Gm., or 8 fluidounces). Put the substance into a suitable vessel provided with a cover, pour upon it 100 parts of cold water, cover it well, and boil for 15 minutes; then let it cool to about 45° C. (113° F.), strain the liquid, and pass through the strainer enough cold water to make the product weigh 100 parts. *Caution.*—The strength of decoctions of energetic or powerful substances should be specially prescribed by the physician."

By following the directions of the P. G., to keep the mixture of drug and cold water for half an hour in a bath of steam arising from boiling water, the time is practically still more reduced; the proportion of very mucilaginous drugs to be used in a decoction is left to the dispenser; but the physician is required to state the quantity of such drugs for which a maximum dose is given by the pharmacopœia; other drugs may be used in the proportion of 1 part for 10 parts of decoction.

The use of cold water to begin with ensures the complete exhaustion from the drug of all its soluble principles by the gradually-heated water, the albuminous principles being subsequently coagulated as the heat is increased to near the boiling-point. If, on the other hand, the drug be at once immersed in boiling water, the albumen contained in cells would be coagulated, and thus seriously interfere with the extraction of the other principles. In preparing compound decoctions all the drugs may be added to the cold water, with the exception of those which, like senna, are injured by long-continued heat or which contain aromatic or other volatile principles. Such should be added when the decoction is ready to be removed from the fire or steam-bath, and allowed to digest until it is sufficiently cooled for straining. The material should in all cases be cut or bruised, the degree of fineness depending upon the nature of its tissue. Woody drugs may be reduced to a moderately fine powder; leaves, however, and other drugs consisting mainly of loose parenchyma, are better used in the form of a moderately coarse or very coarse powder.

Unless the liquid is to be considerably boiled down, decoctions are best prepared in a vessel provided with a cover which may be loosely put on until the boiling is completed, when the vessel should be well closed, particularly if additions have been made at the close of boiling. Porcelain is undoubtedly the best material for vessels used for preparing decoctions, since it is not acted upon by the various vegetable principles; for similar reasons glass flasks will answer a useful purpose in making small quantities of these preparations. As a rule, it is best to avoid metallic vessels, except when made of block-tin and used in connection with a steam-bath. As many drugs contain tannin, vessels made of iron are not adapted for preparing their decoctions, and the usually imperfect covering of galvanized (or zinc) or tinned sheet iron renders the vessels lined with such material but little better suited for this purpose, and still inferior to properly-enamelled iron vessels.

As a rule, decoctions should be allowed to cool to below 50° C. (122° F.) before they are strained; principles which are soluble only in hot water are then mostly precipitated, and removed without, in most cases, weakening the medicinal effects of the preparations. But even with this precaution the strained liquid may become unsightly in appearance by the further deposition, on cooling, of apotheme or matter soluble only in hot water. In such cases the pharmacist should be guided by the directions of the pharmacopœia or by the intentions of the physician, and not sacrifice effect to elegance. With some exceptions, decoctions which were formerly made at the house of the patient have gradually fallen into disuse through the introduction of fluid extracts and similar permanent preparations, by which the medicinal properties can be preserved unaltered for months, or even years, while decoctions cannot be depended upon for more than one or, at the utmost, a few days.

DECOCTUM ALOES COMPOSITUM, *Br.*—COMPOUND DECOCTION OF ALOES.

Tisane (*Décocté*) *d'aloès composée*, Fr.; *Zusammengesetztes Aloedecoct*, G.

Preparation.—Take of Extract of Socotrine Aloes ½ ounce; Myrrh, Saffron, Carbonate of Potassium, of each ¼ ounce; Extract of Liquorice 2 ounces; Compound Tincture of Cardamoms 15 fluidounces; Distilled Water a sufficiency for 50 fluidounces. Reduce the extract of aloes and myrrh to coarse powder, and put them, together with the carbonate of potash and extract of liquorice, into a suitable covered vessel with a pint of distilled water; boil gently for 5 minutes, then add the saffron. Let the vessel with its contents cool, then add the tincture of cardamoms, and, covering the vessel closely, allow the ingredients to macerate for 2 hours; finally, strain through flannel, pouring as much distilled water over the contents of the strainer as will make the strained product measure 50 fluidounces.—*Br.*

The alkaline carbonate is added for the purpose of aiding the solution of the resinous principles of aloes and myrrh; the tincture of cardamom, saffron, and liquorice act as correctives, the latter serving more especially for partially covering the nauseous taste of the aloes. The air should be excluded from this preparation as far as possible.

Medical Action and Uses.—The active agents in this preparation are essentially the same as are in the tincture of aloes and myrrh. It is a useful purgative in numerous cases for which the alcoholic preparation just named would be too stimulating; and it is probable that the permanent solution of its ingredients renders its purgative operation milder—an effect which is enhanced by the liquorice and cardamom it contains. It is an appropriate medicine when purgation is indicated in *amenorrhœa* due to an atonic state of the system, or simply in constipation with a tendency to hæmorrhoidal engorgement. Like the tincture, it is much less used than the corresponding pill (*Pilula aloes et myrrhæ*), but it may be prescribed in doses of from ½ fluidounce to 2 fluidounces (Gm. 15–60).

DECOCTUM CETRARIÆ, *U. S., Br.*—DECOCTION OF CETRARIA.

Decoction of Iceland moss, E.; *Tisane* (*Décocté*) *de lichen d'Islande*, Fr.; *Isländisch-Moos-Absud* (*Decoct*), G.

Preparation.—Cetraria 5 parts (360 grains or 24 Gm.); Water a sufficient quantity; to make 100 parts (7200 grains or 240 Gm., or 16 fluidounces). Cover the cetraria, in a suitable vessel, with 40 parts ($6\frac{1}{2}$ fluidounces) of cold water; express after half an hour, and throw away the liquid. Then boil the cetraria with 100 parts of water for half an hour, strain, and add enough cold water, through the strainer, to make the product weigh 100 parts.—*U. S.*

The decoction of the Br. P. is identical with this, 1 ounce av. of Iceland moss being used for 1 Imperial pint of decoction; the boiling is continued for 10 minutes only, which is ample for the purpose. The tisane of the Fr. Cod. is made in the proportion of 1 to 100.

Medical Uses.—This is the best form for administering Iceland moss. It retains the bitter principle as well as the demulcent elements of the moss, and it is on the former that the therapeutical qualities of that substance chiefly depend. It should be taken in doses of from 2 to 4 ounces (Gm. 60–130) three or four times a day.

DECOCTUM CINCHONÆ, *Br.*—DECOCTION OF CINCHONA.

Decoctum de cinchona, Decoctum chinæ.—Tisane (*Décocté*) *de quinquina rouge*, Fr.; *Chinaabsud*, G.

Preparation.—Take of Red Cinchona Bark, in No. 20 powder, $1\frac{1}{4}$ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel. Strain the decoction when cold, and pour as much distilled water over the contents of the strainer as will make the strained product measure 1 pint (Imperial).—*Br.*

If strained while hot, a turbid preparation is obtained from the deposition, after cooling, of cinchonic red and cinchotannate of the alkaloids; these insoluble compounds are removed by straining *when cold.* The whole of the alkaloids may be kept in solution by the addition of some acid.

Medical Uses.—*Dose*, 2 fluidounces (Gm. 60) to be repeated every 2, 3, or 4 hours in acute diseases, and three times a day before meals, as a tonic.

DECOCTUM GRANATI RADICIS, *Br.*—DECOCTION OF POMEGRANATE-ROOT.

Decoctum corticis radicis granati.—Tisane (*Décocté*) *d'écorce de la racine de grenadier*, Fr.; *Granat-Wurzel-Rinden-Absud*, G.

Preparation.—Take of Pomegranate-Root Bark, sliced, 2 ounces; Distilled Water 2 pints. Boil down to a pint and strain, making the strained product up to a pint (Imperial), if necessary, by pouring distilled water over the contents of the strainer. —*Br.*

The tissue of the bark is not firm enough to require so long-continued a boiling.

Medical Uses.—This decoction may be used for all the purposes to which vegetable astringents of moderate power are applied, such as passive *hæmorrhages* and mucous and serous *profluvia*, as a wash for open *sores* accompanied with a profuse discharge, for *relaxed states* of the mouth, vagina, rectum, etc. It is, however, most useful as a *tænia-fuge.* (For the mode of employing it see GRANATI RADICIS CORTEX.)

DECOCTUM HÆMATOXYLI, *Br.*—DECOCTION OF LOGWOOD.

Tisane (*Décocté*) *de bois de Campêche*, Fr.; *Blauholz-Absud*, G.

Preparation.—Take of Logwood, in chips, 1 ounce; Cinnamon-Bark, in coarse powder, 55 grains; Distilled Water 1 pint. Boil the logwood in the water for 10 minutes in a covered vessel, adding the cinnamon toward the end. Strain the decoction, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

A longer-continued boiling of logwood in chips would improve the result of this formula.

Medical Uses.—Although this decoction may be used for most of the disorders for which vegetable astringents are indicated, it is chiefly employed internally for the relief of *diarrhœa*, but much less so than its cognate medicines. Its mildness adapts it to the treatment of infantile diarrhœas. The *dose* for an adult is about 2 fluidounces (Gm. 60); for infants and children, 1 or 2 fluidrachms (Gm. 4–8).

DECOCTUM HORDEI, *Br.*—Decoction of Barley.

Barley-water, E.; *Tisane (Eau) d'orge perlé*, Fr.; *Gerstenschleim*, G.

Preparation.—Take of Pearl Barley 2 ounces; Distilled Water 1½ pints (30 ounces). Wash the barley in cold water, and reject the washings; boil the washed barley with the distilled water for 20 minutes in a covered vessel, and strain.—*Br.*

The washing of the barley with cold water is intended for the removal of extraneous matters and of any unpleasant odor and taste. Mustiness is still better removed by washing with hot water, or by boiling the barley with the water for 1 or 2 minutes and throwing this liquid away. By this time the barley will be considerably swollen, and the decoction, when completed, will be mucilaginous, and measure about 20 fluidounces.

Medical Uses.—Barley-water, the most ancient of fever-drinks, continues to be the most generally employed. Highly nutritious, extremely digestible, unirritating, tending to promote the *intestinal* and *urinary* secretions, and soothing irritation in the *throat* and *air-passages*, barley seems better adapted to these purposes than rice or any other cereal. According to the state of the patient the decoction may be rendered more or less nutritious by longer or shorter boiling. If no contraindication exists it should be sweetened, and flavored with lemon-juice.

DECOCTUM PAPAVERIS, *Br.*—Decoction of Poppies.

Tisane de pavot, Fr.; *Mohnkapseln-Absud*, G.

Preparation.—Take of Poppy-Capsules, bruised, 2 ounces; Distilled Water 1½ pints. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

The Pharmacopœia does not direct the removal of the seeds, the oil of which will to some extent remain suspended in the mucilaginous liquid.

Medical Uses.—This preparation possesses slight anodyne virtues, and is also emollient in consequence of the oil and mucilage it contains. It has, however, no demonstrable advantage over preparations of flaxseed, slippery elm, and many mucilaginous substances to which oil or glycerin and laudanum have been added. This remark applies particularly to its use in poultices and fomentations.

DECOCTUM PAREIRÆ, *Br.*—Decoction of Pareira.

Tisane de pareira brava, Fr.; *Pareirawurzel-Absud*, *Grieswurzel-Absud*, G.

Preparation.—Take of Pareira-Root, sliced, 1½ ounces; Distilled Water 1 pint. Boil for 15 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

Medical Uses.—(For the action and uses of this preparation see Pareira.) The *dose* of the decoction is 1 or 2 fluidounces (Gm. 30–60) three or four times a day.

DECOCTUM QUERCUS, *Br.*—Decoction of Oak-Bark.

Tisane (Décocté) d'écorce de chêne, Fr.; *Eichenrinden-Absud*, G.

Preparation.—Take of Oak-Bark, bruised, 1¼ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial). —*Br.*

The tannin is readily extracted by the boiling water, and the strained liquid will cause precipitates with most salts of the heavy metals, with solutions of alkaloids, etc. Alkaline liquids will hasten the decomposition of the astringent principles.

Medical Uses.—This preparation is seldom administered internally, but may be used to restrain passive *hæmorrhages* and *chronic fluxes* of the bowels and bronchia. Externally, it is sometimes employed to control *bleeding* and also *suppuration*, and to diminish excessive local *sweats*, but more frequently to constringe relaxed mucous membranes and lessen their secretion, as in cases of *flaccidity of the uvula*, *pharynx*, or *larynx*, *prolapsus* of the *rectum*, *hæmorrhoids*, and *leucorrhœa*. It may be used to promote contraction of the *relaxed skin* of the abdomen, scrotum, etc.; to prevent the formation of *bed-sores* and the chafing of surgical apparatus; to heal flabby and ill-conditioned *ulcers;*

to restrain *gangrene* and prevent its fetor; and finally, in a bath, to counteract extreme relaxation of the general integument. The *dose* of this decoction is 2 fluidounces (Gm. 60). For external purposes a decoction of twice the officinal strength is preferable.

DECOCTUM SARSÆ, *Br.*—DECOCTION OF SARSAPARILLA.

Decoctum sarsaparillæ.—Tisane de salsepareille, Fr.; *Sarsaparilla-Absud,* G.

Preparation.—Take of Jamaica Sarsaparilla, cut transversely, 2½ ounces; boiling Distilled Water 1½ pints. Digest the sarsaparilla in the water for an hour, then boil for 10 minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (Imperial).—*Br.*

The formula is an improvement on the older ones, by which long-continued boiling was directed. The French preparation is made from 6 parts of sarsaparilla to 100 of liquid, by first macerating, then heating to boiling, and finally digesting for 2 hours.

Medical Uses.—The purpose of this preparation is the administration of sarsaparilla without the associate ingredients of the compound decoction. It is, however, very little used. Its *dose* is from 2 to 4 fluidounces (Gm. 60–120) three or four times a day.

DECOCTUM SARSAPARILLÆ COMPOSITUM, *U. S., P. G.*—COMPOUND DECOCTION OF SARSAPARILLA.

Decoctum sarsæ compositum, Br.—*Tisane (Apozème) sudorifique, Décocté de salsepareille composé,* Fr.; *Zusammengesetztes Sarsaparilla-Decoct,* G.

Preparation.—Sarsaparilla, cut and bruised, 10 parts (5 oz. av.); Sassafras, in No. 20 powder, 2 parts (1 oz. av.); Guaiacum-Wood, rasped, 2 parts (1 oz. av.); Glycyrrhiza, bruised, 2 parts (1 oz. av.); Mezereum, cut and bruised, 1 part (½ oz. av.); Water a sufficient quantity; to make 100 parts (50 oz. av. or 48 fluidounces). Boil the sarsaparilla and guaiacum-wood for half an hour in a suitable vessel with 100 parts of water; then add the sassafras, glycyrrhiza, and mezereum; cover the vessel well, and macerate for 2 hours; finally strain, and add enough cold water, through the strainer, to make the product weigh 100 parts.—*U. S.*

Take of Jamaica Sarsaparilla, cut transversely, 2½ ounces; Sassafras-Root, in chips, Guaiacum-Wood turnings, Dried Liquorice-Root, bruised, each ¼ ounce; Mezereon-Bark ⅛ ounce; boiling Distilled Water 1½ pints. Digest the solid ingredients in the water for an hour, then boil for 10 minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (Imperial).—*Br.*

Much of the oil of sassafras is lost by boiling; the first formula is therefore an improvement upon the old one, and has been constructed upon that of the French Codex, which directs boiling 3 parts of sarsaparilla and 6 parts of guaiacum-wood with 100 parts of water, then adding 1 of sassafras and 2 of liquorice-root, and macerating for 2 hours. It will be observed that this last is much the weaker preparation, and that mezereon-bark is not used in it. The first two are simplified formulæ for the *Lisbon diet-drink* or *Decoctum lusitanicum,* which was formerly much employed. The latter may also be said of *Zittmann's decoction,* of which a *stronger* and a *milder* one are used together. *Decoctum Zittmanni fortius:* Take of sarsaparilla-root, cut, 100 parts; digest in water 2600 parts for 24 hours, and add, enclosed in a linen bag, powdered sugar and alum, each 6 parts, calomel 4 parts, and cinnabar 1 part; then heat in a covered vessel placed in a steam-bath for 3 hours, stirring frequently, and near the end of the boiling add anise and fennel, bruised, each 4 parts, senna, cut, 24 parts, and liquorice-root, cut, 12 parts. Express, strain, set aside for some time, and decant to obtain 2500 parts of clear liquid. 2500 Gm. of this are to be divided into 8 parts. *Decoctum Zittmanni mitius:* Take the residue left from the preceding and 50 parts of sarsaparilla, heat with water 2600 parts for 3 hours in a covered vessel placed in a steam-bath, stirring frequently, and when near the end of boiling add lemon-peel, Chinese cinnamon, cardamom, and liquorice-root, each, cut and bruised, 3 parts. Express and operate as before to obtain 2500 parts.—*P. G.* 1872. The present Pharmacopœia omits for the strong decoction cinnabar and calomel, and orders of sugar, alum, and the aromatics each 5 parts, senna 25 and liquorice-root 10 parts; for the weak decoction the expressed residue is omitted, and 5 parts each of the flavoring ingredients are ordered.

Medical Uses.—The virtues of the preparation are chiefly due to sarsaparilla and mezereon, slightly reinforced by the sassafras, which, with the liquorice, serves to mask the acrid flavor of the mezereon. It is chiefly employed in the treatment of chronic *rheumatism*, *scrofula* of the bones, chronic *cutaneous diseases*, and, above all, constitutional *syphilis*. Whatever good it effects is mainly due to its promoting the secretions of the skin and kidneys. (See SARSAPARILLA.) The *dose* is 4 or 5 fluidounces (Gm. 130–160) three or four times a day.

DECOCTUM SCOPARII, *Br.*—DECOCTION OF BROOM.

Tisane de genêt à balais, Fr.; *Besenginster-Absud*, G.

Preparation.—Take of Broom-Tops, dried, 1 ounce; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial). —*Br.*

Medical Uses.—The decoction of broom is apt to excite irritation of the kidneys and urinary passages, and decidedly to increase the quantity of urine. It is the best form in which broom can be administered for the removal of *dropsical effusions*. It should be given in doses of 2 fluidounces (Gm. 60) repeated at intervals, so that from half a pint to a pint (Gm. 250–500) may be taken during the day. A compound decoction may be prepared by boiling broom-tops, dandelion, and juniper-berries, of each ½ ounce, in 1½ pints of water to a pint. *Dose*, 1 or 2 fluidounces (Gm. 30–60).

DECOCTUM TARAXACI, *Br.*—DECOCTION OF DANDELION.

Tisane de pissenlit, Fr.; *Löwenzahnwurzel-Absud*, G.

Preparation.—Take of dried Dandelion-Root, sliced and bruised, 1 ounce; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

Dandelion-root, if properly cut and bruised, is readily extracted by hot water.

Medical Uses.—This preparation represents all the virtues of taraxacum, and is the most suitable mode of exhibiting the medicine. As it is apt to ferment, it should be freshly made when used. The *dose* is 2 or 3 fluidounces (Gm. 60–90), and should be taken about half an hour before meals. Its efficacy is increased by simple bitters, such as gentian and columbo, or by a little orange-peel added near the end of ebullition.

DECOCTUM ULMI.—DECOCTION OF ELM-BARK.

Décocté d'orme, Fr.; *Ulmenrinden-Decoct*, G.

Preparation.—Take of Elm-Bark, cut in small pieces, 2½ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.* 1867.

Medical Uses.—The decoction of this elm-bark is mucilaginous, bitter, and astringent. It is probably not much used in this country. The *dose* is from 2 to 4 fluidounces (Gm. 60–120).

DIGITALIS, *U. S.*—DIGITALIS.

Digitalis folia, Br.; *Folia digitalis*, P. G.—*Digitalis-leaves, Foxglove-leaves*, E.; *Feuilles de digitale pourprée* (*de grande digitale*), Fr.; *Fingerhutkraut*, G.

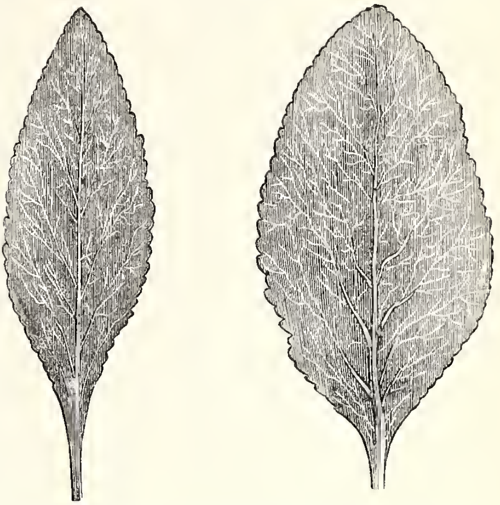
The leaves of Digitalis purpurea, *Linné* (D. tomentosa, *Link et Hoffmann*). Woodville, *Med. Bot.*, plate 24; Bentley and Trimen, *Med. Plants*, 195.

Nat. Ord.—Scrophulariaceæ.

Origin.—Foxglove is a biennial plant indigenous to Southern and Central Europe, particularly in the western section, and grows wild as far north as Norway, likewise in Madeira and the Azores. It is found on the edges of woodlands and thickets in rather sandy soil, and is generally absent from calcareous districts. It is well known as an ornamental garden-plant. The stem is 2 to 5 feet (0.6 to 1.5 M.) high, has alternate leaves, and a long terminal raceme of handsome purplish-crimson and tubular bell-shaped flowers, producing an ovoid glandular pubescent capsule with numerous small seeds. The leaves, which on drying diminish in weight about 75 per cent., should be collected from wild plants growing in mountainous regions when about two-thirds of the flowers are expanded; the leaves of plants grown in plains proved to be less active, according to W. Mayer (1880) and others. F. Schneider (1869) found the radical leaves collected in September of the first year to be very efficacious.

Description.—The radical leaves are 6 to 12 inches (15 to 30 Cm.) long, ovate or oblong-ovate, rather obtuse, at the base contracted into a winged petiole 4 to 6 inches (10 to 15 Cm.) long. The margin is rather irregularly doubly crenate, the upper surface is wrinkled, dull-green, and soft-downy; the lower surface is of a grayish color, densely pubescent and prominently reticulate; the midrib is broad toward the base, and of a slight purplish tint. The stem-leaves are gradually reduced in size and upon shorter petioles, the uppermost being sessile, oblong-lanceolate, and obscurely crenate. The dried leaves have a faint tea-like odor and a bitter rather disagreeable taste. In cultivation the plant usually becomes less hairy, and the radical leaves of the first year's growth are usually narrower and more oblong-lanceolate in outline. The following reactions may be used for determining the absence of leaves containing tannin, and the presence of a proper amount of digitalin: "The infusion, prepared with 10 parts of boiling water, should be of a brownish color, of an acid reaction, of a peculiar odor, and of a nauseously bitter but not aromatic taste; it should on the addition of ferric chloride acquire a darker color, and after several hours a brown precipitate (absence of leaves containing tannin, giving blue-black or black-green precipitates); on dropping tannin solution into the infusion a copious precipitate should be produced, which is with difficulty dissolved by an excess of tannin; the same infusion, diluted with 3 parts of water, should, on the addition of tannin, become turbid (digitalin-tannin)."—*P. G.*

FIG. 101.



Digitalis purpurea, *Linne*: leaf of the first and of the second year's growth.

Constituents.—The medicinally active principle has been named digitalin, and is described below.

DIGITALINUM.—Digitalin, *E.*, *G.*; Digitaline, *Fr.*—The following directions are given for its preparation: Take of Digitalis-Leaf, in coarse powder, 40 ounces; Rectified Spirit, Distilled Water, Acetic Acid, Purified Animal Charcoal, Solution of Ammonia, Tannic Acid, Oxide of Lead, in fine powder, and Pure Ether, of each a sufficiency. Digest the digitalis with a gallon of the spirit for 24 hours at a temperature of 120° F.; then put them into a percolator, and when the tincture has ceased to drop pour a gallon of spirit on the contents of the percolator, and allow it slowly to percolate through. Distil off the greater part of the spirit from the tincture, and evaporate the remainder over a water-bath until the whole of the alcohol has been dissipated. Mix the residual extract with 5 ounces of distilled water, to which ½ ounce of acetic acid has been previously added, and digest the solution thus formed with ¼ ounce of purified animal charcoal; then filter, and dilute the filtrate with distilled water until it measures a pint. Add solution of ammonia nearly to neutralization, and afterward add 160 grains of tannic acid dissolved in 3 ounces of distilled water. Wash the precipitate that will be formed with a little distilled water; mix it with a small quantity of the spirit and ¼ ounce of the oxide of lead, and rub them together in a mortar. Place the mixture in a flask, and add to it 4 ounces of the spirit; raise the temperature to 160° F., and keep it at this heat for about an hour; then add ¼ ounce of purified animal charcoal; put it on a filter, and from the filtrate carefully drive off the spirit by the heat of a water-bath. Lastly, wash the residue repeatedly with pure ether.—*Br.* 1867.

The process of the U. S. P. 1870 was nearly identical with the foregoing. Thus prepared, digitalin forms a white or yellowish-white powder, or it may be obtained in porous mammillated masses or scales. It is inodorous and has an intensely bitter taste; is soluble in alcohol, but almost insoluble in water and in ether. It dissolves slightly in dilute acids without neutralizing them; its solution in concentrated hydrochloric acid is yellowish, but rapidly becomes green, and after some time deposits a green powder. Its dust is irritating and sternutatory. Heated upon platinum-foil, it burns with a sooty flame, finally leaving no residue. The readiness with which the active principle of digitalis as it exists in the plant is altered has been repeatedly pointed out. The properties given by both the former British and United States Pharmacopœias are those mentioned by Homolle (1844) and Quevenne. and by the French Codex for a digitalin prepared, according to Homolle's process, by precipitating gummy and coloring matter from the cold prepared aqueous infusion with subacetate of lead, removing the excess of lead by carbonate of sodium, precipitating with tannin, and treating further in a manner somewhat similar to the preceding process. But the process as described above is that of O. Henry (1845), which yields a different product. Lefort (1864) pointed out that two kinds of digitalin are in the market—namely, *French* or *insoluble digitalin*, which is that of Homolle; and *German or soluble digitalin*, which is readily soluble in water, also in concentrated hydrochloric acid, the solution becoming yellow, brown, and finally a dull green; exposed to the vapor of hydrochloric acid, it turns brown, while insoluble digitalin turns green. Soluble digitalin is made in Germany by processes analogous to that of Henry, and by modifications as suggested by G. F. Walz in his investigations of digitalis (1851 to 1858). Kosmann (1875) endeavored to explain the discrepant results as follows: The active principle of digitalis, which is freely soluble in water, has been named by various authors *digitasolin*, *digitaletin*, *digitalein*, and *digitalin;* it exists in the leaves and seeds. is $C_{27}H_{45}O_{15}$; a compound of 1 molecule of digitalretin and 2 of glucose. and is readily altered even in the plant by saline and acid bodies, and converted into glucose and *insoluble digitalin* (*digitaletin* of Walz), which is $C_{21}H_{33}O_9$, and represents 1 molecule each of digitalretin and glucose. Both digitalins are very bitter and energetic medicinal agents. By the further action of hot dilute acids insoluble digitalin is split into glucose, and *digitalretin* (*paradigitalretin*), $C_{15}H_{25}O_5$, which is slightly bitter, is soluble in alcohol. slightly so in ether, but insoluble in water and alkalies. The continued action of dilute acids results in the production of *dehydrated digitalretin*, $C_{15}H_{21}O_3$, which is resin-like. insoluble in water, soluble in alcohol, ether, and ammonia-water, and has an acrid taste; it has likewise been called *paradigitalein.* Kosmann considers Nativelle's *crystallized digitalin* as being intermediate in composition between insoluble digitalin and digitalretin.

Nativelle's process (1874) is as follows: 1000 Gm. of powdered digitalis-leaves are macerated for 24 hours in a solution of 250 Gm. of acetate of lead in 1000 Gm. of water, then displaced with 50 per cent. alcohol, the percolate treated with 20 Gm. of sodium bicarbonate, and distilled and evaporated to 2000 Gm.; when cool it is mixed with 2000 Gm. of water, and after several days decanted. The precipitate is drained, pressed, mixed with 1000 Gm. of 80 per cent. alcohol, and heated to boiling; 10 Gm. of neutral lead acetate are added, the boiling continued for a few minutes, and when cool the liquid is filtered. The filtrate is mixed with 50 Gm. of powdered wood-charcoal, and distilled, the charcoal exposed to expel the alcohol, drained, dried, and percolated with chloroform. The impure digitalin left on evaporation is dissolved in 100 Gm. of 90 per cent. alcohol. the solution mixed with a concentrated solution of 1 Gm. of lead acetate and with 10 Gm. of granular animal charcoal, boiled for a few minutes, cooled, filtered, and distilled. The granular crystals are drained, dissolved in 10 Gm. of hot alcohol; 5 Gm. of ether and 15 Gm. of water are added, and the whole well shaken together. The ether removes a colored fixed oil, and crystalline digitalin is deposited, which. if necessary, is again subjected to the same process of purification. It crystallizes from hot alcohol in the form of white slender brilliant needles. This is the Digitalina cristallisata, *F. Cod.*

A *digitalin* obtained from the seeds was found by Delffs (1858) to have the composition $C_{17}H_{30}O_7$, and to be colorless, crystalline, readily soluble in alcohol, ether, or chloroform, and not colored by concentrated mineral acids. Schmiedeberg (1875) obtained *digitoxin*, another active principle, from the leaves previously exhausted by water; it is entirely insoluble in water, benzol, or carbon bisulphide, very sparingly soluble in ether, slowly soluble in chloroform, and readily in alcohol, and crystallizes from the saturated solution in hot spirit of chloroform; its solutions are intensely bitter; its composition is $C_{31}H_{33}O_7$. It is not a glucoside, but acids convert it into *toxiresin*, which, like digitoxin, has a powerful action on the heart. Schmiedeberg examined also a commercial digitalin made from the seeds, and found in it *digitonin*, *digitalin* (Kosmann's insoluble digitalin?), and *digitalein.* The latter is yellowish, not colored red by boiling hydrochloric acid, and freely soluble in water, yielding a frothing solution; otherwise it resembles digitalin. This compound is $C_5H_8O_2$, forms soft colorless grains, is nearly insoluble even in boiling water, sparingly soluble in ether and chloroform, dissolves freely in alcohol, spirit of chloroform, and acetic acid, and with warm sulphuric acid strikes a yellow or yellowish-green color, turning red with potassium bromide. Digitonin, $C_{31}H_{52}O_{17}$, is colored red by boiling dilute sulphuric acid, and dissolves in alcohol, spirit of chloroform, and water, this last solution being frothing and precipitated by baryta-water, like saponin. These bodies are readily altered under various circumstances, and their relation to each other and to the active principle or principles naturally contained in the plant must be left to further careful investigation. Duffield (1868) obtained by the officinal process 0.8 to 0.9 per cent. of digitalin from European and American digitalis-leaves.

W. Engelhardt (1862) obtained a physiologically active volatile alkaloid from the leaves; it was also noticed by F. F. Mayer in the leaves, but not in the extract of digitalis. An acrid principle, *scaptin*, was obtained by Radig (1835) in a very impure state, and purer by Walz (1858) as *digitalacrin*. Walz (1852) separated *digitalosmin*, a pearly acrid stearopten of the odor of digitalis. Morin's (1845) *antirrhinic acid* likewise possesses some odor. The *digitoleic acid* of Kosmann and *digitaloic acid* of Walz are volatile and fatty, and probably identical. Schmiedeberg observed a yellow coloring matter which is probably identical with chrysophan.

The other constituents of digitalis are not of medicinal or pharmaceutical importance; they comprize chlorophyll, mucilage, albumen, various salts, and *inosite*, observed by Marmé (1864).

Adulterations and Substitutions are said to have occasionally occurred, but the physical characters of digitalis-leaves are so marked that they cannot easily be confounded with other leaves, even if they are in a broken condition; the rugose upper surface, the crenate margin, and the densely-pubescent lower surface, with its well-defined meshes of white prominent veins, are not met with in any other officinal leaf. As accidental impurities have been mentioned the nearly smooth leaves of Digitalis ochroleuca, *Jacquin*, the stellately hairy and mucilaginous leaves of species of Verbascum, and the nearly entire, obscurely reticulate, and (upon the upper side) rough leaves of Conyza squarrosa, *Linné* (s. Inula Coniza, *De Candolle*), and Symphytum officinale, *Linné*.

Off. Prep.—Abstractum digitalis, *U. S.*; Digitalinum, *Br.*; Extr. digitalis, Extr. digitalis fluid., *U. S.*; Infusum digitalis, Tinctura digitalis, *U. S.*, *Br.*

Physiological Action.—*On Plants and Animals:* Plants watered with an infusion of digitalis wither and die. Fish placed in a weak infusion of the plant die in spasm, with the ventricle of the heart contracted. Digitalin used hypodermically in frogs occasions a tetanoid rigidity of the muscles and an irregular tonic contraction of the heart, with slowness and unsteadiness of its rhythm. The auricle does not seem to participate in this action of the ventricle, but becomes distended as the capacity of the ventricle diminishes. At the same time the pulse-rate declines and the blood-pressure increases. But if the dose of digitalin has been directly poisonous, the pulse-rate rises and the blood-pressure diminishes. Toxical doses of digitalis given to birds, dogs, and other animals occasion active intestinal irritation, with watery or bloody dejections. Carnivorous animals are, more readily than the herbivorous, poisoned by this agent.

The action of poisonous doses of digitalis and its preparations upon the circulatory system, as illustrated by experiments upon animals, is shown first by an increase usually both of the rate and force of the pulse, while the action of the heart is strong and abrupt, and perhaps accompanied by a murmur. But sometimes the primary operation reduces the number of pulsations while augmenting their force. There is no evidence that the volume of the pulse is increased; on the contrary, it denotes the circulation of a diminished amount of blood, and is due to a tonic contraction of the ventricle, which finally arrests the circulation. Indeed, experimental investigation has demonstrated that large doses of digitalin produce a marked contraction, and even a complete closure, of the capillary vessels—a condition which necessarily involves an increased blood-pressure in the larger arteries; a conclusion confirmed by the experiments of Donaldson and Stevens (*Med. News*, xli. 697). At the same time, the heart's diastole is lengthened, it may be to fourfold the normal duration; and this it is that causes the characteristic retardation or infrequency of the pulse. Meanwhile, the auricle does not participate in the contraction affecting the ventricle, but becomes distended by the accumulated blood. The mechanism of these effects is explained to be a primary stimulation and a subsequent paralysis of the inhibitory nerve of the organ, and irritation of the motor nerves.

Later researches have not materially changed the conclusions now stated. The results of different experimenters differ, as in most other cases; thus, according to some, the auricle as well as the ventricle is contracted in death, while the greater number state that the auricle is distended, but the ventricle contracted. The latter act appears to be the result of a gradual and progressive movement, which has been compared to peristalsis. It also is shown that while repeated small doses of digitalis cause a persistent slowing of the heart, large ones directly accelerate it (Chappet. *Contribution à l'étude de la digitale*, 1879; Cadeat, *Bull. de thérap.*, xcvi. 558; F. Williams, *Arch. exper. Pathol., etc.*, xiii. 8; Leyden, *Zeitschr. f. klin. Med.*, iii. 559; Kaufmann, *Bull. de thér.*, ci. 191).

Digitalis is held to act on the vaso-motor centre, and thus to produce contraction of the peripheral arterioles. In exceptional cases, after a lethal dose of digitalin the heart is found in diastole, and will not contract under the strongest galvanic stimulus; but, in general, when animals are killed by digitalis or by digitalin the heart is found strongly contracted. If, before death, aconite is duly administered, it will delay the fatal event, or perhaps prevent it altogether; for aconite tends to relax the heart-muscles, and in animals killed by it the heart is found in diastole. Respiration follows the circulation in its changes, becoming infrequent when the pulse is slow and hurried when the pulse is rapid. The temperature of the body is not materially affected, nor uniformly in the same manner. The preceding statement of the physiological action of digitalis was originally summarized by Niemeyer, who said that "it fills the arteries by emptying the veins." Fothergill finds in his own experiments, observations, and reasonings sufficient confirmation of this view. But the inquiry naturally suggests itself: If the whole arterial system, from the left ventricle of the heart to the systemic capillaries, is in a state of tonic contraction, must not the blood accumulate in the venous system and overload it? But as it evidently does not accumulate there, but, on the contrary, is prevented from so accumulating by digitalis, the mechanism by which the medicine maintains the balance of the circulation would seem to involve some other factor. This may possibly be the increased propulsive power with which the blood passes from the arteries into the veins; so that, although the amount of blood in the arteries is actually diminished and that in the veins increased, yet the rate of movement of the blood-current due to the arteries themselves may be so much accelerated as to overcome infarctions and prevent effusions. The intrinsic diuretic action of digitalis seems to have been asserted by nearly all the early experimenters, but more prolonged and accurate observations prove that no such operation belongs to it.

Extract of Adonis vernalis is stated by Bubnoff to act upon frogs in a manner similar to digitalis—*i. e.* by producing a tonic contraction of the ventricle.

On Man: The symptoms produced by digitalis have been described in substantially the same terms by nearly all observers. The following summary, by Koppe, is complete in its details: In about an hour after taking 2 Mg. ($\frac{1}{33}$ gr.) of *digitoxin* he began to experience malaise, depression, faintness, nausea, and repugnance to food; in 3 or 4 hours the pulse fell from 80 to a point varying between 30 and 58; nausea was intense and indescribably distressing, and only momentarily relieved by a profuse vomiting of dark-green bile, and later of yellow bile; the pulse was intermittent, the features pale and collapsed. In 7 or 8 eight hours prostration was so extreme that without assistance it was impossible to stand; vision was so confused by an indefiniteness of outline that familiar objects and persons were not recognized, but the latter were known by their voices, and the whole field of vision was yellow. During the night bilious vomiting recurred at intervals, and was excited even by iced champagne. The following day the same symptoms continued: the pulse was 54 and intermittent, with a sense of præcordial sinking, and the sphygmographic tracing showed diminished force of the pulse, with inequality. The second night was disturbed with restlessness and nightmare. On the third day small quantities of water were retained, but the vision and the pulse remained as before. It was not until the fourth day that the experimenter was able to walk leaning on a friend's arm, and that the disorder of vision gradually subsided; sleep, which now was refreshing, and an almost voracious appetite, enabled him speedily to renew his strength (*Archiv f. exp. Pathol.*, iii. 289). In other cases in which digitalis or digitalin has been taken in excessive doses the symptoms were essentially the same as these.

Some points of diversity were observed in the following cases: A young man took 13.7 Gm. of digitalis-leaves (about 3 drachms) within 4 weeks; he suffered from severe gastric catarrh, dysphagia, and singultus, and died suddenly while standing (*Edin. Med. Jour.*, xxii. 180). A woman took 15 Mg. (gr. $\frac{1}{4}$) of digitalin; there was abundant urination, and in the course of 14 hours cramps in the legs; the pulse was usually 104, and at no time below 60 (*Phila. Med. Times*, iv. 506). A woman took 14 Mg. (gr. $\frac{1}{4}$) of digitalin on one day and 60 Mg. (gr. j) the following day. Violent pains affected the head and stomach, the pulse was 40 and very feeble, and there was almost complete suppression of urine (*ibid.*, viii. 417). A man took an infusion of 640 grains of digitalis. Two days after the more usual symptoms he suffered from violent headache, hallucinations of light, and aphasia that continued for 4 days (*Med. Record*, xxiv. 489). In several cases an erysipelatoid eruption, with subsequent desquamation of the skin, has followed the internal use of digitalis, and an ointment containing the drug has caused a papular eruption.

As regards the heart, digitalis and its preparations in small doses primarily increase the pulse-rate and tension, and, if continued, lower the rate without diminishing the tension. It is an error to suppose that the increased force of the arterial blood-current, as measured by the dynamometer, denotes an increased volume of that current; on the contrary, the arteries and the heart both experience tonic contraction under the influence of digitalis, and the supply of arterial blood is everywhere diminished. That digitalis does not give a real increase of power to the heart is shown by the fact that when the pulse-rate is slowest a comparatively slight muscular exertion, such as changing the recumbent for the erect posture, will sometimes cause the pulse to rise from the lowest point reached under the influence of the medicine to one far above the normal rate. This effect, however, is said to be produced only when the tonic action of the medicine is about to be replaced by exhaustion. The tendency to rigid contraction does not affect all the heart-muscles in an equal degree, but chiefly those of the left ventricle. It is this power which in certain cases of positive or relative debility of that ventricle renders the medicine a valuable remedy while its action is maintained within certain bounds, but beyond them it tends to obstruct the cardiac circulation, and, by suddenly preventing the free passage of blood through the heart, to cause death by syncope.

Digitalis is totally destitute of direct diuretic properties. The cases which led to a belief in its possessing them were those in which a diminished secretion of urine was produced by obstructive heart disease, with positive or relative debility of that organ. In a healthy state of the heart digitalis diminishes the amount of urine secreted, as well as the proportion of solid excrementitious matter contained in it. There is no reason to suppose that by its direct operation it stimulates any one of the functions. It certainly, in doses which exhibit its physiological operation, depresses the entire nervous system, impairs the digestion, diminishes urination, lowers the animal temperature, retards the respiration, and may for a time annihilate the activity of the genital organs. Its diuretic action, which is the strongest ground of its claim to merit as a medicine, appears, then, to be altogether indirect.

Medical Uses.—As was just stated, the diuretic virtues of digitalis are the most conspicuous, and long before its mode of action had been experimentally investigated it was established as the most efficient remedy for *dropsy* depending directly upon disease of the *heart* and upon that form of *renal disease* which consists of congestion and tubal obstruction depending upon obstacles to the cardiac circulation. On closer examination the affections which produce dropsy by hindering the cardiac circulation, particularly *valvular obstruction*, and notably *stenosis of the mitral valve*, and positive or relative *weakness of the heart-muscle*, were found to be most readily relieved by this medicine. By rendering the action of the heart stronger, as well as more tranquil and regular, and perhaps by producing contraction of the capillary arteries, the venous congestions which directly occasion dropsy are removed, degeneration of the liver or kidneys is retarded, and the absorption of the effused liquid necessarily follows. When dropsy depends upon a congested state of the kidneys, and to the prevented escape of water through these emunctories, and is cured by digitalis, the medicine probably acts by contracting the renal capillaries, and thereby lessening the engorgement which prevented their normal secretion from taking place. In general dropsy of whatever form debility of the circulation, whether it be due to cardiac embarrassment or to renal obstruction, is the essential condition for securing the diuretic operation of digitalis.

No particular lesion of the heart is by itself an indication or a contraindication for the use of digitalis; it is the phenomena which accompany, and usually are caused by, certain lesions that furnish an indication for the medicine. Nor is it indicated by mere irregularity of action due to nervous disorder of the heart itself, or to disease elsewhere acting by a reflex operation upon the heart. *Dilatation*, slight muscular *degeneration*, and *mitral obstruction* and *insufficiency* are the lesions whose effects are favorably influenced by digitalis, which increases the blood-supply to the heart itself, thereby improving its nutrition, renders the irregular heart rhythmical in its movements, and gives a tonic contractility to its flaccid muscles. But this very power is not without its danger if the weakness of the heart is excessive, especially through fatty degeneration. To slow the heart when its muscular structure is greatly impaired is to increase its embarrassment. To slow it when its muscle is simply hypertrophied is to counteract the conservative agency by which the hypertrophy was established, as in cases of *aortic* obstruction or insufficiency, or of both united. So long as the heart's movements are not arhythmical, or do not tend to become so during excitement of the organ, there is no indication for the use of digitalis. Whenever the rhythm of the heart is perverted, especially when its impulse is irregular in force as well as time, and this irregularity is associated with a corresponding irregularity in the duration and intensity of the murmurs and of the pulse, and when at the same time the arterial system is deficient in blood while the veins are overloaded with it, as shown by the feeble and usually irregular pulse, the dropsical limbs, the difficult breathing, the discolored face, and perhaps bloody expectoration and scanty urine, digitalis is clearly indicated. By its means the hurried pulsations are reduced to the normal rate and gain in regularity what they lose in frequency, and the dropsy, if that is present, begins to decline along with the disorder of the circulation. According to Fernet, it is usually on the third or fourth day that diuresis begins, especially in persons who have not become habituated to the drug, and continues for several, or indeed many, days after the medicine has been discontinued. It should not be resumed until either the heart falls again into disorder or the dropsical symptoms recur.

The false and absurd theory according to which the treatment of *fever* should consist of means tending directly and solely to reduce the pulse-rate has been illustrated by the use of digitalis in *typhoid fever*. Even its advocates have not shown that it abridges the disease or lessens its mortality, while it certainly tends to impair the digestion and reduce the strength, and may even occasion sudden death. The use of digitalis in other forms of fever is equally unsatisfactory, and justifies the judgment of Traube, that the true field of action for digitalis is not fever. That it is practically useful in febrile conditions with a feeble heart, as in *typhoid pneumonia* and *relapsing fever*, has been asserted (Fothergill), but has not been proved. Indeed, Liebermeister condemns digitalis in fever, both because its antipyretic operation is uncertain, and because, when it does take place, it is apt to be accompanied by disquieting symptoms. He even remarks that it can do no harm while the heart is strong (a case in which it is not needed) unless it brings on vomiting, as it often does, and should then be discontinued, but that where the heart is feeble it must be very circumspectly used. Indeed, the more frequent the pulse is in fever the less indication is there for digitalis. "A tendency to heart-paralysis is not neutralized, but rather promoted, by digitalis. It is only in an advanced stage of the attack, when the fever has subsided, and yet the pulse continues frequent and the heart weak, that an indication for digitalis arises similar to that in heart disease, and then it will reduce the frequent pulse and strengthen the heart for its work." Upon which it is sufficient to remark that food and cordials have always been found efficient in such conditions, and that they expose the patient to no possible risk, as digitalis does. The recent use of digitalis in fever is only a revival of the old application of it by Rasori to the treatment of *inflammations;* it has also been employed by some who were perhaps ignorant of the history of its vogue and of its condemnation. The results of its revival have been to prove that digitalis does not in the least modify favorably any acute inflammation, and especially *pneumonia*, *pleurisy*, and *pericarditis*, but that, on the contrary, it exposes the patient to the risk of sudden death. The only inflammatory affection in which it may be advantageously used is chronic *bronchitis* with profuse secretion, which is often confounded with consumption. There is no doubt that in this disease it has been found to lessen the pulmonary congestion and secretion, and thereby the dyspnœa, sweating, and wasting of strength which they cause. There is good reason for believing that certain forms of hæmorrhage may be controlled by digitalis, more particularly *uterine hæmorrhage*, whether due to congestion, to vascular relaxation, or to organic diseases of the uterus. Its utility in *pulmonary hæmorrhage* is less demonstrable. The mode of action of digitalis in these cases may be presumed to be analogous to that of ergot—viz. it causes a contraction of the arteries. The same mode of action may be attributed to the medicine in *delirium tremens*, in which it is reputed to be highly efficient if given in large doses, such as ½ fluidounce (Gm. 16) of the tincture, and even as much as 28 fluidrachms (Gm. 100). More frequently, however, doses of 1 or 2 fluidrachms (Gm. 4–8), repeated every 3 or 4 hours, have been employed. It would appear that there is something in this affection which ensures a singular toleration of the medicine. But the necessity of using it at all, and thereby incurring a risk which experience has shown to be occasionally a fatal one, is not apparent in relation to a disease which nearly always recovers under judicious hygienic treatment when the patient's constitution is sound. Digitalis was formerly esteemed as a remedy for *epilepsy*, and recently it has been used by Gowers along with belladonna to reinforce the action of the bromides, and was found by him distinctly more useful than the bromides alone (*Times and Gaz.*, April, 1880, p. 447). The anaphrodisiac virtue of digitalis has been found useful in preventing *erections of the penis* due to local irritation, and also nocturnal *seminal emissions* and other effects of genital excitement. In *poisoning by aconite* digitalis is physiologically indicated, and published cases are supposed to furnish clinical evidence of its value. A man had taken an ounce of strong tincture of aconite, had cold hands and feet, a dusky and moist skin, frothed at the mouth and nose, and was pulseless. An emetic caused vomiting and purging; 20 drops of tincture of digitalis were injected subcutaneously, and galvanism applied to the cardiac region and kept up for 20 minutes. The patient being now able to swallow, some ammonia and brandy, with a teaspoonful of tincture of digitalis, was given, and he recovered perfectly (*British Med. Jour.*, Dec. 1872, p. 680). The use of galvanism, emetics, and diffusible stimulants in this case lessens the value of the evidence in favor of digitalis. In a later case (*Boston Med and Surg. Jour.*, Oct. 1879, p. 544) of recovery under similar treatment it is stated that the hypodermic injection of 15 drops of tincture of digitalis was "followed at once by quite a decided increase in the volume of the pulse," and the patient recovered.

Digitalis has been used as a local application to promote the resolution of *enlarged glands*, and also in infusion or tincture applied to the abdomen, especially in cases of *renal dropsy*. In the former case iodine is preferable, and in the latter the medicine should rather be given internally.

Administration.—Digitalis is given in doses of 1 or 2 grains (Gm. 0.06–0.12) twice or thrice daily until its effects begin to appear, when it should be at once suspended or diminished. The infusion of the fluid extract or the tincture is preferable, and of these the first is by far the most efficient. Besides the officinal infusion, one may be prepared daily with about 3 grains (Gm. 0.20) of digitalis in about 6 ounces (Gm. 200) of hot water, sweetened, and flavored with tincture of cinnamon, bitter orange, or mint. This quantity should be given in three or four doses at regular intervals. There is no doubt that small are preferable to large doses, for if they produce their proper medicinal effects a little later, it is without risk. And it should be understood that these effects are not to be looked for for several days. Poisonous effects are to be combated by wine, opium, and strong coffee. Strychnia has been recommended as a physiological, and tannin as a chemical, antidote. If a poisonous dose has been recently swallowed, ipecacuanha, mustard, and other prompt emetics should be administered. The variable strength of *digitalin* requires that it should be used very cautiously, beginning with the minimum dose, which may be stated at gr. $\frac{1}{60}$ (Gm. 0.001). This dose may be repeated at intervals of 6 or more hours, and gradually and continuously increased, but so as not to exceed gr. $\frac{1}{6}$ (Gm. 0.01) during 24 hours.

DIOSCOREA.—WILD YAM, COLIC-ROOT.

The rhizome of Dioscorea villosa, *Linné.*

Nat. Ord.—Dioscoreaceæ.

Origin.—Wild yam is a diœcious climbing perennial growing in thickets in moist localities of the United States south to Florida and west to the Mississippi. The leaves are alternate, opposite or whorled, broadly ovate-cordate, acuminate, nine- to eleven-ribbed, nearly smooth above, downy and paler beneath. The fruit is a triangular-winged capsule growing in pendulous bunches.

Description.—The rhizome is horizontal, about $\frac{1}{2}$ inch (13 Mm.) thick, somewhat flattened above, repeatedly forked or branched and bent, 6 inches (15 Cm.) or more in length, on the lower side with distant simple wiry rootlets from 2 to 4 inches (5 to 10 Cm.) long. The rhizome is externally of a pale yellowish-brown color, and breaks with some difficulty, showing internally a compact white tissue with numerous scattered yellowish wood-bundles. It is inodorous, and has a taste at first insipid, and afterward strongly acrid. In Virginia it is known as *rheumatism-root.*

Constituents.—Wild yam contains much starch. The acrid principle has not been isolated; it appears to be gradually altered on boiling the rhizome with water.

Other Species.—Most species of Dioscorea which are indigenous and cultivated in the East and West Indies and in other tropical countries have large farinaceous edible tubers, which are known as *yam*, E., G.; *igname*, Fr. The following are the most important: D. ALATA, *Linné*, *White negro yam;* D. TRIPHYLLA, *Linné*, *Buck yam;* D. TRIFIDA, *Linné*, *Indian yam;* D. BULBIFERA, *Linné*, *Ceylon white yam;* and D. SATIVA, *Linné*, *Common yam.*

The smaller cylindrical tuberous rhizomes of D. JAPONICA, *Thunberg*, and D. QUINQUELOBA, *Thunberg*, are eaten in Japan. The former is about 4 inches (10 Cm.) long, farinaceous and white; the latter is smaller, externally pale-brown, internally dingy-white, and has a bitterish taste.

Medical Action and Uses.—Time has not increased our knowledge of the medicinal qualities of wild yam more than it has that of many other indigenous plants which were long ago reputed to be valuable medicines. We are therefore compelled to repeat, without addition or modification, the old-time statement that, according to Riddell, "a decoction of it is eminently beneficial in bilious colic," and that Dr. Neville "places much reliance on the tincture as an expectorant, and also that it acts as a diaphoretic, and in large doses as an emetic." In Iowa it is known as "colic-root." If these statements are correct, it may be assumed that dioscorea has some of the qualities of ipecacuanha. The resin precipitated by water from the tincture is said to produce effects analogous to those above enumerated, and has been prescribed in doses of from 1 to 5 grains (Gm. 0.06–0.30).

DIOSPYROS.—PERSIMMON, DATE-PLUM.

Fruits de plaqueminier de Virginie, Fr.; *Persimmonfrüchte*, *Dattelpflaumen*, G.

The unripe fruit of Diospyros virginiana, *Linné*.

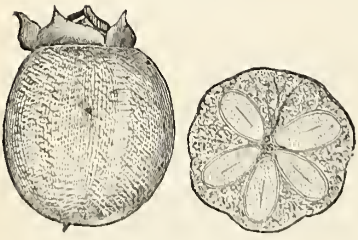
Nat. Ord.—Ebenaceæ.

Origin.—The persimmon tree is indigenous to the United States, and grows in woodlands, in low grounds, and along streams from the New England States west to Illinois, and in the Southern States. It attains a height of 50 to 60 feet (15 to 18 M.), is irregularly branched, has nearly smooth, subcoriaceous, ovate-oblong leaves, and produces in May and June axillary and solitary fertile flowers with eight stamens and clustered sterile flowers with sixteen stamens. The fruit ripens in November, but should be collected not later than October, while green.

Description.—The fruit is a globular berry about an inch (25 Mm.) in diameter, with a short foot-stalk, and the permanent four-lobed calyx at the base, green, smooth, and four- to six-celled, each cell containing a single flat ovate-oblong seed. The unripe persimmon has a short remnant of the style attached, is of a pleasant but weak odor, and contains a viscid juice of a very astringent taste, which is retained when carefully dried, but becomes acidulous-sweet after the fruit has been exposed to the frost.

Constituents.—B. R. Smith (1846) found the unripe fruit to contain tannin, malic acid, and sugar. J. E. Bryan (1860) detected also pectin, and regards the tannin as distinct from the tannin of galls. Charropin (1873), however, considers it identical with the latter, and isolated also a yellow coloring matter which is insoluble in water, but readily soluble in ether.

FIG. 102.



Diospyros virginiana: fruit and transverse section, natural size.

The ripe fruit is edible. Mixed with flour, a pleasant bread or cake is made of it. When kneaded with half its measure of wheat-bran and well baked in an oven, a bread is obtained which in the Southern States is preserved for making *persimmon beer* by fermenting it with some hops. Such beer is also made from the fresh fruit, and by distillation alcohol may be obtained.

Allied Plants.—DIOSPYROS EMBRYOPTERIS, *Persoon* (Bentley and Trimen, *Med. Plants*, 168). The orange-yellow fruit is about 2 inches (5 Cm.) in diameter, about ten-celled, very astringent in its unripe state, and is used in India like persimmon.

DIOSPYROS KAKI, *Linné filius*, a medium-sized tree of China and Japan, has a sweet, reddish fruit, which, preserved with sugar, is occasionally seen in our market, being sold as *Chinese or Japanese persimmon*.

Medical Action and Uses.—The unripe fruit, and also the inner bark, are astringent and bitter, and are used, like other products of the same nature, in the treatment of chronic and subacute *diarrhœa*, *leucorrhœa*, *sore throat*, and *uterine hæmorrhage*. It is also sometimes employed as a tonic and febrifuge. The most convenient preparation is an infusion or a vinous tincture, which may be made by percolation with an ounce of the dried unripe fruit or of the bark to half a pint or less of the menstruum. It may be prescribed in doses of from ½ ounce to 2 fluidounces (Gm. 15–60).

DIRCA.—Leather-Wood.

Dirca palustris, *Linné.*

Nat. Ord.—Thymelaceæ.

Description.—The leather-wood, also called *moose-wood*, *rope-bark*, and in New England *wicopy*, grows in rich damp woods from South Carolina northward to Canada, and is a much-branched shrub about 4 feet (1.2 M.) high, with the branches apparently joined, and with soft white and brittle wood. The smooth yellowish-brown or brown-gray bark is very fibrous and remarkably tough, hence the common names. The leaves are alternate, about 3 inches (75 Mm.) long, subsessile, oval-obovate, acute at each end, pale-green and slightly hairy beneath. The flowers precede the leaves, are in clusters of two to four, have a light-yellow tubular funnel-shaped, four-toothed calyx, eight slender stamens, and ripen an oval, one-seeded, reddish, drupaceous fruit, which is about ¼ inch (6 Mm.) in diameter. All parts of it, but the bark in a greater degree, have a nauseous and acrid taste, and contain an unknown acrid principle, which appears to be freely soluble in alcohol, but slightly soluble in water.

Allied Plants.—Besides the different species of Daphne (see Mezereum), the following deserves to be briefly noticed as possessing similar virtues:

Lagetta lintearea, *Lamarck*, s. Daphne Lagetta, *Swartz.*—Lace tree.—A small tree of Jamaica and other West Indian islands, with small white, nearly sessile flowers, evergreen shining ovate-cordate leaves, and a brownish or ash-colored bark, the liber of which is readily separable into twenty or more transverse bast-layers having the appearance of delicate lace.

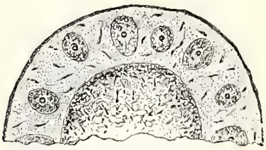
Medical Action and Uses.—The berries are emetic and poisonous. The fresh bark, applied to the skin, causes redness and vesication and sores which are very difficult to heal. When chewed it excites free salivation and causes pain and soreness of the mouth—qualities which have led to its being used as a masticatory in *toothache.* These qualities are very analogous to those of mezereon. The powdered bark is emetic and purgative, and a decoction of it is sudorific and expectorant. As an emetic it may be given in doses of 5 or 6 grains (Gm. 0.30–0.40).

DRACONTIUM.—Dracontium.

Skunk-cabbage, *Skunk-weed*, *Polecat-weed*, E.; *Racine de pothos fétide*, Fr.; *Stinkende Drachenwurzel*, G.

The rhizome and roots of Dracontium fœtidum, *Linné*, s. Ictodes fœtidus, *Bigelow*, s. Symplocarpus fœtidus, *Salisbury*, s. Pothos fœtida, *Michaux.* Meehan, *Native Flowers*, i. pl. 15.

Fig. 103.



Dracontium fœtidum: section through one-half of upper part of rhizome, natural size.

Nat. Ord.—Araceæ.

Origin.—This common North American perennial grows in bogs and moist grounds, and flowers in April and the early part of May. The spathe, which precedes the leaves, is hooded-shellform, pointed, rather fleshy, of a variegated purplish-brown and yellow color, and encloses a short oval spadix which is densely tessellated with fleshy flowers, and enlarges finally to a spongy mass superficially covering the globular seeds. The leaves are radical, 1½ to 2 feet (45 to 60 Cm.) long, on short petioles, smooth, ovate, and heart-shaped. All parts have a very fetid odor, which on bruising is more decided.

Description.—The rhizome, which should be collected early in the spring, is tuberous, truncate above and below, 3 to 4 inches (7 to 10 Cm.) long and about 2 inches (5 Cm.) in diameter, of a gray-brown color, the upper half beset with numerous long fleshy rootlets, which in drying become much shrivelled and longitudinally wrinkled, and are of a lighter color and weaker taste than the rhizome. The latter is white internally, or gray when old, has the fibro-vascular bundles scattered, but rather crowded within the nucleus-sheath, and possesses a very acrid and biting taste, which is gradually lost when long kept.

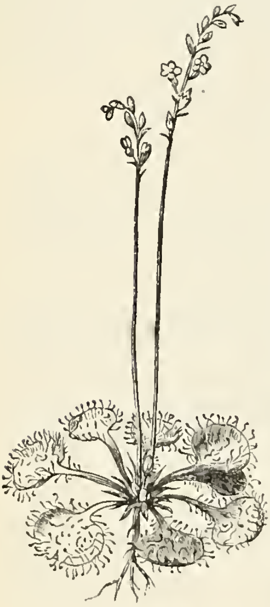
Constituents.—The root was analyzed by J. M. Turner (1836), who did not succeed in isolating the acrid principle, which appears to be altered by heat, and who obtained from it a volatile fatty matter, a little volatile oil, resin, wax, fixed oil, sugar, gum, and starch.

Medical Action and Uses.—Dracontium, when chewed, produces irritation of the mouth, and, applied to a freshly-blistered surface, augments its secretion. Internally, it occasions vertigo, nausea, and frequently vomiting. Its fetid smell probably suggested its employment as an anti-spasmodic, and reports are not wanting of its having cured *hysteria*, *chorea*, and spasmodic *asthma*, and even *chronic bronchitis*, *chronic rheumatism*, and *dropsy*. The *dose* is from 10 to 20 grains (Gm. 0.60–1.20) of the recently-dried root. An infusion made with an ounce (Gm. 32) of the dried root to a pint of water may be prescribed in doses of 1 or 2 tablespoonfuls. A saturated tincture made in the same manner may be given in the dose of 1 or 2 teaspoonfuls.

DROSERA.—SUNDEW.

Herba rorellæ.—Rossolis, Rosée du soleil, Fr.; *Sonnenthau*, G.

FIG. 104.



Drosera rotundifolia, natural size.

The entire plant, Drosera rotundifolia, *Linné*.

Nat. Ord.—Droseraceæ.

Description.—This little perennial is frequently met with in peat-bogs and near swamps in Europe and North America, particularly in the northern section of this continent. It has a tuft of petiolate radical leaves which are nearly orbicular, fleshy, and upon the upper surface covered with numerous whitish or, toward the margin, purplish glandular bristles. The scape is about 4 inches (10 Cm.) high, and bears a circinate one-sided raceme of small flowers with five white petals, five stamens, and three styles. The plant flowers in July and August, is inodorous, and has an acidulous, bitterish, and acrid taste. According to Vigier (1878), the plant loses on drying 85 per cent. of moisture, and when dry yields 25 per cent. of extract with 60 per cent. alcohol.

The nearly-allied D. longifolia, *Linné*, s. D. intermedia, *Hayne*, likewise a native of both continents, is chiefly distinguished by its spatulate-oblong leaves.

Constituents.—The juice of sundew was examined by Trommsdorff (1833), who found in it free malic acid, various salts, and a red coloring matter, which is precipitated by acetate of lead. Hager believed the acid to be a mixture of citric and malic acids. Lugan (1878) succeeded in crystallizing it, and regards it as peculiar; but G. Stein (1879) showed it to be citric acid. By treatment with chloroform, Lugan extracted a greenish-brown, odorous, and very acrid resin; the juice contains also glucose, and the viscous exudation of the glands has a neutral reaction, and does not contain formic and butyric acids, the presence of which was reported by Reiss and Will.

Medical Action and Uses.—Two species which have been used in medicine, D. rotundifolia and D. longifolia, appear to be identical in their qualities. In Europe for several centuries they had a popular reputation as remedies in chronic bronchitis and asthma, and externally the juice was applied to remove warts. In 1860 some attempts were made to revive the use of this medicine by employing its expressed juice, which, however, it was found, might be taken to the extent of 3 or 4 ounces daily without producing any distinct effects. Some cases of *bronchitis* were reported to be benefited by it, and in *whooping cough* it appeared sometimes to exert a palliative influence, particularly by lessening the tendency to vomit during the paroxysms. This effect has been very plausibly attributed to the preparation employed—viz. one made by macerating the plant in alcohol. Murrell, however, alleges that while 5-drop doses of a "one-in-ten tincture" aggravated the cough in a case which he treated, ½-drop doses palliated, and then arrested, the cough (*Lancet*, Apr. 17, 1880).

DUBOISIA.—DUBOISIA.

The leaves of two species of Duboisia, indigenous to Australia.

Nat. Ord.—Solanaceæ, Salpiglossideæ.

Description.—DUBOISIA MYOPOROIDES, *R. Brown*, is a tree-like shrub. Its leaves are alternate, short-stalked, smooth, 2 to 4 inches (5–10 Cm.) long, ½ to 1 inch (12–25 Mm.) broad near the middle, lanceolate, entire and slightly revolute on the margin, narrowed toward the apex and base, inodorous and of a bitter taste. The prominent midrib is marked on the upper side by a slight ridge. The flowers are whitish or lilac-colored, bell-shaped, and have four didynamous stamens with reniform anthers; the fruit is a small roundish black berry, resting with its lower half in the five-toothed, persistent calyx, and containing in each of the two cells two to four oblong-reniform and reticulate brown seeds.

Duboisia Hopwoodii, *F. von Müller.* This tree-like or shrubby plant is called *pituri* or *pedgery;* it is rare and its fruit is unknown. The leaves are short-petiolate, smooth, glossy, and rather thick, about 4 inches (10 Cm.) long, narrow and linear or somewhat lanceolate, narrowed at the base, and finely acuminate, with the end often bent.

Constituents.—Dub. myoporoides was examined by A. W. Gerrard and A. Petit (1878), who isolated the alkaloid *duboisine* as a yellow viscous mass, which is colored red by sulphuric acid, and on warming the mixture gives off an unpleasant odor, suggestive of butyric acid. Duquesnel subsequently obtained the alkaloid in crystals, and Ladenburg (1880) proved it to be identical with hyoscyamine, and that the commercial duboisine sulphate, which is brown, amorphous, and hygroscopic, is identical with hyoscyamine sulphate, but contaminated with a resin-like body. A volatile alkaloid contained in these leaves is probably identical with *piturine.*

Pituri-leaves, examined by Mueller and Rummel, Petit (1879), Liversidge (1881), and others, were found to contain a volatile alkaloid, *piturine*, C_6H_8N, which when pure is a colorless liquid, but on exposure to light or air turns yellow and brown; it is very freely soluble in water, alcohol, and ether, has a nicotine-like odor, which changes to pyridine-like, and has an acrid and persistent pungent taste; its salts are bitter, mostly amorphous or with difficulty crystallizable, and readily part with a portion of the alkaloid. Sulphuric acid and potassium bichromate cause an orange color, changing to brown and green.

Physiological Action.—*On Animals:* The continued use of duboisine excites tetanus in frogs, and antagonizes the paralyzing action of muscarin on the heart. In these animals it seems to be far less operative than atropine (Ringer). $\frac{1}{12}$ grain of sulphate of duboisine subcutaneously administered to a dog lowered the respiration-rate from 20 to 12, and quickened the pulse-rate from 92 to 240 and upward. The animal staggered in walking and voided feces and urine, and was "evidently delirious," "moving as hunting-dogs do when lying before a fire dreaming." The pupils were widely dilated. Administered to a pigeon, it neither dilated the pupils nor in any other way affected the bird (Norris). Gibson concluded from his experiments: "1. That duboisine in quantities not exceeding Gm. 0.005 (gr. $\frac{1}{120}$) raises the arterial pressure without materially affecting the pulse-rate. 2. In doses not exceeding Gm. 0.05 (gr. $\frac{3}{4}$) it diminishes the blood-pressure and lessens the pulse-rate. 3. Gm. 0.05 (gr. $\frac{3}{4}$) and upward causes death, with the heart in diastole. 4. In larger doses than Gm. 0.05 (gr. $\frac{3}{4}$) it arrests the heart in diastole." It also in small doses contracts the arterioles, and in large doses dilates them (*Lancet*, Nov. 5, 1881).

On Man: The first experiments made with the extract and the sulphate of duboisine showed them to be powerful mydriatics, dilating the pupil more promptly and energetically than atropine, and sustaining this influence for a longer time. In its action on the eye duboisine differs from atropine in this, that it rapidly produces dilatation of the pupil and almost simultaneously total paralysis of accommodation, while repeated applications of atropine are necessary to paralyze the ciliary muscle completely. These differences are made apparent by applying the two agents to different eyes of the same person simultaneously. It is said that duboisine is much less apt than atropine to occasion irritation of the conjunctiva (Wecker). The statements of its action on the iris are not uniform. According to Wecker, a $\frac{1}{2}$ per cent. solution dilated the pupil in 20 minutes, and maintained it in that state for 7 days; while Risley found that the duration of its action is less than one-half of that of atropine sulphate, although a 2-grain solution of duboisine sulphate more rapidly paralyzes the ciliary muscle than a 4-grain solution of atropine sulphate (*Amer. Jour. of Med. Sci.*, Apr. 1880, p. 410). $\frac{1}{2}$ Mg. (gr. $\frac{1}{128}$), injected hypodermically, causes some dryness of the throat and indistinctness of vision; 1 Mg. (gr. $\frac{1}{64}$) quickens the pulse, flushes the skin or produces a patchy erythematous redness of it, and impairs the muscular power—an effect which distinguishes it from atropine. It differs further from atropine in lowering the pulse-rate, and, instead of stimulating the brain, it causes a sort of placid indifference or inertness, and even faintness, but, unless in large doses, no drowsiness. It dries the skin sweating under the influence of pilocarpine. In one case (Norris) an exceedingly minute piece of sulphate of duboisine was applied to the conjunctiva, where it melted. A few minutes afterward the patient became dizzy, her face was darkly flushed, and then she grew wildly delirious, was very restless, picked at surrounding objects, and had once or twice slight drawing up of her arms; she also persisted in her efforts to leave the sofa on which she lay. These symptoms were allayed by a hypodermic injection of morphine. In a case reported by Holmes (*Phila. Med. Times*, xi. 189) about $\frac{1}{8}$ grain of duboisine was taken by mistake. In 10 minutes it occasioned dryness of the throat, and in half an hour numbness of the legs and arms; there was no delirium, but the patient became unconscious, and remained so for about 6 hours, breathing quietly; the face was not flushed, but the mouth was very dry and the temperature normal, and the pulse, which ranged to 108 or 112 before unconsciousness came on and so long as the patient was recumbent, fell to 80 when he sat up in bed. For several days the limbs remained weak and uncertain in their movements. Berner instilled into his own eye a solution of duboisine, and observed that "at the end of 10 minutes his sight became dull and objects appeared small and distant. The pupil was fully dilated, the accommodation suppressed, with photopsia and vertigo and a cold constriction of the temples. The face grew pale, the nose cold, and there was singing in the ears, with deafness. The mouth and throat were dry, and vomiting occurred. The respiration was frequent and superficial, the arms and legs were paretic, and limpid urine was copiously discharged. The paresis of accommodation lasted for 4 or 5 days, and the dilatation of the pupils from 5 to 6 days. The day after the experiment a slight sweating occurred, with physical and mental irritability and prostration" (*Times and Gazette*, Feb. 1881, p. 247). Heyl remarks: "That atropine instilled into the eye may excite an attack of acute inflammatory glaucoma is generally accepted by ophthalmologists as an established clinical fact" (*Amer. Jour. of Med. Sci.*, Apr. 1882, p. 398).

Duboisia Hopwoodii furnishes *pituri*, whose action differs from that of duboisine. According to Ringer, "it produces faintness, pallor, giddiness, tremor, hurried and superficial breathing, and increased frequency of the pulse, with perspiration; in large doses salivation, drowsiness, convulsive twitching, spasmodic rigidity of the extremities. In small doses, internally, it contracts, and in large doses widely dilates, the pupils: locally applied, it contracts, and then widely dilates, the pupils." It seems to be a feeble mydriatic (*Amer. Jour. of Med. Sci.*, Apr. 1879, p. 539).

Uses.—Duboisine may be used as a substitute for atropine in all *affections of the eye* for which the latter is employed, including disorders of *accommodation*, *iritis*, and diseases of the *cornea*. "The greater rapidity with which the dilatation of the pupil, and the paralysis of accommodation caused by it, pass off renders it superior to atropine for use in determining the refraction; while, on the other hand, its greater tendency to produce constitutional disturbance should cause it to be carefully used" (Norris). According to Little, the only superiority of duboisine over atropine consists "in gaining time in the study of refraction" (*Phila. Med. Times*, x. 321). It appears to have the same effect as atropine in moderating the *sweats* of phthisis, and the additional merit of reducing instead of accelerating the pulse. Dujardin-Beaumetz, Desnos, and others have used this preparation in the treatment of *exophthalmic goitre*, causing a marked diminution of the cardiac palpitation and vascular throbbing. It does not, however, lessen the tumor nor permanently suspend the symptoms of the disease (*Bull. de thérap.*. xcix. 89; c. 59).

Duboisine may be given hypodermically in the dose of $\frac{1}{120}$ to $\frac{1}{60}$ grain (Gm. 0.0005 to 0.001), and for ophthalmological purposes a solution is used of 3 or 4 grains (Gm. 0.20–0.25) in a fluidounce (Gm. 32) of distilled water.

DULCAMARA, *U. S.*—DULCAMARA.

Stipites dulcamaræ.—*Bittersweet*, *Woody nightshade*, E.; *Tiges de douce-amère* (*de morelle grim-pante*), Fr.; *Bittersüss-Stengel*, G.

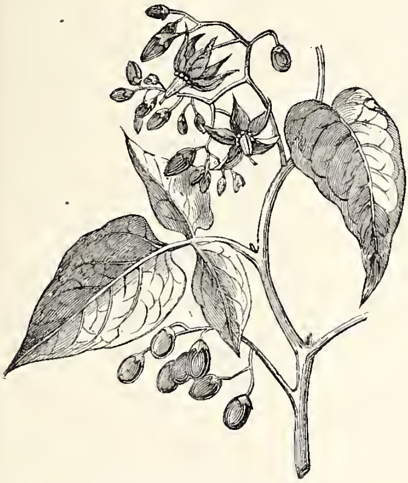
The young branches of Solanum Dulcamara, *Linné* (s. Dulcamara flexuosa, *Moench*). Woodville, *Med. Bot.*, plate 33; Bentley and Trimen, *Med. Plants*, 190.

Nat. Ord.—Solanaceæ, Solaneæ.

Origin.—The bittersweet is a somewhat shrubby and climbing plant which grows throughout the greater part of Europe, in Northern Africa, and from Asia Minor east to North-western India and to China. It is naturalized in North America, and in many places is abundant. It grows around dwellings and in hedges and thickets on moist banks. The stem, when supported by shrubs, is sometimes 15 to 20 feet (4.5 to 6 M.) long, woody at the base, and divided into many flexuose branches dying back during the winter; the leaves are alternate, petiolate, and slightly pubescent beneath, the lower ones ovate with a heart-shaped base, the upper ones halberd-shaped or with two ear-like lobes at the base; the flowers are in small cymes, and have a deeply five-lobed, purple, sometimes whitish, corolla. The berries are oval, bright-red, and contain many minutely-pitted seeds.

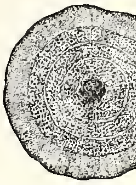
Description.—The branches which are 1 or 2 years old are collected in the autumn after having shed their leaves, or in the spring before the leaves appear. They are ¼ inch (6 Mm.) and less thick, cylindrical or somewhat angular, longitudinally striate or furrowed, and more or less warty. The corky layer is pale greenish- or yellowish-brown, separates easily, and covers a dark-green bark, which is lighter-green in the bast-layer; and this consists of thin-walled parenchyma, containing in the inner layer minute crystals of calcium oxalate, and in the outer zone a circle of tough bast-fibres, either single or in small groups. The greenish (afterward yellowish) wood is porous, striate by the fine medullary rays, and consists of one or two annual rings; the whitish pith has been usually absorbed. The odor is unpleasant, somewhat narcotic, weak in the dried stalks; the taste is bitter, afterward sweet. Bittersweet is generally met with in the market cut into short sections.

Fig. 105.



Solanum Dulcamara, *Linné.*

Fig. 106.



Transverse section of branch.

Constituents.—The bittersweet principle has been variously named *picroglycion*, *dulcarin*, and *dulcamarin.* Desfosses (1821) separated from the drug *solanine*, an alkaloid previously discovered by him in Solanum nigrum, and he, as well as Pelletier, regarded the picroglycion as solanine mixed with glucose. Winckler (1841), Moitéssier (1856), and others considered the alkaloid of dulcamara as distinct from the solanine of potatoes; but since the discovery of the glucoside nature of solanine in 1859 the supposed solanine from bittersweet does not appear to have been again examined.

Wittstein (1852) isolated from bittersweet *dulcamarine*, an alkaloid having a resinous appearance and the odor and taste of the plant. E. Geissler (1875) obtained this product, but recognized it as a mixture. He obtained *dulcamarin*, $C_{22}H_{34}O_{10}$, by digesting the aqueous infusion of bittersweet with granular animal charcoal, washing the latter, and exhausting it with boiling alcohol, evaporating, dissolving in water, precipitating with ammonia, and the filtrate therefrom with subacetate of lead, digesting the washed precipitate with alcohol, and decomposing it with sulphuretted hydrogen. It forms a yellowish powder of a strongly bitter and then sweet taste, is soluble in alcohol and water, insoluble in ether, chloroform, benzol, carbon bisulphide, and petroleum benzin, and is decomposed by diluted acids into sugar and brown, tasteless *dulcamaretin.*

The other constituents, gummy, resinous, and waxy matters, are not of medicinal importance.

Admixtures.—The cut stems of Humulus Lupulus, *Linné*, and Lonicera Periclymenum, *Linné*, are said to be occasionally mixed with dulcamara in Europe; they have none of the characteristics of the latter.

Off. Prep.—Extr. dulcamaræ fluid., *U. S.;* Infusum dulcamaræ, *Br.*

Physiological Action.—*On Animals:* The extract, introduced into the stomach of rabbits, occasions a remarkable degree of apathy, but not true sleep, with great flaccidity of the muscles, but no paralysis. The sensibility to pain as well as to contact is blunted; the pulse- and respiration-rates are reduced; the temperature is raised; the pupils are not altered; the ears and the lips become cyanosed; the head is bowed downward, and moves laterally to and fro; and death takes place in convulsions. The stomach presents an intensely dark-red color from the congestion of its blood-vessels, while the intestinal mucous membrane is pale. The large veins of the thorax and abdomen are distended with dark blood.

On Man: In large doses dulcamara is stated by some reporters to cause dryness, heat, and constriction and stinging in the throat, thirst, and sometimes diarrhœa. Feeble persons, it is said, are apt to experience twitching of the eyelids and lips, with tremulousness of the limbs; the head is heavy and giddy, and, as in the lower animals, a cyanotic hue of the face and hands may be observed, and sometimes an erythematous eruption of the skin, with a tendency to diaphoresis. The action of dulcamara upon the human heart is not definitely determined, but it probably renders the circulation slower and more languid. Dulcamara, it has been alleged, produces itching and heat in the female organs of generation, with painful strangury, and sometimes even venereal desires; while, on the other hand, to it has been attributed a power of subduing the morbidly-active sexual appetite. It is proper to state that Dr. John Harley experimented upon man with the expressed juice, and also with the tincture, in small and large doses, without any appreciable physiological effect.

Medical Uses.—The so-called scientific therapeutists of the present day are disposed to deny any curative virtues to dulcamara, because they are unable to explain those it is alleged to possess according to their notions of its mode of action. Such a reason may, in a logical sense, be called impertinent. The claims of dulcamara rest on the same grounds as those of opium, mercury, and cinchona—the ground of clinical experience. It was long used as a popular remedy, and subsequently by physicians, for *cutaneous eruptions*, both internally and externally, and especially for psoriasis and other scaly diseases of the skin, and also for acne, impetigo, chronic eczema, and ecthyma. It is said to be most apt to cure those diseases when they occur in persons of a strumous habit. It has had considerable repute as a remedy for chronic muscular *rheumatism*, and also in chronic *bronchitis*, *whooping cough*, and other chronic pulmonary affections in which cough is a prominent symptom. An antaphrodisiac property was ascribed to dulcamara by Dr. W. P. Dewees, who observed that a patient who was taking it for a disease of the skin lost his venereal desire. On discontinuing the use of the medicine the patient's normal function was restored, but on resuming its use again the original effect was repeated. In five cases in which Dr. Thomas Harris employed it the venereal appetite was suspended during its use. Dr. Dewees prescribed it successfully in cases of *nymphomania* and *satyriasis* (*Amer. Cyclopædia of Med. and Surg.*, ii. 23).

Dulcamara is best used in decoction, which is made from the fresh young branches (℥i to q. s. of water reduced by boiling for 15 minutes, then adding water to make a pint). The infusion and the fluid extract may also be employed. It must be long continued to produce its curative effects.

ECBALLII FRUCTUS, *Br.*—SQUIRTING-CUCUMBER FRUIT.

Cucumis asininus, Cucumis agrestis.—*Wild cucumber*, E.; *Concombre sauvage* (*purgatif d'ane*), Fr.; *Springgurke, Esels-Kürbis, Spritzgurke*, G.

The fruit of the squirting cucumber, Ecballium (Momordica, *Linné*) Elaterium, *A. Richard*, s. Ecb. officinale, *Nees*, s. Ecb. agreste, *Reichenbach*, s. Elaterium cordifolium, *Moench*. Step and Church, *Med. Bot.*, plate 34; Bentley and Trimen, *Med. Plants*, 115.

Nat. Ord.—Cucurbitaceæ.

Origin.—The plant is a common weed in dry and waste places in Southern Europe, and eastward thence to Persia. It has a perennial, fleshy, white root, a trailing, succulent, bristly stem 2 to 4 feet (0.6 to 1.2 M.) long, alternate, bristly, bluntly-triangular, and cordate leaves, and unisexual monœcious flowers with deeply five-lobed, yellow, and veined corollas. The plant is cultivated to a small extent for medicinal purposes in Germany, France, and at Mitcham and Hitchin in England, the seeds being sown about March, the seedlings planted out in June, and the nearly ripe fruit collected in August or early in September.

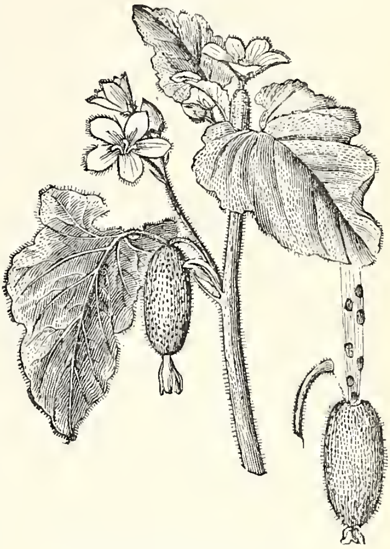
Description.—The fruit is nodding from the recurved stalk, 2 inches (5 Cm.) or less in length, about 1 inch (25 Mm.) thick, oblong, and somewhat tapering above, pale-green, beset with fleshy prickles, three-celled, and contains a bitter watery, mucilaginous juice in which the numerous oblong, compressed, polished, light-brown seeds are immersed. When mature the fruit becomes yellowish, and separates suddenly from the stalk, at the same time violently expelling the juice and seeds from the orifice formed at the base. The fruit is collected with the stalk when almost ripe for preparing elaterium.

ELATERIUM, *Br.*—Elaterium, *E.*, *Fr.*, *G.* The following process is given for its preparation: Take of Squirting-Cucumber fruit, very nearly ripe, 1 pound. Cut the fruit lengthwise and lightly press out the juice. Strain it through a hair-sieve and set it aside to deposit. Carefully pour off the supernatant liquor, pour the sediment on a linen filter, and dry it on porous tiles with a gentle heat. The decanted fluid may deposit a second portion of sediment, which can be dried in the same way.—*Br.*

This is essentially the process recommended by Dr. Clutterbuck (1820), except that he directs the surface of the fruit to be moistened with cold water, thus preventing the juice from adhering, and the split fruit to be rinsed in cold water for recovering the juice adhering to the inside. With an increased pressure a larger amount of juice and of deposit is obtained, but the latter is then of inferior quality. The deposited elaterium may be dried with a very moderate heat, but exposure to the sunshine should be avoided. Clutterbuck obtained only 6 grains of elaterium from forty specimens of squirting cucumber; with slight pressure 40 pounds of the fruit will generally yield ½ ounce, and in warm, dry seasons even ¾ ounce, of elaterium.

Elaterium is in light, friable, flat, or slightly incurved, cake-like fragments, frequently marked on their surfaces with the impression of the linen or paper on which they were dried. When fresh it has a pale-green color, changing by age to gray, and then often containing minute sparkling crystals on the surface. It breaks with a fine granular fracture, and has a slight tea-like odor and an acrid and bitter taste. It does not effervesce with acids; a cooled decoction of it is not colored blue or is but slightly tinged by solution of iodine, showing the nearly complete absence of starch. It yields half its weight to boiling rectified spirit; and this solution, on being concentrated and added to warm solution of potassa, deposits on cooling not less than 20 per cent. of elaterin in colorless crystals.—*Br.*

FIG. 107.



Ecballium officinarum, *Richard.*

Constituents.—The analyses of Braconnot, Paris, Marquart, Landerer, and Koehler indicate the presence in the fruit of resin, pectin, and albuminous and gummy matters, but besides *elaterin* no compound of importance. (See ELATERINUM.) According to Koehler (1869), the juice contains only 3.5 per cent. of organic and 1.5 per cent. of inorganic constituents.

Walz (1859) obtained from the entire plant collected with the root the following principles, which are stated to be present likewise in elaterium:

Prophetin, also found in the fruit of Cucumis prophetarum, *Linné*, a yellowish powder, slightly soluble in water, more in alcohol, freely in ether; precipitated by tannin; is a glucoside; *ecbalin* or *elateric acid*, resin-like, bitter, and acrid, soluble in alkalies, alcohol, ether, and in 20 parts of water; *hydro-elaterin*, amorphous, soluble in water, alcohol, ether, and alkalies; is not a glucoside; *elaterid*, very bitter, insoluble in water and ether, soluble in alcohol and alkalies, also in concentrated acids.

ELATERINUM, *U. S., Br.*—ELATERIN.

Elatérine, *Elatine*, Fr.; *Elaterin*, G.

Formula $C_{20}H_{28}O_5$. Molecular weight 348.

Preparation.—Elaterin is a neutral principle prepared from elaterium, and discovered by Hennell and by J. D. Morries (1831). The latter prepared it by evaporating the tincture of elaterium to an oily consistence, and, while still warm, pouring it into a warm solution of potassa; in place of which he afterward recommended boiling water. The chlorophyll adhering to the crystals was recommended by Marquart (1833) to be removed by careful washing with ether, or by Power (1875) preferably by agitating the alcoholic solution with benzin. It is not unlikely, however, that in this way a portion of the principle may be lost, for Buchheim (1872) observed that on adding potassa to a hot alcoholic solution of elaterin a compound soluble in water is formed. According to him, elaterin is the anhydride of elateric acid, and converted into the latter by heat alone; hence the importance of avoiding heat in the preparation of elaterium. The best method of obtaining elaterin is to exhaust elaterium with chloroform, from which solution white crystals will be immediately deposited on the addition of ether; after washing with a little ether and recrystallizing from chloroform pure elaterin will be obtained (*Pharmacographia*). The yield varies to some extent; Morries (1831) obtained between 15 and

26 per cent.; Flückiger and Hanbury (1874), 27.6 and 33.6; Walz (1859), even 50 per cent. It was observed by Marquart (1833), Walz (1859), and Köhler (1869) that the amount of elaterin diminishes very considerably in the fruit as the season advances.

Properties.—Elaterin is in colorless, shining, hexagonal scales or prisms, which are not altered on exposure, are inodorous, and have a somewhat acrid and extremely bitter taste. They have a neutral reaction to test-paper, are insoluble in water and petroleum benzin, and require for solution in the cold over 120 parts of alcohol (Golding Bird, 1840), 290 parts of ether (Hennell), and 2 parts of boiling alcohol. Elaterin is likewise soluble in amylic alcohol, carbon bisulphide, chloroform, hot olive oil, and oil of turpentine. The effect of potassa has been referred to above; the acid body thereby produced is inert, since 1.0 Gm. of it produced no effect. Elaterin is not a glucoside, and its solutions are not precipitated by tannin. When heated to 200° C. (392° F.) it turns yellow and melts to a transparent liquid, which on cooling congeals to an amorphous mass; at a higher heat it gives off white somewhat acrid vapors, and burns with a sooty flame, leaving no residue (Zwenger, 1843). According to Power (1875), elaterin is not changed by chlorinated alkalies. Nitric acid produces, after several hours, a pinkish tinge, but when heated at once a red coloration. Sulphuric acid dissolves it with a deep-red color, the solution yielding a brown precipitate with water; the color of the solution gradually changes to deep-brown, and ultimately to light-green, on the addition of a fragment of potassium bichromate. Lindo (1878) observed that the addition to elaterin of a few drops of melted carbolic acid, followed by sulphuric acid, produces a magnificent crimson color, changing to orange and scarlet.

Off. Prep.—Trituratis elaterini, *U. S.*

Physiological Action.—Elaterium, however it may be given to dogs and rabbits, does not vomit or purge them, but destroys them with tetanoid phenomena. In some other animals the subcutaneous use of elaterium produces profound and fatal exhaustion. In man its internal use causes more or less vomiting, severe griping, and profuse watery stools, with a sense of great debility.

Medical Uses.—Elaterium is used as a purgative in those cases only in which a drastic operation, with profuse serous discharges, is desired. Hence it may be prescribed with great effect to relieve the brain or the lungs threatened with the dangers of *congestion*, provided no contraindication exists in the patient's debility or in diseases of the digestive canal. It was one of the most renowned of the ancient remedies for *dropsy*, and in recent times it has shown its power by evacuating serous collections which other purgatives and all diuretics failed to remove. It is, however, most frequently used in abdominal dropsy.

The variable strength of elaterium suggests caution in its use. $\frac{1}{16}$ grain (Gm. 0.004) may be given in a pill made with extract of hyoscyamus or confection of roses, and repeated every hour until the effects begin to appear. Elaterin is more active in alcoholic solution, or it may be given in the officinal (1882) trituration of elaterin. The *dose* is from $\frac{1}{30}$ gr. to $\frac{1}{12}$ gr. (Gm. 0.002–0.005).

ELEMI, *Br.*—Elemi.

Resina (s. Gummi) Elemi.—Elémi, Résine élémi, Fr.; *Elemi*, G.

A concrete resinous exudation, the botanical source of which is undetermined, but is probably Canarium commune, *Linné* (*Rumph. Amb.*, vol. ii. plate 47). Chiefly imported from Manila. *Br.* Bentley and Trimen, *Med. Plants*, 61.

Nat. Ord.—Burseraceæ.

Origin.—The name of elemi has been given to various resinous products which have from time to time appeared in commerce, and which, it is believed, are all derived from trees of the Nat. Ord. Burseraceæ. The British Pharmacopœia refers Manila elemi, a product of the Philippine Islands, to the species named above, a tall tree indigenous to the Moluccas and to other parts of tropical Asia, while Blanco (1845) states that it is obtained from Icica abilo, a tree scarcely known. Perrottet (1821) sent specimens of the elemi tree to Paris and to Senegambia, and stated (1823) that the tree is scarified twice a year, and the flow of the oleoresin promoted by kindling a fire near the tree. Baup (1851) believed Canarium album, *Ræuschel*, to be Perrottet's tree (Flückiger, *Pharmakognosie*).

Description.—Manila elemi is in soft, granular, transparent masses when fresh, but is generally met with in the shops in solid pieces, which are externally pale lemon-yellow and clear, internally opaque, nearly white, and mixed with chips and other impurities.

It breaks with a dull granular fracture and readily fuses to a transparent liquid. Moistened with alcohol, it disintegrates and shows a large number of small acicular crystals. It has a strong aromatic somewhat terebinthinate odor and a warm, aromatic, and acrid taste.

Constituents.—Flückiger and Hanbury (*Pharmacographia*) obtained from the drug 10 per cent. of a colorless, neutral, fragrant, and strongly dextrogyre volatile oil. An oil of elemi obtained by H. St. Claire-Deville (1849) had a strong rotatory power to the left and the composition $C_{10}H_{16}$.

On treating elemi with alcohol, Maujean (1823) obtained a soluble amorphous resin, which Baup (1851) named *breïn*, and succeeded in crystallizing by the very slow evaporation of its alcoholic solution. Maujean's insoluble resin was by Bonastre (1824) crystallized from its solution in boiling strong alcohol; it is Baup's *amyrin*, and, like breïn, is readily soluble in ether and insoluble in water. The same author obtained also *bryoidin* and *breïdin*, both fusible, the former having a bitter and acrid taste; it is easily soluble in alcohol, ether, and volatile and fixed oils, slightly soluble in cold water, but crystallizes from boiling water, from alkaline solutions, or from dilute acetic acid in silky threads or in moss-like masses. *Breïdin* is likewise crystalline, readily soluble in alcohol, less in water or ether. E. Buri (1876) gives to amyrin the formula $(C_5H_8)_5.2H_2O$. He found it to be soluble in ether, chloroform, and carbon bisulphide, to be fusible at 177° C. (350.6° F.), and to sublime when carefully heated in thin layers. The mother-liquors of amyrin yielded him (1878) *elemic acid*, $(C_5H_8)_7O_4$, the potassium salt of which crystallizes from its strong alkaline solution in needles.

Varieties.—The following resinous products are sometimes met with as distinct varieties of elemi:

Mauritius Elemi, obtained from Colophonia mauritiana, *Commerson*, a large tree of Mauritius; it is at first liquid, and resembles the Manila elemi.

Mexican Elemi, supposed to be obtained from Amyris elemifera, *Royle*, is in light- or dark-yellow somewhat greenish masses, of a waxy lustre, translucent or opaque, friable, but readily softening in the mouth.

Brazilian Elemi, collected from Icica Icicariba, *De Candolle*, and other species of the same genus; it forms soft yellowish-white or solid pale or greenish-yellow masses.

All these varieties have a similar though not identical odor, and disintegrate when treated with cold alcohol, with the separation of small crystals, which are probably identical with *amyrin*.

The *decamalee resin* of India, which resembles elemi, is the exudation of Gardenia gummifera, *Linné*, and G. lucida, *Roxburgh*, Nat. Ord. Rubiaceæ.

Off. Prep.—Unguentum elemi, *Br.*

Medical Action and Uses.—The qualities of elemi are analogous to those of the turpentines, and it might probably be used for the same purposes internally. It is, however, only employed as an external application, in plaster or ointment, as a dressing for *blisters*, *issues*, *indolent ulcers*, etc. In this country it is rarely prescribed. Oil of elemi is analogous in its action to oil of turpentine.

ELIXIR AURANTII, *U. S.*—Elixir of Orange.

Elixir simplex.—*Simple elixir*, E.; *Elixir simple*, Fr.; *Einfaches Elixir*, G.

Preparation.—Oil of Orange 1 part (100 grains or 6.5 Gm.); Cotton 2 parts (200 grains or 13 Gm.); Sugar, in coarse powder, 100 parts (10,000 grains = 23 oz. av. or 650 Gm.); Alcohol, Water, each a sufficient quantity; to make 300 parts (30,000 grains or 69 oz. av., about 60 fluidounces.) Mix alcohol and water in the proportion of 1 part of alcohol to 3 parts of water (alcohol 20 to water 49 fluidounces). Add the oil of orange to the cotton in small portions at a time, distributing it thoroughly by picking the cotton apart after each addition; then pack tightly in a conical percolator, and gradually pour on the mixture of alcohol and water until 200 parts (20,000 grains = 46 oz. av. = 45 fluidounces, or 1300 Gm.) of filtered liquid are obtained. In this liquid dissolve the sugar by agitation, without heat, and strain.—*U. S.*

(For remarks on the solution of volatile oils in aqueous liquids see Aquæ Medicatæ, page 232.) The elixir aurantii, *U. S. P.*, should not be confounded with the elixir aurant. comp., *P. G.* (for formula of which see page 289).

Elixiria (Elixirs, *E.*, *Fr.*; Elixire, *G.*), in the sense in which this name was formerly, and is still to a certain extent, applied on the continent of Europe, are certain compound tinctures, spirits, and wines, many of which have an unpleasant taste. In modern American pharmacy the name has been adopted for sweetened and aromatized alcoholic preparations or *cordials* containing often minute quantities of the medicinally active ingredients, which are added in the form of tincture or of fluid extract or as a solution of the saline ingredient, so that a tablespoonful or wineglassful of the elixir will represent only a very moderate or even minute dose of the active drug. (For a full account of this class of preparations, with formulas for about 250 varieties, consult *Elixirs, their History, etc.*, by J. U. Lloyd, 1883.) The elixirs adopted by the American Pharmaceutical Association (1873, 1875) have for their base either the simple (uncolored) or the red elixir; a teaspoonful or a tablespoonful represents a medicinal dose. The formulas here given will serve as types for preparing others, and, if desired, the flavor may be varied by the substitution of other volatile oils for the oil of orange:

Compound Tincture of Cochineal. Macerate for a day 120 grains compound powder of cochineal (composed of 48 grains of potassium bitartrate and 24 grains each of powdered cochineal, alum, and potassium carbonate) in 2 fluidounces of diluted alcohol, and filter.

Red Elixir. Mix simple elixir 15½ fluidounces with compound tincture of cochineal ½ fluidounce.

Elixir of Calisaya. Mix 3 fluidounces of tincture of cinchona with 13 fluidounces of simple elixir.

Compound Elixir of Cinchona. Mix compound tincture of cinchona 3 fluidounces with simple elixir 13 fluidounces.

Elixir of Quinine, Cinchonine, and Iron (incorrectly called *elixir of cinchona and iron*). Dissolve 256 grains of ammonio-citrate of iron and 12 grains each of the sulphates of quinine and cinchonine in ½ fluidounce of water, and mix with 15½ fluidounces of simple elixir.

Elixir of Quinine, Cinchonine, Iron, and Bismuth. Dissolve 256 grains of ammonio-citrate of bismuth in 1 fluidounce of water, and mix with 15 fluidounces of the elixir of quinine, cinchonine, and iron.

Elixir of Quinine, Cinchonine, Iron, and Strychnine. Dissolve 2½ grains of strychnine with 5 grains of citric acid in 16 fluidounces of the elixir of quinine, cinchonine, and iron.

Elixir of Pyrophosphate of Iron, Quinine, and Strychnine. Dissolve 256 grains of pyrophosphate of iron in 4 fluidounces of distilled water, and add 6 fluidounces of syrup and a solution of 2½ grains of strychnine and 128 grains of quinine in 5½ fluidounces of alcohol and ½ fluidounce of spirit of orange.

Elixir of Hops. Mix tincture of hops 8 fluidounces, spirit of orange 2 fluidrachms, spirit of cinnamon 10 minims, syrup 6 fluidounces, and water 2 fluidounces.

Elixir of Gentian with Iron. Mix fluid extract of gentian ½ fluidounce, diluted alcohol 7½ fluidounces, spirit of orange 2 fluidrachms, spirit of cinnamon 10 minims, syrup 6 fluidounces, and 256 grains of ammonio-citrate of iron previously dissolved in 2 fluidounces of water.

Elixir of Guarana. Percolate 4 troyounces of powdered guarana with diluted alcohol until 8 fluidounces of tincture have been obtained; then add spirit of orange 2 fluidrachms, spirit of cinnamon 10 minims, syrup 6 fluidounces, and water 2 fluidounces.

Elixir of Valerianate of Ammonium. Dissolve 256 grains of crystallized ammonium valerianate with the aid of a few drops of ammonia-water in 16 fluidounces of red elixir.

Elixir of Valerianate of Ammonium and Quinine. Dissolve in 16 fluidounces of the preceding elixir 128 grains of valerianate of quinine.

Elixir of Bromide of Potassium. Dissolve 1280 grains of potassium bromide in 16 fluidounces of red elixir.

Elixir of Pyrophosphate of Iron. A mixture of 256 grains of pyrophosphate of iron, dissolved in 1 fluidounce of water, and 15 fluidounces of simple elixir.

Elixir of Citrate of Bismuth. Dissolve 256 grains of citrate of bismuth in 4 fluidounces of water, adding a few drops of ammonia, and mix with 12 fluidounces of simple elixir.

EMPLASTRA.—Plasters.

Emplâtres, Fr.; *Pflaster*, G.

Plasters are solid tenacious preparations intended for external use, considerably harder than cerates, so that they cannot be spread at the ordinary temperature, yet of such a composition that they will be pliable and adhesive at the temperature of the body

According to their composition they are distinguished into two classes—namely, *plasters* properly so called (*stéarates* of the French), the base of which consists of a fusible and insoluble lead soap; and *resinous plasters*, which owe their adhesiveness to a resin mixed with some wax or fat, and for this reason are called *ointment-plasters* (*onguents-emplâtres* by the French); they are the *rétinolés solides*, or hard resin-fats, of Guibourt.

The *preparation* of all plasters containing more than one ingredient is effected in a manner similar to that of the cerates, with such modifications as are necessitated by their greater firmness and higher fusing-point. The simple plaster or the resin is first liquefied, care being taken to avoid too high a heat; the wax, fat, or other fusible substances are then added, and lastly oleoresins and aromatic products which would be injured by long-continued heat, and gum-resins or other substances which are infusible and must be mechanically incorporated with the solidifying plaster. The latter may be accomplished in several ways, according to the nature of the substances to be added: they are either rubbed fine and to a perfectly smooth paste with some fat, volatile oil, or oleoresin, or they are finely powdered and passed through a sieve into the cooling plaster, which is then to be stirred until firm enough to prevent the mechanical admixtures from separating. If extracts are to be incorporated, they should, if possible, be prepared with strong alcohol, so as to be fusible with the other ingredients of the plaster. Most gum-resins are not completely fusible or readily pulverizable, and are therefore best converted into a smooth paste in the manner indicated above. The use of some petroleum benzin during the trituration will often be found advantageous for accomplishing the object in view.

Straining is best avoided in preparing plasters. Should it be found necessary, it is never to be deferred until the infusible ingredients have been added, but performed with the smallest possible bulk and with those portions of the material having the lowest fusing-point. On the whole, however, it will be found more advantageous and expeditious, more particularly for the extemporaneous preparation of plasters, to use only purified ingredients, so that straining may not be required.

For convenience in handling and dispensing plasters are rolled into cylinders of convenient thickness. A slab or thick board is suitable for the purpose. The melted plaster is allowed to cool until it is of a soft, pliable consistence, when a convenient quantity is transferred to the slab previously moistened with water, and then kneaded with the moistened hand and rolled out to the desired thickness; when larger quantities are thus to be rolled out a smooth and straight board will be convenient as a roller, with its ends supported by ledges, whereby uniform thickness is secured. Plasters which contain vegetable powders or other substances soluble in water are treated in the same manner, except that the water is replaced by olive or a similar bland and non-drying oil. The most convenient size of such rolls or sticks is, for dispensing purposes, about the thickness of a finger or even smaller. They keep well if they are wrapped in wax- or paraffin-paper. The soft plasters are sometimes poured into boxes or kept in square cakes, the latter being cast in tin or paper moulds, as described under CERATES (see page 411).

Plasters are usually spread upon white sheepskin; for particular purposes chamois-skin, linen, muslin, or even paper (see CHARTÆ, page 420), may be used. The leather is extended and fastened upon a smooth board, and the desired size and shape are marked upon it either by pasting strips of paper on it or using tin frames of the requisite size and shape. Sometimes an apparatus is used consisting of a block of hard wood with an even or somewhat convex surface, over which a sheet-iron frame is fitted, cut out to the dimensions and shape of the plaster to be spread, and covering sufficient leather to serve for a margin. For rectangular plasters it is convenient to have two L-shaped pieces of sheet tin, each side of which is graduated in inches, commencing from the angle; by bringing the angle of one diagonally opposite to that of the other piece a rectangular or square outline of any desired size may be formed. When the leather has been properly prepared, a sufficient quantity of the plaster is to be fused by a moderate heat and with frequent stirring to avoid burning, and while still liquid is poured upon the leather and spread by means of a warm stout pallet-knife, with sufficient pressure to obtain a smooth and even surface. Various plaster-spreaders, with long and short, straight and curved handles, have been constructed, the spreader generally being a solid square or triangular piece of iron, which, once heated, will remain warm for a sufficient length of time to soften such portions of the plaster as may become hard until the whole has been evenly spread. Sometimes the spreader or blade is made hollow, for the purpose of introducing boiling water or a heater to maintain the necessary temperature. But with some practice the pallet-knife will be found quite sufficient for the ordinary sizes of plaster. The consistence at which the fused mass should be poured upon the leather is of importance; if it be too thin, it will partly pass through the material and stain the outer surface; if too thick, it will congeal before it can be spread out, and require reheating by means of the plaster iron, and is then apt to become too fluid. For true plasters a temperature of 50° to 55° C. (120° to 130° F.) will be found to give the proper consistence; resinous plasters containing wax or fats should be cooled to a still lower degree. So-called *porous plasters* have been used for some years past. To perforate spread plasters extemporaneously, Prof. Remington (1878) devised a tool consisting of a brass wheel ¾ inch wide, and studded with sixteen punches in two alternating rows ½ inch apart. The wheel revolves around a steel axle, which is connected with a handle 9 inches long, by means of which the requisite pressure is obtained.

The *amount* of plaster necessary for spreading a given area will depend partly upon the nature of the plaster and partly upon the thickness to which it is spread; on an average, 10 grains will be found sufficient for 1 square inch of surface. To prevent the clothes from becoming soiled, and to facilitate the removal of the plaster, a margin of about ¼ inch is left around the spread surface.

In European pharmacy the term *sparadrap* is used to designate plasters which, like adhesive, court, and similar plasters, consist of adhesive substances thinly spread upon certain kinds of muslin, silk, or paper. They are prepared in various ways, according to the nature of the adhesive material; two of these, capsicum plaster and court plaster, have now been admitted into the U. S. P. True plasters, to be made into sparadraps, require an apparatus generally consisting of a smooth board, upon which rests in an upright position a kind of trough into which the melted plaster is put; the trough is provided below with a slit through which the plaster escapes; the cambric or other material is guided by rulers while being drawn underneath the trough, which must be kept sufficiently warm to prevent the plaster from becoming too firm, and should be so constructed as to act not merely as a scraper, but likewise to press upon the material beneath sufficiently for spreading the plaster thinly but evenly. Paper sparadraps are made in the same manner. (See also CHARTA, page 421.) (For a figure and description of an apparatus suitable for the purpose see *Amer. Jour. Pharmacy*, 1869, p. 455.)

When kept for a long time plasters are apt to become brittle. With rolled plasters the cause may be found partly in the removal of the glycerin. If not otherwise injured, they may be usually restored by fusing them carefully over a little water and incorporating with the melted mass ½ to 1 per cent. of olive oil. To restore the adhesiveness of spread plasters is often a difficult matter, and must in all cases depend upon the nature of the plaster. Heating the surface of the plaster until it becomes soft, covering the softened surface with a solution of turpentine or Canada balsam, and then laying aside the plaster for a day, will usually accomplish the object. For some years past certain manufacturers have used caoutchouc to keep plasters pliable and adhesive. This can be successfully made, according to J. W. Worthington (1871), by macerating 1 ounce of finely-cut caoutchouc in a pint of petroleum benzin until a thick solution is obtained, of which 1 part is added to 7 or 8 parts of melted plaster. Chicle is likewise used for this purpose, and is incorporated by melting it with the plaster. (See GUTTA-PERCHA.)

If non-resinous extracts and fixed or volatile oils are ordered in such quantities as to interfere with the adhesive properties of the plaster, Shael (1873) recommends them to be incorporated with powdered tragacanth. This mixture is spread upon adhesive plaster, of which a sufficient margin is left uncovered

EMPLASTRUM AMMONIACI, *U. S.*—Ammoniac Plaster.

Emplâtre de gomme ammoniaque, Emplâtre fondant (résolutif), Fr.; *Ammoniak-Pflaster*, G.

Preparation.—Ammoniac 100 parts (5½ oz. av.); Diluted Acetic Acid 150 parts (8¼ oz. av. or ½ pint). Digest the ammoniac in the diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly until a small portion, taken from the vessel, hardens on cooling.—*U. S.*

The present directions are precise in emulsionizing instead of dissolving the ammoniac. To evaporate the liquid until the residue "hardens on cooling" appears to be less definite than to evaporate "to the proper consistence."

The finished preparation is quite adhesive, but has lost nearly all its volatile oil. It must be prepared in porcelain vessels, and during the evaporation, as well as during the emulsionizing, stirred with a porcelain or glass spatula to avoid contamination with metals.

Medical Action and Uses.—It is used as a stimulant discutient over swellings which have ceased to exhibit an inflammatory tendency, such as *scrofulous joints* and *glands*. It is apt to irritate the skin and produce a papular eruption.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO, *U. S., Br.*—AMMONIAC PLASTER WITH MERCURY.

Ammoniacum and mercury plaster, E.; *Emplâtre de gomme ammoniaque mercuriel*, Fr.; *Quecksilber und Ammoniak-Pflaster*, G.

Preparation.—Ammoniac 720 parts (12 oz. av.); Mercury 180 parts (3 oz. av.); Olive Oil 8 parts (59 grains); Sublimed Sulphur 1 part (7¼ grains); Diluted Acetic Acid 540 parts (9 oz. av.); Lead Plaster, a sufficient quantity; to make 1000 parts (16⅝ oz. av.). Digest the ammoniac in the diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling. Heat the olive oil and gradually add the sulphur, stirring constantly until they unite; then add the mercury, and triturate until globules of the metal cease to be visible. Next add gradually the ammoniac while yet hot; and finally, having added enough lead plaster, previously melted by means of a water-bath, to make the mixture weigh 1000 parts (16⅝ oz. av.), mix the whole thoroughly.—*U. S.*

Take of ammoniacum 12 ounces; mercury 3 ounces; olive oil 56 grains; sublimed sulphur 8 grains. Heat the oil, and add the sulphur to it gradually, stirring till they unite. With the mixture triturate the mercury until globules are no longer visible; and lastly, add the ammoniacum, previously liquefied, mixing the whole carefully.—*Br.*

It is obvious that the sulphur merely serves the purpose of facilitating the fine division of the mercury. For incorporating the ammoniac the U. S. P. now directs it to be emulsionized with acetic acid, in place of the objectionable boiling with water directed before; the addition of a small quantity of lead plaster, as previously recommended, is a decided improvement. The British Pharmacopœia directs the ammoniac to be liquefied, but omits to state how the liquefaction is to be accomplished.

Medical Action and Uses.—The mercury in this plaster is supposed to add to its discutient effects, and to render it a suitable application to swellings of a *syphilitic* nature. The presence of a syphilitic element is not necessary to render it more efficient than the simple plaster of ammoniac. Its prolonged application sometimes excites ptyalism.

EMPLASTRUM ARNICÆ, *U. S.*—ARNICA PLASTER.

Emplâtre d'arnique, Fr.; *Arnikapflaster*, G.

Preparation.—Extract of Arnica-Root, 50 parts; Resin Plaster, 100 parts. Add the extract to the plaster, previously melted by means of a water-bath, and mix them thoroughly.—*U. S.*

The officinal formula, strictly followed, yields a good plaster; the extract of arnica-root has very properly been substituted for that of the flowers, which was formerly directed. In other respects the preparation remains unchanged.

Medical Action and Uses.—Among the plasters which are more frequently procured without the prescription of a physician than with it, this is in popular use as a remedy for a variety of *local pains* which are generally muscular. It serves to protect, support, and mildly stimulate.

EMPLASTRUM ASAFŒTIDÆ, *U. S.*—ASAFETIDA PLASTER.

Emplastrum asæ fœtidæ, Emplastrum fœtidum.—Emplâtre d'ase fétide, Emplâtre fétide (*antihystérique*), Fr.; *Stinkasant-Pflaster*, G.

Preparation.—Asafetida 35 parts (14 oz. av.); Lead Plaster 35 parts (14 oz. av.); Galbanum 15 parts (6 oz. av.); Yellow Wax 15 parts (6 oz. av.); Alcohol 120 parts (48 oz. av. or 56 fluidounces). Digest the asafetida and galbanum with the alcohol on a water-bath, separate the liquid portion from the coarser impurities by straining while hot, and evaporate it to the consistence of honey; then add the lead plaster and the wax, previously melted together, stir the mixture well, and evaporate to the proper consistence.—*U. S.*

The present directions, though not quite correct, are an improvement over those of the previous Pharmacopœia, which directed the gum-resins to be "dissolved" in the alcohol. The intention is to disintegrate them, so that by straining they may be freed from the coarser impurities. The plaster is of good consistence.

Medical Action and Uses.—The local stimulation of the galbanum and the action of the absorbed asafetida upon the nervous system render this plaster an appropriate application to the chest in *whooping cough* and to the abdomen in habitual flatulent *colic*. It is recommended in *hysteria*, but can hardly act upon that disease except through the patient's imagination.

EMPLASTRUM BELLADONNÆ, *U. S.*, *Br.*—BELLADONNA PLASTER.

Emplâtre de belladone, Fr.; *Belladonna-Pflaster*, G.

Preparation.—Belladonna-Root, in No. 60 powder, 100 parts (15 oz. av.); Alcohol, Resin Plaster, each a sufficient quantity; to make 100 parts (15 oz. av.). Moisten the powder with 40 parts (6 oz. av. or 7 fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the belladonna-root is exhausted. Reserve the first 90 parts (13½ oz. av. or 14 fluidounces) of the percolate; evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to 10 parts (1½ oz. av. or 1½ fluidounces); mix this with the reserved portion and evaporate, at or below the above-mentioned temperature, to a soft, uniform extract. Add to this enough resin plaster, previously melted, to make the whole weigh 100 parts (15 oz. av.) and mix thoroughly.—*U. S.*

Take of alcoholic extract of belladonna-root 4 ounces (or 1 part); resin plaster, soap plaster, each 8 ounces (or 2 parts). Melt the plasters by the heat of a water-bath; then add the extract, and mix the whole thoroughly together.—*Br.*

Both formulas yield good and efficient plasters, and now direct them to be prepared from the root, while heretofore the extract of the herb was used. In following the first formula, particular attention should be paid to the character of belladonna-root, which if woody and from old plants should be rejected. A definite proportion of extract, as ordered in the second formula, would be preferable. The plaster is often used in the form of sparadrap.

Medical Action and Uses.—Belladonna plaster diminishes the circulation of the blood in the part to which it is applied, and thereby, as well as by a direct action on the nerves, lessens pain. It is habitually employed to allay *neuralgic* and *rheumatic pains*, over *inflammatory swellings* in their congestive stage, and especially upon engorged *glands*, as the *mamma* and the *testicle*. Care must be taken that the skin is sound where it is applied, as the characteristic symptoms of belladonna-poisoning of a high grade have resulted from a neglect of this precaution. A very striking case of the kind is reported by Mather (*Med. Record*, xxiii. 82). The symptoms in a mild form, such as dilatation of the pupils, dryness of the throat, and a papular eruption on the skin, are common even when the plaster has been applied to the unbroken skin.

EMPLASTRUM CAPSICI, *U. S.*—CAPSICUM PLASTER.

Sparadrapum capsici.—*Sparadrap de capsique*, Fr.; *Capsicumpflaster*, G.

Preparation.—Resin Plaster, Oleoresin of Capsicum, each a sufficient quantity. Melt the resin plaster at a gentle heat, spread a thin and even layer of it upon muslin, and allow it to cool. Then, having cut off a piece of the required size, apply a thin coating of oleoresin of capsicum by means of a brush, leaving a narrow blank margin along the edges. A space of 4 inches (10 Cm.) square should contain 4 grains (25 Cgm.) oleoresin of capsicum.—*U. S.*

This new pharmacopœial plaster is simply adhesive plaster rendered irritating by a very thin layer of the oleoresin.

Allied Plasters.—EMPLASTRUM AROMATICUM, Emplastrum stomachicum.—Aromatic or stomach plaster, *E.*; Emplâtre aromatique, *Fr.*; Aromatisches Pflaster, Magenpflaster, *G.*—Yellow wax 32 parts; suet 24 parts; turpentine 8 parts. Melt them together, and to the nearly-cooled mass add of expressed oil of nutmeg 6 parts; powdered olibanum 16 parts; powdered benzoin 8 parts;

oil of peppermint and of cloves, each 1 part. Mix intimately, form into rolls, and keep them in wax-paper.—*P. G.* 1872. The plaster is of a grayish-brown color and has an aromatic odor.

Spice plaster, as generally used in the United States, is a mixture of various spices mixed with honey or water, and really belonging to the class of cataplasms. The following formula was used by the late Dr. Parrish, Sr.: Powdered capsicum, cinnamon, and cloves, of each 2 ounces; rye-meal, spirits, and honey sufficient.

Medical Action and Uses.—Capsicum plaster is mildly counter-irritant and decidedly stimulating. It is a convenient and efficient application to parts affected with *muscular rheumatism* or *neuralgia*, and to palliate some internal pains.

Spice plaster is popularly used in Germany to palliate *rheumatic* and other local pains, and deserves to be made officinal in this country.

EMPLASTRUM CERATI SAPONIS, *Br. 1867.*—Soap Cerate Plaster.

Emplâtre de savon saturné, Fr.; *Seifencerat-Pflaster*, G.

Preparation.—Take of Curd Soap, in powder, 10 ounces; Yellow Wax 12½ ounces; Olive Oil 1 pint; Oxide of Lead 15 ounces; Vinegar 1 gallon. Boil the vinegar and oxide of lead together by the heat of a steam-bath, constantly stirring them until the oxide has combined with the acid; then add the soap, and boil again until most of the moisture is evaporated; finally, add the wax and oil melted together, and stir the whole continuously, maintaining the heat until by the evaporation of the remaining moisture the product has acquired the proper consistence for a plaster.—*Br.*

A similar preparation was formerly (1850) officinal in the United States, but has been replaced by Ceratrum Saponis (which see). To avoid the prolonged unnecessary boiling, A. W. Gerrard (1874) proposed to substitute for the vinegar 18 ounces of acetic acid, which is sufficient to dissolve the oxide of lead; the acetate of lead formed reacts with the soap, forming lead plaster. The present Pharmacopœia has changed the name to Emplastrum saponis fuscum.

Medical Uses.—Soap cerate plaster is used for the general purposes of adhesive plaster, and for supporting and protecting *enlarged joints* and other swollen parts.

EMPLASTRUM FERRI, *U. S., Br.*—Iron Plaster.

Emplastrum roborans; Emplastrum ferratum s. martiale.—Chalybeate plaster, Strengthening plaster, E.; *Emplâtre d'oxyde rouge de fer, Emplâtre de Canet*, Fr.; *Eisenpflaster, Stärkendes Pflaster*, G.

Preparation.—Hydrated Oxide of Iron, dried at a temperature not exceeding 80° C. (176° F.), 10 parts (1 oz.); Canada Turpentine 10 parts (1 oz.); Burgundy Pitch 10 parts (1 oz.); Lead Plaster 70 parts (7 oz.); to make 100 parts (10 oz.). Melt the lead plaster, Canada turpentine, and Burgundy pitch by means of a water-bath; then add the oxide of iron, and stir constantly until the mixture thickens on cooling.—*U. S.*

Hydrated peroxide of iron 1 ounce; Burgundy pitch 2 ounces; lead plaster 8 ounces.—*Br.*

The first is an improvement on the old formula in having one-half of the Burgundy pitch replaced by the turpentine, as previously suggested by us. The lead plaster and Burgundy pitch should be melted first, after which the Canada turpentine should be added, and finally the hydrated oxide of iron, the latter being used now in place of the so-called subcarbonate of iron.

Medical Action and Uses.—There is no reason for believing that the iron in this plaster exerts any special therapeutic influence. Its protective, supporting, and stimulant action renders it a useful application to parts affected with chronic muscular and articular *rheumatism*, to the chest during the decline of acute *pleurisy*, to enlarged *glands*, etc.

EMPLASTRUM GALBANI, *U. S., Br.*—Galbanum Plaster.

Emplastrum galbani compositum, U. S. 1870; *Emplastrum lithargyri (vel plumbi) compositum*, P. G.; *Emplastrum diachylum gummatum*, F. Cod.; *Emplastrum diachylon compositum.—Compound galbanum plaster*, E.; *Emplâtre diachylon gommé*, Fr.; *Mutterharz-Pflaster, Gummipflaster, Zugpflaster*, G.

Preparation.—Galbanum 16 parts (4 oz.); Turpentine 2 parts (½ oz.); Burgundy Pitch 6 parts (1½ oz.); Lead Plaster 66 parts (19 oz.); to make 100 parts (25 oz.). To the galbanum and Canada turpentine, previously melted together and strained, add, first, the Burgundy pitch, then the lead plaster melted over a gentle fire, and mix the whole thoroughly.—*U. S.*

Galbanum, ammoniacum, yellow wax, each 1 ounce; lead plaster 8 ounces.—*Br.*

Lead plaster 12 parts; yellow wax 1½ parts; galbanum, ammoniac, and common turpentine, each 1 part.—*P. G.*

The corresponding plaster of the F. Cod. contains also elemi and sagapenum.

By rubbing 30 grains of powdered saffron with sufficient alcohol to produce a pulpy mass, and mixing this intimately with 4 troyounces of galbanum plaster (U. S. P.), previously fused, a good substitute for *Emplastrum galbani crocatum*, used in Europe, is obtained.

EMPLASTRUM OXYCROCEUM, s. EMPL. GALBANI RUBRUM. This compound galbanum plaster is frequently used by our German population; it is prepared as follows: Take of yellow wax, resin, Burgundy pitch, each 6 parts. Melt them together with a moderate heat, and to the strained mass add of ammoniac, powdered, and galbanum, each 2 parts, previously liquefied with turpentine 3 parts. Then add an intimate mixture consisting of mastic, myrrh, olibanum, each, in powder, 2 parts, and saffron, powdered, 1 part, and mix the whole together.—*P. G.* 1872. The plaster is reddish-brown and very tenacious.

Medical Action and Uses.—As a more stimulant application than most of the other plasters used for the same purposes, it may be preferred before them in the treatment of various local affections named in the preceding articles.

EMPLASTRUM HYDRARGYRI, *U. S., Br., P. G.*—MERCURIAL PLASTER.

Emplastrum mercuriale.—Emplâtre mercuriel, Fr.; *Quecksilber-Pflaster*, G.

Preparation.—Mercury 30 parts (3 oz.); Olive Oil 10 parts (1 oz.); Resin 10 parts (1 oz.); Lead Plaster 50 parts (5 oz.); to make 100 parts (10 oz.). Melt the olive oil and resin together, and, when the mixture has become cool, rub the mercury with it until globules of the metal cease to be visible. Then gradually add the lead plaster, previously melted, and mix the whole thoroughly.—*U. S.*

Take of mercury 3 ounces; olive oil 56 grains; sublimed sulphur 8 grains; lead plaster 6 ounces. Heat the oil, and add the sulphur to it gradually, stirring until they unite; with this mixture triturate the mercury until globules are no longer visible; then add the lead plaster, previously liquefied, and mix the whole thoroughly.—*Br.*

The extinguishment of the metallic mercury is accomplished in the first formula by the mixture of resin and olive oil; in the second, by the little sulphur combined with the olive oil. Canada or Venice turpentine would have a similar result.

The French Codex gives a formula for EMPLASTRUM DE VIGO CUM MERCURIO (*Emplâtre mercuriel dit de Vigo*), which is occasionally used here. It is made by fusing together lead plaster 200 parts; yellow wax and resin, each 10 parts: add thereto the following powders: olibanum, ammoniac, bdellium, and myrrh, of each 3 parts, and saffron 2 parts; also 60 parts of mercury extinguished by 10 parts of turpentine, and finally 30 parts of liquid storax and 1 part of oil of lavender.

Medical Action and Uses.—The virtues of mercurial plaster depend upon its being not only a mechanical support to the affected parts and a mild counter-irritant, but also upon the specific operation of its mercury, whereby it tends to promote the absorption of exudation-matter, both by its direct local action and by its producing on the system a greater or less mercurial impression. Indeed, it not unfrequently occasions soreness of the gums and a degree of salivation. It is frequently employed for the removal of *syphilitic nodes* and *glandular engorgements* produced by the same cause, including those of the *liver*. It appears also to reduce that organ and the *spleen* when enlarged by malarial disease. The Vigo plaster of the French Codex, which is described above, has been applied as a mask to the face during the papular stage of *small-pox*, with the effect of preventing a full development of the pustules and the consequent pitting. The simpler mercurial plaster appears to have been used with equally good results. In both cases the influence of mechanical compression and of the exclusion of light should not be overlooked.

EMPLASTRUM ICHTHYOCOLLÆ, *U. S.*—ISINGLASS PLASTER.

Emplastrum adhæsivum anglicum, Sparadrapum s. Taffetas adhæsivum, Sericum anglicum.—Court plaster, E.; *Sparadap de colle de poisson, Taffetas d'Angleterre*, Fr.; *Englishes Pflaster, Klebtaffet*, G.

Preparation.—Isinglass 10 parts (155 grains); Alcohol 40 parts (620 grains or 13½ fluidrachms); Glycerin 1 part (15½ grains); Water, Tincture of Benzoin, each a sufficient quantity. Dissolve the isinglass in a sufficient quantity of hot water to make the solution weigh 120 parts (4¼ oz. av.). Spread one-half of this, in successive layers, upon taffeta (stretched on a level surface) by means of a brush, waiting after each application until the layer is dry. Mix the second half of the isinglass solution with the alcohol and glycerin, and apply it in the same manner. Then reverse the taffeta, coat it on the back with tincture of benzoin, and allow it to become perfectly dry. Cut the plaster in pieces of suitable length and preserve them in well-closed vessels. Substituting *Gm.* (15.5 gr.) for *part*, the above quantities are sufficient to cover a piece of taffeta 15 inches (38 Cm.) square.—*U. S.*

This formula has been taken from the German Pharmacopœia of 1872. The taffeta should be stretched upon a frame, so as to present a level surface. For the first two applications the isinglass solution should be warmed merely to above its congealing-point, so that when spread out it may rapidly solidify, and at the same time firmly adhere to, but not pass through, the fabric. The air having access to both sides of the taffeta, each coating will dry readily and uniformly in a dry and moderately warm atmosphere, and should be quite hard before a new application is made. The addition of glycerin to the last portion of the isinglass solution prevents the plaster from breaking and preserves its flexibility for a long time. The tincture of benzoin applied to the reverse side leaves a thin layer of resin, which, in a measure, renders this plaster waterproof; it is, however, advisable to repeat this application once or twice. The plaster should only be removed from the frame when thoroughly dry.

EMPLASTRUM OPII, *U. S., Br.*—OPIUM PLASTER.

Emplastrum opiatum s. cephalicum s. odontalgicum.—Emplâtre d'opium, Emplâtre céphalique (temporal, odontalgique, calmant), Fr.; *Opiumpflaster, Hauptpflaster*, G.

Preparation.—Extract of Opium 6 parts (1½ oz.); Burgundy Pitch 18 parts (4½ oz.); Lead Plaster 76 parts (19 oz.); Water 8 parts (2 oz.); to make 100 parts (25 oz.). Rub the extract of opium with the water until uniformly soft, and add the Burgundy pitch and lead plaster, melted together by means of a water-bath; then continue the heat for a short time, stirring constantly, until the moisture is evaporated.—*U. S.*

Take of opium, in finest powder, 1 ounce; resin plaster 9 ounces. Melt the resin plaster by means of a water-bath; then add the opium by degrees and mix thoroughly.—*Br.*

Both these formulas yield good and efficient plasters, the first being preferable on account of the absence of the insoluble and non-adhesive constituents of opium, and for being rather stronger as far as opium is concerned.

Medical Uses.—This plaster is a convenient form for the local application of opium to painful parts of limited extent—*e. g.* to the face in *toothache.*

EMPLASTRUM PICIS BURGUNDICÆ, *U. S.*—BURGUNDY PITCH PLASTER.

Emplastrum picatum, F. Cod.—*Emplâtre de poix de Bourgogne*, Fr.; *Burgunder Pech-Pflaster*, G.

Preparation.—Burgundy Pitch 90 parts (9 oz.); Yellow Wax 10 parts (1 oz.); to make 100 parts (10 oz.). Melt them together, strain the mixture, and stir constantly until it thickens on cooling.—*U. S.*

The present formula is an improvement on the former one, in that the proportion of wax has been increased one-third, thus diminishing the brittleness of the plaster. The French Codex directs 1 part of yellow wax to 3 parts of Burgundy pitch.

The formula of the British Pharmacopœia for *Emplastrum picis*, or *pitch plaster*, is as follows: Take of Burgundy pitch 26 ounces; common frankincense 13 ounces; resin and yellow wax, each 4½ ounces; expressed oil of nutmeg 1 ounce; olive oil and water, each 2 fluidounces. Add the oils and water to the frankincense, Burgundy pitch, resin, and wax, previously melted together; then, constantly stirring, evaporate to a proper consistence.—*Br.*

Medical Uses.—Burgundy pitch plaster, besides giving mechanical support, is useful through its stimulant and mildly counter-irritant action. The British preparation is the more efficient of the two.

EMPLASTRUM PICIS CANADENSIS, *U. S.*—Canada Pitch Plaster.

Hemlock pitch plaster, *Hemlock plaster*, E.; *Emplâtre de poix de Canada*, Fr.; *Canada-Pech-Pflaster*, G.

Preparation.—Canada Pitch 90 parts (9 oz.); Yellow Wax 10 parts (1 oz.); to make 100 parts (10 oz.). Melt them together, strain the mixture, and stir constantly until it thickens on cooling.—*U. S.*

The increase of one-third in the proportion of yellow wax is, as in the preceding case, a decided improvement.

This plaster has been occasionally prescribed under the incorrect names of *Empl. cicutæ* and *Empl. conii*. *Emplastrum conii*, P. G. 1872, is made by melting together 4 parts of yellow wax and 1 part each of turpentine and olive oil, and before congealing mixing with 2 parts of powdered conium-leaves. The French Codex recognizes two conium plasters, the simplest being the *Emplâtre d'extrait de ciguë*, which contains elemi 2 parts, wax 1 part, and alcoholic extract of conium 9 parts.

Medical Uses.—Its uses are the same as those of Burgundy pitch plaster.

EMPLASTRUM PICIS CUM CANTHARIDE, *U. S.*—Pitch Plaster with Cantharides.

Emplastrum calefaciens, Br.—*Warm or warming plaster*, E.; *Emplâtre de poix cantharidé*, Fr.; *Pechpflaster mit Canthariden*, G.

Preparation.—Burgundy Pitch 92 parts (23 oz.); Cerate of Cantharides 8 parts (2 oz.); to make 100 parts (25 oz.). Heat the cerate as nearly as possible to 100° C. (212° F.) on a water-bath, and, having continued the heat for 15 minutes, strain it through a close strainer which will retain the cantharides. To the strained liquid add the pitch, melt them together by means of a water-bath, and having removed the vessel stir the mixture constantly until it thickens on cooling.—*U. S.*

Take of cantharides, in coarse powder, expressed oil of nutmeg, yellow wax, resin, each 4 ounces; resin plaster 3¼ pounds; soap plaster 2 pounds; boiling water 1 pint. Infuse the cantharides in the boiling water for 6 hours, squeeze strongly through calico, and evaporate the expressed liquid by a water-bath till reduced to one-third. Then add the other ingredients and melt in a water-bath, stirring well until the whole is thoroughly mixed.—*Br.*

A. W. Gerrard (1874) recommends the substitution of resin plaster for the soap plaster.

Allied Plasters.—Emplastrum cantharidum perpetuum, *P. G.*—Perpetual cantharides plaster, *E.;* Emplâtre perpétuel, Emp. vésicatoire anglais, *Fr.:* Immerwährendes Zugpflaster, Ewiges Pflaster, *G.*—Melt with a gentle heat resin 70 parts, yellow wax 50 parts, turpentine 35 parts, and suet 20 parts, and add very finely-powdered cantharides 20 parts and finely-powdered euphorbium 5 parts. It has a greenish-black color.

Emplastrum picis irritans.—Irritant pitch plaster, *E.:* Vésicatoire de Janin, *Fr.:* Reizendes Pechpflaster, *G.*—Melt together Burgundy pitch 32 parts, yellow wax and turpentine each 12 parts, and add finely-powdered euphorbium 3 parts.

Emplastrum thapsiæ, Sparadrapum revulsivum.—Thapsia plaster, *E.:* Sparadrap révulsif de Thapsia, *Fr.:* Thapsiapflaster, *G.*—Melt together yellow wax 42 parts, common turpentine 5 parts, colophony, Burgundy pitch, and boiled turpentine each 15 parts; strain, and add glycerin and honey each 5 parts, thapsia resin 7.5 parts; when the mixture has become homogeneous spread upon linen.—*F. Cod.*

Medical Action and Uses.—This plaster maintains a mild counter-irritant action greater than that of the simple pitch plaster, but less than is caused by a blister. It is often of signal advantage in chronic affections of the *joints*, chronic muscular *rheumatism*, and chronic diseases of the *chest*. Of the last, chronic *bronchitis* is often greatly benefited by its use, and next to this is chronic *pleurisy*. It is of service in the treatment of chronic pulmonary engorgement due to the presence of *tubercle*, or in that of *broncho-pneumonia*, which so often tends to pulmonary phthisis.

EMPLASTRUM PLUMBI, *U. S.*, *Br.*—Lead Plaster.

Emplastrum lithargyri (*simplex*), P. G.; *Emplastrum simplex*, F. Cod.; *Emplastrum diachylon simplex*.—*Diachylon plaster*, *Litharge plaster*, E.; *Emplâtre simple*, *Emplâtre de plomb* (*de litharge*), Fr.; *Bleipflaster*, *Diachylon-Pflaster*, G.

Preparation.—Oxide of Lead, in very fine powder, 32 parts (16 oz.); Olive Oil 60 parts (30 oz.); Water a sufficient quantity. Rub the oxide of lead with about one-half of the olive oil, and add the mixture to the remainder of the oil contained in a suitable vessel of a capacity equal to three times the bulk of the ingredients. Then add 10 parts (5 oz.) of boiling water, and boil the whole together until a homogeneous plaster is formed, adding from time to time during the process a little water as that first added is consumed.—*U. S.*

The French and German Pharmacopœias use equal parts of olive oil and lard in place of olive oil alone, which is directed by the British and United States Pharmacopœias. A much greater discrepancy, however, exists in the proportion of the fat to the other ingredients. Calculated for 100 parts of fat, there are ordered of water 100 (*F. Cod.*), 50 (*Br.*), 16.7 (*U. S.*) parts, and sufficient (*P. G.*); of litharge 53.33 (*U. S.*), 50 (*F. Cod.* and *P. G.*), and 50 (*Br.*) parts. A much smaller amount is decidedly insufficient, and yields a plaster which is and remains sticky. The litharge should be not less than half the weight of the fat used, and in view of its variable quality may very properly be increased somewhat beyond that proportion, as directed by the United States Pharmacopœia.

In view of the importance of this plaster as a basis for many others, it is usually prepared in larger quantities, and an expeditious and successful manipulation is therefore to be preferred to methods which may involve more labor and time. The oxide of lead may be triturated in the kettle in which the plaster is to be made, with a portion of the oil gradually added until a thin, smooth, and uniform pasty mass is obtained, when the oil may be added more rapidly, the trituration being continued. But if the litharge is in very fine powder, as directed by the Pharmacopœia, there is no necessity for such trituration; the litharge, however, may be passed through a sieve for the purpose of removing impurities and breaking up lumps, and sifted directly into the mixture of oil and water, which may at the same time be heated. The whole is then boiled, and frequently stirred to prevent the litharge from settling to the bottom, and a little hot water is added from time to time to supply that which may have evaporated. The mixture has at first a reddish color, which gradually changes until it finally becomes white. From the time it commences to boil the mixture foams, on account of the extrication of the watery vapors, and as the saponification proceeds the foaming increases. Now it requires additional attention to keep up the supply of water, the proportion ordered by the U. S. P. being ample for all purposes, and to prevent the mass from becoming overheated, which would interfere with the adhesive qualities of the plaster and more or less darken its color. The temperature may be allowed to rise to about 120° C. (248° F.), but it will be below that point if sufficient water be present. Instead of boiling the mixture, it may be digested in a water-bath, but the formation of the plaster will then require 2 or 3 days, while by the pharmacopœial process it will be completed in little more than as many hours, depending upon the quantity worked. Without the addition of water, litharge will decompose fats, uniting with the fatty acids, but a much higher temperature will be required, and in the absence of water glycerin cannot be separated, but is decomposed. Plumbic hydrate, the hydrated oxide of lead, contains enough water for the separation of glycerin, and its combination with the acids of the oil is effected more readily and at a lower temperature. The relations are similar if the officinal directions are followed; but the saponification of the fat requires more time, as plumbic hydrate is slowly formed; however, with sufficient attention no secondary decomposition-products are formed. To increase the saponifying action of the litharge a small quantity of acetate of lead is sometimes added, by which the oxide is more readily dissolved, but the addition is not necessary. Since carbonate of lead saponifies fat with greater difficulty than the oxide, the latter should be as free from the former as possible; the carbonic acid is gradually evolved as the saponification proceeds.

Lead plaster may also be obtained by precipitating a solution of soap by sugar of lead, but the plaster thus obtained soon becomes hard and dark-colored. Similar objections exist against the substitution of many other fats for olive oil. As we have seen, the French and German Pharmacopœias sanction the use of equal weights of olive oil and lard.

The process is known to be finished when, after dropping a little of the plaster in cold water and kneading it between the fingers, it is found to be pliable, but not sticky. When this point has been reached the vessel is removed from the fire and allowed to cool somewhat. The temperature may then be reduced by the addition of cold water, and the mass kneaded and rolled out, as described above (see Emplastra), into cylinders of any convenient size. The yield is but little more than the weight of the ingredients used.

Lead plaster is of a uniform grayish-white color, but not white, as stated by the U. S. P. and P. G. At a low temperature the plaster breaks with a finely-granular fracture. On keeping, it becomes of a more dingy tint, and superficially changes to yellowish or pale-brownish. As stated above, it should, when warm, be pliable and not sticky, due to unsaponified fat, and it should be entirely free from uncombined litharge, the presence of which is easily recognized by its reddish color or may be detected by the plaster not being "entirely soluble in warm oil of turpentine" (*U. S.*). Chemically, lead plaster is a mixture of oleate and palmitate of lead, containing also stearate if lard has been used in its preparation.

Zinc plaster, in which oxide of zinc is substituted for litharge, has been occasionally recommended; it is most expeditiously prepared by mixing concentrated solutions of 2 parts of white Castile soap and 1 part of sulphate of zinc, digesting the mixture until the decomposition has been completed, and washing out the salt by kneading the mass under water.

Off. Prep.—Empl. ammoniacicum hydrargyri, Empl. asafœtidæ, *U. S.;* Empl. ferri, Empl. galbani, Empl. hydrargyri, *U. S.*, *Br.;* Empl. opii, *U. S.;* Empl. resinæ, Empl. saponis, *U. S.*, *Br.*

Medical Action and Uses.—The oxide of lead in this plaster is its only active ingredient, and hence it is used as a discutient as well as a protective. Owing to the possibility of absorption of the lead, it should not be applied to raw surfaces. It is frequently used to prevent *bed-sores* and the *abrasions* which many forms of surgical apparatus tend to produce. Zinc plaster may be used instead of lead plaster where a large surface is to be covered or the skin is delicate.

EMPLASTRUM PLUMBI IODIDI, *Br.*—Iodide of Lead Plaster.

Emplâtre d'iodure de plomb, Fr.; *Jodblei-Pflaster*, G.

Preparation.—Take of Iodide of Lead 2 ounces (or 1 part); Lead Plaster 1 pound (or 8 parts); Resin 2 ounces (or 1 part). Add the iodide of lead in fine powder to the plaster and resin, previously melted at as low a temperature as possible, and mix them intimately.—*Br.*

The present formula was proposed by A. W. Gerrard (1874), who showed that the plaster, as formerly prepared with soap plaster, contained very little iodide of lead, which was nearly all decomposed by the soap.

Medical Action and Uses.—This is perhaps the best form in which iodide of lead can be employed topically for promoting the resolution of indurations resulting from inflammation, and especially from articular *rheumatism*.

EMPLASTRUM RESINÆ, *U. S.*, *Br.*—Resin Plaster.

Emplastrum adhæsivum, P. G.—*Adhesive plaster*, E.; *Emplâtre résineux* (*adhésif*), Fr.; *Heftpflaster*, G.

Preparation.—Resin, in fine powder, 14 parts (7 oz.); Lead Plaster 80 parts (40 oz.); Yellow Wax 6 parts (3 oz.); to make 100 parts (50 oz.). To the lead plaster and wax, melted together over a gentle fire, add the resin, and mix them.—*U. S.*

Take of resin 4 ounces; lead plaster 2 pounds; curd soap 2 ounces. To the lead plaster, previously melted with a gentle heat, add the resin and soap, first liquefied, and stir them until they are thoroughly mixed.—*Br.*

This is the plaster which, spread upon muslin, forms the sparadrap commonly known as *adhesive plaster* or *sticking plaster*. The relative proportion of resin in the plaster of the U. S. P. is very nearly the same as formerly, but a portion of the lead plaster has been replaced by yellow wax; which is an improvement, the plaster when spread being less brittle in cold weather than formerly. About 2 per cent. more of resinous matter is contained in the plaster of the P. G., which is made by melting lead plaster 100 parts until all the water has evaporated; then adding yellow wax 10 parts and a previously melted mixture of dammar 10 parts, colophony 10 parts, and turpentine 1 part. This plaster is more pliable and adhesive at a low temperature, a quality possessed also by that of the Br. P. For the latter, A. W. Gerrard (1874) suggests that for use in summer one-fourth the quantities of soap and resin ordered should be used; in the spring one-half the quantity will answer, but in cold weather the officinal proportions are preferable. The *sparadrap commun* used in France is compound galbanum plaster.

Good adhesive plaster should not be sticky at the ordinary temperature; when spread upon muslin it should be pliable without cracking, and when applied to the skin should adhere firmly.

Emplastrum adhæsivum edinburgense is adhesive plaster containing 3 per cent. of black pitch.

Off. Prep.—Empl. arnicæ, *U. S.;* Empl. belladonnæ, *U. S., Br.;* Empl. calefaciens, *Br.;* Empl. capsici, *U. S.;* Empl. opii, Empl. plumbi iodidi, *Br.*

Medical Uses.—Adhesive plaster is chiefly employed for the support of mobile parts, for exerting pressure, for securing the coaptation of *wounds* and *fractures*, for maintaining *surgical dressings*, etc. It is apt to irritate delicate skins.

EMPLASTRUM SAPONIS, *U. S., Br.*—Soap Plaster.

Emplastrum saponatum, P. G.; *Emplastrum cum sapone*, F. Cod.—*Emplâtre de savon*, Fr.; *Seifenpflaster*, G.

Preparation.—Soap, dried and in coarse powder, 10 parts (1 oz.); Lead plaster 90 parts (9 oz.); Water a sufficient quantity. Rub the soap with water until brought to a semi-liquid state; then mix it with the lead plaster, previously melted, and evaporate to the proper consistence.—*U. S.*

Take of curd soap 6 ounces; lead plaster 2¼ pounds; resin 1 ounce. To the lead plaster, melted by a gentle heat, add the soap and the resin, first liquefied; then, constantly stirring, evaporate to a proper consistence.—*Br.*

The proportion of soap directed is 5.6 (*F. Cod.*), 5.8 (*P. G.*), 10 (*U. S.*), and 14 (*Br.*) per cent. The French Codex orders also 4.5 per cent. of white wax, while the German Pharmacopœia uses yellow wax 11.6 and camphor 1.16 per cent. The U. S. P. alone requires the soap to be rubbed up with water; the F. Cod. and P. G. order the soap to be powdered, when it may be uniformly incorporated with the melted plaster by sifting. Soap plaster has a whitish color, and to be adhesive should be nearly free from water, which renders the soap slippery. (For Emplastrum saponis fuscum, *Br.*, see p. 567.)

The following preparation has been dropped from the U. S. P. 1880:

Ceratum saponis.—Soap cerate, *E.;* Cérat de savon, *Fr.;* Seifencerat, *G.*—Melt together soap plaster 2 ounces; yellow wax 2½ ounces; and add olive oil 4 ounces.—*U. S.* 1870.

Off. Prep.—Empl. calefaciens, Empl. plumbi iodidi, *Br.*

Among the unofficinal plasters, more or less employed in different sections, the following deserve to be mentioned in this place:

Emplastrum cerussæ, s. Empl. album coctum.—White lead plaster, *E.;* Emplâtre de céruse, Empl. blanc cuit, *Fr.;* Bleiweisspflaster, *G.*—Melt together lead plaster 60 parts and olive oil 10 parts; add finely-powdered lead carbonate 35 parts, and boil with the occasional addition of a little water until a plaster is formed.—*P. G.* The plaster may be obtained in one operation by using in place of the lead plaster the requisite quantities of fat and litharge. A similar composition, containing a little wax and powdered orris-root, is known as *Mahy's plaster.*

Emplastrum fuscum, s. Empl. matris fuscum, Empl. nigrum, s. noricum, s. minii adustum, s. universale. Finely-powdered red oxide of lead 2 parts and olive oil 4 parts are boiled, with constant stirring, until the mass assumes a dark-brown color, when 1 part of yellow wax is added. For some purposes 1 per cent. of camphor is added, when it is known as *Emplastrum fuscum camphoratum*, *P. G.* The plaster is put up in square cakes and in boxes, and is also sold in some parts of the United States as *universal plaster* and *breast plaster*, and as a secret preparation under different names. It is extensively employed by the German population, and known to them as *Mutterpflaster*, *Universalpflaster*, etc. A very similar preparation, but boiled with litharge and twice the above amount of fat, is known in France as *Onguent de la mère Thècle* and *Emplâtre brun.*

Emplastrum matris album, s. Empl. lithargyri molle. Melt together lead plaster 3 parts, lard 2 parts, yellow wax and suet each 1 part.—*P. G.* 1872.

Emplastrum (ceratum) minii rubrum. Triturate 100 parts of powdered red oxide of lead and 3 parts of camphor with 60 parts of olive oil. Add the mixture to yellow wax and suet each 100 parts and olive oil 40 parts, previously heated together, and stir well until it has congealed.—*P. G.* 1872.

Logan's Plaster. Boil together over a slow fire olive oil 2½ pints, fresh butter 4 ounces, Castile soap 12 ounces, litharge 16 ounces avoirdupois, until the mass has a pale-brown color; then add carbonate of lead 16 ounces, and continue the heat until the plaster is formed; lastly, add 2 drachms of powdered mastich.

Medical Uses.—Soap plaster is generally used to prevent *abrasions*, *bed-sores*, etc., and, like other plasters containing lead, it possesses some discutient powers. Owing to the thickness of the layer as it is usually spread, it is apt to be moved from its original position, and is therefore not so efficient as adhesive plaster in preventing bed-sores. Soap cerate applied upon appropriate tissues affords mechanical support to joints, while it acts as a sedative of inflammation by promoting transpiration, and possibly by the direct operation of the lead in its composition. It is used to envelop *sprained*, *gouty*, *rheumatic*, and *scrofulous joints*, and as an application to *glandular swellings* and local hypertrophies.

ENEMATA.—Clysters.

Clysmata, *Clysteria.*—*Lavements*, *Clystères*, Fr.; *Klystiere*, G.

Clysters are liquid medicines which are injected into the rectum by means of a syringe, and ordinarily consist of water or of infusions mixed with solutions of salts or holding insoluble substances in suspension. They are rarely if ever prepared by the apothecary, but are generally made at the bedside, and the introduction of formulas into the Pharmacopœia serves mainly the purpose of informing the physician of the mode of their preparation.

ENEMA ALOES, *Br.*—Enema of Aloes.

Lavement aloétique, Fr.; *Aloeklystier*, G.

Preparation.—Take of Aloes 40 grains; Carbonate of Potash 15 grains; Mucilage of Starch 10 fluidounces. Mix, and rub together.—*Br.*

Medical Action and Uses.—It is far from certain that the enema of aloes exerts any special influence, or any that would not be secured equally well by a solution of common salt or of a magnesium salt. Aloetic enemata, when they are intended to purge, should be large, but when they are to be retained to destroy *ascarides* of the rectum or to stimulate the *uterus*, they should not exceed 2 or 3 fluidounces (Gm. 60–90).

ENEMA ASAFŒTIDÆ, *Br.*—Enema of Asafetida.

Enema fœtidum s. antihystericum, *Clysma tonicum.*—*Lavement d'ase fétide*, Fr.; *Asafötida-Klystier*, G.

Preparation.—Take of Asafetida 30 grains; Distilled Water 4 fluidounces. Rub the asafetida in a mortar, with the water added gradually, so as to form an emulsion.—*Br.* This is identical with a mixture of equal parts of water and milk of asafetida.

Medical Action and Uses.—The use of asafetida by enema is often the most eligible mode of its administration, on account of the patient's inability to swallow, as in *hysteria*, or because it acts very promptly, as in cases of *intestinal flatus*. The association of aloes with the emulsion of asafetida forms a very useful enema in cases of *constipation* with flatulence. A mixture of the wine or tincture of aloes and tincture of asafetida, sufficiently diluted with water, is far better than the officinal enema made with water alone.

ENEMA MAGNESII SULPHATIS, *Br.*—Enema of Sulphate of Magnesium.

Enema catharticum.—*Lavement de sulfate de magnésie*, Fr.; *Bittersalz-Klystier*, G.

Preparation.—Take of Sulphate of Magnesia 1 ounce; Olive Oil 1 fluidounce; Mucilage of Starch 15 fluidounces. Dissolve the sulphate of magnesia in the mucilage of starch, add the oil, and mix.—*Br.*

Medical Action and Uses.—The oil and mucilage in this enema are worse than useless. A simple solution of Epsom or of Glauber salt in water is preferable. It may be used as an evacuant of constipated bowels when a prompt operation is desired, as in cases of obstinate *constipation* or of *congestion of the brain*. For such purposes an enema should always be large.

ENEMA OPII, *Br.*—Enema of Opium.

Enema anodynum s. sedativum.—Lavement opiacé anodin, Fr.; *Opium-Klystier*, G.

Preparation.—Take of Tincture of Opium ½ fluidrachm; Mucilage of Starch 2 fluidounces. Mix.—*Br.*

Medical Action and Uses.—The proportion of laudanum or of other liquid opiate in an enema must vary with the age and state of the patient, with the local or general narcotic effect that is sought, etc. As the enema ought to be retained, the quantity of liquid in it should not exceed 2 ounces (Gm. 60); and if designed to affect the system it should consist of water, which is promptly absorbed, and not of starch, which may not be absorbed at all.

ENEMA TABACI.—Enema of Tobacco.

Lavement de tabac, Fr.; *Tabak-Klystier*, G.

Preparation.—Take of Leaf Tobacco 20 grains; Boiling Water 8 fluidounces. Infuse in a covered vessel for half an hour, and strain.—*Br.* 1867.

Medical Action and Uses.—The quantity stated in the formula is intended for one enema. The infusion of tobacco (*U. S. P.* 1870) was stronger than this preparation by one-half, but was prepared in the same way and used for the same internal purposes—that is to say, for producing nausea and muscular relaxation in cases of strangulated *hernia* and promoting alvine evacuations in *ileus*, as well as in the various cases indicated in the article on Tobacco. About 1 fluidounce (Gm. 32) of the former American preparation was intended to be given at a time. Its use requires caution.

ENEMA TEREBINTHINÆ, *Br.*—Enema of Turpentine.

Lavement térébinthiné, Fr.; *Terpentinöl-Klystier*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Mucilage of Starch 15 fluidounces. Mix.—*Br.*

Medical Action and Uses.—The proportion of oil of turpentine in an enema should vary with the case in which it is used. It is most frequently employed to lessen *tympanitic* distension of the bowels, but is of little use, comparatively, unless the flatus is confined in the colon. It sometimes affords great relief to suffering in *vesical calculus*. It has been used with alleged advantage in certain cases of *amenorrhœa* and to destroy *ascarides* of the rectum. It may be administered during a paroxysm of *hysteria*. When it is intended that a turpentine enema shall be retained, its bulk should be small, and it should also be made into an emulsion with yelk of egg.

EPIGÆA.—Trailing Arbutus.

Ground-laurel, Gravel-plant, May-flower, E.

Epigæa repens, *Linné.*

Nat. Ord.—Ericaceæ, Ericineæ.

Description.—The trailing arbutus is a prostrate hairy North American shrub about a foot (30 Cm.) long, growing in sandy woods and flowering in early spring. The thin woody stem is covered with a brown bark. The evergreen leaves are alternate, about 2 inches (5 Cm.) long, petiolate, coriaceous, and reticulated; their shape is ovate, the margin entire, the base heart-shaped, and the apex tipped with a short point. The flowers are in small axillary clusters, rose-colored or whitish, fragrant, have a deeply five-parted bracted calyx, a salver-form corolla with the tube hairy inside, ten stamens, and produce five-lobed and five-celled capsules containing numerous seeds. The leaves are inodorous, and have a bitterish and astringent taste.

Constituents.—The leaves contain tannin, which produces a black precipitate with iron salts. Using gelatin as a precipitant, H. K. Bowman (1869) determined its amount to be 3.5 per cent. Jefferson Oxley (1872) proved the constituents to be identical with those of uva ursi—namely, *arbutin*, *urson*, and *ericolin*. Formic acid was also found, and a principle having in its behavior to tests some resemblance to gallic acid, without, however, yielding pyrogallic acid.

Medical Action and Uses.—Trailing arbutus has been compared with uva ursi and buchu; it possesses some astringency, like the former, and has been used for the relief of *strangury* and *vesical catarrh.* A decoction is prepared with an ounce (Gm. 32) of the dried leaves and stems in a pint (Gm. 500) of water, and given in the *dose* of a wine-glassful three or four times a day.

EPILOBIUM.—Willow-Herb.

Herbe de St. Antoine, Fr.; *Weidenröschen*, *Antonskraut*, G.

Epilobium angustifolium, *Linné*, s. E. spicatum, *Lamarck*.
Nat. Ord.—Onagraceæ.

Origin.—A perennial herb about 4 to 6 feet (1.2 to 1.8 M.) high, and growing in low grounds and woodlands, occasionally also in dry and sunny localities. It is indigenous to North America, Northern Asia, and the greater portion of Europe, and flowers in July and August.

Description.—The root is long, fleshy, yellowish-white, and has a thick bark. The stem is erect, smooth, often reddish, branching above. The leaves are scattered, subsessile, from 3 to 6 inches (7 to 15 Cm.) long, lanceolate or linear-lanceolate, nearly entire, with a marginal vein, smooth, pale-green beneath. The flowers are in a long terminal spicate raceme; the calyx adheres to the long linear four-sided ovary; the four unguiculate petals are spreading, purple-colored or pinkish, and showy. The eight stamens and the style with the long four-lobed stigma are bent downward. All parts of the plant have a mucilaginous and astringent taste.

Constituents.—Analyzed by C. J. Biddle (1877), the usual constituents of plants were found. The astringent taste is due to a tannin which produces bluish-black precipitates with ferric salts. Gallic acid is also stated to be present.

Medical Action and Uses.—The demulcent, tonic, and astringent qualities of willow-herb are said to render it useful in mild or subacute forms of *diarrhœa*. It may be given internally in decoction and applied externally to unhealthy *ulcers*, including *aphthæ*.

The root and young shoots are eaten by the inhabitants of subarctic regions, and in Russia and Siberia the leaves are used in place of tea.

EPIPHEGUS.—Beechdrop.

Cancer-root, E.; *Orobanche de Virginie*, Fr.; *Krebswurz*, G.

Epiphegus (Orobanche, *Linné*) virginiana, *Barton*, s. E. americanus, *Nuttall*. Meehan, *Native Flowers*, ii. p. 93.
Nat. Ord.—Orobanchaceæ.

Origin.—A perennial parasite growing upon the roots of beech trees in North America from New Brunswick to Florida and Missouri, and flowering from August to October. It is collected in autumn.

Description.—The subterraneous portion consists of a subglobular scaly tuber ½ inch (12 Mm.) and more in diameter. The stem is 12 to 18 inches (30 to 45 Cm.) high, much branched, angular, with ovate scales at the base of the branches and flowers. The flowers are in long spicate racemes, the lower ones fertile and with a short corolla, the upper ones sterile, with a long tubular and two-lipped corolla, about ⅓ inch (8 Mm.) long. The stamens are didynamous, and the superior capsule is one-celled, two-valved, and contains numerous minute seeds. All parts of the plant have a pale purplish- or yellowish-brown color, and a disagreeable, bitter, and somewhat astringent taste.

The constituents of the plant have not been investigated.

Allied Plants, belonging to the same natural order, have been medicinally employed in Europe and America. They are all parasitic, destitute of green foliage, and have a more or less bitter, astringent, and nauseous taste. We mention the following North American species:

CONOPHOLIS (OROBANCHE, *Linné*) AMERICANA, *Wallroth*.—Cancer-root, Squaw-root, *E.*—It is from 4 to 6 inches (10 to 15 Cm.) high, nearly an inch (25 Mm.) thick, fleshy, yellowish or brownish, covered with pale shining imbricated scales, resembling a pine-cone. The flowers have a curved two-lipped corolla and four exserted stamens. It grows in oak woods.

APHYLLON UNIFLORUM, *Torrey et Gray*, s. Orobanche uniflora, *Linné*.—Naked broom-rape, *E.*—It grows in woodlands, has a very short nearly subterraneous scaly stem bearing one or several peduncles about 4 inches (10 Cm.) long, each with a nodding flower having a curved tubular somewhat two-lipped corolla and included stamens. Its color is whitish or pale tawny.

Medical Action and Uses.—This plant appears to be astringent. Dried and powdered, it has been given internally to control *diarrhœa* and applied externally to fungous and unhealthy *ulcers*. *Conopholis*, as its popular name implies, has been used for similar purposes, and *aphyllon* is credited with analogous virtues.

EQUISETUM.—Horsetail.

Prêle, Fr.; *Schachtelhalm*, G.

Equisetum arvense, *Linné*, and Eq. hyemale, *Linné*.
Nat. Ord.—Equisetaceæ.

Description.—Both plants are leafless, and grow in damp soil in Europe and North America.

E. arvense, *common horsetail*, has a simple, smooth, fertile stem, appearing in March or April. The barren stems, which alone are used, are slender, about 2 feet (60 Cm.) long, green, jointed, about twelve-furrowed, with simple or compound quadrangular branches bearing at the joints four scales.

E. hyemale, *scouring rush* or *shave-grass*, has a simple stem about 2 feet (60 Cm.) or more long, round, grooved, the ridges rough, and at the joints with sheaths of about twenty narrow teeth, having a black girdle at the base and tip.

Constituents.—The scouring rush was analyzed by Diebold (1828), who found in it resin, wax, sugar, and other common vegetable principles. John obtained 13 per cent. of ash, 63 per cent. of which (or 8 per cent. of the plant) was silica. The common horsetail gave to Willing (1856) 4.07 per cent. of ash, 41.4 per cent. of which was silica.

Medical Action and Uses.—The various species of Equisetum have had the reputation of being diuretic and astringent. It has been used in *dropsy*, *calculous affections*, *hæmaturia*, *nocturnal incontinence of urine*, *diabetes insipidus*, *hæmoptysis*, *diarrhœa*, and *dysentery*, and also as an *emmenagogue*. If too freely used it is said to render the urine bloody, and therefore it should not be given when the urine is high-colored and the general condition feverish. A decoction may be prepared with 1 or 2 drachms (Gm. 4–8) of the dried plant to a pint of water, of which 2 fluidounces (Gm. 64) may be taken several times a day; or, the fresh expressed juice may be given in the dose of from 1 to 3 ounces daily (Gm. 30–90), diluted with water or whey.

Arenaria rubra. It appears that this plant has long been used in Malta and in Algeria as a remedy for *dropsy*, *gravel*, and inflammations of the *urinary passages*, and that its use involves no risk. The large proportion of its alkaline and earthy salts appears to explain its diuretic virtues. It is best administered in decoction or infusion made with 3 per cent. of the dried plant (*Bull. de thérap.*, xcvii. 69).

ERGOTA, *U. S.*, *Br.*—Ergot.

Secale cornutum, P. G.; *Secale clavatum*, *Mater secalis*, *Clavus secalinus.*—*Spurred rye*, E.; *Ergot de scigle*, *Seigle ergoté (noir)*, *Blé cornu*, Fr.; *Mutterkorn*, *Kornmutter*, *Zapfenkorn*, *Hungerkorn*, G.

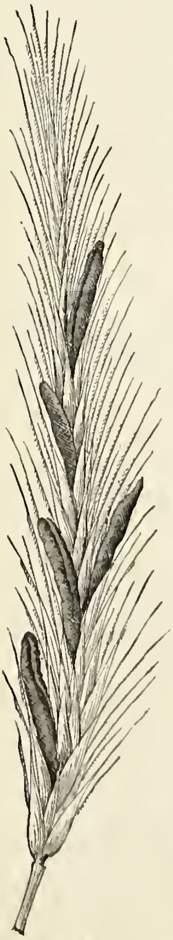
The sclerotium (compact mycelium or spawn) of Claviceps purpurea, *Tulasne*, replacing the grain (produced within the paleæ, *Br.*) of the common rye, Secale cereale, *Linné*. Steph. and Church, *Med. Bot.*, plate 113; Bentley and Trimen, *Med. Plants*, 303.
Nat. Ord.—Fungi, Ascomycetes.

Origin.—The ergot fungus and similar but probably distinct organisms are met with upon many grasses and species of Carex and Cyperus. For medicinal purposes that of rye alone is collected. In its development three distinct stages are observed: At the flowering season one or more ovaries in an ear of rye appear covered by a sweet yellowish mucus, the so-called *honey-dew of rye*, which has a disagreeable odor and is avoided by bees, but attracts other insects, mainly ants and beetles, which were formerly considered to cause the disease of the grain. This honey-dew contains innumerable microscopic cells called *conidia*, and a sugar which reduces alkaline solutions of cupric oxide to cuprous oxide, and is a product of decomposition of the constituents of the ovary caused by the developing *mycelium* of the fungus. This is formed of filamentous cells called *hyphæ*, with an outer layer forming a kind of membrane, the *hymenium*, composed of short linear cells, the *basidia*, by which the oblong or oval conidia are separated. In this stage of development it was formerly considered a distinct fungus, and received various names, the best known being Sphacelia segetum, *Léveillé*; this is often used as a descriptive term for the first stage, which is completed when the hyphæ have penetrated the lower part of the ovary and the separation of the conidia ceases; the relation of the sphacelia to ergot was first made known by Meyen (1841).

The hyphæ of the sphacelia now begin to unite at the base of the ovary into a compact body, which is purplish-black externally, and rapidly grows in length, carrying upon its apex, in the form of a hood, the remains of the ovary and fragments of the sphacelia-tissue. Occasionally the formation of the honey-dew does not commence until some time after fructification has taken place and the fruit is partially developed; in such a case the ergot will be crowned by a stunted grain. When full grown the second stage of the fungus has been reached, which forms the officinal ergot, or *sclerotium*, and was formerly regarded as a distinct fungus, named Sclerotium (Spermœdia, *Fries*, Clavaria, *Schrank*) Clavus, *De Candolle.*

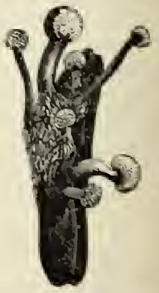
After some months of rest, in the succeeding spring small circular patches of the external layer are loosened and fold back, while at the same time small heads make their appearance, which, at first white, change to yellowish, reddish, and finally purple, and are upon slender, pale-purplish, curved stipes. On the surface of the head small wart-like excrescences are formed, containing the apertures of bottle-shaped cavities or conceptacles, the *perithecia*. Each one of these conceptacles contains a large number of somewhat fusiform cells or spore-sacs, the *asci*, each one of these containing eight filiform spores, which are discharged from the aperture of the conceptacle agglutinated in a bundle. The formation of the spores takes place about the time of the flowering of rye, and when brought in contact with its flowers the spores develop again the sphacelia. The spore-producing heads are nourished from the contents of tissue of the sclerotium, which at first becomes loose and spongy from the disappearance of the oil, and finally shrivels and is destroyed. This third and final stage was formerly likewise regarded as a distinct fungus, known, among other names, as Cordiceps purpurea, *Fries*, until Tulasne (1853) proved it to be merely the final stage in the development of a fungus, as described above. The production of spores may be observed by leaving the ergot in the open air or by keeping it upon moist earth under a bell-glass; we have noticed it in a damp stoppered bottle containing some ergot.

Fig. 108.



Ergotized Rye.

Fig. 109.

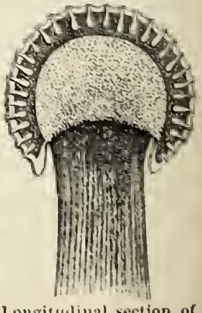


Ergot: fruiting stage.

It will be seen that the officinal ergot is merely the intermediate or dormant state of a fungus named by the different pharmacopœias sclerotium, *U. S.*, compact mycelium or spawn, *Br.*, and stromata sterilia (sterile beds), *P. G.* 1872.

The United States imported 7553 pounds of ergot during the fiscal year 1866–67, and during the years 1875–82 an average of 98,326 pounds annually.

Fig. 110.



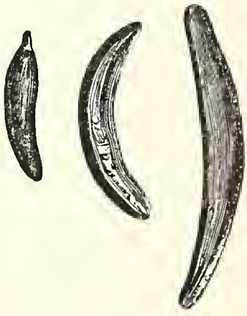
Longitudinal section of fruiting head, showing conceptacles.

Description.—Ergot forms a solid somewhat fusiform body, which is 1 to 1½ inches (25 to 38 Mm.) long, ⅛ to ¼ inch (3 to 6 Mm.) thick, subcylindrical or often obtusely triangular, tapering at both ends, usually somewhat curved, with three longitudinal furrows and an easily-detached, yellowish, small appendage or hood at the apex. It is externally of a purplish-black color, the surface frequently fissured transversely, internally whitish, with some purplish striæ, of a uniform texture, and breaks readily with a smooth fracture. It has a peculiar heavy odor, particularly when moist or when treated with potassa solution; its taste is oily and unpleasant. It is frequently attacked by a mite, from which it may be preserved by thoroughly drying it and keeping it in well-stopped bottles or by putting a few drops of chloroform into the bottle containing it. Ergot appears to preserve its virtues not much over a year, and should therefore be annually renewed—a precaution which is no longer prescribed by the German Pharmacopœia. Bernbeck (1881) ascertained that the fixed oil obtained with petroleum benzin from recent ergot has a neutral reaction, while that from old ergot shows a decided acid reaction to test-paper.

Powdered ergot spoils after a short time, the deterioration being induced by the fixed oil becoming rancid; it should therefore not be kept on hand in the powdered state except for a brief period. According to Mourrut (1877), the powder may be preserved unaltered for a long time by the addition to it of 5 per cent. of benzoin; but the evident change produced in the fixed oil, and probably other constituents, of the powder has caused a number of suggestions to be made looking toward the removal of the oil. For this purpose benzin or ether has been mostly recommended, and the last-named menstruum has been adopted by the P. G.; which authority directs that the powder should be employed only after having been thoroughly exhausted by ether. Ferret (1882) recommends bruising of the ergot, and drying it at 40° C. (104° F.), after which it should be powdered, again dried at 80° C. (176° F.), then exhausted with ether, and dried at 35° C. (95° F.), the heat being gradually raised just to 100° C. (212° F.), when the powder is to be put into small vials. Benzin of a low boiling-point will likewise answer for this purpose. While there can be no doubt that powdered ergot deprived of fixed oil will not deteriorate readily, investigations are still needed as to the effects of the different solvents of the oil upon the other constituents, and to the length of time for which such ergot will retain its activity; Werner (1881) reported its virtues unimpaired after more than two years.

Constituents.—The separation of the constituents of ergot offers peculiar difficulties, which have been in part explained by the recent researches of Buchheim and of Dragendorff (1876); the former regards the active principle as a body somewhat resembling gelatin, and that it is formed from the gluten of rye-ovary, and readily changed by the influence of chemical agents. The latter, in connection with Podwissotzky, has isolated a number of uncrystallizable compounds possessing more or less activity, the most important being *sclerotic acid*, present to the amount of 4 or 4½ per cent., and *scleromucin*, of which 2 to 3 per cent. are obtained, and which is insoluble in alcohol of 40 per cent. by volume. The following principles are less active: *sclererythrin*, the red coloring matter, which was first noticed as peculiar by Winckler, is soluble in alkalies with a splendid murexid color, also in alcohol, ether, and chloroform; it is present in minute quantity ($\frac{1}{100}$ per cent.); *scleroiodin* ($\frac{1}{10}$ per cent. of ergot) after drying is insoluble in water, alcohol, and ether, and dissolves with a violet color in potassa or strong sulphuric acid; *sclerocrystallin* and *scleroxanthin* are crystallizable, but without medicinal effect; their alcoholic solutions acquire with ferric chloride a violet and afterward blue-red color. Wenzell's pure alkaloids (see below) are likewise regarded as nearly inert.

Fig. 111.



Ergot.

This multiplicity of uncrystallizable principles seems to support the views of Buchheim, that the low organization of ergot prevents the formation of well-characterized principles, and that those which are formed are easily altered; it may also explain why preparations possessing some activity may be obtained by very different processes. Wiggers's *ergotin* (1830) was prepared from ergot deprived of fixed oil by ether, by extracting it with hot alcohol, evaporating, and washing the extract with water; the yield was about 1 per cent. It resembles cinchonic-red, is soluble in alcohol, but insoluble in water and ether, and is said to have poisonous properties. Bonjean's *ergotin* is soluble in water and in alcohol. (See Extract. Ergotæ.) More light was apparently thrown upon the active principles of ergot by the researches of Wenzell (1864), who proved the presence of two alkaloids—*ecboline* and *ergotine*, the former of which is precipitated by corrosive sublimate, and produces decided effects upon the brain and contractions of the muscles, while the less active *ergotine* reduces the pulse and is precipitated by phosphomolybdic acid, but not by corrosive sublimate. Both alkaloids are brownish, uncrystallizable, soluble in water, and have an alkaline reaction and bitterish taste. Ganser (1870) obtained from ergot 0.16 per cent. of ecboline and 0.04 of ergotine, the hydrochlorate of the latter crystallizing in needles. Manassewitz (1867) gives the composition of ergotine as $C_{50}H_{52}N_2O_3$. The alkaloids, according to Wenzell and Ganser, exist in combination with *ergotic acid*, which is volatile and yields crystallizable salts. Dragendorff (1876), however, regards the two alkaloids as identical; and this seems to have been proven by Blumberg (1878), who found that concentrated solution of ergotine is precipitated by corrosive sublimate in the same way as ecboline, and that this precipitate with the latter alkaloid is not entirely insoluble in water. Moreover, Dragendorff denies that ecboline, which is entirely free from the compounds mentioned above, possesses any decided physiological action. Another alkaloid, *ergotinine*, soluble in alcohol, ether, and chloroform, was isolated by Tanret (1875) from the fixed oil of ergot prepared with ether by agitating it with acidulated water; Dragendorff could not obtain it. According to Villiers (1878), it has the formula $C_{35}H_{40}N_4O_6$. Blumberg obtained from fresh ergot .12 per cent. of ergotinine, which is crystalline, but soon becomes resinous; oil of vitriol colors it violet-blue, and with Fröhde's reagent it becomes blue and blue-green; in its effects upon frogs it resembles *picrosclerotine* (producing decreased sensibility, paralysis of the extremities, and death without convulsions). This amorphous alkaloid was obtained, together with *fusco-sclerotic acid*, by Dragendorff and Podwissotzky in purifying sclererythrin. That water distilled from ergot, particularly in presence of an alkali, possesses an alkaline reaction was observed by F. L. Winckler (1826); the alkaline principle was subsequently (1853) named *secaline*, but was found to be identical with *trimethylamine* (*methylamine*, according to Ludwig and Stahl). According to Ganser, it does not pre-exist in ergot, but appears to be formed through the decomposition of the protein compounds.

Ergot contains between 28 and 35 per cent. of bland, yellowish, non-drying *fixed oil*, from which warm alcohol removes some acrid *resin* and *cholesterin*; the latter was obtained by L. Stahl (1865), and its character proven by Ludwig (1869). Schoonbroodt (1866) found in it *lactic acid*, which, according to Buchheim, often renders ergotine strongly acid. *Formic* and *acetic acids* appear also to be sometimes present. Starch is entirely absent. The ash of ergot amounts to 3 or 4 per cent., and consists almost exclusively of phosphates.

Sclerotic acid and *scleromucin* having attracted some attention as medicinal preparations, we give the process by which they may be isolated: Digest ergot, previously exhausted by ether and absolute alcohol, with water, dialyze, evaporate the dialysate to a syrupy consistence, and treat with sufficient alcohol to obtain a mixture containing 40 to 45 per cent. alcohol, which precipitates the potassium phosphate, while more alcohol, added until the strength is increased to 75 or 80 per cent., precipitates the salts of sclerotic acid, which are soluble in dilute but insoluble in stronger alcohol, and leave about 19 per cent. of ash. The acid is obtained in a nearly pure state by kneading the mixed sclerotates with 80 per cent. alcohol and afterward dissolving them in 40 per cent. alcohol; the solution is mixed with an excess of hydrochloric acid, and after several hours filtered and precipitated with absolute alcohol, whereby the ash is reduced to about 3 per cent., and consists mainly of some silica, manganium, and phosphates of iron and potassium. The acid is not a glucoside, and yields no precipitates with the reagents for alkaloids—except with phosphomolybdic acid a yellow, and with tannin a nearly colorless, one. Sclerotic acid is obtained as a yellowish-brown, tasteless, and inodorous substance, which has a very slight acid reaction and is hygroscopic without being deliquescent. It is very well adapted for subcutaneous injections in doses of 0.03 to 0.045 Gm.

The dark liquid remaining on the dialyzer, when mixed with sufficient alcohol to bring it to 45 or 60 per cent., precipitates the *scleromucin*, which while moist forms a mucilaginous solution with water, but after drying is only partially soluble, differing in this respect from sclerotic acid, which is soluble in all proportions before and after drying. Scleromucin is darker in color, slightly hygroscopic, gummy, inodorous and tasteless, yields 26.8 per cent. of ash, and, like sclerotic acid, contains nitrogen, is not a glucoside, and is precipitated by tannin and phosphomolybdic acid.

Detection in Flour and Bread.—This depends upon dissolving the principles giving a color reaction. According to Hofmann (1878), bread 30 Gm. is grated, macerated in ether 40 Gm. containing 12 drops of diluted sulphuric acid; after 24 hours the clear ethereal solution is agitated with a concentrated solution of sodium bicarbonate, the latter acquiring a reddish-violet color, due to sclererythrin. The percentage of ergot present, according to Poehl (1882), may thus be determined by comparison with the results from mixtures of known composition.

Off. Prep.—Extr. ergotæ fluidum (liquidum), *U. S.*, *Br.*; Infusum ergotæ, Tinct. ergotæ, *Br.*; Vinum ergotæ, *U. S.* (For Ergotinum, *Br.*, see page 631.)

Physiological Action.—*On Animals:* Among the most characteristic and immediate effects of ergot given to dogs in large doses are dilated pupils, tremulousness, staggering, paraplegia, general prostration, tonic and clonic convulsions, and death. When its action is prolonged the chief phenomena observed are these: gradual paralysis of the hind legs, thirst, anorexia, emaciation, imperfect sight and hearing, shedding of the hair, debility and slowness of the heart, and death by exhaustion. Mixed largely with the food of pigs, it occasions redness of the eyes and ears, then coldness and gangrene of the latter, and also of the tail and limbs. Death occurs usually in convulsions. The action upon birds is even more characteristic: they grow dull and languid; the comb and wattles turn cold, bluish, or ecchymotic, and are ulcerated; black blood flows from the nostrils; the plumage is shed; the pulse and respiration become slower; and convulsions precede death. Upon pregnant animals (Mammifera) the effect of ergot is, among other things, to produce abortion at an advanced period of gestation. Epidemics of abortion in cows have been traced to this cause, and veterinary surgeons employ ergot habitually to expedite languid labor. The internal lesions of animals destroyed by ergot consist of congestion and softening of the lining membrane of the digestive organs; more or less wasting of the muscles in chronic and their rigidity after acute poisoning, the rigidity being especially marked in the hinder limbs; the blood-vessels of the brain are apt to be congested, and in some cases, it is said, the spinal marrow is softened; the lungs are congested and the blood is liquid and very dark.

The attempts which have been made to determine the physiological action of this drug have not been fruitless. Probably on account of the evident control of ergot over hæmorrhage it was long supposed to cause contraction of the arteries; and this power was affirmed by Holmes as the result of experiment in 1870. He injected preparations of ergot under the skin of frogs, and found that there resulted a contraction of the capillaries. These effects have been confirmed by later observers, some of whom have also witnessed the contraction of the retinal vessels of man under the influence of ergot, and more recently by Péton (1878), who employed in his experiments chiefly hypodermic injections of the extracts of Bonjean and of Yvon. He found that they excited the action of the gravid uterus and induced abortion, and that during its operation the blood-vessels, and especially the arteries, of the organ contracted. He attributed both of these effects to the direct action of the drug upon the smooth muscular fibres. He also observed in a rabbit's ear a complete change of color from red to pale under the influence of the preparation, and proved that this anæmiation was independent of any influence exerted by the central nervous system. He further noticed dilatation of the pupil when the agent was injected not far from the eye. It produced corresponding effects upon the muscular coats of the intestine and bladder, in the case of the latter causing sometimes an energetic spirt of urine, and in the former active and apparently painful peristaltic movements. The investigations of Nikitin (1879) led him to quite different results. He claimed that sclerotic acid exhibits all the effects of ergot, and that sodium sclerotate does so likewise, but in a somewhat feebler degree. His principal and most important conclusion is, that the chief action of sclerotic acid is upon the nerve-centres. The usual discord of physiological interpretations is here unusually absolute.

On Man: In doses of a drachm or two the first action of ergot is to occasion more or less vomiting and purging, but its more characteristic effects are headache, fulness of the head, vertigo, drowsiness, and dilatation of the pupils. The pulse falls from 70 to 60, or even less, in a minute, and this reduction may continue for several days, as may also the dilatation of the pupils. The respiration also becomes slower. Examples have occurred of what may be regarded as acute poisoning by ergot. In some cases, besides the above symptoms, convulsions and loss of consciousness by syncope have been observed. In one instance Dr. J. M. Keating (*Med. Record*, xviii. 318) states that nearly half an ounce of fluid extract of ergot was given, in divided doses, in the course of several hours to a woman suffering with post-partum hæmorrhage. Her face turned bluish; the pupils were dilated; the pulse frequent, weak, and sometimes irregular; and there was dyspnœa, with nausea and faintness, and buzzing in the ears. Under stimulants restoration took place. A pregnant woman, in order to produce abortion, took in vain for several months the fluid extract of ergot; she then took "two handfuls of powdered ergot" in a dry state. She vomited a reddish-brown matter, the tongue was swollen, dry, and dark; the temperature 96° F.; the skin was pale at first, and afterward yellow; the pulse was weak and rapid and soft; the respiration was also rapid, but labored; the area of the heart's dulness was increased, its action was rolling, and its rate 150. Death was attributed to progressive heart-failure. Capillary hæmorrhages were found after death in many organs, but not in the brain; the stomach and peritoneal cavity contained blood; the lungs were anæmic and the heart empty (*Phila. Med. Times*, xiii. 104). An occasional and peculiar action of ergot consists in its producing swelling of the face and arms (*Times and Gaz.*, Oct. 1879, p. 397). The oil extracted from ergot by macerating it with ether displays even greater energy in producing the same symptoms, and, in addition, great languor and lassitude, lividity of the skin, painful rigidity of the muscles, and sometimes diuresis.

These effects may continue for several days. The oil exerts no influence upon the gravid uterus, but the residual ergot from which it had been extracted seems to possess the ecbolic power of the drug unimpaired.

Ergotism, as an epidemic disease, exhibits the poisonous effects of ergoted rye upon a large scale and in various phases, which probably depend upon the amount of the poison ingested, as is shown by experiments on animals. In one class of cases the cerebro-spinal nervous system is mainly involved, which is indicated by neuralgic pains, formication and numbness of the extremities, paroxysmal flexures and extensions of the limbs, opisthotonos, violent delirium, etc.—symptoms which are succeeded by exhaustion, and sometimes by strabismus and more or less impairment of vision. In fact, the symptoms are very analogous to those associated with lesions, and especially sclerosis, of the posterior columns of the spinal cord. Death may occur in coma or in convulsions. In the other class of cases the nervous system is not conspicuously deranged, but the function of nutrition is impaired. A sense of muscular lassitude and a dull hue of the skin precede graver derangements of nutrition, shown by the formation of gangrenous areas in various parts of the body. They begin most frequently in the thickness of a limb, and afterward form on the superficial parts, extending from the fingers or toes upward, causing these parts to blacken, shrivel, and harden—in a word, to become mummified or affected with dry gangrene. The dead parts may, as in gangrene from other causes, separate, so as to leave a clean wound behind. In a majority of cases, however, the attack is fatal. Gangrene has also been produced by the continued medicinal use of ergot. Debove reports the case of a woman with "chronic nephritis" who took about 4 grains a day of ergot for 20 days, and suffered gangrene of the hands; and Dujardin-Beaumetz relates that having, in a case of typhoid fever, prescribed a daily dose of 15 grains of ergot, the patient had sphacelus of the right hand, but recovered. A similar one is narrated by Boissaire (*Bull. de thérap.*, xcviii. 229, 373). In some cases of locomotor ataxia the symptoms have become distinctly aggravated under the use of ergot (*Centralblatt f. Therapie*, i. 227).

In comparing the different grades of the operation of ergot in animals and in man it is evident that the action in both cases is essentially the same, and that it is manifested mainly by the nervous and the circulatory functions. The former exhibits debility of the general and special senses—dilated pupils, spinal paralysis, and general convulsions, usually clonic in type; the gravid uterus is thrown into tonic contractions; the circulatory and nutritive functions are shown to be deranged by the slowness of the pulse, the fall of temperature, the cyanosis of vascular parts, the discharge of dark blood, the occurrence of cutaneous eruptions, the shedding of the hair, feathers, etc., and the gangrene of various parts, but in man of the feet and hands especially.

It may be hence inferred that the primary sensible action of ergot is upon the nervous system, since the lower degrees of its operation interest exclusively the functions of that system, while its more prolonged action gives rise to radical changes in tissue-nutrition. But all the evidence goes to show that the modifications of nervous action are consequent upon a diminished supply of arterial blood to the cerebro-spinal and the ganglionic nerve-centres. This diminished supply of blood is due partly to the sedative operation of the drug upon the heart, and partly to the contraction of the capillaries, which is demonstrable by the ophthalmoscope in the case of the human eye, and is also visible in the frog's foot and in the membranes of the brain and spinal membranes; it is inferred to exist in the spinal cord from the successive muscular spasm and paralysis which affect the voluntary and also the intestinal and uterine muscles, and the loss of vitality, with gangrene, which have been mentioned. It is, however, upon the non-striated muscular fibres, and especially upon those of the arteries and the uterus, that ergot displays its action first and most conspicuously.

Medical Uses.—*In Labor:* Rules have long been in use for the administration of ergot during labor. It may be employed—1, in lingering labors when the child's head is low, the parts relaxed, the pains absent or feeble, and there is danger in delay from hæmorrhage or other alarming symptoms; 2, when the pains are suspended and convulsions set in, venesection being premised; 3, in inevitable abortion; 4, when the placenta is retained by uterine inertia; 5, in post-partum hæmorrhage under like circumstances. The influence of ergot upon the uterus in labor is unlike that of the natural forces: they are intermittent and rhythmical; it is constant and steady, and, as it were, tetanic, and therefore tends to destroy the child by interrupting the placental blood-supply and impeding the fœtal circulation. After labors with ergot the uterus is much larger and harder than natural, and remains so for several days. Ergot has been accused of causing rupture of the uterus, but the evidence is incomplete when the drug has been administered according to settled rules. Disease of the uterus, deformity of the pelvis or spine, and similar conditions forbid its use. No doubt laceration of the perineum and of the os uteri and hourglass contraction may sometimes be attributed to its imprudent exhibition, as well as prolapse of the uterus or of the rectum. Retention of the placenta is even more apt to occur. In some cases also, perhaps from an overdose of ergot, it has appeared to cause delirium or coma, lividity of the face, muscular rigidity, etc. There is no doubt that ergot is dangerous to the child in proportion to the duration of its action, and that therefore it should not be administered until labor is near its termination. Fatal effects of the drug may occur even when it has not occasioned contraction of the uterus. Children are then born dead, with cyanosed skin and distorted limbs, and the discoloration has followed the use of the oil of ergot, which does not stimulate the uterine contractions. It follows from these facts that the rules above are justified, and that another might be added to them—viz. never to give ergot to expedite labor in larger doses than are necessary to produce that effect. In premature labor the drug appears to be more hostile to the child's life than at term, but is decidedly profitable to the mother. When the uterus is not in action, ergot does not readily excite its contractions; hence it seldom occasions abortion as a direct effect. Indeed, in certain cases when this occurrence is imminent from accidental uterine hæmorrhage small and repeated doses of ergot have appeared to prevent it. It is stated that in the Dublin Lying-in Hospital it is a rule to administer the infusion of ergot immediately after delivery in all cases, and to multiparæ three times a day for 2 days. It is also given in all cases where there is any tendency to flowing, to a relaxed condition of the uterine walls, or to tenderness over the uterine region. The results, it is said, are the prevention of a tendency to subinvolution and the disappearance of threatening inflammatory symptoms.

Ergot has long been known as a remedy for *uterine hæmorrhage* after labor, as well as for *menorrhagia* and bleeding from *cancer* and other diseases of the uterus. In menorrhagia it seems to be most efficient when the uterus is in a flaccid condition, as shown, amongst other ways, by the persistence of uterine leucorrhœa between the menstrual periods. It doubtless in all these cases contracts the uterine tissue, but that it acts directly upon the blood-vessels is proved by its efficacy in other forms of hæmorrhage—*gastric*, *pulmonary*, *nasal*, *intestinal*, *hæmorrhoidal*, *urethral*, *vesical*, and *renal*—and also in *purpura hæmorrhagica.* In all of these cases it probably becomes efficient through its power of contracting the muscular coat of the small arteries of the bleeding part. It may be employed in substance or as a fluid extract by the mouth, or with more prompt effect by the hypodermic injection of ergotin. Full doses should be given. For hypodermic injection a solution may be prepared with 30 grains (Gm. 2) of ergotin, 13 drachms (Gm. 50) of water, and an equal proportion of glycerin. 1 fluidrachm (Gm. 4), containing about 1 grain (Gm. 0.06) of ergotin, may be used hypodermically. It does not cause local irritation, and its effect upon the hæmorrhage is very prompt. Yvon's preparation is said to be the best.

The power of ergot to contract the uterus may be used to expel retained *placentæ*, mural *fibroid tumors*, *polypi*, *hydatids*, etc. In regard to the advantages of ergot in the treatment of *uterine fibroids* the reports are very conflicting, but they are fairly represented in the conclusions arrived at by Herman (*Times and Gaz.*, Aug. 1879, p. 205): "1. Ergot will often produce the diminution in size, and sometimes even complete absorption, of fibroid tumors of the uterus, and will, in the majority of cases, relieve their symptoms. 2. These effects will often follow the administration of the drug by the mouth, but will more certainly be produced by its hypodermic injection in the neighborhood of the tumor." Even when the medicine has little or no appreciable effect upon the size of the uterus, it almost always checks the hæmorrhage which is a common and serious symptom of fibroid tumors of that organ. In *uterine hæmorrhage* due to other causes, such as chronic metritis, the menopause, cancer, subinvolution, parturition, abortion, etc., ergot, but more particularly ergotin hypodermically, has proved more completely and promptly successful than any other medicine. It is also useful in treating chronic *endo-metritis* itself. This action, which under certain circumstances may be called tonic, has been found efficient in the treatment of uterine *leucorrhœa*, and even of *amenorrhæa* due to an enfeebled and anæmic state. It is stated that ergot moderates the excessive *secretion of milk*, and it is employed to prevent *mammary abscesses* and the engorgement of the breasts in weaning. It is one of the most efficient remedies in *diabetes insipidus*, in the treatment of which it was first used by Dr. J. M. Da Costa (*Phila. Med. Times*, July, 1875, p. 636), and afterward by Murrell, Rendu, and others in Europe (Garens, *Thèse*, 1879; *Lancet*, April, 1882); in 1882–83, Da Costa reported seven additional cases, in all of which, save one, a cure was wrought (*Med. News*, xl. 5; xlii. 72), and three other similar cases occurred to Lacy (*Med. News*, xlii. ix.). The medicine sometimes fails entirely. (Compare *Practitioner*, xxix. 209; xxx. 136.) The more distinctly the affection is connected with nervous disorder, the greater is the benefit derived from ergot. In most cases the cure is complete and permanent. It is probably most efficient when associated with belladonna, and should be given in the form of the fluid extract in the dose of a fluidrachm (Gm. 4) three times a day, gradually increased to double that quantity. It is remarkable that in several cases the diminution of the urine was attended with severe pains in the head. In one case (Garens) the polyuria was associated with "interstitial nephritis," and while using the medicine the patient ceased to urinate, and died of apoplexy. Ergot has long been used with advantage in the treatment of *paralysis of the bladder* and in *paraplegia*. Theoretically, it is most appropriate to cases in which hyperæmia of the spinal cord exists, but it would be very difficult, if not impossible, to account for its efficacy in all successful cases upon this ground, particularly since it appears to have been curative in reflex as well as in congestive paraplegia. It should be given in full doses to ensure its beneficial effects. *Incontinence of urine*, depending either upon paralysis or irritability of the bladder or upon enlarged prostate, is palliated or cured by it, according to the nature of the primary cause. It has been found efficient particularly in those cases of retention or incontinence of urine which are so apt to occur in the typhoid state of febrile diseases. Luton (*Bull. de l'Acad. de Méd.*, xxvi. 803) states that in *dysentery* he found that powdered ergot, or ergotin, in the dose of 8 grains arrested the course of the disease; but Dewar (*Practitioner*, xxviii. 361) states that the medicine always increased the *diarrhœa* for which it was given. Its power of contracting the blood-vessels has been exemplified in cases of *enlarged spleen* of malarial origin, and even when it occurred as a symptom of leucocythemia. In simple *goitre*, or vascular enlargement of the *thyroid* gland, the hypodermic injection of ergotin has been followed in many cases by a complete cure. Suppositories containing ergotin are reported to have cured four out of five cases of *hæmorrhoids*, although the first effect of the application was to cause pain for an hour or more (Lansing). Hypodermic injections of ergotin have been used by Vidal, Fernand, and others to prevent *prolapsus of the rectum*, both when attended with hæmorrhoids and when free from that complication. The injections were sometimes made into the hæmorrhoidal tumors, and sometimes into the skin around the anus. A solution of ergotin (1 : 5) was employed, of which from 15 to 20 drops were used for each injection (*Bull. et Mémoires de la Soc. de thérap.*, 1881, p. 116). A convenient solution may be made with 1 part of ergotin to 3 parts each of water and glycerin. Suppositories containing ergotin have been used in the cases just referred to—with advantage, according to some, but others declare that they are tolerated with difficulty. They may contain 1 part of ergotin to 10 of cocoa-butter and a sufficient proportion of wax. The hypodermic method has been used with advantage in cases of ingravescent *apoplexy* and *mania à potu*, and might probably be applied in the same way in heat-apoplexy or *sunstroke*, for which it has been administered by the mouth in India. Several years ago numerous cases of *cerebro-spinal meningitis* were published in which the treatment consisted mainly of a dose every 3 hours of 1 grain of ergotin and $\frac{1}{10}$ grain of extract of belladonna. The results were regarded by the reporter as exceptionally favorable (W. Read). We have not met with any reports which tend either to confirm or invalidate this conclusion. A case of supposed *tubercular meningitis* cured by ergot has been reported (Gibney). It is likewise credited with the cure of certain cases of *typhoid fever* in which active cerebral or cerebro-spinal symptoms existed. Chevallereau claims that the hypodermic injection of ergotin is capable of arresting the course of acute articular *rheumatism* (*Practitioner*, xxvi. 289). According to J. G. Rogers, it is remarkably potent in repressing the excitement of *insanity* depending upon "cerebral plethora, whether active or passive" (*Med. Record*, xx. 503). It is true that he associated with it bromide of potassium or chloral. In nervous *headache*, or migraine, there seems to be good reason for believing it to be useful when continued for some time in doses of 6 grains a day, gradually increased to 15 grains (Schumacher). It is claimed that *dilatation of the heart* from impaired nutrition and independent of valvular disease is greatly benefited by this medicine. Used hypodermically in the neighborhood of *aneurismal* tumors, ergotin is credited with having a share in their cure, along with digitalis, electro-puncture, etc. (*Bull de thérap.*, cii. 505). It has also been used in *whooping cough* with apparent success. Dewar declares that in scores of cases he proved its power to cut short the disease (*Practitioner*, xxviii. 357), and Allan attributes to it a power of controlling other coughs, even that of phthisis (*ibid.*, xxvi. 291). It is said to relieve impaired vision arising from congestion of the *retina* and due to excessive strain of the eye in examining minute objects. A solution of 1 part of ergotin in 15 or 20 of glycerin and water has been used as a collyrium in numerous cases of *conjunctivitis*, *keratitis*, and *iritis*, and it is advised that it be applied every 2 or 3 hours, and that in severe cases a rag wetted with the solution should be kept almost constantly upon the affected eye (Planat; Dabney). The action of ergot upon the capillary blood-vessels has been tested in several *diseases of the skin*, with alleged advantage, by Heitzmann and by D'Enslow (*Boston Med. and Surg. Jour.*, Sept. 1882, p. 253; *Phila. Med. Times*, xii. 873), and especially in acne rosacea, erythema, urticaria, and prurigo—affections which are notoriously rebellious to treatment. It seemed useless in eczema and psoriasis, perhaps because in those affections an exudation exists. Its utility in *purpura hæmorrhagica* has already been noticed. According to Bulkley (*Trans. Med. Soc. of State of N. Y.*, 1876, p. 176), it causes "an almost, if not quite, immediate cessation of cutaneous and other hæmorrhages." He advises 1 or 2 grains of ergotin or 20 or 15 minims of the fluid extract hypodermically once or twice a day, but says that these doses may be more than doubled without harm. It is alleged by Schilling that ergot prevents the tinnitus and deafness occasioned by quinine or by salicylic acid, and also the amblyopia which the former sometimes induces (*Med. News*, xliii. 123). It would be singular if ergot, which is believed to contract the capillaries, were to relieve a symptom supposed to be induced by that very mechanism.

Administration.—Ergot is conveniently administered by making an infusion of 120 grains (Gm. 8) of the drug, coarsely powdered, in about half a pint of hot water, which should be given in tablespoonful doses every 10 or 15 minutes if contraction of the distended uterus is desired or if hæmorrhage from any part is to be checked. The powder may be given in doses of from 5 to 20 grains (Gm. 0.30–1.30) at similar intervals. Bonjean's or Yvon's ergotin may be prescribed in doses of from 1 to 3 grains (Gm. 0.06–0.20) under like circumstances. 1 Mgm. of ergotin is said to be equal to about 1 Gm. of ergot. Hypodermically, it may be administered in warm water with the aid of glycerin. Ergotin is usually taken in capsules. According to Nitikin, *sclerotic acid* possesses all the physiological and therapeutical properties of ergot, and its sodium salt, although feebler, has the same kind of action (*Phila. Med. Times*, x. 167). Robert, on the other hand, maintains that the acid speedily undergoes decomposition and is practically useless. Strumpf found it highly irritating when used hypodermically. It has been used in this manner in the dose of from $\frac{1}{25}$ to $\frac{1}{10}$ gr. (Gm. 0.002–0.006) (*Bull. de thér.*, xciv. 90), and in the dose of from $\frac{2}{3}$ to $\frac{3}{4}$ gr. (Gm. 0.04–0.05) (Dragendorff).

ERIGERON.—Erigeron.

Fleabane, E.; *Herbe d'érigeron*, *Herbe de vergerette*, Fr.; *Berufkraut*, G.

Bentley and Trimen, *Med. Plants*, 148, 149.

Nat. Ord.—Compositæ, Asteroideæ.

The U. S. P. 1870 recognized two drugs from this genus—one, as Erigeron, being the leaves and tops of Erigeron heterophyllum, *Muhlenberg* (s. E. annuum, *Persoon*, s. E. strigosum, *Bigelow*), and of Erigeron philadelphicum, *Linné* (s. E. purpureum, *Aiton*); with these two a third species, Erigeron strigosum, *Muhlenberg* (E. integrifolium, *Bigelow*), is frequently collected. The three species inhabit fields and pastures, are common weeds in many parts of Canada and the United States, and are known as *scabious*, *sweet scabious*, and *daisy fleabane*. All attain a height of about 3 feet (90 Cm.), begin to flower in June, and are more or less hairy.

As Erigeron canadense (Canada Erigeron, *E.*) the leaves and tops of Erigeron canadense, *Linné*, were recognized. This is known throughout North America as *horseweed*, *mare's tail*, *fireweed*, *butterweed*, *colt's tail*, etc., flourishes in fields and waste places, and has established itself as a more or less common weed in most countries. Three of these species are annuals or biennials, E. philadelphicum being perennial. A number of other species are indigenous to the country west of the Mississippi.

Description.—E. philadelphicum has the radical leaves spatulate and tapering to a margined petiole, the stem-leaves oblong or lanceolate, the upper ones clasping, all somewhat toothed or the upper entire; the few flower-heads on slender peduncles; the numerous rays almost filiform, pale-purple or flesh-colored, and twice longer than the involucre; the pappus consists of a single row of capillary bristles.

E. heterophyllum has roundish-ovate, coarsely-dentate radical leaves upon petioles about twice their length; the stem-leaves are ovate-lanceolate or lanceolate, serrate in the middle, the upper ones smaller, narrowed at base, and sessile; the rays are numerous, white, tinged with purple, narrow, and less than twice the length of the involucre, the pappus is double, the outer row consisting of minute scales.

E. STRIGOSUM has the radical leaves spatulate-lanceolate, petiolate; the stem-leaves lanceolate, all nearly entire; the numerous rays white, and twice the length of the involucre; the scanty pappus is double, like the preceding.

The plants are collected in the middle of summer, and have a slight aromatic odor and a bitterish taste.

E. CANADENSE grows to the height of 5 or 6 feet (1.5 or 1.8 M.), but in sterile locations is usually dwarfed and only a few inches high. The stem is bristly-hairy, erect, and much branched; the leaves are lance-linear, hairy, and mostly entire; the flower-heads are small and numerous, have a cylindrical involucre, many capillary ray-florets, which are nearly included in the involucre, and a straw-colored, bristly pappus. It flowers from July to October, and should be collected when in full bloom. It has an aromatic odor and a bitterish somewhat acrid and astringent taste.

Constituents.—Canada erigeron contains a notable quantity of volatile oil (see OLEUM ERIGERONTIS); the other species contain very little, the yield, as ascertained by F. L. John (1855), being only ½ drachm from 45 pounds of the dry herb; it is described by Procter as greenish-yellow, of a penetrating odor, a bitterish, pungent taste, of the spec. grav. 0.946, and more viscid than the oil of E. canadense. The plants contain also a little tannin, mucilage, and other common principles, but other active constituents have not been isolated. Analyses of the different species are desirable.

Pharmaceutical Preparation.—EXTRACTUM ERIGERONTIS CANADENSIS FLUIDUM, *U. S. P.* 1870, is prepared like other fluid extracts, the menstruum being alcohol sp. gr. .835; alcohol of .870 to .875 answers equally well.

Medical Action and Uses.—Erigeron is a diuretic, and has been used in the treatment of *dropsies* and of various disorders of the *urinary organs.* An infusion may be prepared with an ounce of the plant to a pint (Gm. 32 in Gm. 500) of boiling water, and given in given in doses of a wine-glassful or more.

Canada erigeron is a stimulant which owes its virtues to a volatile oil that is officinal. It was popularly supposed to have a special action upon the uterus (whence its name "squaw-weed"), and it has been used successfully to arrest *uterne hæmorrhage.* It has also been employed to palliate *vesical irritation* and *strangury* and cure *gonorrhœa.* An infusion may be prepared with an ounce (Gm. 32) of the plant to a pint of boiling water. *Dose*, a wine-glassful. The oil has been used in the dose of 5 drops (Gm. 0.30), repeated at intervals of half an hour, to arrest post-partum hæmorrhage.

ERIODICTYON.—MOUNTAIN-BALM.

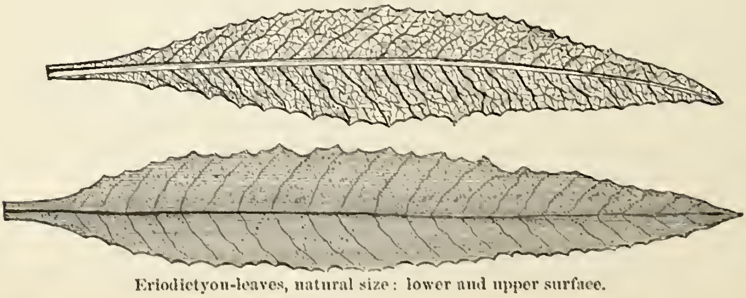
Consumptive's weed, Bear's weed, E.

Eriodictyon californicum, *Bentham* (E. glutinosum, *Bentham*), s. Wigandia californica, *Hooker et Arnott.*

Nat. Ord.—Hydrophyllaceæ.

Origin.—An evergreen shrub 3 to 5 feet (1 to 1.5 M.) high, growing thriftily among the rocks on the mountain-ranges of Central California southward to Northern Mexico. It has axillary and terminal racemose clusters of showy purplish-blue flowers, with a funnel-shaped corolla and five stamens, and ovoid, semi-transparent capsules supported by the persistent five-lobed calyx and containing about twenty seeds. The leaves are employed.

FIG. 112.



Eriodictyon-leaves, natural size: lower and upper surface.

Description.—The leaves are alternate, petiolate, 2 or 3 inches (50 to 75 Mm.) long, elliptic-lanceolate, sub-entire or finely dentate, with the upper surface smooth, green, and often varnished with a resinous exudation, and the lower surface white, hairy, and delicately reticulated by a network of veins. After bruising the leaves their balsamic odor becomes more apparent; their taste is aromatic, balsamic, and free from bitterness.

Constituents.—The leaves evidently contain *volatile oil* and *resin*. According to H. S. Wellcome (1876), the latter is transparent, amber-colored, balsamic in odor and taste, amounts to from 20 to 30 per cent. of the leaves, and consists of several distinct resins. The same resin covers also the branches. Thal (1883) showed the presence of *ericolin*. (See Ledum.)

Pharmaceutical Uses.—Wellcome has suggested the preparation from it of a *fluid extract* and a *tincture*, the latter representing 4 troyounces to the pint, using 75 per cent. alcohol as the menstruum. By triturating the resin with powdered French chalk, and following the officinal process for syrup of tolu, a *syrup* is obtained having a delicious fruity aroma and taste, closely resembling those of the pineapple, due, probably, to the presence of butyric ether in the resin.

Medical Action and Uses.—Although supposed at first to possess medicinal value, it speedily ceased to attract attention. It is said that chewing the leaf masks the bitterness of quinine. It was stated to be very serviceable in atonic *bronchitis*, but worse than useless in the inflammatory form of the disease; but other accounts present the exact converse of this opinion, and a bold ignorance has pronounced it to be a "specific for chronic lung disease and a certain cure for consumption." Its real value as a medicine is not determined.

ERYNGIUM.—Eryngo.

Button snakeroot, *Corn snakeroot*, *Rattlesnake's-master*, E.

The rhizome of Eryngium yuccæfolium, *Michaux*, s. Er. aquaticum, *Linné*.
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant grows in pine-barrens and prairies from New Jersey westward to Wisconsin and southward to South Carolina. It has grass-like, nerved and bristly-fringed leaves, the radical leaves being 12 to 18 inches (30 to 45 Cm.) long, those of the stem much shorter; the white flowers are in dense ovate heads, which are larger than the nearly-entire leaflets of the involucre. It blooms in July and August.

Description.—Button snakeroot consists of a short root-stock $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 12 Mm.) long, with numerous short branches, terminating with a more or less deeply cup-shaped scar. A transverse section exhibits a large whitish central pith and several short wood-wedges, separated from the bark by a brown cambium-line. Below, the root-stalk is divided into a large number of thin nearly simple rootlets from 2 to 3 inches (5 to 8 Cm.) long, and containing a rather thick and soft whitish meditullium. Button snakeroot has a dark-brown color externally, a slight but rather heavy aromatic odor, and a sweetish and somewhat acrid and aromatic taste, recalling that of parsnip, which is probably due to a volatile oil.

Allied Plants.—Eryngium virginianum, *Lamarck*, has linear-lanceolate leaves and a spiny-toothed involucre longer than the heads of bluish flowers. It is biennial, and grows in swampy localities in the vicinity of the coast from New Jersey southward.

Er. campestre, *Linné*.—Eryngo, *E.*; Chardon-Roland, Panicaut, *Fr.*; Mannstreu, Brachdistel, *G.*—A European perennial. Its root is cylindrical, about 2 feet (60 Cm.) long and 1 inch (25 Mm.) thick, with several conical heads, brown externally, and with a thick internally white bark, covering the porous yellowish wood.

Medical Action and Uses.—Button snakeroot has an acrid and aromatic taste, and is reputed to be diaphoretic and expectorant, and emetic in large doses. In Europe E. maritimum was once celebrated for its diuretic virtues, as was also E. campestre. Both species continue to be used in the treatment of *dropsy*, *gravel*, and *jaundice*. Eryngium may be given in a decoction made with half an ounce (Gm. 16) of the root to a pint of water, and reduced by boiling to half a pint, and given in 1-ounce doses.

ERYTHROPHLŒUM.—Sassy-Bark.

Mancona-bark, *Saucy-bark*, E.; *Écorce de mançône*, Fr.; *Mancona-Rinde*, G.

The bark of Erythrophlœum guineense, *Don* (E. judiciale, *Procter*), s. Fillæa suaveolens, *Guillemin et Perrottet*.

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—Sassy-bark comes from a large tree with bipinnate coriaceous leaves, terminal compound spicate racemes of decandrous flowers, and flat legumes with three or four lenticular seeds. The tree grows in Central and Western Africa, and the bark is used by the natives as an ordeal- and arrow-poison.

Description.—The bark is seen in flat or curved pieces, of irregular size, about ¼ inch (6 Mm.) thick, covered externally with an uneven warty and fissured corky layer, or deprived of the same, of a dull red-brown color. It is hard, brittle, of a fibrous texture, internally with pale yellowish-brown spots, inodorous, of an astringent, somewhat bitter, and acrid taste, and when powdered excites violent sneezing.

Constituents.—Sassy-bark contains tannin and a red derivative of it, and yields its active principle to water and alcohol (Procter, 1852). Gallois and Hardy (1876) isolated the poisonous constituent by treating the aqueous extract of the alcoholic extract of the bark with an alkali, and exhausting the mixture with acetic ether. This alkaloid, *erythrophleïne*, is colorless, crystalline, soluble in water, alcohol, amylic alcohol, and acetic ether, but nearly or entirely insoluble in ether, chloroform, and benzol. With sulphuric acid and potassium permanganate a violet coloration is obtained, less intense than the one produced by strychnine, and soon changing to dirty brown. The solutions of its salts are precipitated by the usual reagents for alkaloids, including bichromate of potassium, which yields a yellowish precipitate. Harnack and Zabrocki (1882) ascertained that when boiled with acids or alkalies erythrophleïne yields *erythrophleic acid*, which is free from nitrogen and *manconine*, which is a volatile base resembling pyridine and nicotine.

Erythrophlœum couminga (or *koumanga*) is also a large tree, all parts of which are poisonous, containing an alkaloid which is closely related to erythrophleïne, if not identical with it.

Physiological Action.—*On Animals:* The first systematic experiments with sassy-bark were made in Philadelphia in 1859 by Drs. S. Weir Mitchell and W. A. Hammond. Its most conspicuous effect was general muscular resolution, so that the animal would remain quiescent in whatever position it was placed, even until death in some instances, without exhibiting any evidence of suffering. Indeed, a degree of anæsthesia was observed. If disturbed, it speedily recovered its activity and sought to escape, although its efforts were marked by a certain languor and difficulty which brought it to rest again almost immediately. When a fatal dose was administered the head fell and was caught up again, and at last reposed upon the fore paws; vomiting usually took place, the pupils contracted, the heart became slow and irregular, the respiration quick and labored, and at length death occurred with general convulsions and sudden dilatation of the pupils. Upon examination, the membranes of the brain were found to be highly congested, but there were no other peculiar changes. In 1876 was published an account of experiments with "casca-bark" performed by Drs. Brunton and Pye, which agree with the statement above given, for these authors say: "In cats and dogs it causes restlessness and nausea, succeeded by violent and repeated vomiting. The respiration is very much quickened. The first symptom of any affection of the locomotor organs in cats is a peculiar jerk of the hind limbs, as if something were sticking to the feet and the animal was trying to shake it off while walking; then the gait becomes staggering and the animal ceases to be able to stand. Death generally occurs during a convulsion of an emprosthotonic character, apparently connected with an attempt to vomit. Consciousness seems to be preserved to the last."

In 1876, MM. Gallois and Hardy discovered in sassy-bark and leaves an alkaloid with which they experimented, and obtained the following results: It is a heart-poison. 2 Mgm. injected under the skin of a frog arrest the heart in systole in from 5 to 8 minutes, voluntary muscular movement and irritability remaining unimpaired for several hours. In warm-blooded animals the alkaloid excites convulsive shocks and extreme dyspnœa as consequences of the disorder in the circulation of the blood—*i. e.* of the heart's arrest. After the animal's death this organ is found distended with blood. During the progress of the poisoning the pulse is alternately accelerated and retarded; in the latter state it becomes fuller, in the former small and feeble. Although the heart-muscle is the first to die, the voluntary muscles are nevertheless, in their turn, paralyzed. In these experiments no mention is made of paralysis as a direct symptom of the poisoning, nor yet of vomiting or diarrhœa. More recent experiments of Sée and Rochefontaine led to a number of conclusions, of which the more important are these: Erythrophleïne, used hypodermically in animals, occasions agitation and restlessness, followed by vomiting and prostration. Primarily, the arterial pressure is increased, and the pulse, at first hurried and irregular, becomes slow, and then, at an advanced stage of the poisoning, grows increasingly weak and rapid until the final cessation of the heart's action. The respiration is slow and full at first, but, in proportion as the heart becomes accelerated, it also grows very energetic. Respiration and the heart's action generally cease simultaneously, but sometimes the former is renewed after suspension and when the heart has for 2 or 3 minutes ceased to beat. After death the heart is found in diastole, flaccid, and full of blood (*Bull. de thér.*, xcviii. 546; *Med. Record*, xxiii. 59). Harnack and Zabrocki (*Archiv f. exper. Pathol. u. Pharm.*, xv. 417), on the other hand, liken the action of erythrophleïne to that of picrotoxin, and state that both in frogs and mammals it primarily induces a paralytic condition, followed by agitation, and even convulsion of a tetanoid description. Not only does this conclusion differ from that of Sée, but another also which declares that the heart pulsates after the suspension of respiration, and even more vigorously.

On Man: The accounts which were long ago received of the effects produced by the sassy-ordeal agree in certain points, but not in others. In most of them the production of vomiting appears to be the capital phenomenon, for upon its ocurrence or non-occurrence the accused was held to be innocent or guilty. "It is supposed that the fetish goes down with the water into the man's stomach, and looks about in his heart for the guilt—that if he discovers the prisoner to be innocent, he comes back with the draught, which is vomited up again, but if he finds the alleged guilt, he remains in the stomach with the water to inflict merited chastisement upon the culprit." According to another account, the accused, after the trial, "is obliged to move his arms and legs, to show that he has not lost the use of them;" and Santas, who first analyzed this bark, states that the sufferer "loses the power of contracting the muscles throughout the body; he is incapable of standing or walking, and the head rolls heavily about the breast and shoulders."

According to Drs. Brunton and Pye, the vomiting produced by sassy occurs whether it be given internally or hypodermically, but purging only in the former case. The paralysis it causes they explain as being due not to a direct action upon the muscles or the motor nerves, or the spinal cord itself, but to the contraction of the blood-vessels, which lessens the supply of blood to these parts. It acts directly upon the ends of the vagus nerve in the heart, and also upon the nerve itself, and much in the same manner as digitalis. But the final slowing of the heart produced by large doses of "casca" is due to the action of the drug upon the ganglionic apparatus contained in the heart itself. It has "a most extraordinary power of contracting the blood-vessels"—not as digitalis has, by stimulating the vaso-motor centre in the medulla oblongata, but by acting either on the blood-vessels themselves, the vaso-motor nerves, or the vaso-motor centre not contained in the medulla. It appears to act as a diuretic by contracting the arteries and so increasing the blood-pressure.

Medical Uses.—When, in 1859, the essay referred to was published, it had an appendix describing the medicinal applications of sassy. It was said to be astringent, narcotic, acrid, cholagogue, and diaphoretic, and to be used successfully in the treatment of *periodical fevers*, *colic*, *diarrhœa*, and *dysentery*. A summary of cases of the last-named disease treated by the medicine appears to demonstrate its possession of marked curative virtues. It was given in tincture and also in extract. While these clinical reports point in one direction, physiological reasons are now given for using the medicine in *cardiac dropsy*, especially when it depends on mitral obstruction, and in cases of *hæmorrhage* due to flaccidity of the capillaries. Sée states that he has used a tincture of erythroplœum in *cardiac asthma* with the effect of rendering "the movements slower and fuller." But "the arhythmia does not disappear, the pulse is not slowed, the valvular murmurs are not modified, there is no diuresis. As a cardiac remedy it presents no advantage." Experience has not yet determined what medicinal value, if any, this agent possesses.

ERYTHROXYLON, *U. S.*—Erythroxylon.

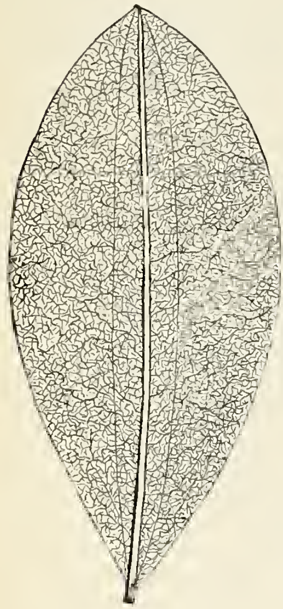
Coca. Br. — *Coca-leaves*, E.; *Feuilles de coca*, Fr.; *Cocablätter*, G.

The leaves of Erythroxylon Coca, *Lamarck.* Bentley and Trimen, *Med. Plants*, 40.
Nat. Ord.—Erythroxylaceæ.

Origin.—Coca is a small shrub 4 to 6 feet (1.2–1.8 M.) high, with numerous spreading purplish-brown branches. It has small, yellowish, five-petalous flowers in axillary clusters of three or four, ten hypogynous stamens, and an oblong, scarlet-red, pointed, and smooth drupaceous fruit containing a single albuminous seed. It is indigenous to the mountains of Peru and Bolivia, and is cultivated in both these countries on the eastern slope of the Andes in damp warm valleys at an altitude of 5000 or 6000 feet; also in some parts of Colombia, Brazil, and the Argentine Republic. The leaves, when collected, are carefully dried in the sun to preserve their green color. About 40,000,000 pounds are annually produced.

Description.—The leaves are alternate, 2 or 3 inches (50 or 75 Mm.) long, 1 to 1½ inches (25 to 37 Mm.) broad, obovate- or oval-oblong, rather obtuse, and frequently emarginate, somewhat narrowed into the short petiole, entire on the margin, rather thin, smooth, the lower surface pale bluish-green, reticulate on both sides, with a prominent midrib, on each side of which is a curved line running from the base to the apex and representing two longitudinal folds. The leaves have a slight but agreeable odor, similar to that of tea, and a somewhat astringent, bitter, and aromatic taste.

FIG. 113.



Coca-leaf: lower surface, natural size.

Constituents.—Wackenroder (1853) showed the presence in coca-leaves of a peculiar tannin, which reacts with a green color upon iron salts, and has since been called *coca-tannic acid*. Gaedcke (1855) isolated a crystalline alkaloid, which was provisionally named *erythroxyline*, and further examined by A. Niemann (1860) and W. Lossen (1865), the name being changed to *cocaine*. It is obtained from the infusion, which has been freed from tannin by acetate of lead and rendered alkaline by soda, by agitation with ether, and by evaporating the ethereal solution. When pure it is in colorless prisms of a strong alkaline reaction, has a bitterish taste, produces a transient numbness upon the tongue, and dissolves in 704 parts of water and in much less alcohol and ether. Its composition is $C_{17}H_{21}NO_4$, and on being heated with concentrated hydrochloric acid it is decomposed into methylic alcohol, CH_4O, benzoic acid, $C_7H_6O_2$, and *ecgonine*, $C_9H_{15}NO_3$, the latter having a sweetish-bitter taste and being soluble in water, but insoluble in alcohol. Maclagan first observed the presence in coca of a volatile alkaloid, which Lossen named *hygrine;* it was obtained by the latter as a thick pale-yellow oil of a burning taste, a strong alkaline reaction, and an odor resembling that of trimethylamine. The other constituents of coca appear to be of neither pharmaceutical nor medicinal importance.

Off. Prep.—Extr. erythroxyli fluid., *U. S.* (For Cocaine hydrochloras, *Br.*, see p. 1646.)

History.—Coca was used by the aborigines of South America long before their conquest by the Spaniards. They regarded it as a divine gift, employed it in religious ceremonies, and spoke of it as "that heavenly plant which satisfies the hungry, strengthens the weak, and makes men forget their misfortunes." These reasons were sufficient to render it abominable in the sight of the fanatical invaders, who forbade its use and culture. But when they discovered that it enabled the conquered people to perform the work of their taskmasters, they winked at its diabolical origin and virtues.

Physiological Action.—*On Animals:* It seems to result from experiment that in very large doses coca produces tetanic convulsions; that in much smaller doses it causes hyperæsthesia, dilatation of the pupils, and impaired movement, apparently from the loss of co-ordination; that in intermediate doses it diminishes, and then extinguishes, sensibility without destroying motility. According to Bennett, cocaine and the alkaloids of tea, coffee, guarana, and cocoa produce identical effects, in small doses causing cerebral excitement and impaired sensibility, and in large doses an increase of these symptoms, followed by tonic or clonic convulsions. He found that they at first increase, and afterward diminish, the force and frequency of the heart's action; that they affect the capillaries by first contracting and then relaxing them; that they slightly lower and then raise the temperature, increase the salivary secretion, etc. When the alkaloid cocaine is given to rabbits by the stomach, it only slightly disturbs the heart's action or the respiration; but hypodermically administered, even in small doses, it occasions, according to Schroff, violent tonic spasms, extreme dilatation of the pupil, and an increased pulse- and respiration-rate. The experiments of Bennett, on the other hand, performed on frogs and rabbits, show that its direct tendency is to cause spinal paralysis and loss of reflex action. These observations and conclusions are confirmed by those of Van Anrep (*Practitioner*,

xxv. 204), who found that cocaine in moderate doses stimulates the nervous system, in large doses depresses it, and in excessive doses causes general spasm. It dilates the pupil.

On Man: Owing to the small quantity of coca, and that often impaired in activity, which is to be procured in countries where physiological research is practised, the conclusions in regard to its action are somewhat deficient in fulness and precision. Its principal effects are manifested in enabling those who use it to remain for a long time without food, to endure unusual fatigue, and to preserve a cheerful temper. Some of the first historians of its use, as Von Bibra, state that it suspends the appetite for food for some hours, and at the same time greatly increases the muscular strength and endurance. Schroff found that it quickened the pulse and occasioned an agreeable sense of lightness and activity of mind and body, followed by some lassitude and an inclination to sleep. When the proper quantity has been chewed the laborer goes cheerfully to his work and gives no heed to meal-times while the influence lasts. By repeated doses abstinence from food can be maintained for 3 or 4 days. In some persons it produces an exhilarating effect. The celebrated traveller Tschudi and more recent observers found that when taken in infusion it conferred a singular immunity from suffering, and prevented the hæmorrhages which are apt to occur in the elevated passes of the Andes, some of which are 17,000 feet high. Christison, who tested its action among the Highlands of Scotland, observed that it entirely prevented the fatigue which follows severe pedestrian exercise and suspended hunger and thirst during its action. It had no effect upon the mental faculties beyond liberating them from the dulness and drowsiness which fatigue occasions. The most recent testimony quite confirms these statements. Dr. T. E. Charles says (*Times and Gazette*, Aug. 1882, p. 165): "I lately took one guide and three porters with me to the top of Mont Blanc, and supplied each man with 5 Gm. of coca-leaf. They spent about 2 hours on the mountain without a drop of water and with only a limited quantity of wine. Besides the wine, they drank no tea or coffee or other liquid, neither did they use ice or snow. The evidence of these four men is unanimous and explicit as to the great relief they experienced in chewing this leaf, and how much easier it rendered the great exertion required of them by assuaging a tormenting thirst." The experiments of Mason upon himself are of similar import (*Boston Med. and Surg. Jour.*, Sept. 1882, p. 221): "Shortly after taking the fluid extract of the drug I felt slight weakness in the legs, passing away gradually. My spirits were buoyant and walking seemed easier. It seemed to produce a sort of dream-like condition, and I would walk almost automatically at times. I always noticed dilatation of the pupils. I felt fresher in the evening after a long walk when I had taken coca than when I had not, and often noticed a tendency to wakefulness in the former case on going to bed." A native of Colombia, however (Posada-Arango) declares that coca has none of the virtues attributed to it—that the use of it by chewing is a mere distraction, like reading, to make the time pass. Bouchardat also considers that its virtues are merely such as belong to Chinese tea. Scrivener reports: "I have seen hundreds of Indians during my residence in Bolivia who have chewed coca-leaf from youth upward, many of whom had attained their eightieth year, who showed no signs of being affected by the plant." But a very different account is given by competent witnesses of those who use it in excess. It is said to derange the digestion and to induce habitual constipation, with jaundice, loss of appetite, emaciation, and dropsy. It would seem that mental disorder is not frequent, although foreigners unaccustomed to the plant suffer from delirium and hallucinations (Von Bibra). Other reporters add that the mind is affected with imbecility and the muscular system with weakness and trembling, and that the circulation becomes slow, feeble, and intermittent. It may safely be assumed that coca, like alcohol and tobacco, may be useful or poisonous according to the quantity taken and the manner of using it, and that, like tea and coffee, it may in like manner be wholesome or noxious.

So far as experiments have been undertaken, they do not agree in their physiological results. Ott found that during the use of coca for 5 days the solid elements of the urine diminished, while the weight of the body slightly increased. During the experiment the urine contained oxalate of lime. Christison states that it increased the saliva and probably lessened the secretion of the urinary solids. Gazeau, on the other hand, observed that it augmented the excretion of urea and lessened the weight. According to him, its power consists in its sustained excitation of the vital functions, along with an anæsthetic power which lessens the sense of fatigue and hunger. The first and the last conclusions are reasonable, and seem to be confirmed by the experiments of Mason (*loc. sup. cit.*), who inferred from them that the effects of coca include stimulation of the nervous system and retardation of metamorphosis.

In its native country, Colombia, coca is used, precisely as Chinese tea is elsewhere, as a mild stimulant and diaphoretic and an aid to digestion. These are mainly the purposes of coffee, chocolate, and guarana; and experiment has proved that the active constituents of all these productions, "although unlike one another and procured from totally different sources, possess in common prominent principles which are not only almost identical in chemical composition, but also appear similar in physiological action" (Bennett).

Medical Uses.—Coca has been gravely suggested as a means of appeasing hunger and thirst in armies on forced marches and on voyages with insufficient food and water: but the fact is overlooked that hardly enough of it has hitherto been procurable for laboratory experiments, and that tobacco, coffee, and tea, which are abundant, have closely analogous virtues. It has also been proposed for allaying the canine hunger observed in some cases of *epilepsy* and *insanity*, and to appease the thirst in *diabetes*. Opium has generally been used to fulfil these indications. In *melancholia* it may be employed as opium and also cannabis have been, and probably with as little real advantage. Like tea and coffee, it has been found useful in nervous *headache* and in the *typhoid state* of fevers. It is one of the stimulants that may be substituted for opiates in treating the *opium habit*. It is said to have been used in South America to overcome *uterine inertia* and to allay pain and the discharges in *cholera morbus*. It is reported to have been useful in *spermatorrhœa* and *generative debility*, but no proof exists of so improbable a statement. According to one reporter, it is of use in granular *pharyngitis* and in relaxation of the *vocal* cords.

Administration.—The Indian coca-chewer always carries a bag of the leaves hanging from his neck and a small flask filled with ashes or lime. After having withdrawn the filaments from a handful of leaves, he chews them until they are reduced to a pulp; this he forms into a ball, which he pierces with a splinter wetted and covered with adhering ashes. The mass has then acquired a pungent taste which excites copious salivation; a part of the saliva is ejected and a part swallowed. The ball is retained in the mouth for about an hour, and then is renewed with a fresh handful of leaves. For medicinal purposes the most convenient form is an infusion made with about 2 drachms (Gm. 8) of the leaves in 4 fluidounces (Gm. 120) of water. Of cocaïne the *dose* is stated to be from ⅛ grain to 1 grain (Gm. 0.008–0.06), in substance or as an acetate or muriate.

ESSENTIÆ.—Essences.

Alcoolés concentrés, Fr.; *Essenzen*, G.

Two preparations of this class have been admitted into the British Pharmacopœia. They are simply solutions of volatile oils in alcohol, and are therefore identical with, except that they contain a much larger amount of volatile oil than, the officinal spirits. The volatile oils are in France usually termed *essences*, while the spirits containing volatile oils, but prepared by distillation, are called *alcoolats*, and those made by simple solution of volatile and non-volatile substances are known as *alcoolés*. The *Essenzen*, popularly so called in Germany, are often strong tinctures or strong solutions of volatile oils, or mixtures of the two.

ESSENTIA ANISI, *Br.*—Essence of Anise.

Alcoolé d'anis concentré, Fr.; *Anisessenz*, G.

Preparation.—Take of Oil of Anise 1 fluidounce; Rectified Spirit 4 fluidounces. Mix.—*Br.*

Medical Action.—(For medical uses see Spiritus Anisi.)

ESSENTIA MENTHÆ PIPERITÆ, *Br.*—Essence of Peppermint.

Alcoolé de menthe poivrée concentré, Fr.; *Pfefferminz-Essenz*, G.

Preparation.—Take of Oil of Peppermint 1 fluidounce; Rectified Spirit 4 fluidounces. Mix.—*Br.*

Medical Action.—(For medical uses see Spiritus Menthæ Piperitæ.)

EUCALYPTUS, *U. S.*—Eucalyptus-Leaves.

Feuilles d'eucalyptus, Fr.; *Eukalyptus-Blätter*, G.

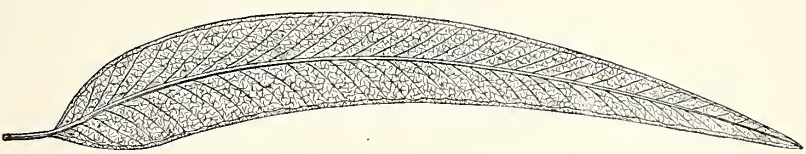
The leaves of Eucalyptus globulus, *Labillardière.* Bentley and Trimen, *Med. Plants*, 109.

Nat. Ord.—Myrtaceæ, Leptospermeæ.

Origin.—This is the *blue-gum tree* of Tasmania, which was discovered by Labillardière in 1792. It grows on moist slopes of wooded hills in the southern half of that island, and in Victoria on the mainland of Australia; it was introduced into Europe in 1856, and has since then been very extensively planted in the southern part of Europe, in Northern Africa, in the Southern United States, and in California. It is a rapid grower, and attains a height of 200, and occasionally even of over 300, feet (60 and 90 M.). The flowers are upon short and broad axillary peduncles, either solitary or in clusters of two or three. The buds are covered with a whitish bloom, and consist of a top-shaped, ribbed, and warty calyx-tube covered by a so-called operculum, which is composed of the united petals, is hemispherical in shape and prolonged into a cone, and separates entire like a lid from the calyx-tube. The flowers are hermaphrodite, with numerous stamens inserted on a disk, a short style, and a four- or five-celled ovary united with the calyx-tube.

Description.—The leaves of young plants are opposite, shortly petiolate, broadly oval or oblong, rather obtuse, heart-shaped at base, and of a pale bluish-green color. They are not employed medicinally. Older trees have the leaves alternate, petiolate, falcate, lanceolate, or oval-lanceolate, rounded and oblique at the base, very entire, and above gradually tapering to the acute apex. They have a length of 6 to 12 inches (15 to 30 Cm.), are thick, leathery, and of a pale yellowish-green or gray-green color, contain numerous pellucid oil-glands, are straight feather-veined, and have, besides the prominent midrib, two lateral veins near the margin. The leaves have a peculiar strong balsamic, camphoraceous odor, and an aromatic, bitterish, pungent taste, followed by a sensation of coolness.

Fig. 114.



Eucalyptus globulus, *Labillardière:* leaf, about half natural size.

Constituents.—Hartzer (1876) obtained from the leaves tannin, cerylic or an allied alcohol, a crystallizable fatty acid—the sodium salt of which is soluble in ether—and three resins, one of which has acid properties, and yields with sulphuric acid a carmine-colored copulated acid, becoming violet with ether. E. S. Wayne (1876) likewise isolated an acid resin, which he found to be crystallizable and to give a brown-red reaction with ferric chloride. The most important constituent, however, is the volatile oil, of which the leaves yield about 6 per cent. (See Oleum Eucalypti.)

Off. Prep.—Extract eucalypti fluid., *U. S.*

Physiological Action.—*On Animals:* The real action of this medicine is yet to be determined, for the reported results of experiments with it are the reverse of harmonious. While one observer states that the oil and the extract do not appear to occasion any special phenomena, unless they perhaps increase the appetite, another declares that in pigeons and rabbits the former produces general excitation, and in excessive doses may prove fatal by paralyzing the excito-motor function, like bromide of potassium, rendering respiration irregular and intermittent, and at last suspending it before the heart ceases to beat. According to Siegen, it depresses the temperature even more than quinine, for 20 grains of the oil caused a rabbit's temperature to fall 3° F., and 120 drops reduced the evening temperature of a healthy man nearly 1° F. Dr. Bernard Berens, Jr. (*Inaugural Thesis*, Univ. of Penna., 1880), deduced from his experiments, upon frogs chiefly, the following among other conclusions: 1. The oil of eucalyptus increases the respirations at first, and then slows them until it destroys life. 2. It does not occasion convulsions. 3. It causes adynamia by acting both upon the muscles and the spinal cord. 4. It suspends reflex action through the latter operation. 5. It diminishes or abolishes muscular contractility when applied locally or through the circulation. 6. It has no marked action on the nerves themselves. 7. In small doses it increases the blood-pressure and slows the pulse. 8. In large doses it lowers the blood-pressure, and at first quickens the pulse, but in excessive doses it directly slows the pulse. 9. As a rule, it lowers the temperature. 10. It has no action upon the pupil. 11. It is eliminated by the lungs, skin, and kidneys.

On Man: When the oil is taken internally it excites a sense of warmth in the fauces and stomach, with increased salivation and subsequent eructations of gas, but in doses of from 15 to 20 grains it is readily tolerated. It is apt to cause some fulness of the head and vascular excitement. It seems to be eliminated through the lungs. It does not impart to the urine a peculiar odor unless given in tincture and in large doses, and no resinous matter is detected in the urine by nitric acid, as is the case when copaiva is taken. According to Guibert, it eliminates an enormous proportion of urea. We are informed also by him that in doses of 20 drops the oil causes general stimulation, a feeling of lightness, and an irresistible desire to keep moving, together with a remarkable suppleness of the back and limbs. The spirits are raised and the mind is clear and active; the appetite is increased, and sometimes aphrodisiac effects are observed. To use this author's words, "there is a true medicinal intoxication," which is not followed by a corresponding depression. In doses relatively or absolutely excessive there is more or less general muscular paresis, without mental depression, and easily dissipated by coffee or alcohol. It is theoretically held to promote the capillary circulation by dilating the capillaries, and thereby rendering the pulse more frequent. Applied to the raw skin, it causes burning pain.

Medical Uses.—Eucalyptus has been very extensively used as a remedy for *intermittent fever.* As in all similar cases, the discovery of its virtues was accidental. It is alleged that more than 40 years ago the crew of a French man-of-war, having lost a number of men with "pernicious fever," put into Botany Bay, where the remaining sick were treated with eucalyptus and rapidly recovered. It is also said that the virtues of the tree were well known to the aboriginal inhabitants. In 1867 some peasants of the Spanish province of Valencia were found to be using the leaves of the plant to cure fever and ague. In the following year Dr. Brunel of Montevideo was led by reports of this experience to employ it in hospital practice, and especially by such statements as the following of Dr. Ramel of Valencia: "I assure you that 4 leaves of this precious plant infused in water form an excellent febrifuge. The sick as soon as they find themselves attacked hasten to procure these leaves, and in no instance do they fail, contrasting strongly with cinchona, which not only is often unavailing, but often also does not prevent a relapse." The report of Dr. Brunel is scarcely less glowing and positive. In 1871, Dr. Keeler, an official physician of certain Austrian railways in malarious districts, affirmed that it was quite as efficient as cinchona. Others have attributed to it marvellous results in cases in which cinchona failed. Others, still, conclude that it is peculiarly curative in the inveterate forms of the disease. There were not wanting, however, physicians who doubted the published reports, some of them upon the ground of their own experience; and among them one, at least, accounts for their discrepancies by supposing that different species of Eucalyptus had been employed, and that E. latifolius is generally inefficient, while E. longifolius seldom fails (Oeffinger). We regard the report of Burdel as probably the most accurate and satisfactory. His field of observation was in one of the most marshy departments of France, La Sologne, where periodical fevers are exceptionally rife and grave. He put the alleged remedy to a prolonged and thorough test, and concluded that it possessed little or no curative power over intermittent fever. Out of one hundred and twenty-three cases only eleven were cured without relapse, and these were, moreover, treated in a hospital; and it is well known that intermittent-fever patients, on being removed from a malarial locality, are very apt to recover without any medicinal treatment at all. And, still further, it was observed that among those whose paroxysms ceased under the use of this medicine there was no diminution of the malarial cachexia, such as usually takes place after the treatment by quinia. In a report on its use in the British East Indian army it would seem to have failed in more than half the cases (Roberts). On the whole, there does not appear to be any substantial reason for believing that a substitute for cinchona has been found in eucalyptus.

It has been alleged that this tree has a special power of destroying malaria in the localities where it grows, but as the statement still lacks confirmation, it is unnecessary to refute the causes assigned for this effect—viz. "that its dead leaves, etc. raise the soil; that it energetically absorbs the soil-water in consequence of its very rapid growth and the multitude of stomata that stud its leaves; and, finally, that it protects the soil against the extreme solar heat so favorable to the generation of animalculæ" (Gubler). These reasons would be equally valid as proofs of its power to generate malaria. The improvement that has taken place in the sanitary state of certain malarial localities where the eucalyptus has been planted is real, but it should be remembered that all arboriculture has a similar effect. The extremely rapid growth of the eucalyptus may render it peculiarly efficient.

As a summary of the virtues claimed for this medicine the following may be cited: "Not being an irritant, it may be liberally used in all cases of hospital *gangrene* and other gangrenous affections, of fetid suppuration, such as occurs in glanders, syphilis, abscesses connected with dead bone, etc. It may be used with advantage to prevent animal and vegetable putrefaction, and hence as a *deodorizer* of hospital wards. Internally, it may be given in all cases of *ulcer* of the *stomach or bowels*, in *septicæmia*, *typhoid fever*, *scarlatina*, *pulmonary gangrene*, *fetid bronchitis*, etc." To this enumeration may be added cases of *fetid lochia*, *ozæna*, and *cancer of the tongue*. It would seem to be useful in *uterine* and *vesical catarrh* and in *gonorrhœa* and *gleet*, and in some cases apparently of chronic *ulcer of the stomach* it has arrested the vomiting and enabled the patient to retain and digest food. According to Mosler, a solution of 1 part of eucalyptus oil in 5 of alcohol and 35 of water forms an efficient liquid, when atomized, for inhalation in *diphtheria* (*Times and Gazette*, Aug. 1879, p. 214; Gibbes, *Am. Jour. Med. Sci.*, July, 1883, p. 244). It seems quite possible that the 5 parts of alcohol would be more efficient than the 1 part of oil in this liquid. A similar criticism is suggested by the alleged virtues of eucalyptus oil as a vulnerary. Schultze used as a dressing for *wounds* a mixture of 1 part of this oil to 9 parts of olive oil (*Bull. de thérap.*, xcix. 430). As a rationale of its mode of action we are told that if a person is kept under its influence the blood drawn from his veins will not undergo putrefaction. "At all events, the hæmato-globulin is expelled from the globules and becomes oxidized externally to them, and the anatomical element is, as it were, embalmed." It is somewhat difficult to conceive that the sick of any disease should profit by the mummification of their blood-corpuscles.

Undoubtedly, eucalyptus, and especially its oil, tend to restrain putrefactive fermentation, as all aromatics have been known to do since the beginning of history; and very possibly these new agents may excel the old in this respect. Certain it is that the oil is a most efficient deodorizer, and, having a very agreeable perfume of its own, is capable of substituting a pleasant for an offensive smell, while its stimulant operation upon diseased tissues assists them in recovering a natural mode of action. As an *antiseptic* dressing many surgeons have employed it as a substitute for carbolized oil, and it is stated to have been approved by Mr. Lister (*Lancet*, May 21, 1881). It has been inhaled with great advantage in an atomized solution in cases of *gangrene of the lung* and of *fetid bronchitis*, and applied on tampons it corrects the *fetor* of *lochial* and other uterine discharges (Sloan, *Lancet*, Sept. 2, 1882). Similar applications of fluid extract of eucalyptus and glycerin are said to be very efficient in relieving *pain* in displacements and other painful disorders of the uterus (*Amer. Jour. Med. Sci.*, Oct. 1882, p. 397).

It has been claimed that tincture of eucalyptus will cure *whooping cough*, but there is no adequate proof of its efficacy. Its astringent and balsamic qualities naturally suggested its use in the topical treatment of various affections in which other medicines of like qualities had been found useful, especially in alcoholic tincture. But it cannot be doubted that the alcohol had a potent influence in the treatment by tincture of eucalyptus of slight *hæmorrhages*, *mucous profluvia*, *leucorrhœa*, *gonorrhœa*, indolent and irritable *ulcers*, *spongy gums*, etc. In certain of these affections, especially in *ulcers*, the fresh bruised leaves deprived of their nerves have been found to cause sufficient stimulation to promote a cure.

It is alleged that smoking the dried leaves of eucalyptus in a pipe or cigar is, with the exception of hypodermic injections of morphia, the most efficient means of calming irritation and procuring sleep in *cardiac* and *aneurismal asthma*, and particularly in cases of pressure on the vagus or its branches by thoracic aneurisms (Maclean). When the patient is too ill to inhale actively he may be kept in an atmosphere filled with the smoke of the burning leaves. The tincture of eucalyptus is said to remove the fishy flavor and smell from *cod-liver oil* when added in the proportion of 1 part to 100. The leaves are strewn among woollen clothing to protect it from *moths*.

Administration.—The leaves may be applied fresh and bruised or mixed with poultices. They may be given internally in doses of 5 grains (Gm. 0.30) or more, but efficient doses of them are too bulky for convenient use in this manner. The extract is very apt to derange digestion and occasion diarrhœa. The *dose* of the oil may be stated at from 2 to 5 drops. The tincture is the most agreeable form of the medicine; it may be prescribed in doses of 15 or more minims (Gm. 1). Topically, the oil may be diluted with alcohol or oil or incorporated with the ordinary constituents of suppositories.

EUONYMUS, *U. S.*—EUONYMUS.

Cortex euonymi.—Wahoo, Spindle tree, Burning bush, E.; *Écorce de fusain* (*de bonnet de prêtre*), Fr.; *Spillbaumrinde, Spindelbaum, Pfaffenhütchen*, G.

The bark of Euonymus atropurpureus, *Jacquin.*

Nat. Ord.—Celastraceæ.

Origin.—The wahoo is a shrub 6 to 10, or even 14, feet (1.8 to 3 or 4.2 M.) high, and is found in shady woods of the northern and middle section of the United States east of the Mississippi. As an ornamental shrub it is of a strikingly handsome appearance in autumn from its copious crimson, smooth, four-lobed capsules, which are pendulous on long peduncles. Its branches are slightly quadrangular, the leaves opposite, petioled, elliptic-ovate, serrate, and pointed; the flowers are dark-purple, in loose cymes of three to six, and appear in June. The root-bark is preferred.

Description.—It comes in curved or quilled fragments varying in thickness between $\frac{1}{16}$ and $\frac{1}{8}$ inch (1.5 and 3 Mm.). It is externally of a light ash-gray color, mottled with larger or smaller patches, or fine longitudinal scaly ridges and meshes, brown or blackish cork, detaching in very thin and small scales. The inner surface, to which fragments of the white wood are often adhering, is pale brownish-white and smooth. When dry the bark breaks, both transversely and longitudinally, with a nearly smooth fracture, exhibiting a whitish and pale-brownish tissue, which in the inner layers has a distinct tangential arrangement. The bark attracts moisture in a damp atmosphere, thereby losing its brittleness, is nearly inodorous, and has a sweetish afterward bitterish and somewhat acrid taste.

Constituents.—W. P. Clothier (1861) isolated bitter, yellow, acicular crystals from the tincture prepared with diluted alcohol by agitating it with chloroform. The same principle is probably contained in the so-called *euonymin* of the eclectics, which is obtained by precipitating a concentrated tincture of the bark with water. W. T. Wenzell (1862), however, obtained by treatment of the tincture with chloroform a dark-yellow substance from which ether dissolved a golden-yellow resin; the insoluble portion was dissolved by alcohol, a resin precipitated by acetate of lead, and the lead removed from the filtrate; on evaporation, uncrystallizable *euonymin* was left, having an intensely bitter taste. It is a neutral principle soluble in ether (?), alcohol, and water, and precipitated by subacetate of lead and phosphomolybdic acid. Wenzell obtained also *asparagin*; *euonic acid*, which crystallizes in needles and is precipitated by subacetate of lead; tartaric, malic, and citric acids; several resins, starch, pectin, and other common vegetable principles. The dried bark left 14.75 per cent. of ash, about half of which consisted of silica.

Allied Drugs.—EUONYMUS AMERICANUS, *Linné*—Strawberry bush, E.—is a low, usually trailing shrub, with crimson warty capsules and orange-red roots.

EUON. EUROPÆUS, *Linné*, is 8 to 20 feet (2.4 to 6 M.) high, occasionally cultivated in gardens, has greenish-yellow flowers and pale-red capsules, the arillus being orange-red. All parts of it are emetic and purgative; the fruit, made into an ointment, has been used for the destruction of pediculi. Riederer (1833) believed the bitter taste to be due to an alkaloid, *euonymine*, which he did not succeed in obtaining pure. Grundner (1847) regarded it as a mixture of resin with bitter extractive. The arillus yields by pressure an orange-colored oil which has a bitter taste. The orange-red coloring matter, which is quite prevalent in this natural order, seems to deserve careful investigation.

Medical Action and Uses.—Euonymus was formerly reported to be "tonic, a hydragogue cathartic, diuretic, and anti-periodic." This barbarous jumble of incongruous qualities is now replaced by one which belongs to euonymin, in common with many other purgatives which also increase the secretion of the bile, especially aloes, colocynth, and rhubarb, and many other medicines which are not purgatives, such as colchicum, ipecacuanha, nitro-muriatic acid, phosphate of ammonium, benzoate and salicylate of sodium, and phosphate of sodium, which last is only feebly laxative.

According to Rutherford (*Physiological Action of Drugs on the Secretion of Bile*, 1880, p. 45), "5 grains of euonymin, mixed with a small quantity of boiling water and placed in the duodenum of dogs, powerfully stimulated the liver." In these animals it only slightly increases the intestinal secretion, but is an active purgative in the human subject. Whether, therefore, it is a cholagogue in man is not yet demonstrated. We are indeed assured that one practitioner has prescribed it "in over fifty cases of *biliary derangement* and *sick headache*, and finds it of much value" (*Practitioner*, xxiii. 336); and another declares it to be "one of the best remedies in the materia medica, when used in small doses, for torpidity of the mucous membrane and liver, for hæmorrhoids with torpidity of the peristaltic action of the bowels, and in the 'erysipelatous diathesis'" (*Edinb. Med. Jour.*, xxvii. 175); but what is meant by "biliary derangement," or "torpidity," etc., it is impossible to define; and the impression remains that it signifies mainly *constipation*, which any familiar and thorough purgative, such as the compound cathartic pill, would be adapted to remove, or podophyllin, whose action upon dogs seems to be almost identical with that of euonymin. On the whole, neither wahoo-bark nor its purgative principle can be said to possess any peculiar virtues. Either is an active and useful purgative, but nothing more.

A decoction or an infusion of euonymus may be prepared with an ounce of the bark to a pint (Gm. 32 to Gm. 500) of water, and given in the *dose* of a wine-glassful. The average dose of euonymin is 2 grains. It is usually taken at bed-time, and followed the next morning by a saline purge, which should be sulphate of sodium, according to Rutherford, a "hepatic stimulant," and not sulphate of magnesium, which the same authority assures us "has no cholagogue action."

Griffith states (*Med. Botany*) that E. americanus, E. europæus, and still other species, including E. atropurpureus, "have similar properties; the seeds are all nauseous, purgative, and emetic, and are used in some places to destroy vermin in the hair; the leaves are poisonous to sheep and other animals feeding on them."

EUPATORIUM, *U. S.*—EUPATORIUM.

Herba eupatorii perfoliati.—Thoroughwort, Boneset, Indian sage, E.; *Herbe d'eupatoire perfoliée, Herbe à fièvre, Herbe parfaite*, Fr.; *Durchwachsdost, Durchwachsener Wasserdost*, G.

The leaves and flowering tops of Eupatorium perfoliatum, *Linné*, s. E. connatum, *Michaux*, gathered after flowering has commenced. Bentley and Trimen, *Med. Plants*, 147.

Nat. Ord.—Compositæ, Eupatorieæ.

Description.—Thoroughwort inhabits damp soil and low swampy grounds in Canada and the United States. It is a hairy perennial, with an erect stout stem 2 to 4 feet (0.6 to 1.2 M.) high and much branched at the summit; the leaves are opposite, tapering, lanceolate, 4 to 6 inches (10 to 15 Cm.) long, united at the base, with the margin crenately serrate, rugosely veined, rough above and minutely resinous dotted beneath. The flowers are in dense level-topped corymbs; the heads have an oblong involucre consisting of lance-linear scales, and contain ten to fifteen tubular white florets with a bristly pappus in a single row. Its flowers appear in July, and it continues to bloom until September. The leaves and the flowering tops with the small branches are collected in July; on drying, they lose from 75 to 80 per cent. in weight. The drug has a rather weak aromatic odor and a somewhat astringent and persistently bitter taste.

Constituents.—Boneset contains a minute quantity of volatile oil, some tannin, and a bitter principle which has not been isolated. The analyses of W. Peterson (1851) and M. H. Bickley (1854) elicited, besides those mentioned, the usual common constituents of herbs. G. Latin (1880) isolated from the ethereal extract, by means of benzin, white needles of a tasteless wax, and ascertained the bitter principle *eupatorin* to be a glucoside soluble in alcohol, chloroform, ether, and boiling water; boiled with sulphuric acid and water, it gives off a raspberry-like odor. Parsons (1879) determined in the air-dry herb 13.5 albuminoids, 15.2 resin and chlorophyll, and 7.5 ash.

Off. Prep.—Extract eupatorii fluid., *U. S.*

INFUSUM EUPATORII.—Infusion of thoroughwort, *E.;* Tisane d'herbe à fièvre, *Fr.;* Eupatorium-Aufguss, *G.*—Take of thoroughwort a troyounce; boiling water a pint. Macerate for 2 hours in a covered vessel, and strain.—*U. S. P.* 1870.

Allied Species.—Most of the numerous species of Eupatorium and of some allied genera appear to possess similar properties, and are occasionally employed in regular or domestic practice. The following may be mentioned:

EUP. TEUCRIFOLIUM, *Willdenow*, s. E. verbenæfolium, *Michaux*, s. E. pubescens, *Persoon*, grows from Massachusetts to Louisiana, and is characterized by lance- or oblong-ovate leaves, which are truncate below, coarsely toothed toward the base, and are alternate on the branches. It is popularly known as *wild horehound*, like the nearly-allied Eup. rotundifolium, *Linné*, which is found in similar localities, and is mainly distinguished by its roundish-ovate and slightly heart-shaped leaves.

E. FŒNICULACEUM, *Willdenow*, called *dog-fennel*, is a common weed in fields and damp places from Virginia to Florida, with the leaves pinnately dissected into filiform segments. The juice is used for relieving pain from the bites of insects.

E. INCARNATUM, *Walter*, of the Southern United States from Texas to North Carolina, has triangular ovate, long-petioled leaves, and is used in Texas under the name of *mata* for flavoring tobacco.

E. PURPUREUM, *Linné*, is common in low grounds, with a tall, simple, purplish-colored or spotted stem, ovate or lanceolate-petiolate leaves in whorls of three to six, and dense corymbs of mostly purplish flowers. It is known as *trumpet-weed* and *gravel-root*, the rhizome and rootlets being popularly used in various ailments of the urinary organs. The rhizome contains a yellow crystallizable principle which gives a dark-green color with ferric chloride; it is probably *quercitrin*.

E. CANNABINUM, *Linné*.—Water-hemp, *E.*; Eupatoire d'Avicenne, Origan aquatique, *Fr.*: Wasserhanf, *G.*—It is indigenous to Europe; the leaves resemble hemp-leaves, but are mostly trifoliate; the root and leaves have diuretic, and in larger doses emetic, properties. Righini states that the leaves and flowers contain a white bitter alkaloid soluble in ether; the sulphate is said to crystallize in silky needles.

E. AYAPANA, *Ventenat*, of Brazil, has short-stalked, lanceolate, hairy, and almost entire leaves with purplish veins and a coumarin-like odor. It is an aromatic tonic.

MIKANIA GUACO, *Humboldt et Bonpland*, a native of Colombia and the West Indies, is an aromatic, bitter climbing herb 20 feet (6 M.) long, with the leaves ovate-elliptic and rusty tomentose beneath; it was at one time highly lauded as a remedy in cholera and in hydrophobia; in its native country it is reputed to be an antidote to the poison of serpents, like the Brazilian Mik. opifera, *Martius*, which is called *erva da cobra*. Their medicinal properties are probably not superior to those of Mik. scandens, *Linné*, of the United States, which has nearly triangular heart-shaped leaves. The genus Mikania is closely allied to Eupatorium, not only botanically, but also in its sensible properties.

Medical Action and Uses.—Eupatorium resembles chamomile in its effects. It is a stimulant tonic in small and a laxative in large doses, and an emetic or diaphoretic in warm infusion. Like all such plants, it is used to prevent or to break the chill in *intermittent fever* of a mild type. A hot infusion is a popular and efficient remedy in the forming stage of *muscular rheumatism*, *sore throat*, *bronchitis*, and even *influenza*. Its power of relieving pain in the limbs in the last-named disease entitled it to the popular name of "boneset." In atonic *dyspepsia* its effects resemble those of other bitter tonics. The *dose* of the powder is stated to be 20 or 30 grains (Gm. 1.30–2.00). The infusion, which is the most convenient form for administering the medicine, is made with 1 ounce of the herb to a pint of boiling water, macerated for 2 hours in a covered vessel and strained. *Dose* as a tonic, 1 or 2 fluidounces.

Mikania guaco was first known (1788) medicinally as an antidote to serpents' bites used in South America, and about 1831 it had a reputation in Europe for the cure of dyspepsia, debility, asthma, gout, rheumatism, and even cholera! It is therefore probably a stimulant tonic (Strumpf, *Handbuch*, ii. 14). More recently (1879) it was proposed as a cure for cancer.

Of the other allied species mentioned above, the greater number appear to possess essentially the same properties as the officinal plant, but E. purpureum and E. cannabinum are believed to be diuretic.

EUPHORBIA.—SPURGE.

Wild ipecac, *Wild hippo*, E.; *Euphorbe*, Fr.; *Wolfsmilch*, G.

The roots of two plants of this genus were recognized by the U. S. P. previous to 1880—namely, Euphorbia corollata, *Linné* (Meehan, *Native Flowers*, i. 109), and Euph. Ipecacuanha, *Linné*.

Nat. Ord.—Euphorbiaceæ.

Origin.—EUPH. COROLLATA, the *blooming* or *large-flowering spurge*, also called *snake-milk* and *milk purslain*, is a smooth perennial herb which is met with in low, sandy, and dry soil from Canada to Florida and west to Mississippi, and is abundant in many localities, chiefly of the Southern and Western States. It produces a slender, nearly simple stem 2 to 3 feet (60 to 90 Cm.) high, which has the leaves, excepting the floral ones, alternate, linear-oblong, and obtuse. The flowers are in umbels of five to seven rays, each one being again two- or three-forked, and are conspicuous for the showy white appendages to the involucre, which have the appearance of petals and bear a greenish gland at the base. The smooth capsule separates at maturity into three carpels, each containing a single ash-colored seed. It flowers in the latter part of summer and in autumn, when the root should be collected. This, like the next, is rarely met with in the market; we have received instead of it the roots of Gillenia stipulacea, of Triosteum perfoliatum, and of other plants.

EUPH. IPECACUANHA, called *ipecac spurge* and *American*, *Carolina*, or *white ipecac*, is a smooth perennial herb of a dark-green or dark-purplish color, growing in barren, sandy soil at a limited distance from the seashore from Connecticut southward to Georgia. It produces several ascending or often diffusely-spreading stems, which fork from near the base and have opposite, obovate or oblong, obtuse, and entire, nearly sessile leaves. The flowers are inconspicuous, long-peduncled, and appear singly from the forks or the axils of the upper leaves. The nearly smooth capsule contains in each of its three cells one white somewhat dotted seed. It flowers during the spring months.

Description.—The root of the *blooming spurge* is 1½ to 2 feet (45 to 60 Cm.) long, and, when full grown, about an inch (25 Mm.) thick, cylindrical, and little branched; is externally of a dark-brown or, when old, of a blackish, color; has underneath the thin corky layer a thickish white bark, which encloses a spongy, porous, whitish wood, radially striate by many medullary rays. In the dry state it is longitudinally wrinkled and breaks with a short nearly smooth fracture. It is inodorous and has a sweetish afterward warm taste.

The root of the *ipecace spurge* resembles the preceding in general characters, but is thinner, from 3 to 6 feet (0.9 to 1.8 M.) long, has externally a gray or brownish-yellow corky layer, which is never blackish or dark colored, and shows internally a yellowish porous wood. Odor and taste are similar to the preceding. Barton believed it to be equally efficacious throughout the year.

Constituents.—The latest analyses of the last-named root, by Petzelt (1873) and Dilg (1875), agree with the older one of Bigelow in proving the presence of resinous, gummy, and other common constituents of plants; they also showed abundant presence of starch. Petzelt regards the resinous portions as containing the emetic principle. The root may possibly contain a glucoside, since Dilg did not get a reaction for glucose until the decoction had been boiled with an acid. *Euphorbon* was found among the products extracted by petroleum benzin. The constituents of blooming spurge-root are probably similar.

Allied Plants.—The genus Euphorbia comprises a large number of shrubby and herbaceous species, all of which are laticiferous and possess more or less acrid properties. Of the thirty or more species growing in the United States, we give brief descriptions of a few which are low or prostrate:

EUPHORBIA PROSTRATA, *Aiton*. It is villous-pulverulent, with roundish, very obtuse, and above serrulate leaves, and produces a woolly fruit with quadrangular, rugose, and brown seeds. It grows in moist localities in the Southern States.

EUPH. MACULATA, *Linné*. It is a common weed, growing on roadsides, with oblong or nearly linear leaves, having usually a brownish spot upon the upper surface, and being very oblique at the base and serrulate above. Like the following species, it is known in some places as *spotted eyebright:*

EUPH. HUMISTRATA, *Engelmann*. It inhabits rich soil in the Mississippi Valley, and resembles the two preceding, but has elliptical or obovate leaves and obtusely-angled seeds.

EUPH. HYPERICIFOLIA, *Linné*. It is found in the West Indies, and is common in the United States and Canada, grows to the height of 15 or 20 inches (38 to 50 Cm.), resembles in foliage the preceding, and has smooth capsules and obtusely-angled seeds.

These and allied species probably contain the same principles found by Zollikofer (1842) in E. maculata—namely, caoutchouc, resin, tannin, gallic acid (?), etc. Similar constituents have been found by John, Stickel, and others in E. Cyparissias, *Linné*, E. Esula, *Linné*, E. Peplus, *Linné*. E. helioscopia, *Linné*, and others which are natives of Europe, but occasionally met with in cultivation or spontaneous in North America. Their acrid principle has not been fully isolated. Numerous other species of Euphorbia are medicinally employed in those countries where they are indigenous. Recently, Euph. pilulifera, *Linné*, an herbaceous plant of India and Australia, has been recommended in bronchial and asthmatic affections.

Medical Action and Uses.—Large-flowering spurge is reputed to possess emeto-cathartic properties, and its bruised root will vesicate the skin. Hence it cannot be a safe agent in cases of gastro-intestinal irritation. *Dose* as an emetic, 20 grains (Gm. 1.30); as a cathartic, 10 grains (Gm. 60); as a diaphoretic, 5 grains (Gm. 0.30).

Ipecacuanha spurge does not differ essentially from the other officinal species of Euphorbium. It may be used under the same conditions and in similar doses.

A case of poisoning by the seeds of *Euphorbia latas*, found in the neighborhood of Philadelphia, is related by Harlan (*Med. and Physical Researches*, p. 603). The symptoms included violent retching and vomiting, with excessive purging, followed by stupor and dilated pupils. The patient recovered after cold affusions. A similar case of poisoning by the seeds of E. lathyris is reported in a French journal for 1881 (*Bull. de thérap.*, ci. 541). The reporter recommends opiates as the most appropriate antidote.

Euphorbia prostrata was in 1861 reported by Dr. Irwin, Asst. Surgeon U. S. A., to be esteemed by the Indians and settlers in Arizona as an infallible remedy for the bite of the *rattlesnake* and for the bites and stings of almost all *venomous* animals and *insects*. In several experiments performed by him on dogs allowed to be bitten by rattlesnakes, and after the characteristic effects of the venom had been fully developed, the fresh juice of this plant was applied to the wounds, and at the same time administered internally in doses of from 4 to 6 ounces, with the effect of immediately abating the symptoms and afterward curing the animals.

EUPHORBIUM, *P. G.*—Euphorbium.

Euphorbe, *Gomme-résine d'euphorbe*, Fr. ; *Euphorbium*, G.

The gum-resin obtained from Euphorbia resinifera, *Berg.* Bentley and Trimen, *Med. Plants*, 240.

Nat. Ord.—Euphorbiaceæ.

Origin.—The plant is indigenous to the lower slopes of the Atlas Mountains of Morocco. It has an ascending, cactus-like, fleshy, quadrangular stem with spreading branches, and, instead of leaves, is furnished with divergent, spinescent stipules, situated in pairs on the angles; the flowers are in pedunculate cymes of three or rarely more. On wounding the branches a milk-juice exudes, which hardens upon the plant, usually encrusting the spines. While it is being collected the mouth and nostrils are protected by a cloth from the irritating effects of the dust.

Description.—Euphorbium is seen in roundish or somewhat three-cornered, conical-cylindrical, or irregular pieces varying considerably in size, the largest measuring nearly an inch (25 Mm.). The shape is influenced by the portion of the plant around which the exudation is hardened, and most pieces are observed with one or more holes and enclosing fragments of the spines, flowers, or fruit. Euphorbium is light brownish-yellow, scarcely glossy, somewhat translucent, brittle, nearly inodorous, but the dust excites violent sneezing, and, if inhaled, acts as an acrid poison. The taste is at first slight, afterward burning and acrid. When heated it gives off a faint odor, suggesting that of benzoin, and afterward fuses and burns with a bright, sooty flame. Euphorbium is not entirely soluble in any of the simple solvents, and when triturated with water yields a turbid mixture, but not an emulsion.

Constituents.—The older analyses by Braconnot, Brandes, and others seem to indicate that the composition of euphorbium varies to some extent; the *resin*, readily soluble in cold alcohol and possessing an extremely burning taste, varied between 37 and 44 per cent.; Flückiger (1868) obtained 38 per cent. of it, and Hlasiwetz (1867) ascertained its composition to be $C_{10}H_{16}O_2$. This resin is amorphous, imparts to boiling water its acrid and bitter taste, and, according to Sommer (1859), does not yield umbelliferon. The sparingly soluble, crystallizable resin of Bonastre and others was named *euphorbon* by Flückiger, who obtained 22 per cent. and gave it the formula $C_{13}H_{22}O$. It is soluble in ether, benzol, benzin, amylic alcohol, chloroform, acetone, glacial acetic acid, and hot alcohol, but requires about 60 parts of alcohol for solution at the ordinary temperature. When the last traces of the acrid resin have been destroyed by boiling in a weak solution of potassium permanganate it is entirely tasteless. If its alcoholic solution is allowed to evaporate until it forms a thin film, and this is moistened with sulphuric acid, the slow addition of a little strong nitric acid produces a fine violet color—a reaction which is also observed with lactucerin. Braconnot (1808) observed the presence of malic acid in euphorbium. Flückiger obtained 12 per cent. of *malates*, chiefly of calcium and sodium, 10 per cent. of *mineral compounds*, and 18 per cent. of *gum*, which is precipitated by acetate of lead, also by silicate of sodium and borax.

Pharmaceutical Uses.—Euphorbium is an ingredient in a few plasters. Tinctura euphorbii is made with 1 part of euphorbium and 10 parts of alcohol.

Physiological Action.—The extremely acrid qualities of euphorbium were known to the ancients, for both Pliny and Dioscorides describe the mode of collecting the juice so as to prevent its irritating emanations from affecting the face or hands. They also speak of its taste as persistently hot and acrid, drying the throat. Its dry powder does not affect the sound skin usually, but it irritates the mucous membranes, and causes the eyes to weep and grow red, the nose to run with watery and even bloody mucus, and saliva to flow abundantly from the mouth. To prevent these effects, says Pereira, some drug-grinders employ masks with glass eyes, others apply a wet sponge to the nose and face, while others cover the face with crape. Individuals who have been exposed for some time to the influence of this dust suffer with headache, giddiness, and ultimately become delirious. I was informed, he adds, of an Irish laborer who was made temporarily insane by it, and who during the fit insisted on saying his prayers at the tail of the mill-horse. In a case which fell under his notice a man grew suddenly delirious, and presently became insensible and fell in a fit. His face was red and swollen, his pulse frequent and full, and his skin very hot. On being bled his consciousness returned and he complained of great headache. Internally, it causes great thirst, dryness of the throat, colic, vomiting, and purging, and in excessive doses, besides these symptoms, cold sweats, syncope, thready pulse, and even inflammation and gangrene of the bowels.

Medical Uses.—Although euphorbium was anciently and even in comparatively modern times used as a drastic purgative in *dropsy*, yet the extreme harshness of its operation led to its being associated with milder drugs for the same purpose, and at the present day it is never given internally. It was also at one time applied as a local stimulant in certain cases of *paralysis*, and more recently as a *sternutatory* when mitigated with inert or mild powders. As a local irritant it has been used in the same cases for which mezereon is appropriate, and particularly in plasters intended to prolong *suppuration*, as in cases of obstinate *sciatica*. In ointments it was applied to *ulcers* maintained by necrosed bone. Plasters containing it have also been employed in the treatment of chronic swellings of the *joints* induced by scrofula, gout, or rheumatism.

EUPHRASIA.—Eyebright.

Euphraise, Fr.; *Augentrost*, G.

Euphrasia officinalis, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Description.—An annual plant about 6 inches (15 Cm.) high, indigenous to the greater part of Europe, and in North America to the White Mountains and from the Great Lakes northward. It has opposite, shortly petiolate or sessile, ovate or lanceolate leaves, which are about ⅓ inch (8 Mm.) long, and have four or five teeth on each side; the upper (floral) leaves are alternate, nearly rhomboid, and bristly-toothed. The axillary flowers have a four-cleft calyx and a white or lilac two-lipped corolla with a yellow throat, four ascending stamens, and an oblong, many-ovuled ovary. When fresh, the plant has a faint balsamic odor which is almost completely lost on drying; the taste is somewhat saline, bitter, and scarcely astringent.

Constituents.—Examined by J. B. Enz (1859), the fresh plant was found to contain 62 per cent. of moisture and 10.8 per cent. of cellulose, the remainder being tannin, a little volatile oil, an acrid and bitter principle, several organic acids, mannit, glucose, and other common principles. The tannin precipitates ferric salts dark-green, and lead salts of a bright-green, color.

Medical Action and Uses.—The name "euphrasia," signifying cheerfulness, was anciently as well as in more recent times given to this plant, which was supposed to render the vision clearer and to cure various inflammatory affections of the eyes. Its English name, *eyebright*, may be due to this circumstance, but some maintain that its use in such disorders was prompted by the doctrine of signatures, for a yellow spot upon its flower suggests the pupil of the eye. Its utility, when applied as a fomentation or decoction in *ophthalmia*, was probably due to its astringency. A vinous decoction of it was esteemed in *toothache;* a closely-allied species, also used for this affection, was for that reason called *odontitis*. Internally, eyebright was also given, as a distilled water or a tincture, for *chronic catarrhs*.

EXTRACTA ET EXTRACTA FLUIDA.—Extracts and Fluid or Liquid Extracts.

Extraits et Extraits liquides, Fr.; *Extrakte und Flüssige Extrakte*, G.

Extracts are preparations which are obtained by removing from crude drugs a solution of their medicinal principles and evaporating it to the consistence of a soft solid or to dryness. The medicinal principles may be removed either by expressing the crude drugs while fresh and juicy or by exhausting the dried and powdered drugs with water, alcohol and water, alcohol, or ether, whereby the *inspissated juices* or the *aqueous*, *hydro-alcoholic*, *alcoholic*, or *ethereal extracts* are obtained; the latter contain all the fixed and volatile oils, together with resin, which may have been contained in the drug, and usually remain liquid after the solvent has been completely evaporated; for which reasons the Pharmacopœia has separated them as OLEORESINÆ (which see).

INSPISSATED JUICES.—The United States Pharmacopœia has admitted only one inspissated juice (Ext. taraxaci), while those of the narcotic herbs which are not indigenous or grow spontaneously only in a few localities have very properly been dismissed. The expressed juices of herbs contain, besides the medicinal principles, chlorophyll in suspension and albuminous and mucilaginous matters in solution. Of these the chlorophyll separates on heating the liquid to about 55° C. (130° F.); the albuminoids are coagulated between this temperature and about 94° C. (200° F.), and the solubility of the gum and mucilage is not affected by heat; but these principles may be removed by alcohol, in which they are insoluble. The different pharmacopœias have adopted different processes for the purification of the expressed juices: that of Germany endeavors to obtain the extracts as free as possible from inert principles, and purifies by heat and by alcohol, as recommended by C. F. Mohr (*Pharmacopœia universalis*, 1845); the French Codex, like the former U. S. P., directs the juice to be coagulated by heat, but the gum is not precipitated; and that of Great Britain aims only at the separation of the albumen, and reincorporates with the extract the previously-removed chlorophyll. The inspissated juices of the latter are of a green color and of a firm pilular consistence; those of the other pharmacopœias are brown in color, and cannot be made into pills without the addition of some vegetable powder. Provided the material has been of the same quality, an inspissated juice made according to the German Pharmacopœia ought to be stronger, and if made by the British Pharmacopœia weaker, than is obtainable by the French (and former United States) process.

To obtain the juice, the vegetable should have been recently collected, well washed with water to free it from extraneous matter, and the superfluous water drained off. It is .then cut into pieces of convenient size and bruised in a stone mortar, by means of a pestle made of hard wood, until reduced to a smooth pulpy mass. If not succulent enough, a little water may be sprinkled over it during this operation. The mass is then enclosed in canvas bags, strongly expressed, again mixed with water, and expressed a second time, whereby that portion of the juice remaining in the pulp is obtained. The mixed liquids are then heated to 80° C. (176° F.) to coagulate the albumen, which encloses also the chlorophyll, and is removed by straining, after which the clear liquid is evaporated to the proper consistence (*F. Cod.*). The German Pharmacopœia directs the strained liquor to be evaporated until reduced in weight to 10 per cent. of the weight of the plant, when an equal weight of alcohol is added to precipitate gummy matter; the mixture is set aside until the insoluble matter has subsided; it is then decanted and filtered, and the retained liquid obtained by the addition of a little diluted alcohol; the alcohol is partly distilled off and the remaining liquor evaporated as before. The British Pharmacopœia directs the heating of the expressed juice to 130° F., whereby the chlorophyll separates from the liquid and is collected upon a calico strainer. The strained liquor is now heated to 200° F. to coagulate the albumen, again strained, and evaporated to the consistence of a thin syrup, to which the chlorophyll, previously separated, is added and well mixed by assiduous stirring. Evaporation to the proper consistence will complete the extract. If the part of the plant employed does not contain chlorophyll, its removal and subsequent readmixture are obviously omitted from the process, and if starch is present some of it will pass through the press-cloth, and the expressed juice must be allowed to subside and then be decanted from the deposited fecula. The U. S. process for extract of taraxacum is faulty in not removing the albumen.

AQUEOUS EXTRACTS were formerly usually made by boiling the drug with water, expressing the watery solution, and evaporating. The pharmacopœias have very properly discontinued this process almost altogether, and have in nearly all cases substituted infusion or percolation with water. Prolonged boiling with water will often render inert constituents (starch, etc.) soluble in water, and thus increase the amount of extract, to the injury of its quality. In other cases, however, it may not only injure the quality, but also decrease the yield of the extract, as in the case of krameria, the tannin of which is either partly destroyed or becomes insoluble through combination with other constituents. Some pharmacopœias exhaust the comminuted drugs by hot infusion or digestion, but cold infusion or percolation appears to produce not only unobjectionable aqueous extracts, but they are in some cases at least superior in appearance to those made by hot infusion or digestion. When infusion is directed, the properly-comminuted drug is mixed with sufficient water to cover it, and in case the material be light, it is submerged by putting a perforated cover with sufficient weights upon it to keep it covered by the water. After due maceration or digestion a concentrated solution of the principles is at once obtained by expression, and a second maceration with a small amount of water and expression will practically exhaust the drug. If a large quantity of water be used in the beginning, a second maceration may be avoided or becomes unprofitable, but a longer-continued evaporation is necessary.

Only two extracts are prepared with water containing acetic acid or ammonia, which chemicals are ordered in a fixed proportion to the drug, the extraction being finished with water, used merely for the purpose of recovering a percolate equal to the amount of menstruum first employed. (For the proper treatment of the material by displacing with an aqueous menstruum we refer to the remarks on PERCOLATION.) The menstruum used is—

Water for Aloe, Gentiana, Hæmatoxylon, Krameria, Maltum, Opium, Quassia;

Water and acetic acid for Colchici radix; and

Water and ammonia for Glycyrrhiza.

ALCOHOLIC EXTRACTS.—Whether made with strong or diluted alcohol, the powdered material is most conveniently exhausted by percolation. In all cases where alcohol or diluted alcohol is directed in the beginning, the same menstruum is now ordered until exhaustion is accomplished. But for some extracts a stronger and a diluted alcohol are directed; in such cases the former is always used first, and by the addition of the latter an amount of percolate obtained equal in weight to that of the stronger alcohol employed, and usually more than sufficient to practically exhaust the drug. It is obvious that the tinctures obtained in this manner must be of uniform alcoholic strength from beginning to end; which is a decided improvement as compared with a number of processes of the old Pharmacopœia. This uniformity of the menstruum of the percolate renders a separate treatment of different fractions unnecessary; the alcohol is distilled off from the whole of the tincture, and the residue left is then evaporated to the proper consistence. Yet for several extracts it has been deemed proper to distil or evaporate only the weak tincture, and after mixing the residue with the percolate first obtained—rather less than one-third of the whole amount—to evaporate to the proper consistence. Such a precaution is particularly commendable for physostigma, but scarcely necessary for mezereum. Spontaneous evaporation of the most concentrated portion of the percolate has been retained only for rhubarb. Only one extract, ergot, is directed to be made from the fluid extract, yet when the processes for several other extracts and the corresponding fluid extracts are examined, there would appear to be as little objection to prepare the former from the latter as with the important preparation mentioned.

The menstruum used for this class of extracts, as a rule, has been judiciously selected, and leaves but little occasion for criticism:

Alcohol for Aconitum (with tartaric acid), Cannabis indica, Juglans, Mezereum, Physostigma;

Alcohol 8 parts, water 1 part, for Nux vomica;

Alcohol 3 parts, water 1 part, for Cinchona, Iris, Podophyllum, Rheum;

Alcohol 2 parts, water 1 part, for Belladonnæ folia, Digitalis, Hyoscyamus, Leptandra;

Diluted alcohol for Arnicæ radix, Colocynthis, Conium (with hydrochloric acid), Euonymus, Stramonii semen;

Alcohol 3 parts, water 4 parts, for Ergota (with hydrochloric acid).

ETHEREAL EXTRACTS.—All the ethereal extracts of the United States Pharmacopœia will be found under OLEORESINÆ, where also the necessary apparatuses and operations are described. Ext. mezerei æthereum, *Br. P.*, is the ethereal extract of an alcoholic extract, the latter being prepared from the drug and afterward exhausted by ether.

Fluid or **Liquid Extracts,** in the meaning of the United States and British Pharmacopœias, are permanent concentrated solutions of vegetable drugs, made of such a strength that, in the United States, 1 Ccm. contains the medicinal principles and represents the virtues of 1 Gm. of the drug. Formerly the pharmacopœial strength was 1 troyounce of drug to 1 fluidounce of the fluid extract. The present Pharmacopœia has decreased the strength about 5 per cent., and based it upon the relation of the metric measures of weight and capacity, so that any weight of a given drug is to be converted into a fluid extract having the bulk of the same weight of water at its maximum density; or, in other words, a Gm. of the drug is to be represented by 1 Ccm. of the fluid extract. The Pharmacopœia omits to state the temperature at which the finished preparation is to be measured; it is obvious, however, that the fluid extract should in all cases be cooled and measured at or near 15° C. (59° F.), which is the standard temperature adopted for taking specific gravity. The relation of the former and present fluid extracts is shown at a glance by the following table:

100 troyounces	of drug yield	2952.4 Ccm.	or 100 f℥	U. S. 1870;	3110.3 Ccm.	= 105.25 f℥	U. S. 1880.
100 ounces av.	“ “	2691.1	“ 91.15	“ “	2834.9 “	= 95.94	“ “
100 Gm.	“ “	95.15	“ 3.22	“ “	100.0 “	= 3.38	“ “

It will be observed that 100 ounces avoirdupois of a drug will practically make 6 pints or 96 fluidounces of fluid extract, the actual difference as compared with the pharmacopœial requirements being about half a fluidrachm; or for 20 fluidounces of the present fluid extracts only 19 troyounces, not 20 (as heretofore), of drug will be required.

The liquid extracts of former pharmacopœias of Continental Europe, which are still occasionally described under their older officinal title, *Mellago*, were solutions of extracts in water, made in proportions of 3, or sometimes 2, parts of the former to 1 of the latter; they can be kept unaltered for a short time only, and are best prepared extemporaneously. The liquid extracts of the British Pharmacopœia are of the same strength as those of the U. S. P. (1 oz. avoir. to 1 fl. oz. Imperial), except that of male fern, which is an oleoresin, and those of cinchona, glycyrrhiza, opium, and pareira.

All the pharmacopœial fluid extracts are directed to be prepared by percolation, and, as with the extracts, a menstruum uniform in alcoholic strength is employed during the process of exhaustion. This statement requires to be qualified in this, that when glycerin is used with the first portion of the menstruum percolation is continued and finished with the same alcoholic liquid, but not mixed with glycerin. The only exception to this rule is cinchona, the percolation of which is commenced with a mixture of glycerin 1 and alcohol 3 parts, and is finished with a mixture of water 1 and alcohol 3 parts. As has been customary for these preparations, a portion of the strongest percolate is reserved; but while the weaker percolate was heretofore concentrated to a given volume, which, added to the reserved portion, would produce the required measure of fluid extract, it is now directed to be evaporated to a soft extract, which is dissolved in the reserved portion, the requisite measure being made up with the initial menstruum containing no glycerin. On the concentration of an alcoholic tincture the residue left will always have a more aqueous menstruum, and on adding such to the reserved portion the alcoholic strength of the whole menstruum is necessarily weakened, causing disturbance in the solvent power and more or less precipitation of some of the principles originally held in solution. By evaporating the weak tincture to a soft extract most of the water is also expelled, and the comparatively small portion remaining with the extract will occasion but a slight change in the menstruum of the reserved portion, this menstruum being at the same time the most suitable for dissolving the extractive matter, and its alcoholic strength being not changed by the subsequent addition of some of the original menstruum. Special authority is given by the Pharmacopœia to employ, where it may be applicable, the process of re-percolation, described below, without change of the initial menstruum.

An unusually large number of critical experiments were performed for use in the last Pharmacopœia revision, many being embodied in the three reports on fluid extracts made by Prof. Diehl to the American Pharmaceutical Association. (See *Proceedings A. P. A.*, 1878–80). The selection of the most suitable menstruum was thereby greatly facilitated, and the changes which may become necessary after practical experience during several years will probably be few and unimportant. The practicability of the menstruum used for each pharmacopœial fluid extract has been discussed by Mr. Alonzo Robbins in a series of papers (see *Amer. Jour. Phar.*, 1883), giving his observations with fluid extracts especially prepared for this purpose and kept on hand for over three years. When it is considered that the material from which fluid extracts are prepared is not anhydrous, but merely air-dry; that in the manipulation a partial though slight evaporation of alcohol takes place; that in percolating each subsequent portion of the tincture has a more or less different composition from the preceding one; and that the alcoholic strength of the menstruum is finally somewhat, though slightly, changed,—there must be abundant cause for deposition occuring in these preparations, which, together with the influence of changes in temperature and other causes, has been fully discussed in elaborate papers by Prof. J. U. Lloyd in *Proc. Amer. Phar. Assoc.*, 1881–82.

For the pharmacopœial extract and fluid extract of the same drug the menstruum is usually alike. For cinchona, glycerin has in part replaced the water to ensure the greater permanence of the liquid preparation; for gentian and quassia an alcoholic menstruum instead of water was necessary to prevent fermentation; and for digitalis, hyoscyamus, and stramonium an increased strength of alcohol has been selected, perhaps for insufficient reasons, at least as far as the two last-named drugs are concerned. The menstruum for exhausting the drugs is as follows:

Alcohol for Aconitum, Pulvis aromaticus, Belladonnæ radix, Brayera, Calamus, Cannabis indica, Capsicum, Cimicifuga, Cubeba, Cypripedium, Eucalyptus, Gelsemium, Ipecacuanha (special process), Lupulinum, Mezereum, Sabina, Sanguinaria, Scilla, Veratrum viride, Xanthoxylum, Zingiber;

Alcohol 8 parts, water 1 part, for Nux vomica;

Alcohol 3 parts, water 1 part, for Digitalis, Grindelia, Guarana, Hydrastis, Hyoscyamus, Iris, Podophyllum, Rheum, Serpentaria, Stramonii semen;

Alcohol 2 parts, water 1 part, for Buchu, Colchici radix, Colchici semen, Senega (special process), Valeriana, Viburnum;

Diluted alcohol for Arnicæ radix, Calumba, Conium (special process), Dulcamara, Erythroxylon, Eupatorium, Gentiana, Glycyrrhiza (special process), Lobelia, Pilocarpus, Quassia, Rumex, Spigelia, Stillingia;

Alcohol 3 parts, water 4 parts, for Ergota (special process), Senna;

Alcohol 2 parts, water 3 parts, for Taraxacum;

Alcohol 1 part, water 2 parts, for Aurantii amari cortex, Frangula, Hamamelis, Scutellaria;

Alcohol 1 part, water 3 parts, for Lactucarium (special process);

Alcohol 13 parts, glycerin 7 parts, followed by alcohol, for Gossypii radix;

Alcohol 3 parts, glycerin 1 part, then alcohol 3 parts, water 1 part, for Cinchona flava;

Alcohol 15 parts, water 5 parts, glycerin 2 parts, for Matico;

Alcohol 9 parts, water 7 parts, glycerin 4 parts, for Rubus;

Diluted alcohol 9 parts, glycerin 1 part, for Chimaphila, Chirata, Geranium, Rhus glabra, Rosa gallica, Uva ursi;

Diluted alcohol 17 parts, glycerin 3 parts, for Leptandra;

Diluted alcohol 4 parts, glycerin 1 part, for Cornus, Krameria, Pareira;

Alcohol 3 parts, water 6 parts, glycerin 1 part, for Sarsaparilla (two fluid extracts);

Water 2 parts, glycerin 1 part, afterward diluted alcohol, for Prunus virginiana;

Boiling water for Castanea, Triticum (both fluid extracts contain about 20 per cent. by measure of alcohol).

Infusion is better adapted than percolation for exhausting the two drugs last mentioned.

Preparation.—Fineness of Powder. (For remarks on powdering consult the article Pulveres.) "The fineness of powder is expressed in the Pharmacopœia either by descriptive words (generally so in the case of brittle or easily pulverizable substances) or in terms expressing the number of meshes to a linear inch in the sieve. These different forms of expression correspond to each other as follows:

A *very fine* powder	should pass through a sieve having 80 or more meshes to the linear inch.	= No. 80 powder.
A *fine* powder	should pass through a sieve having 60 meshes to the linear inch.	= No. 60 powder.
A *moderately fine* powder	should pass through a sieve having 50 meshes to the linear inch.	= No. 50 powder.
A *moderately coarse* powder	should pass through a sieve having 40 meshes to the linear inch.	= No. 40 powder.
A *coarse* powder	should pass through a sieve having 20 meshes to the linear inch.	= No. 20 powder.

"In certain cases powders of a different degree of fineness (*e. g.* No. 30, No. 12) are directed to be taken. When a substance is directed to be in a limited degree of fineness, as specified by the number of meshes to the linear inch in the sieve, not more than a small (indefinite?) proportion of the powder should be able to pass through a sieve having ten meshes more to the linear inch."—*U. S.*

Percolation.—"The process of percolation or displacement directed in the Pharmacopœia consists in subjecting a substance or substances, in powder, contained in a vessel called a percolator, to the solvent action of successive portions of menstruum in such a manner that the liquid, as it traverses the powder in its descent to the recipient, shall be charged with the soluble portion of it, and pass from the percolator free from insoluble matter. When the process is successfully conducted, the first portion of the liquid or percolate passing through the percolator will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion will be destitute of color, odor, and taste other than those possessed by the menstruum itself.

"The percolator most suitable for the quantities contemplated by the Pharmacopœia should be nearly cylindrical or slightly conical, with a funnel-shaped termination at the smaller end. The neck of this funnel-end should be rather short, and should gradually and regularly become narrower toward the orifice, so that a perforated cork bearing a short glass tube may be tightly wedged into it from within until the end of the cork is flush with its outer edge. The glass tube, which must not protrude above the inner surface of the cork, should extend from 1⅛ to 1½ inches (3 to 4 Cm.) beyond the outer surface of the cork, and should be provided with a closely-fitting rubber tube at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding it in position. The dimensions of such a percolator, conveniently holding 500 Gm. of powdered material, are preferably the following: Length of body, 14 inches (36 Cm.); length of neck, 2 inches (5 Cm.); internal diameter at top, 4 inches (10 Cm.); internal diameter at beginning of funnel-shaped end, 2½ inches (6½ Cm.); internal diameter of the neck, ½ inch (12 Mm.), gradually reduced at the end to ⅖ of an inch (1 Cm.). It is best constructed of glass, but, unless otherwise directed, may be constructed of a different material. The percolator is prepared for percolation by gently pressing a small tuft of cotton into the space of the neck above the cork, and a small layer of clean and dry sand is then poured upon the surface of the cotton to hold it in place.

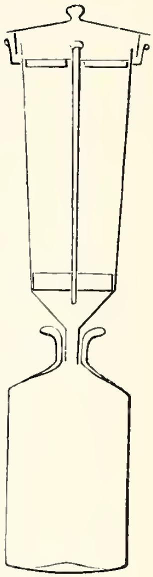
"The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and it is thoroughly stirred with a spatula or other suitable instrument until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No 40 powders and those that are finer requiring a No. 20 sieve, whilst No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper and the whole quantity poured from it into the percolator. It is then shaken down lightly, and allowed to remain in that condition for a period varying from 15 minutes to several hours, unless otherwise directed, after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly in proportion to the character of the powdered substance and the alcoholic strength of the menstruum, strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately-fitting disk of filtering-paper or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions are accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached in this the height corresponding to its level in the percolator, which is now closely covered to prevent evaporation, and the apparatus allowed to stand at rest for the time specified in the formula.

"To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for the quantity of liquid to be percolated if the percolate is to be measured, or of a tared bottle if the percolate is to be weighed; and by raising or lowering this recipient the rapidity of percolation may be increased or lessened as may be desirable, observing, however that the rate of percolation, unless the quantity of material taken in operation is largely in excess of the pharmacopœial quantities, shall not exceed the limit of 10 to 30 drops in a minute. A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

"When the dregs of a tincture or similar preparation are to be subjected to percolation after maceration with all or with the greater portion of the menstruum, the liquid portion should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on until all has passed from the surface, when immediately a sufficient quantity of the original menstruum should be poured on to displace the absorbed liquid until the prescribed quantity has been obtained."—*U. S.*

Although, with proper management, good results may be obtained in the preparation of extracts and fluid extracts by using a funnel-shaped (usually termed *a conical*) percolator for exhausting the powder, experience has demonstrated that the so-called *cylindrical* percolator is to be preferred, having the shape described above, which represents the section of a long cone, and this is terminated below either by a funnel or by a shorter cone. The relative proportion of *diameter to height* of powder is of importance, since it is evident that with an increase of the latter the same fraction of menstruum must come into contact with a larger number of particles of the powder. Its height should be four or five times greater than its mean diameter. The *cover* of the percolator should not fit air-tight, or, if from the volatility of the menstruum, this should be desirable, a communication should be established by means of a glass tube between the receiving vessel and the top of the percolator for the equalization of pressure. Gum-cloth furnishes a convenient material for an ordinary cover.

FIG. 115.



Tin Percolator, arranged for volatile liquids.

In conducting a series of experiments on percolation Dr. Squibb (1866) proved, first, that there is a sufficient degree of uniformity of results to admit of the adoption of a model plan of proceeding applicable to drugs in general; second, that the extract or soluble matter yielded to the menstruum is not uniform in its chemical and therapeutical value as obtained during the different stages of the percolation, but diminishes in effective value far more rapidly than the extract does in weight; and third, that this decrease in value depends upon the difference in solubility between the active and inactive portions of the extract, and that the ratio of this decrease is about the same for drugs in general, provided the proper menstruum be used. Critical experiments made with seven different drugs proved that the first 12 fluidounces of the percolate contained from 61 to 78 per cent. of the total extract obtainable from 16 tro ounces of a drug with 3 or 4 pints of percolate, as directed by the Pharmacopœia of 1860, and that the first 16 fluidounces contained from 71 to 84 per cent. of the total amount of extract. Subsequently (1869), Samuel Campbell showed that some drugs may be practically exhausted by careful management on obtaining 1 fluidounce for every troyounce of the drug used. This principle, however, is applicable to those drugs only which are rather heavy, and at the same time are readily permeated by a menstruum in which the active principles are easily and freely soluble, so that complete exhaustion is attained without difficulty. The U. S. P. 1870 directed in most cases 24 fluidounces of percolate for 16 troyounces of drug, and regarded the latter then as practically exhausted. The present Pharmacopœia directs displacement to be continued until the drug is exhausted—a point which may be reached by careful manipulation without requiring finally long-continued evaporation. But while for fluid extracts the *exhaustion* of the material is mostly left to the good judgment of the pharmacist, definite quantities of percolate are usually directed for the extracts—sufficient to exhaust the material completely. In the light of the experience cited above it would seem that this might likewise have been left to the judgment of the experienced operator.

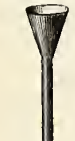
When the active principles possess a decided taste their gradual diminution in the percolate is easily ascertained; in other cases recourse may be had to chemical tests, especially in the presence of alkaloids. The color of the percolate alone is no reliable criterion for its medicinal strength, some drugs continuing to yield colored percolates after the active principles have been exhausted, while others still yield appreciable quantities of the latter after most of the coloring matter has been taken up. The strength of extracts and fluid extracts depends solely on the amount of the active principles, and not on the total amount of extractive matter, obtained.

For *moistening* the powder a definite quantity of menstruum is now directed which experience has shown to be most suitable; generally, this quantity is greater than was formerly thought desirable. The manner of *packing* described is the most convenient, the pressing of the whole amount of the powder in one operation giving better and more uniform results in the hands of most operators than if done in fractions. Ligneous material requires to be very firmly packed, and when of more loose cellular structure the packing should be less firm, but in all cases it should be uniform. Again, when an alcoholic menstruum is used the packing must be correspondingly firmer as the menstruum is stronger in alcohol. When well packed, a disk of paper or muslin is spread upon the surface and the requisite menstruum poured upon it. Thus arranged, the material is permitted to macerate for 2 days, both orifices of the percolator being securely closed to prevent evaporation. The time directed for maceration is ample, but may be prolonged to 3 or 4 days without disadvantage, or for easily-exhausted drugs even shortened. It is to be observed that the powder is to remain constantly covered by a stratum of the menstruum; this precaution is of imperative necessity until the powder has been deprived of the greater proportion of its active principles, and the liquid in the percolator may be more than sufficient to displace the solution of the remainder.

After the exhaustion of the powder has been accomplished the absorbed alcohol may be recovered by distillation with steam, or, when this is impracticable, it may be obtained by percolation with a weaker alcohol, the alcoholic strength being gradually reduced until finally water is used for pushing the last portions of the percolate through. The more mucilaginous the material is, the greater the caution which should be exercised in this decrease of the alcoholic strength. The alcohol thus obtained requires to be rectified, and may usually be deprived of its foreign odor by distillation with a small quantity of potassium permanganate.

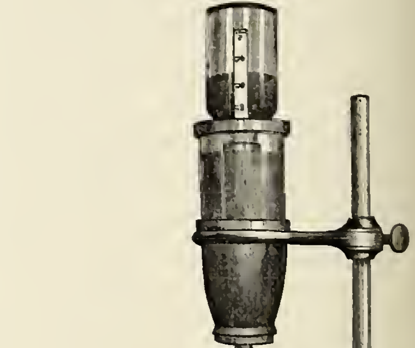
RE-PERCOLATION—or, as it has been called by Prof. Diehl, *fractional percolation*—is a process recommended by Dr. Squibb in 1866, and was more recently somewhat modified with the view of obtaining more uniform results, the object being preparation of fluid extracts without the use of heat. The process may be briefly described as follows: 32 parts of powder are divided into four equal portions, one of which is moistened, packed, macerated, and then slowly displaced until exhausted. The percolate is collected in fractions, the first 6 parts being reserved, and the next fraction used for moistening the second portion of 8 parts of the powder, which is afterward macerated and displaced with the remaining fractions, the weakest being used last. Of this portion 8 parts of percolate are reserved. The third and fourth portions of 8 parts each of the powder are percolated in the same manner as the second portion, and, finally, the 4 reserved percolates are mixed to obtain 30 parts of fluid extract. The weaker percolates from the fourth portion are preserved for a subsequent operation, when from each portion of 8 parts of powder 8 parts of percolate are reserved. (See paper on "Fluid Extracts by Re-percolation" by Dr. Squibb, and "Report on Fluid Extracts" by Prof. Diehl, in *Proc. Am. Phar. Assoc.*, 1878.)

FIG. 116.



Réal's Filter-press.

FIG. 117.



Glass Percolators, with supply- and receiving-bottles.

A series of percolators may be conveniently arranged on a retort-stand, and the rapidity of percolation regulated, as suggested by Dr. Squibb, by connecting the lower aperture of the percolator with a thin rubber tube, the end of which is raised high enough to prevent the liquid from escaping during maceration, and afterward lowered, so that the percolation may proceed in drops, the position of the rubber tube being changed to ensure uniformity and regularity; the last portions of the liquid are withdrawn from the percolator, either by removing the rubber tube or by straightening it by sufficiently elevating the percolator. A uniform supply of menstruum may be provided for in various ways, the most simple of which is to invert a bottle containing the requisite quantity of liquid over the orifice of the percolator. The mouth of the bottle should be immediately above the disk covering the powder, and, if necessary, may be lengthened by a piece of rubber tubing.

Sectional percolation is a modification of this process proposed by William M. Thomson (1883). The percolator is an elongated cone, which may be taken apart in sections, each section forming a percolator, ending below with a perforated diaphragm of the same diameter as that of the top portion of the next section; the powder to be exhausted is packed in the different sections, and the liquid, percolating through from above, as it leaves one section is again uniformly distributed over the powder contained in the next.

A process for the preparation of fluid extracts without the use of heat deserves a passing notice, since from the employment of a very powerful press it is perhaps better adapted for the manufacturer than for the pharmacist. It was devised by N. S. Thomas (1865), and consists in moistening the ground drug with a portion of the menstruum, and after sufficient maceration expressing the liquid. The operation of maceration and expressing is repeated several times until the proper quantity of fluid extract is obtained. A very efficient press, serviceable for this purpose and for other pharmaceutical preparations, has been constructed by Mr. Charles T. George (*Proc. Penna. Phar. Assoc.*, 1878).

Percolation under Pressure.—The first notice of percolation under pressure was given by Count Réal (*Jour. de phar.*, 1816, April), who constructed an apparatus known as *Réal's solution-press or filter-press*, and which consisted in a tin percolator surmounted by a tube which could be made 50 feet (15 M.) or more in length; after the fine, previously-moistened powder had absorbed all the menstruum provided for its exhaustion, the tube was filled with water, and the menstruum absorbed by the powder was thus forced out by hydrostatic pressure. The inconvenience of the long water-tube suggested its replacement by a column of mercury, which, communicating with a reservoir, forced the water through the powder. Semmelbauer (*Buchner's Repertorium*, 1817, iii.) already conceived the idea of using compressed air for the same purpose, and a suitable apparatus for this purpose was constructed by Dr. Romershausen, and is described in *Buchn. Repert.*, 1819, vi. p. 316. The process was subsequently applied by Boullay (*Jour. de phar.*, 1833, June) to displacement under the pressure of a low column of liquid, as in the percolators at present in use. The necessity of saturating the powder with the menstruum without rendering it adhesive, and of firmly compressing the moistened powder, was early recognized as essential conditions for success. The same principle of percolating under pressure applies to the apparatuses more recently constructed by Duffield, Stearns, and others, in which the air in the receiver may be rarefied and that contained in the percolator above the powder may be compressed. Rosenwasser's percolator (1881) is simply Réal's press, with this addition, that the powder, by a screw arrangement, may be confined in any desired space, without the possibility of expansion on coming in contact with the bulk of the liquid percolating through it.

Evaporation.—Spontaneous evaporation at ordinary temperatures of the atmosphere is easily accomplished with ethereal and similar volatile liquids, but alcoholic tinctures, in order to avoid a too-prolonged contact with air, require a somewhat elevated temperature, that directed by the Pharmacopœia being usually about 50° C. (122° F.). Where a higher temperature exerts no injurious influence upon the important constituents, a *water-bath* is most convenient for the purpose; and since the evaporating liquid will always remain several degrees below the boiling-point of water, even though the water in the bath may be actively boiling, empyreuma is effectually prevented. *Steam-baths* will likewise be useful, provided the arrangements are such that the pressure of steam cannot, or only slightly, exceed that of the atmosphere. *Sand-baths* and other contrivances by which the temperature is likely to rise above 100° C. (212° F.) should be used only with due precautions. Evaporation is most successful if conducted from a shallow dish, with a current of dry air passing over the surface of the liquid, which may at the same time be agitated; but the use of metallic spatulas for stirring during evaporation is generally inadmissible: the

Fig. 118.

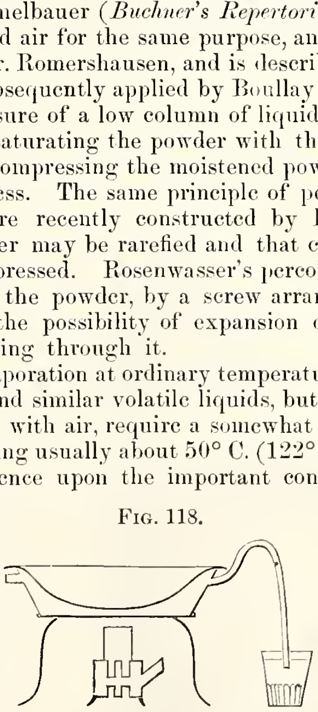
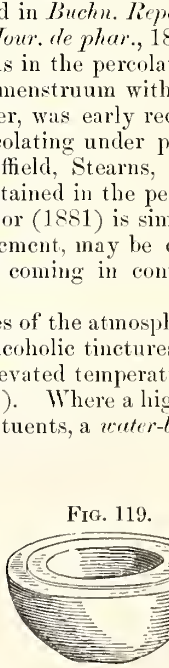


Fig. 119.

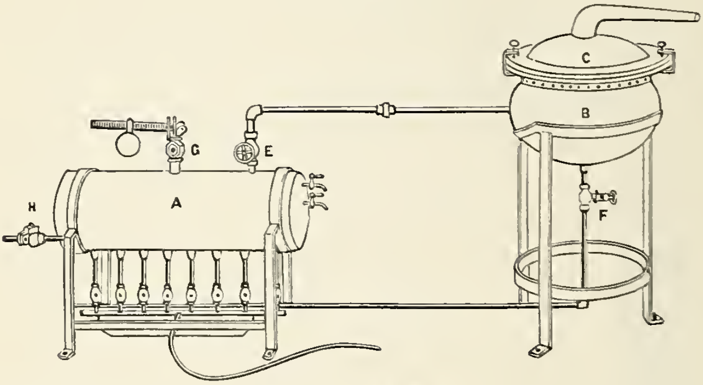


Water-baths.

proper material is porcelain or wood. Various mechanical contrivances have been constructed with the view of saving the manual labor and constant attendance in stirring, and they serve a good purpose.

In evaporating a tincture the alcohol is lost, but in many cases it is desirable to recover it, when *distillation* is resorted to. For pharmaceutical purposes a glass retort heated by a water-bath may be used. The apparatus, often called a "pharmaceutical still," serves a useful purpose; it is a rather shallow tin basin, which may be placed in a water-bath, and the head of which is provided on the inside with a gutter; the tincture to be concentrated is put into a porcelain evaporating-dish; this is placed in the still, and the moderate heat of a water-bath applied, when the alcohol will slowly evaporate, condense upon the inside of the cooled head, collect in the gutter below, and be discharged through the neck. Besides recovering the alcohol, this arrangement has also the advantage of keeping the liquid free from dust and other accidental impurities. For use on a small scale, Prof. Parrish has somewhat modified the steam evaporating-pan and still, and constructed an apparatus which is shown in Fig. 120. *A* is a boiler made of thick copper, which may be heated either by a furnace or by several Bunsen burners. Water is supplied through the valve *H*; *G* is a safety-valve; *E* is the valve for regulating the supply of steam, which is carried off through the exhaust-valve *F*. The evaporating-pan, made of well-tinned copper, is coupled together with the steam-jacket *B*, upon the flanges of which is fitted the head *C*, and secured by means of clamps, the joint being made steam-tight by placing a coil of lampwick or loose cord between the flanges. If used for distillation, *C* is connected with a condenser; if for evaporation only, *C* is removed. By proper regulation at *E* and *F* either a very moderate heat may be applied to the pan or the temperature may be raised above the boiling-point of water.

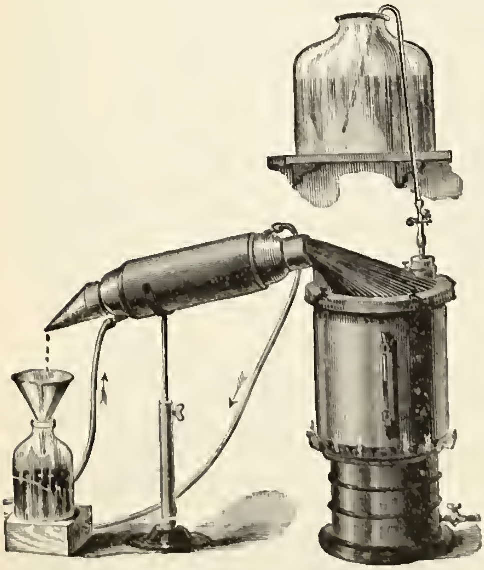
FIG. 120.



Steam-boiler, with Still.

A very serviceable pharmaceutical still has been constructed by Prof. Remington (1879). It is made of copper; the head, which is fastened in the same manner as the preceding, connects with a condenser formed of a combination of several Liebig's tubes, whereby the condensing surface is very materially increased. The still may be used in a water-bath or over direct fire, and if desired may be converted into a steam-bath by fastening a suitable dish as an evaporating-pan upon the body of the still containing some water.

FIG. 121.



Remington's Pharmaceutical Still.

In many processes carried on in the arts *vacuum-stills* are used for the evaporation of liquids, the boiling-point of which is lowered in proportion as the pressure within the apparatus is reduced to below that of the surrounding atmosphere. For operations on a small scale, and quite suitable for the requirements of the pharmacist, the *water-air-pump* described by Dr. Sprengel in 1865, and known also as Bunsen's water-air-pump, may be used with advantage. It is simply water descending in a perpendicular tube which laterally communicates with the interior of the otherwise hermetically-closed vessel containing the liquid to be evaporated; the descending column of water creates suction, the air in the apparatus being carried down with the water, and thus causes a partial vacuum, in which the liquid evaporates at a low temperature. The apparatus is well adapted for rapid filtration, washing of precipitates, evaporation, etc., but provision may also be made for condensing the vapors and recovering the menstruum.

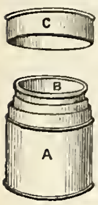
Changes by Evaporation.—All plants contain one or more principles, which, though originally colorless, are very easily altered under the influence of air and heat, acquiring a yellow or brown color. It is not known whether the so-called *colorless extractive* is alike in all plants, nor is its composition known or the nature of changes produced under the conditions mentioned, except that the heat of boiling water and the prolonged action of oxygen will convert it ultimately into a blackish insoluble substance, to which the name *apotheme* has been given, and which appears to be allied to *humin*. Extractive is almost insoluble in absolute alcohol and ether, but dissolves freely in weaker alcohol and water, and is removed from its solutions by animal charcoal and hydrate of aluminium, the more readily after it has become colored by oxidation. It is with difficulty freed from all admixtures, and the terms sweet, bitter, acrid, etc. extractives refer to the same body in a more or less altered condition, combined or intimately mixed with other principles to which the peculiar taste is due. The injurious influence of air and heat upon the vegetable juices is mainly confined to the alterations of this extractive, and extends in a limited degree only to the majority of the well-defined principles. Its effects have often been much overrated, except as regards the appearance of the extracts. The color of the different extracts and fluid extracts varies with the nature of the drug from which they have been made, but should never be black. Fluid extracts should preserve the taste and also the odor of the drug, except in so far as both may be modified by the menstruum. The characteristic taste, and to some extent also the odor, of the drug should be perceived in the extracts, and these should yield a nearly clear or moderately turbid solution of the menstruum used in their preparation. Not to come up to these requirements is indicative of carelessness, and the presence of empyreumatic products proves the operation to have been slovenly.

Consistence of Extracts.—The Pharmacopœia recognizes three degrees of consistence—namely, 1, like thick honey (Extr. malti); 2, pilular consistence; and 3, dry. These degrees are practically the same as those adopted by the German Pharmacopœia, but designated as—1, thin extracts, of the thickness of fresh honey (mostly oleoresins); 2, thick extracts, which when cold cannot be poured from a vessel; and 3, dry extracts, which may be rubbed to powder. A pilular consistence is practically unattainable for most extracts unless some dry substance is added, like the chlorophyll to the inspissated juices of the British Pharmacopœia. The nearest degree of consistence attainable with some extracts is such that they may be formed into pills, which, however, do not retain their globular shape. Others, like Extr. gentianæ, taraxaci, etc., are even too soft for that purpose, while some, like Extr. rhei, etc., gradually become quite tough or hard. The addition of 5 per cent. of glycerin to some extracts is intended to preserve the proper consistence. Extracts which do not contain any fixed oil or hygroscopic constituents may usually be reduced to powder when sufficiently evaporated and cooled. On being warmed all extracts become softer, and, if pulverulent at the ordinary temperature, acquire sufficient pliability to be rolled into pills.

The *abstracts* admitted in the present Pharmacopœia are powdered extracts, which, however, have no simple relation to the extracts proper. The *powdered* or *dry narcotic extracts*, P. G., are identical with those of the Prussian Pharmacopœia of 1862, and are prepared by mixing 4 parts of the extract with 3 parts of finely-powdered liquorice-root, drying the mixture between 40° and 50° C. (104° and 122° F.), rubbing the residue to powder while warm, and adding sufficient powdered liquorice-root to make 8 parts. These are made for convenience in dispensing only, but, while they are well adapted for being added to powders, they cannot be used in mixtures, owing to their partial insolubility. The use of dextrin in place of liquorice-root, prescribed by the P. G. 1872, has been abandoned, most of the powders thus prepared being too hygroscopic.

Preservation.—The consistence of *extracts* nearly neutralizes any injurious effect which contact with the atmosphere might otherwise exert, and the most ordinary care will therefore suffice to keep them unaltered for a considerable time. The sprinkling upon the softer extracts of a small quantity of alcohol has been recommended, but this is entirely unnecessary for those which are to some degree hygroscopic, and of little permanent utility for those which have a tendency to become tough. The difficulty may generally be avoided by spreading a few drops of glycerin over the surface, or, as has been proposed, by working into the warm extract half its weight of glycerin and dispensing 50 per cent. more than prescribed. This plan has been adopted in principle by the U. S. P., but the glycerin has been reduced to 5 per cent.

Fig. 122.



Jar in tin box.

The ordinary extracts are kept in jars of queensware, or, preferably, of porcelain or glass, with a cover of the same material. Small quantities may be kept in wide-mouthed vials with a very narrow shoulder, or in an ordinary tie-over jar enclosed in a tin-box just large enough to receive it and provided with a well-fitting cover to prevent absorption of moisture from the atmosphere or evaporation of the water contained in the extract. Extracts are rarely liable to mould unless they contain a considerable proportion of mucilaginous principles, and such are nearly always adapted to be brought to a dry condition. Dry extracts are in most cases preferably reduced to a granular or rather coarse powder. Extracts which have become too soft should be evaporated to the proper consistence by means of a water-bath, and those having become hard and unmanageable should be softened by the heat of a water-bath, when the requisite quantity of distilled water may be incorporated to bring them to the proper consistence.

For the preservation of *fluid extracts* the same precautions are required as for the preservation of most other liquid medicines. The bottles in which they are kept should be provided with a well-ground glass stopper or with a sound cork to prevent the slow evaporation of alcohol, which would occasion a change in the solvent power of the menstruum; and they should be placed in a position where they are exposed neither to the direct sunlight nor to any great or sudden changes in temperature. It should be remembered that perhaps all fluid extracts are saturated solutions of some of the principles naturally contained in the drug, and that their re-solution in the fluid extract from which they may have deposited in the cold can be effected only very gradually at the same temperature at which they previously existed in perfect solution.

Variation.—By Mohr's process (see above) for inspissated narcotic juices a number of inert principles are excluded from the extracts; the use of one menstruum in the preparation of extracts from dry drugs excludes many inert constituents. While it is known that drugs may vary in their medicinal activity within rather considerable limits, few or no analytical researches have been made as to the variation of the extracts prepared from such varying material by a uniform process. In the near future the progress of science will most likely require a standardizing of these preparations, as it has been already deemed necessary for the more important crude drugs.

Fluid extracts, if properly made, will fairly represent the drugs, and necessarily must vary to some extent in their efficacy; but the variation should be only within the limits of the variation which is unavoidable in the crude material.

EXTRACTUM ACONITI, *U. S., P. G.*—Extract of Aconite.

Extractum aconiti radicis.—*Extract of aconite-root*, E.; *Extrait de racine d'aconit*, Fr.; *Akonitknollen-Extrakt*, G.

Preparation.—Aconite, in No. 60 powder, 100 parts (20 oz. av.); Tartaric Acid 1 part (146 grains); Glycerin, Alcohol, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or $9\frac{3}{8}$ fluidounces) of alcohol in which the tartaric acid has previously been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts (60 oz. av. or about $3\frac{3}{4}$ pints) of tincture are obtained or the aconite is exhausted. Reserve the first 90 parts (18 oz. av. or about 18 fluidounces) of the percolate, evaporate the remainder in a porcelain capsule at a temperature not exceeding 50° C. (122° F.) to 10 parts (2 oz. av.), add the reserved portion, and evaporate at or below the above-mentioned temperature until an extract of a pilular consistence remains.

Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

Exhaust by maceration aconite-root with a mixture of alcohol sp. gr. .832 4 parts with water 3 parts. and evaporate to a thick extract.—*P. G.*

Alcohol appears to be the most appropriate menstruum, but the necessity for the use of tartaric acid is not apparent in the light of what is known about the alkaloids of aconite-root. The yield is about 16 per cent.; the color yellowish-brown. It should be remembered that this extract is from six to nine times stronger than that of aconite-leaves recognized by the U. S. P. 1870 under *the same name;* it is therefore advisable to designate in prescriptions the new pharmacopœial extract as *Extract. aconiti radicis.*

Extractum aconiti, *Br.*, is the inspissated juice of the fresh herb, and is appropriately prescribed as *Extract. aconiti herbæ.* The process, which will serve as an example of the one adopted by that authority for inspissated narcotic juices, is as follows:

Take of the fresh leaves and flowering tops of aconite 112 pounds. Bruise in a stone mortar and press out the juice; heat it gradually to 130° F., and separate the green coloring matter by a calico filter. Heat the strained liquor to 200° F. to coagulate the albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green coloring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F. until the extract is of a suitable consistence for forming pills.—*Br.* The color is brown-green, and the extract contains the chlorophyll and mucilaginous constituents.

Medical Uses.—This extract of aconite-root is represented to be about nine times as strong as the preparation of the leaves, which was officinal in the Pharmacopœia of 1870. Its *dose* may be stated as ⅙ to ⅓ grain (Gm. 0.01–0.02). The dose of the British extract is 1 to 2 grains (Gm. 0.06–0.12).

EXTRACTUM ACONITI FLUIDUM, *U. S.*—FLUID EXTRACT OF ACONITE.

Extractum aconiti radicis fluidum.—*Fluid extract of aconite-root*, E.; *Extrait liquide de racine d'aconit*, Fr.; *Flüssiges Akonitknollen-Extrakt*, G.

Preparation.—Aconite, in No. 60 powder, 100 Gm. (25 oz. av.); Tartaric Acid 1 Gm. (¼ oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (10 oz. av. or 11¾ fluidounces) of alcohol in which the tartaric acid has previously been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the aconite is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

In this preparation, as in the extract, the addition of tartaric acid is of no apparent utility. The fluid extract is practically of the same strength as the Linimentum aconiti, *U. S. P.* 1870 and *Br. P.* 1867.

Medical Uses.—Each minim of this preparation represents about 1 grain of aconite-root. Its commencing *dose* should not exceed 1 minim (Gm. 0.06), and it is more prudent to use only half that quantity. This extract is a convenient addition to liniments intended to relieve neuralgic and rheumatic pains.

EXTRACTUM ALOES AQUOSUM, *U. S.*—AQUEOUS EXTRACT OF ALOES.

Extractum aloes socotrinæ, Br.; *Extract of Socotrine aloes*, E.; *Extrait d'aloès sucotrin*, Fr.; *Socotora Aloe-Extrakt*, G.

Preparation.—Aloes 100 parts (8 oz. av.); Boiling Distilled Water 1000 parts (80 oz. av. or 5 pints). Mix the aloes with the water in a suitable vessel, stirring constantly, until the particles of aloes are thoroughly disintegrated, and let the mixture stand for 12 hours; then pour off the clear liquor, strain the residue, mix the liquids, and evaporate to dryness by means of a water- or steam-bath.—*U. S.*

The Br. P. process is identical with the foregoing, as is also that for *Extractum aloes barbadensis*, Br., prepared from Barbadoes aloes. The *Extractum aloes*, P. G., is made in the same manner from Cape aloes, using 5 parts of boiling water and decanting after two days. *Extractum aloes acido-sulphurico correctum* was obtained by diffusing 8 parts of the extract in 32 parts of distilled water, adding gradually 1 part of sulphuric acid and evaporating to dryness.

Socotrine aloes yields from 18 to 25 per cent. of aqueous extract, Cape aloes about twice that amount. The extracts are yellowish-brown powders and yield turbid solutions with water. According to Tilden (1870), an efficient extract of aloes is obtained by evaporating the mother-liquor from which aloin has been deposited, but this should never be substituted for the officinal product.

Off. Prep.—Decoct. aloes comp., Extract colocynth. comp., *Br.*

Medical Uses.—It may be given for the same purposes as the extract of Barbadoes or Socotrine aloes or as aloes itself, and in the same *dose*—from 1 to 6 grains (Gm. 0.06–0.40).

EXTRACTUM ANTHEMIDIS, *Br.*—Extract of Chamomile.

Extractum chamomillæ Romanæ.—Extrait de camomille romaine, Fr.; *Römisch-Kamillen-Extrakt*, G.

Preparation.—Take of Chamomile-Flowers 1 pound; Oil of Chamomile 15 minims; Distilled Water 1 gallon. Boil the chamomile with the water until the volume is reduced to one-half, then strain, press, and filter. Evaporate the liquor by a water-bath until the extract is of a suitable consistence for forming pills, adding the oil of chamomile at the end of the process.—*Br.*

It is a dark-brown extract having the odor and bitter taste of chamomile. It would seem not to be very difficult to work out a better process, in which the long boiling should be avoided.

Extractum anthemidis fluidum.—Fluid extract of chamomile, *E.*—This is sometimes called for. Prof. Procter (1857) suggested exhaustion with alcohol and diluted alcohol, and after evaporation preservation by sugar. Mr. Samuel Campbell (1870) suggested a menstruum composed of 2 measures of alcohol and 1 measure each of glycerin and water.

Medical Uses.—Like extract of gentian, it is a convenient excipient for tonic medicines given in the pilular form, especially quinia and the salts of iron. It is by itself a mild stomachic tonic. *Dose*, from 2 to 10 grains (Gm. 0.10–0.60).

EXTRACTUM ARNICÆ RADICIS, *U. S.*—Extract of Arnica-Root.

Extrait de racine d'arnique, Fr.; *Arnika-Extrakt*, *Wohlverleih-Extrakt*, G.

Preparation.—Arnica-Root, in No. 60 powder, 100 parts (20 oz. av.); Glycerin, Diluted Alcohol, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 8⅜ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts (60 oz. av. or about 3⅝ pints) of tincture are obtained or the arnica-root is exhausted. Reserve the first 90 parts (18 oz. av. or about 17½ fluidounces) of the percolate; evaporate the remainder to 10 parts (2 oz. av.) at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The yield is about 30 per cent. The extract is brown, of a slight odor, and has the bitter and acrid taste of the root. Formerly extract of arnica was prepared from the flowers. A mixture of 2 parts of alcohol and 1 of water yields a better extract, although arnica-root is completely exhausted by diluted alcohol.

Off. Prep.—Emplastrum arnicæ, *U. S.*

Medical Uses.—*Dose*, from 3 to 5 grains (Gm. 0.20–0.30).

EXTRACTUM ARNICÆ RADICIS FLUIDUM, *U. S.*—Fluid Extract of Arnica-Root.

Preparation.—Arnica-Root, in No. 60 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (8 oz. av. or 8⅜ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the arnica-root is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The fluid extract is of a reddish-brown color, and has the bitter and acrid taste of arnica-root.

Medical Uses.—*Dose,* 10 to 30 minims (Gm. 0.60–2).

EXTRACTUM AROMATICUM FLUIDUM, *U. S.*—Aromatic Fluid Extract.

Extrait liquide des aromates, Fr.; *Flüssiges Gewürzextrakt,* G.

Preparation.—Aromatic Powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the aromatic powder is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This newly-introduced preparation is of a rich red-brown color, and has the warm aromatic taste of the powder.

Medical Uses.—This tincture of several aromatics is convenient as a flavoring ingredient of mixtures, and may be used alone to relieve flatulent colic in the *dose* of half a teaspoonful or more (Gm. 2).

EXTRACTUM AURANTII AMARI FLUIDUM.—Fluid Extract of Bitter Orange-Peel.

Extrait liquide d'écorce d'orange amère, Fr.; *Flüssiges Pomeranzenschalen-Extrakt,* G.

Preparation.—Bitter Orange-Peel, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 1 part of water (or, by measure, 25 fluidounces of alcohol and 10¼ fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 9½ fluidounces) of the mixture, pack it moderately in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the orange-peel is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

In preparing this new officinal fluid extract it should be remembered that the orange-peel should consist almost exclusively of the glandular epidermal layer, known in commerce as Curaçoa orange-peel. Prepared of good material, the preparation will be of a yellowish-brown color and have the agreeable odor and pleasantly bitter taste of the peel.

Medical Uses.—A flavoring agent especially suitable for bitter mixtures, and also as a mild stimulant tonic in the *dose* of a fluidrachm (Gm. 4).

EXTRACTUM BELÆ LIQUIDUM, *Br.*—Liquid Extract of Bael.

Extrait liquide de bael, Fr.; *Flüssiges Belaextrakt,* G.

Preparation.—Take of Bael-Fruit 1 pound; Distilled Water 12 pints; Rectified Spirit 3 fluidounces. Macerate the bael for 12 hours in one-third of the water; pour off the clear liquor; repeat the maceration a second and third time for 1 hour in the remaining two-thirds of the water; press the marc and filter the mixed liquors through flannel. Evaporate to 14 fluidounces, and when cold add the rectified spirit.—*Br.*

This fluid extract represents 1 avoirdupois ounce of bael in each fluidounce, Imperial measure. The amount of spirit seems very small for such a concentrated liquid.

Medical Uses.—In the *dose* of 1 or 2 fluidrachms (Gm. 4–8) it may be given in chronic diarrhœa and dysentery.

EXTRACTUM BELLADONNÆ ALCOHOLICUM, *U. S.*—ALCOHOLIC EXTRACT OF BELLADONNA.

Extrait de belladone alcoholique, Fr.; *Spirituöses Tollkirschen-Extrakt*, G.

Preparation.—Belladonna-Leaves, in No. 60 powder, 100 parts (20 oz. av.); Alcohol 200 parts (40 oz. av. or 47 fluidounces); Water 100 parts (20 oz. av. or 19 fluidounces; Glycerin, Diluted Alcohol, each a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 40 parts (8 oz. av. or 8⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding first the remainder of the menstruum, and then diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the belladonna-leaves are exhausted. Reserve the first 90 parts (18 oz. av. or about 18 fluidounces) of the percolate, evaporate the remainder to 10 parts (2 oz. av.) at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The corresponding preparation of the U. S. P. 1870, and that of the French Codex, are made with alcohol of 61 and 60 per cent. by volume; the present Pharmacopœia directs the menstruum to be 60.5 per cent. by weight—an increase of strength for which there is no necessity; nor is the addition of glycerin necessary, the extract retaining its consistence if properly prepared and kept with ordinary care. The yield is about 22 per cent. The color is greenish-brown or brown-green, and the extract has the bitter taste of belladonna. EXTRACTUM BELLADONNÆ ALCOHOLICUM, *Br.*, is made from the *root.*

Off. Prep.—Unguentum belladonnæ, *U. S.*

EXTRACTUM BELLADONNÆ, *Br.*, *P. G.*, is the inspissated juice of fresh belladonna-herb, prepared in accordance with the formulas outlined on page 602. The extract of Br. P. is brown-green, of P. G. brown; the yield by the latter is 3 to 3½ per cent. On keeping, crystals are formed in the extract, which were found by Attfield (1862) to be potassium chloride and nitrate; according to Biltz, crystals of asparagin are sometimes observed.

Medical Uses.—The local applications of this, as of all other narcotic extracts, are numerous. Softened with water or mixed with oil, it enters into many magistral formulas for the relief of local pains, especially those of a *neuralgic* sort. A more elegant form for this purpose is belladonna plaster. The relaxing and anodyne operation of the extract is used to allay spasm of the muscles surrounding canals, as the *ureter*, *bladder*, *urethra*, *os uteri*, *vagina*, and *rectum*, when irritation excites their contraction. In these several cases the softened extract may be rubbed in as near as possible to the seat of pain, or it may be introduced in a suppository into the vagina or rectum. When applied to the prepuce in *phimosis* and in *paraphimosis* it sometimes reduces the engorgement and stricture. Rubbed on the forehead or eyelids, it was formerly much used to *dilate the pupil*, but the more cleanly solution of atropia is to be preferred. It may be given internally for all the purposes to which belladonna is appropriate. Extract of belladonna is of uncertain strength, and its *dose* is therefore variable. A quarter of a grain (Gm. 0.01) may be given three times a day, and the quantity gradually increased until the state of the pupil denotes the degree of its action.

The *dose* of the British preparation is stated to be ¼ to ½ gr. (Gm. 0.016–0.03), and of the German extract gr. i (Gm. 0.06).

EXTRACTUM BELLADONNÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF BELLADONNA.

Extractum belladonnæ radicis fluidum, U. S. 1870.—*Fluid extract of belladonna-root*, E.; *Extrait liquide de racine de belladone*, Fr.; *Flüssiges Tollkirschenwurzel-Extrakt*, G.

Preparation.—Belladonna-Root, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the belladonna-root is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Since a fluid extract of belladonna-leaves is occasionally employed, the above preparation should always be designated by the title of the U. S. P. 1870, given above. Care should be taken in the selection of belladonna-root, which should not be woody. This fluid extract has a reddish-brown color, and may be used for the preparation of belladonna plaster.

Off. Prep.—Linimentum belladonnæ, *U. S.*

Medical Uses.—The *dose* of this preparation is from 1 to 2 minims (Gm. 0.06–0.12). It is one of the most efficient representatives of belladonna.

EXTRACTUM BRAYERÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF BRAYERA.

Extractum koso fluidum.—Fluid extract of kooso, E.; *Extrait liquide des cousso*, Fr.; *Flüssiges Kosoextrakt*, G.

Preparation.—Brayera, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (10 oz. av. or 11¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the brayera is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Alcohol is a good solvent for the active principles of kooso. The fluid extract has a brownish-green color, possesses the unpleasantly bitter and acrid taste of the drug, and if properly made produces only a slight deposit.

Medical Uses.—This preparation is intended to supplant the infusion and decoction of brayera, but its efficacy has not yet been demonstrated. The *dose* may be stated at 2 or 3 teaspoonfuls (Gm. 8–12); but doses twice as large have been given.

EXTRACTUM BUCHU FLUIDUM, *U. S.*—FLUID EXTRACT OF BUCHU.

Extrait liquide de bucco, Fr.; *Flüssiges Buccoextrakt*, G.

Preparation.—Buchu, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 1 part of water (or, by measure, 25 fluidounces of alcohol and 10¼ fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 8 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the buchu is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The volatile oil and other medicinal principles are dissolved and kept in perfect solution by the menstruum directed, if proper care be taken to prevent the evaporation of alcohol. Alcohol of this strength was first suggested for the purpose by Prof. I. J. Grahame in 1859, and experience has shown that this fluid extract is much superior to that made with alcohol. The color is a deep olive-brown, and the odor and taste of buchu-leaves are well marked.

Medical Uses.—This fluid extract is inferior to the infusion of buchu for diseases of the urinary organs, but in default of that preparation may be prescribed in *doses* of 20 to 30 minims (Gm. 1.20–2.00), very largely diluted with water.

EXTRACTUM CALAMI FLUIDUM, *U. S.*—Fluid Extract of Calamus.

Extrait liquide d'acore vrai, Fr.; *Flüssiges Kalmusextrakt*, G.

Preparation.—Calamus, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the calamus is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Made from peeled calamus, this fluid extract is of a brownish-yellow color, but if prepared from the unpeeled rhizome, which is now to be used, it is of a considerably darker tint, the characteristic odor and taste being likewise more prominent. For preparing the powder the air-dry calamus should be dried over unslaked lime, but not by heat, which would expel much of the volatile oil. In view of the large intercellular passages contained in the tissue of calamus a powder passing through a No. 40 or No. 30 sieve would seem to be sufficiently fine for ready extraction.

(For Extractum calami, *P. G.*, see page 349.)

Medical Uses.—It may be used in all the cases for which calamus is appropriate. It is a convenient form of that drug. *Dose*, 10 to 20 minims (Gm. 0.60–1.30).

EXTRACTUM CALUMBÆ, *Br.*—Extract of Calumba.

Extractum columbo.—Extrait de colombo, Fr.; *Kolombo-Extrakt*, G.

Preparation.—Take of Calumba-Root, cut small, 1 pound; Proof Spirit 4 pints. Macerate the calumba with 2 pints of proof spirit for 12 hours, strain and press. Macerate again with the remainder of proof spirit; strain and press as before. Mix and filter the liquors, and evaporate them by the heat of a water-bath until the extract is of a suitable consistence for forming pills.—*Br.*

The present formula is an improvement compared with that of the Br. P. 1867, which directed water for exhausting the root, and yielded a very mucilaginous extract liable to become mouldy. The French Codex uses alcohol of 60 per cent. volume for preparing this extract, the yield being 14 to 16 per cent.

Medical Uses.—This preparation, which in its action differs but little from the extracts of quassia and gentian, may be prescribed in the *dose* of from 2 to 10 grains (Gm. 0.10–0.60).

EXTRACTUM CALUMBÆ FLUIDUM, *U. S.*—Fluid Extract of Calumba.

Extrait liquide de colombo, Fr.; *Flüssiges Kolomboextrakt*, G.

Preparation.—Calumba, in No. 20 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 7¾ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the calumba is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The present Pharmacopœia directs a stronger alcoholic menstruum for the tincture than for the fluid extract; the employment of a menstruum composed of 2, or even 3, parts of alcohol and 1 part of water would ensure a more permanent fluid extract. It is of a rich orange-brown color and possesses a strongly bitter taste.

Medical Uses.—It is a convenient substitute for the infusion, and may be prescribed in *doses* of a fluidrachm in 2 fluidounces (Gm. 4 in Gm. 64) of water.

EXTRACTUM CANNABIS INDICÆ, *U. S., Br., P. G.*—EXTRACT OF INDIAN CANNABIS.

Extrait de chanvre indien, Fr.; *Indisch Hanfextrakt*, G.

Preparation.—Indian Cannabis, in No. 20 powder, 100 parts (20 oz. av.); Alcohol a sufficient quantity. Moisten the powder with 30 parts (6 oz. av. or 7 fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding alcohol until 300 parts (60 oz. av. or about 4 pints) of tincture are obtained or the cannabis is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—*U. S.*

The processes of the Br. P. and P. G. are practically identical with the foregoing, except that the drug is exhausted by maceration. The yield is from 12 to 14 per cent. The extract is of a blackish-green color, and has a slight but heavy narcotic odor and a bitter taste. It should be completely insoluble in water, and dissolve in alcohol, ether, chloroform, and oil of turpentine; its alcoholic solution should be precipitated by aqueous solution of potassa or soda, the resin being insoluble in alkalies. Nitric acid converts the extract into an orange-red resin, which after washing with water has the color of gamboge (Procter, 1864).

Medical Action and Uses.—This extract varies so greatly in activity that its dose cannot be definitely fixed. Half a grain (Gm. 0.03) of a specimen not before tested should be given at first, and the *dose* gradually increased until its sensible effects are produced.

EXTRACTUM CANNABIS INDICÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF INDIAN CANNABIS.

Extrait liquide de chanvre indien, Fr.; *Flüssiges Indisch Hanfextrakt*, G.

Preparation.—Indian Cannabis, in No. 20 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the Indian cannabis is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

There is scarcely any necessity for this preparation, since the extract of Indian cannabis is readily soluble in alcohol. The fluid extract is of a dark-green color. If properly prepared it may be used for the extemporaneous preparation of the extract, and this extract should have the characteristics mentioned under the preceding article.

Medical Uses.—As each minim represents a grain of Indian cannabis, the fluid extract may be given in commencing *doses* of from ½ to 1 minim (Gm. 0.12–0.30).

EXTRACTUM CAPSICI FLUIDUM, *U. S.*—FLUID EXTRACT OF CAPSICUM.

Fluid extract of red pepper, E.; *Extrait liquide de capsique, de piment des jardins*, Fr.; *Flüssiges Spanisch-Pfefferextrakt*, G.

Preparation.—Capsicum, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 50 Gm. (12½ oz. av. or 14⅝ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator;

then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the capsicum is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

There is likewise little need for this preparation, the drug being already represented by the oleoresin and the tincture. The fluid extract is of a rich brown-red color, yields a turbid mixture with water, and has the hot taste of the drug.

Medical Uses.—*Dose*, 1 to 2 minims (Gm. 0.6–0.12).

EXTRACTUM CARNIS.—Extract of Meat.

Extractum carnis Liebig.—Extract of beef, E.; *Extrait de viande de Liebig*, Fr.; *Liebig's Fleischextrakt*, G.

Preparation.—Extracts of meat have been prepared for many years. Thouvenel exhausted fresh meat with alcohol, and Van Mons used the same menstruum for dry meat. Cadet de Gassicourt recommended the meat to be minced, mixed with cold water, the liquid expressed, boiled, skimmed, and evaporated. In 1854, Liebig published a formula for preparing a *broth for invalids* as follows: ½ pound of fresh meat is finely chopped and macerated for 1 hour with 1 pound of cold distilled water, to which 4 drops of hydrochloric acid and from 30 to 60 grains of table-salt are added. The mass is then displaced on a colander, a little water being added, until 1 pound of percolate has been obtained. The clear liquid has a red color and contains the albuminoids of the meat in solution. In 1859 the Bavarian Pharmaeopœia adopted a process for extract of meat in which chopped meat was exhausted with hot water, and the expressed liquid, carefully freed from fat and albumen, was evaporated.

Since then factories have been established in different parts of South America, Australia, and the United States, where cattle are abundant and cheap. In the majority of these establishments Liebig's process appears to be followed, perhaps with some slight modification. At Fray-Bentos, on the river Uruguay, where a factory was conducted under the direction of Liebig, the extract, according to F. Müller (1868), is prepared as follows: The freshly-slaughtered meat is allowed to cool for 24 hours, and then ground into a pulpy mass by passing it between iron rollers furnished with small projections. The pulp is stirred with water for about an hour, strained through sieves, the fat carefully removed, and the liquid evaporated in steam-pans, a current of air being continuously passed over the surface. At a certain state of concentration the liquid is filtered, and the evaporation continued until the extract is transferred to well-glazed stoneware jars, which are carefullly covered.

Properties.—Thus prepared, extract of meat is of a brown color, usually somewhat granular, and has a pleasant odor suggestive of roasted meat, and a characteristic, distinctly saline, and faintly acidulous taste. It is completely soluble in water, yielding a clear solution, which on the addition of a little table-salt has the flavor of beef-broth. When dried at the temperature of 110° C. (230° F.) 100 parts of the extract should lose not over 22 parts of moisture, and after incineration not less than 18 parts of ashes should be left, containing only a small quantity of sodium chloride. If 100 parts of the extract are digested with alcohol, and the liquid filtered and evaporated, not less than 56 parts of extract should be obtained (*P. G.* 1872). The figures given by Liebig himself as indicating the limits of variation in extract of meat prepared by his process are for *moisture* 16 to 22 per cent.; *ash* 18 to 22 per cent.; *extractive*, soluble in 80 per cent. alcohol, 56 to 66 per cent. Niederstadt (1881) gives the actual variation of the commercial Fray-Bentos extract as follows: moisture 13.2–29.2; nitrogen 2.6–9.04; organic matter 49.5–68.7; ash 10.5–21.4 per cent.; the ash contains potassa 30.1–32.5 and phosphoric acid 36.5–38.0 per cent. The absence of chloride of sodium in meat-juice is proven by precipitating first the salts of inosic acid by an equal bulk of alcohol, and then adding 5 volumes of alcohol, when the mixture will separate into two layers, the lower of which, about one-twentieth of the whole, on evaporation at a low temperature will yield prisms of the chloride of potassium containing not a trace of sodium salt.

The amount of nitrogen in extract of meat is sometimes as low as 2.6 per cent., but if made of good beef usually between 9 and 10 per cent., and depends chiefly on the presence of *creatin*, *creatinin*, *globulin*, and *urea*. The solution in water of the extract usually yields a slight precipitate with tannin, which, according to Eichhorn (1867), is due to the presence of a nitrogenated body which somewhat resembles gelatin, but is not identical with it. Werner (1868), however, states that, if in preparing the extract the temperature of 60° C. (140° F.) be not exceeded, the aqueous solution will give no reaction for gelatin. It would seem, therefore, best to evaporate the liquid under reduced pressure. It is well known, however, that some extracts of meat which have appeared in our market have contained large quantities of gelatin. (See paper by A. E. Ebert in *Proc. Amer. Phar. Assoc.*, 1871, p. 512.)

Other extracts of meat, liquid as well as solid, have from time to time claimed attention, some of the former containing the soluble albuminous compounds or the ground flesh-fibres. In 1873, Prof Leube recommended an extract in which the meat-fibrin was emulsionized by heating meat, free from fat and bones and chopped fine, in very diluted hydrochloric acid until almost completely disintegrated. At the present time peptones are used in preference to this preparation. (See PEPSINUM.)

Physiological Action and Medical Uses.—It appears to be too often overlooked that Liebig, to whom is due the vogue of beef-tea during the last quarter of a century, expressly declared it to be incapable of promoting nutrition, and that it is to be classed as nervous food, along with tea, coffee, and alcohol, and even as inferior to the last—a judgment which has been expressed in almost identical words by Virchow and emphasized by Sibson, Brunton, and many others. The small proportion of creatin it may contain does not materially alter this estimate. Its 2½ per cent. of albumen, according to some modes of preparation, is altogether eliminated in Liebig's extract, and the gelatin almost completely, leaving the organic alkaloids and acids and the salts. That these act as temporary nervous stimulants there can be no doubt; but the popular impression is that beef-tea is a substitute for food, and hence it often happens that the patient is plied with it inordinately, with the result of provoking vomiting or diarrhœa. That it often occasions the latter when habitually used as a substitute for food, to repair fatigue, or to fortify the body or mind for an unusual exertion, is probably within the experience of many physicians. Sibson, alluding to its use in diarrhœa, and especially in that of typhoid fever, declares that he looks "upon this fluid in the light of a poison in such cases," and strongly condemns its use in Bright's disease as burdening the already overtaxed kidneys with the duty of eliminating this non-assimilable matter. It is, however, rather indirectly than directly injurious by being used as a nutrient—a function which it has no claim to perform. On the other hand, it has not that poisonous operation which science, "falsely so called," attributed to it through Kemmerich in 1868. He arrived at the singular conclusion that concentrated cold extract of horse-flesh injected into the stomach of dogs in small doses increases the number and strength of the heart's pulsations, but that in large doses it kills, with all the appearances of cardiac paralysis. This remarkable result he attributes to the potash salts of the meat! In 1880, Mr. Masterman (*Lancet*, Oct. 1880, p. 562) showed that beef-tea is analogous to urine, except that it contains less urea and uric acid, and that it is merely a stimulant; and Dr. Neale (*Practitioner*, xxvii. 343) calls attention to the fact that in several countries, including South America and Eastern Asia, the urine of young persons is used as a medicinal stimulant.

The stimulant and non-nutritious qualities of beef-tea render it peculiarly fitted for the treatment of the greater number of acute *febrile diseases.* Nature protests against the use of food in them by the repugnance of the patients to taking it and by the aggravation of the fever which it induces. During the augment and acme of these affections food in a literal sense heaps fuel on the fire, but in many of them the animal mechanism must be kept in such active movement as to enable it to resist the disintegrating tendencies of the disease, and afterward to throw off the effete accumulations. This beef-tea aids in accomplishing, and in the same manner as alcohol. When that end is attained, and when the fever has declined, the preparation holds only a secondary place in the treatment, the first being occupied by true nutrients, which are better prepared by culinary skill than by chemical science. No more serious mistake can be made in the treatment of acute diseases, when the febrile stage has passed by, than to continue to administer beef-tea, soups, and jellies. By such agents the patient may literally die of inanition while being gorged with what erroneously passes for food. Feeding by the rectum with beef-tea is, if possible, of even more temporary utility than when this preparation is given by the stomach. *Pancreatic emulsion* is more efficient. It is highly recommended in various affections of the stomach when the mucous coating requires to be protected from irritation, in convalescence from typhus, etc., and may be combined with broth or with Liebig's extract of meat, or milk and powdered cracker (hard biscuit) may be used alternately with it. It has been employed with marked advantage in cases of fatty *diarrhœa* due to obstruction of the pancreatic secretion and in the *wasting diseases* of children induced by artificial feeding. It also promotes the digestion and assimilation of *cod-liver oil.*

EXTRACTUM CASCARÆ SAGRADÆ and EXTRACTUM CASCARÆ SAGRADÆ LIQUIDUM, *Br.* (See pp. 1654, 1655.)

EXTRACTUM CASTANEÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CASTANEA.

Fluid extract of chestnut-leaves. E.; *Extrait liquide de feuilles de châtaignier*, Fr.; *Flüssiges Kastanienblätter-Extrakt*, G.

Preparation.—Castanea, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Pour 500 Ccm. (125 oz. av. or 7½ pints) of boiling water upon the powder, allow it to macerate for 2 hours, then express the liquid, transfer the residue to a percolator, and pour water upon it until the powder is exhausted. Evaporate the united liquids on a water-bath to 200 Ccm. (3 pints), let cool, and add 60 Ccm. (14½ fluidounces) of alcohol. When the insoluble matter has subsided separate the clear liquid, filter the remainder, evaporate the united liquids to 80 Ccm. (19¼ fluidounces), and add to it when cold enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

It is well known that hot water extracts the virtues of chestnut-leaves. The toughness of the fibro-vascular tissue (veins) of the latter render their reduction to a powder of the required fineness a matter of difficulty. This is practically recognized by the Pharmacopœia in ordering the partial extraction of the leaves by hot maceration and expression; a repetition of this manipulation with one-half the amount of hot water would have virtually exhausted the drug, provided a sufficiently powerful press be used. By clarification with $\frac{3}{10}$ volume of alcohol albuminous and some mucilaginous matters are removed. The finished fluid extract is preserved by alcohol equal to nearly one-fourth its measure; formerly, it was customary to use sugar for this purpose. The fluid extract is reddish-brown, and of a slight odor and of a strongly but pleasantly astringent taste. Mr. A. Robbins states that there is no special difficulty in exhausting chestnut-leaves by percolation if a weak alcoholic menstruum be used, the most suitable being composed of alcohol 1 part and water 2 parts, and the first 80 parts of this mixture being used with 20 parts of glycerin.

Medical Uses.—*Dose*, 1 to 2 fluidrachms (Gm. 4–8).

EXTRACTUM CHIMAPHILÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CHIMAPHILA.

Extrait liquide de pyrole ombellée, Fr.; *Flüssiges Doldenmangold-Extrakt*, G.

Preparation.—Chimaphila, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (25 fluidounces). Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol. Moisten the powder with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the chimaphila is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The fluid extract has the sensible properties of the leaves in a high degree, but on keeping a considerable precipitate is formed, which is to some extent obviated by a slight increase of the alcoholic strength. In this and most other processes in which glycerin is used, this is directed to be mixed with diluted alcohol (or alcohol) sufficient to make more than 100 Ccm. (24 fluidounces); a considerable proportion of the glycerin enters the weak percolate, and renders its evaporation to a soft extract difficult.

Medical Uses.—This preparation is less eligible than the decoction. *Dose*, a fluidrachm (Gm. 4), largely diluted, three or four times a day.

EXTRACTUM CHIRATÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CHIRATA.

Extrait liquide de chirette, Fr.; *Flüssiges Chirettaextrakt*, G.

Preparation.—Chirata, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol. Moisten the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the chirata is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The fluid extract is reddish-brown, and has the intensely bitter taste of the drug. The bitter principles of chirata being soluble in water, a largely aqueous menstruum is indicated for this drug. Although precipitation takes place after some time, the active principles are probably not affected thereby.

Medical Uses.—*Dose*, about 20 minims (Gm. 1.30).

EXTRACTUM CIMCIFUGÆ FLUIDUM, *U. S., Br.*—FLUID EXTRACT OF CIMICIFUGA.

Extrait liquide d'actée à grappes, Fr.; *Flüssiges Cimicifuga-Extrakt*, G.

Preparation.—Cimicifuga, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 25 Gm. (6¼ oz. av. or 7⅜ fluidounces) of alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cimicifuga is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This has all the sensible properties of the drug from which it was made, and is a permanent preparation. Owing to difference in manipulation, the corresponding fluid extract U. S. P. 1870 was slightly weaker in alcohol, but remained unaltered on keeping. That of the Br. P. is nearly identical with the foregoing, the menstruum being alcohol sp. gr. .838.

Medical Uses.—This preparation is greatly preferable to the decoction, which was formerly used. *Dose*, from 30 minims to a fluidrachm (Gm. 2–4).

EXTRACTUM CINCHONÆ, *U. S.*—EXTRACT OF CINCHONA.

Extractum chinæ spirituosum, P. G.—*Extract of calisaya-bark*, E.; *Extrait de quinquina jaune*, Fr.; *Weingeistiges China-Extrakt*, G.

Preparation.—Yellow Cinchona, in No. 60 powder, 100 parts (20 oz. av.); Alcohol 300 parts (60 oz. av. or 70¼ fluidounces); Water 100 parts (20 oz. av. or 19¼ fluidounces); Glycerin, Diluted Alcohol, each a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 35 parts (7 oz. av. or 7¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 400 parts (5 pounds av. or about 5 pints) of tincture are obtained or the cinchona is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The present process is a great improvement over that of 1870, when alcohol, followed by water, was the menstruum. The yield varies between about 12 and 16 per cent. The extract is of a reddish-brown color, is only partly soluble in water, and has the persistently bitter taste of cinchona. Its tendency to become dry on keeping is sought to be prevented by glycerin. The German Pharmacopœia directs its spirituous extract of cinchona to be made with alcohol spec. grav. .894. and to be evaporated to dryness; it recognizes also an *Extractum chinæ aquosum*, s. *Extractum chinæ frigide paratum*, which is obtained by evaporating the cold aqueous infusion of cinchona-bark. The cinchona extracts of the French Codex are prepared with boiling water.

Medical Uses.—Extract of cinchona, since it possesses all the virtues of Peruvian bark, would for many purposes be preferable to quinine were it less bulky. The *dose* is from 10 to 30 grains (Gm. 0.60–2.00).

EXTRACTUM CINCHONÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CINCHONA.

Extractum cinchonæ rubræ liquidum, Br.; *Extractum chinæ calisayæ fluidum.—Liquid extract of yellow cinchona- or calisaya-bark*, E.; *Extrait liquide de quinquina jaune*, Fr.; *Flüssiges Chinaextrakt*, *Kalisayarinden-Extrakt*, G.

Preparations.—Yellow Cinchona, in No. 60 powder, 100 Gm. (25 oz. av.); Glycerin 25 Gm. (6¼ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 75 Gm. (18¾ oz. av. or 22 fluidounces) of alcohol. Moisten the powder with 35 Gm. (8¾ oz. av. or 9½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, and when the liquid in the percolator has disappeared from the surface gradually pour on a mixture of alcohol and water, made in the proportion of 3 parts of alcohol to 1 part of water (or, by measure, of 15 fluidounces of alcohol and 4 fluidounces of water), and continue the percolation until the cinchona is exhausted. Reserve the first 75 Ccm. (18 fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 Ccm. (24 fluidounces). —*U. S.*

Macerate for two days red cinchona in No. 60 powder 20 oz., with water 100 oz., glycerin 2½ fluidounces, and hydrochloric acid 5 fluidrachms; percolate, exhaust with water, evaporate below 82.2° C. (180° F.) to 20 fluidounces. Agitate 50 fluidgrains of this liquid with benzolated amyl alcohol 1 fluidounce (benzol 3 vol., amyl alcohol 1 vol.), and soda solution ½ fluidounce; separate the alkaline watery liquid, wash the remainder with water, then evaporate to dryness and weigh. By evaporation, or if necessary by dilution with water, adjust the concentrated percolate to 85 fluidgrains for every 5 grains of total alkaloids; add 12.5 fluidgrains of alcohol and enough distilled water to make 100 fluidgrains.—*Br.*

The first formula is decidedly the better, and, though the addition of a small quantity of water to the mixture of alcohol and glycerin would yield an equally good preparation, the fluid extract remains practically unaltered. It is of a rich red-brown color, and if made of good bark contains all the alkaloids in their natural combination. Water alone will but partially exhaust cinchona-bark, and during the long-continued evaporation a portion of the alkaloids will become insoluble through the alteration of the tannin. On the other hand, a stronger alcohol will dissolve more cinchonic red, but secure the more thorough exhaustion of the alkaloids. The product of the second formula contains 5 grains of the alkaloids of red cinchona in every 100 fluidgrains.

Medical Uses.—An advantage of this preparation is, that it contains in solution all the active principles of cinchona, and not merely one or the other of the alkaloids. As a tonic it may be given in the *dose* of ½ fluidrachm (Gm. 2). For securing the antiperiodic effects of cinchona it is eligible only in mild cases of periodical fever; in severer cases efficient doses of it would be too bulky.

EXTRACTUM COLCHICI RADICIS, *U. S.*—EXTRACT OF COLCHICUM-ROOT.

Extractum colchici aceticum, U. S. 1870, Br.—*Acetic extract of colchicum*, E.; *Extrait de colchique acétique*, Fr.; *Zeitlosen-Essigextrakt*, G.

Preparation.—Colchicum-Root, in No. 60 powder, 100 parts (20 oz. av.); Acetic

Acid 35 parts (7 oz. av.); Water a sufficient quantity. Mix the acetic acid with 150 parts (30 oz. av. or 28 fluidounces) of water, and, having moistened the powder with 50 parts (10 oz. av. or 9¼ fluidounces) of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then water, until the colchicum-root is exhausted. Evaporate the percolate in a porcelain vessel by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence. —*U. S.*

The corresponding preparation of the Br. P. is made like the extract, the formula of which is given below, the only difference consisting in the addition of 6 fluidounces of acetic acid to the bruised colchium-tubers before the juice is expressed. The extract is of a brown color and bitter taste, and yields with water a rather turbid solution. The U. S. P. errs in directing it to be of pilular consistence, while the Br. P. is correct in stating it to be a soft extract; it is certainly softer than the next:

EXTRACTUM COLCHICI, *Br.*—Extract of colchicum, *E.;* Extrait de bulbe de colchique, *Fr.;* Zeitlosen-Extrakt, *G.*—Take of fresh colchicum-corms, deprived of their coats, 7 pounds. Crush the corms, press out the juice, allow the feculence to subside, and heat the clear liquor to 212° F.; then strain through flannel, and evaporate by a water-bath, at a temperature not exceeding 160° F., until the extract is of a suitable consistence for forming pills.—*Br.*

The extract of colchicum of the French Codex is prepared from the seeds with alcohol of 60 per cent.

Medical Uses.—These two extracts are convenient forms of colchicum for prescription in pills, and especially in those purgative pills which gouty patients commonly require. The *dose* of either is from ½ grain to 2 grains (Gm. 0.03–0.12), according to the British Pharmacopœia, but some German authorities state the dose at from ⅙ to ½ grain (Gm. 0.01–0.03).

EXTRACTUM COLCHICI RADICIS FLUIDUM, *U. S.*—FLUID EXTRACT OF COLCHICUM-ROOT.

Extrait liquide de bulbe de colchique, Fr.; *Flüssiges Zeitlosenknollen-Extrakt*, G.

Preparation.—Colchicum-Root, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 1 part of water (or 50 fluidounces of alcohol with 20½ fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 9½ fluidounces) of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum-root is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract is of a deep brown-red color, keeps well, and fully represents the drug from which it is prepared. Made with diluted or a somewhat stronger alcohol, it likewise preserves its properties for a long time.

Medical Uses.—This preparation contains all the virtues of colchicum. *Dose*, from 2 to 8 minims (Gm. 0.10–0.50).

EXTRACTUM COLCHICI SEMINIS FLUIDUM, *U. S.*—FLUID EXTRACT OF COLCHICUM-SEED.

Extrait liquide de semence de colchique, Fr.; *Flüssiges Zeitlosensamen-Extrakt*, G.

Preparation.—Colchicum-Seed, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 1 part of water (or 50 fluidounces of alcohol with 20½ fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 8 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum-seed is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces). —*U. S.*

The present menstruum is weaker in alcohol than heretofore; hence a much smaller amount of fixed oil is taken up by it and separates from the fluid extract on standing; the use of diluted alcohol would entirely obviate this, and such a change would be of no disadvantage, since the active principle is readily soluble in water and its preservation ensured by the glycerin and alcohol. As stated on page 483, the unbroken seeds may be completely deprived of their colchicine by a warm menstruum; and such a change seems desirable in view of the difficulty experienced in reducing the seeds to powder.

Medical Uses.—Like the preceding, this extract is a full representative of colchicum. *Dose*, from 2 to 8 minims (Gm. 0.10–0.50).

EXTRACTUM COLOCYNTHIDIS, *U. S., P. G.*—EXTRACT OF COLOCYNTH.

Extractum colocynthidis alcoholicum.—Extrait de coloquinte, Fr.; *Koloquinten-Extrakt*, G.

Preparation.—Colocynth, dried and freed from the seeds, 100 parts (20 oz. av.); Diluted Alcohol a sufficient quantity. Reduce the colocynth to a coarse powder by grinding or bruising, and macerate it in 250 parts (50 oz. av. or 52 fluidounces) of diluted alcohol for 4 days, with occasional stirring; then express strongly and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour diluted alcohol upon it until the tincture and expressed liquid, mixed together, weigh 500 parts (100 oz. av. or 6¼ pints). Having recovered from the mixture 300 parts (60 oz. av. or about 4 pints) of alcohol by distillation, evaporate the residue to dryness by means of a water-bath. Lastly, reduce the dry mass to powder. Extract of colocynth should be kept in well-stopped bottles.—*U. S.*

This is the process of 1870, with slight modifications of manipulation, which are questionable improvements. For 48 troyounces of colocynth, equal to about 16 troyounces of pulp, 8 pints of diluted alcohol were considered to be not too large a quantity for the first maceration; and Klie (1878) found 4 pints to be requisite for the complete immersion of 15 troyounces of pulp, the powder being pressed down. The present formula orders only 3¼ pints of diluted alcohol for more than 18 troyounces of the pulp, which is entirely insufficient. Maceration and expression being considered necessary in the beginning, it would seem that the extract remaining in the press-cake could be more expeditiously obtained, and with a smaller amount of menstruum, by repeating the operation once or twice. This is the process of the German Pharmacopœia, which directs for 2 parts of colocynth, with the seeds, for the first maceration, 15 parts of alcohol spec. grav. .894, and for the second maceration 5 parts each of the same alcohol and of water. With some care colocynth may be treated at once by percolation, but owing to the spongy character of its tissues it is advisable to express the absorbed liquid with a good press as soon as the greater portion of the active matter is exhausted. When the extract is made on a large scale the removal of the seeds is a tedious operation, if not impossible. For this reason the colocynth is ground, care being taken not to crush the seeds, which would load the extract with much oily matter. Dr. Squibb (1867) obtained from very dry colocynth 20.6 per cent. of extract; the general yield from the commercial article is about 14 to 14.5 per cent. After completely removing the seeds, Procter (1867) had left, from 49 troyounces of colocynth, only 12 troyounces of pulp, which yielded 3¼ troyounces of extract, equal to 6.8 per cent., while G. H. C. Klie (1878) obtained 16 troyounces of pulp, and not over 6 troyounces, or 12.5 per cent., of extract. The pulp alone yields usually from 30 to 40 per cent., the seeds about 5 per cent., of extract, the latter being far less bitter than the former.

Off. Prep.—Extr. colocynthidis comp., *U. S.*

Medical Uses.—It is seldom used alone, but is an ingredient of the compound extract of colocynth. In Germany this extract is prescribed as a mild laxative in the *dose* of from ½ grain to 1 grain (Gm. 0.03 to 0.06), and as a drastic purgative in the *dose* of from 1½ to 2 grains (Gm. 0.1 to 0.3).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM, *U. S., Br.*—COMPOUND EXTRACT OF COLOCYNTH.

Extrait de coloquinte composé, Fr.; *Zusammengesetztes Koloquinten-Extrakt*, G.

Preparation.—Extract of Colocynth 16 parts (8 oz. av.); Aloes 50 parts (25 oz. av.); Cardamom, in No. 60 powder, 6 parts (3 oz. av.); Resin of Scammony, in fine powder, 14 parts (7 oz. av.); Soap, dried and in coarse powder, 14 parts (7 oz. av.); Alcohol 10 parts (5 oz. av. or $5\frac{7}{8}$ fluidounces). Heat the aloes on a water-bath until it is completely melted; then add the alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve which has just been dipped into boiling water. To the strained mixture, contained in a suitable vessel, add the soap, extract of colocynth, and resin of scammony, and heat the mixture, at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous and a thread taken from the mass appears brittle when cool. Then withdraw the heat, thoroughly incorporate the cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder. Compound extract of colocynth should be kept in well-stopped bottles.—*U. S.*

Take of colocynth-pulp 6 ounces; extract of Socotrine aloes 12 ounces; resin of scammony 4 ounces; curd soap, in powder, 3 ounces; cardamom-seeds, in fine powder, 1 ounce; proof spirit 1 gallon. Macerate the colocynth in the spirit for 4 days; press out the tincture and distil off the spirit; then add the aloes, scammony, and soap, and evaporate by a water-bath until the extract is of a suitable consistence for forming pills, adding the cardamoms toward the end of the process.—*Br.*

The first formula is preferable for directing a definite amount of the extract of colocynth, instead of the extract obtained from a definite weight of colocynth-pulp, which may vary considerably (see above). By mixing the ingredients in the state of fine powder a preparation uniform in appearance cannot be obtained. But by melting them together with the assistance of a little alcohol, and by subsequently drying and powdering, an unobjectionable compound extract is produced. It is, however, difficult to understand why the Pharmacopœia has introduced a new element of uncertainty in directing the use of commercial aloes, and straining it, instead of using *purified* aloes. The change in composition is thus shown:

1870: Extr. coloc. 13.33; Aloe purif. 53.33; Pulv. cardam. 6.67; Res. scammon. 13.33; Sapo 13.33 per cent.
1880: " " 14.0; " commer. 50.0; " " 6.0; " " 14.0; " 14.0 " "

Medical Uses.—As an efficient and safe purgative this compound, when well prepared, is not excelled by any other in cases of habitual *constipation* produced by torpor of the bowels. Calomel or rhubarb can be added to it to meet special indications, or, if it is disposed to gripe, extract of hyoscyamus will help to correct this tendency. The *dose* is from 5 to 20 grains (Gm. 0.30–1.30). This extract, as found in the shops, is often inert.

EXTRACTUM CONII ALCOHOLICUM, *U. S.*—ALCOHOLIC EXTRACT OF CONIUM.

Alcoholic extract of hemlock-fruit, E.; *Extrait alcoolique de semence (fruit) de ciguë*, Fr.; *Spirituöses Schierlingsfrucht-Extrakt*, G.

Preparation.—Conium, in No. 40 powder, 100 parts (20 oz. av.); Diluted Hydrochloric Acid 3 parts ($\frac{3}{5}$ oz. av. = $262\frac{1}{2}$ gr.); Glycerin, Diluted Alcohol, each a sufficient quantity. Moisten the powder with 30 parts (6 oz. av. or $6\frac{1}{4}$ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or until the conium is exhausted. Reserve the first 90 parts (18 oz. av. or 18 fluidounces) of the percolate, add the diluted hydrochloric acid to the remainder, and evaporate it, at a temperature not exceeding 50° C. (122° F.), to a soft extract; mix this with the reserved portion in a porcelain capsule, and evaporate at or below the before-mentioned temperature to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The extract formerly recognized under the above title was made from the leaves, and was of slight efficacy and variable strength. By using the green fruit a more reliable preparation is obtained, of which, however, the limits of variation of strength have not been ascertained. The addition of hydrochloric acid is intended to prevent the volatilization of the coniine. The yield is between 10 and 12 per cent.

EXTRACTUM CONII, *Br.*, is the inspissated juice of the fresh herb, prepared in precisely the same manner as the corresponding inspissated juices of aconite and belladonna. The yield is 3 or 4 per cent.

Medical Uses.—The primary *dose*, of about 2 grains (Gm. 0.10), may be gradually increased until its operation becomes manifest.

EXTRACTUM CONII FLUIDUM, *U. S.*—FLUID EXTRACT OF CONIUM.

Extractum conii fructûs fluidum, U. S. 1870.—*Fluid extract of hemlock-fruit, of conium-seed*, E.; *Extrait liquide de semence (fruit) de ciguë*, Fr.; *Flüssiges Schierlingsfrucht-Extrakt*, G.

Preparation.—Conium, in No. 40 powder, 100 Gm. (25 oz. av.); Diluted Hydrochloric Acid 3 Gm. (¾ oz. av. = 328 grains); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 7¾ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the conium is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and, having added the diluted hydrochloric acid to the remainder, evaporate it, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

A fluid extract, prepared from the fully-developed green fruit of conium, is preferable to that from the leaves, which was formerly officinal. The hydrochloric acid is added to the portion to be evaporated for the purpose of preventing the evaporation of the readily volatile coniine. The present formula differs from the former one mainly in omitting glycerin from the menstruum, which is not required. The fluid extract keeps well, is of a brown-green color, and has the peculiar odor of conium, and this is considerably increased on the addition of potassa.

Medical Uses.—It is a convenient form, and, next to the juice, the most reliable, for the administration of conium. *Dose*, from 2 to 6 minims (Gm. 0.10–0.40).

EXTRACTUM CORNUS FLUIDUM, *U. S.*—FLUID EXTRACT OF CORNUS.

Extractum cornûs floridæ fluidum, U. S. 1870.—*Fluid extract of dogwood*, E.; *Extrait liquide de cornouiller à grandes fleurs*, Fr.; *Flüssiges Kornelrinden-Extrakt*, G.

Preparation.—Cornus, in No. 60 powder, 100 Gm. (25 oz. av.); Glycerin 20 Gm. (5 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 80 Gm. (20 oz. av. or 20¾ fluidounces) of diluted alcohol. Moisten the powder with 30 Gm. (7½ oz. av. or 7½ fluidounces) of the mixture, and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the cornus is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract is of a reddish-brown color, represents fully the virtues of the bark, and keeps well. The present menstruum is identical with that of 1870, but the process is an improvement over the former one.

Medical Uses.—This officinal preparation appears to be entirely superfluous. It may be given in the *dose* of a fluidrachm (Gm. 4) or more.

EXTRACTUM CUBEBÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF CUBEB.

Extrait liquide de cubèbe, Fr.; *Flüssiges Kubeben-Extrakt*, G.

Preparation.—Cubeb, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 25 Gm. (6¼ oz. av. or 7⅜ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cubeb is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract should not be confounded with the oleoresin of the same drug, which was formerly recognized as fluid extract; it contains the medicinally active resin, together with most of the volatile oil, is of a dark-green color, and has the odor and taste of cubeb.

Medical Uses.—As a substitute for cubeb this preparation is of doubtful utility, except, perhaps, in chronic affections of the genito-urinary passages. *Dose*, from 10 to 30 minims (Gm. 0.60–2.00).

EXTRACTUM CYPRIPEDII FLUIDUM, *U. S.*—Fluid Extract of Cypripedium.

Extrait liquide de cypripède de jaune, Fr.; *Flüssiges Gelbfrauenschuh-Extrakt*, G.

Preparation.—Cypripedium, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the cypripedium is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

From what is known of the constituents of cypripedium, it is likely that a weaker alcohol would yield an equally efficient and permanent preparation. It is of a reddish-brown color, with the taste of the drug well marked.

Medical Uses.—*Dose*, from 10 to 20 minims (Gm. 0.60–1.30).

EXTRACTUM DIGITALIS, *U. S.*—Extract of Digitalis.

Extractum digitalis alcoholicum.—Extrait alcoolique de digitale, Fr.; *Fingerhut-Extrakt*, G.

Preparation.—Digitalis, recently dried and in No. 60 powder, 100 parts (20 oz. av.); Alcohol 200 parts (40 oz. av. or 47 fluidounces); Water 100 parts (20 oz. av. or 19 fluidounces); Glycerin, Diluted Alcohol, each a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 40 parts (8 oz. av. or 8⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the digitalis is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

In the selection of the menstruum this formula is an improvement on that of 1870, when alcohol followed by diluted alcohol was directed; the French Codex directs a weaker alcoholic solvent of 60 per cent. by volume. The yield is usually from 22 to 25 per cent. The extract is of a green-brown color, and with ordinary care retains a good consistence without having glycerin incorporated with it. Extractum digitalis, *P. G.*, is the inspissated juice, prepared like Extractum belladonnæ. It is brown, and its weight is equal to that of 3 or 4, or sometimes 5, per cent. of the fresh leaves and branches employed.

Medical Uses.—This extract is rarely used, and probably is less reliable than any other preparation of digitalis. *Dose*, ¼ grain (Gm. 0.01), and gradually increased.

EXTRACTUM DIGITALIS FLUIDUM, *U. S.*—Fluid Extract of Digitalis.

Extrait liquide de digitale, Fr.; *Flüssiges Fingerhut-Extrakt*, G.

Digitalis, recently dried and in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol. Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 9⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the digitalis is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Digitalis not being indigenous to North America, and the leaves varying in activity according to the locality of their growth, the directions of this and the preceding formula to employ recently-dried leaves cannot well be carried out. The present formula differs from that of 1870 mainly in omitting the glycerin and in using a menstruum stronger in alcohol. This is an improvement, and the precipitate which is formed on standing probably retains little or none of the active principles of the leaves. The fluid extract is of a green-brown color, and a fair representative of digitalis.

Medical Uses.—Its advantages over the tincture, and especially over the infusion, are not very apparent. The *dose* is 1 or 2 drops (Gm. 0.06–0.12).

EXTRACTUM DULCAMARÆ FLUIDUM, *U. S.*—Fluid Extract of Dulcamara.

Fluid extract of bittersweet, E.; *Extrait liquide de douce-amère*, Fr.; *Flüssiges Bittersüss-Extrakt*, G.

Preparation.—Dulcamara, in No. 60 powder, 100 Gm. (25 oz. av.): Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (10 oz. av. or 10⅜ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the dulcamara is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Glycerin, which was directed in 1870 as part of the menstruum, has been omitted, and the alcoholic strength of the finished preparation has been increased, which was scarcely necessary for the permanence of the fluid extract. It is of a deep-brown color, and on standing deposits a precipitate which probably contains none of the active principle.

Extractum dulcamaræ, *U. S.* 1870, which has been dismissed from the Pharmacopœia, was made with diluted alcohol, and may be prepared extemporaneously by evaporating the fluid extract; the twigs yield from 20 to 25 per cent. of extract.

Medical Uses.—This fluid extract probably contains all the active elements of dulcamara, and may be prescribed in the *dose* of a fluidrachm (Gm. 4), largely diluted and gradually increased.

EXTRACTUM ERGOTÆ, *U. S.*—Extract of Ergot.

Extractum secalis cornuti, P. G.; *Extractum hæmostaticum.*—*Extrait d'ergot de seigle*, Fr.; *Mutterkornextrakt*, G.

Preparation.—Fluid Extract of Ergot 500 parts (5 oz. av.); to make 100 parts (1 oz. av.). Evaporate the fluid extract of ergot, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to 100 parts (1 oz. av.).—*U. S.*

Exhaust ergot 10 parts by maceration with cold water; evaporate the mixed infusions to 5 parts, add alcohol spec. grav. .894, 5 parts, shake well; after 3 days filter, and evaporate to the consistence of an extract; treat this extract twice with its weight of alcohol, decant the liquid, and evaporate the residue to a thick extract.—*P. G.*

The first formula is based upon observations made by Dr. Squibb (*Proc. Amer. Phar. Assoc.*, 1873, p. 644) with fluid extract of ergot, *U. S. P.* 1860; this was prepared with diluted alcohol containing some acetic acid, and represented 5 per cent. more of ergot than the present fluid extract. 6 parts of the former yielded 1 part of extract, which was insoluble in cold alcohol, perfectly soluble in diluted alcohol, and easily soluble in water, with the exception of an insignificant residue which could easily be filtered out, the filtrate being of a garnet-red color. The above formula directs 5 parts of the present weaker fluid extract to yield 1 part of extract, or 20 per cent. more than was obtained by Dr. Squibb. Considering the variation of soluble matter in ergot (see below), the extract strictly prepared in accordance with the above directions may vary greatly in consistence. It is of a light-brown or reddish-brown color, having the behavior to solvents stated above; on being treated with an alkali the peculiar odor of ergot is strongly increased.

The extract resulting from the second formula is evidently intended to contain the active sclerotic acid in a more concentrated state. The concentrated infusion on being mixed with the quantity of alcohol stated yields a precipitate consisting mainly of inert salts and scleromucin; on treating the extract subsequently with alcohol coloring matters and alkaloidal salts are removed and the sclerotates left in the extract. The yield is about 14 per cent. By treating the concentrated infusion with alcohol, Hirsch (*Vergleichende Uebersicht*, 1883, p. 119) obtained from 8.66 to 20, and on an average 15, per cent. of extract.

Ergotinum, *Br.;* Ergotin, *E., G.;* Ergotine, *Fr.*—Evaporate 4 fluidounces of liquid extract of ergot to a syrupy consistence; add 4 fluidounces of rectified spirit, filter, and evaporate to a soft extract.—*Br.* To the aqueous infusion of ergot, concentrated to a syrupy liquid, add alcohol until the liquid begins to lose its transparency; agitate, decant, and evaporate.—*F. Cod.* The first is Bonjean's process; the second is very similar to that of the *P. G.* above, the precipitation of the active sclerotates being avoided by lessening the alcohol. (See paper by Prof. Diehl in *Proc. Amer. Phar. Assoc.*, 1881, p. 69.)

Medical Uses.—*Dose*, 3 to 15 grains (Gm. 0.20–1).

EXTRACTUM ERGOTÆ FLUIDUM, *U. S., Br.*—Fluid Extract of Ergot.

Extrait liquide d'ergot de seigle, Fr.; *Flüssiges Mutterkornextrakt*, G.

Preparation.—Ergot, recently ground and in No. 60 powder, 100 Gm. (25 oz. av.); Diluted Hydrochloric Acid 6 Gm. (1½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 4 parts of water (or, by measure, 10 fluidounces of alcohol and 11 fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 7⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the ergot is exhausted. Reserve the first 85 Ccm (20½ fluidounces) of the percolate, and, having added the diluted hydrochloric acid to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The menstruum used contains 46 per cent. by volume of absolute alcohol, and the resulting tincture must therefore be free from scleromucin and other less active principles, but contain all the sclerotates. The addition of hydrochloric acid to the portion to be evaporated, if not positively injurious, is of no advantage whatever. None of the alkaloids which are acknowledged to naturally exist in ergot are volatile, and the volatile so-called secaline—more properly trimethylamine—the presence of which in the fluid extract it was formerly intended to secure by the addition of acetic acid, is a product of decomposition, and probably does not contribute to the medicinal activity of this preparation. The presence of glycerin, which was ordered in 1870, is not necessary for preservation; its absence renders the fluid extract suitable for the preparation of a thick extract and of solutions adapted for hypodermic use.

The corresponding preparation of the Br. P. is equally efficient, and has the advantage of not containing any uncombined mineral acid. The following is the formula: Take of ergot crushed 1 pound; distilled water 6 pints (Imperial); rectified spirit 6 fluidounces. Digest the ergot in 4 pints of the water for 12 hours; draw off the infusion and repeat the digestion with the remainder of the water; press out, strain, and evaporate the liquors by the heat of a water-bath to 11 fluidounces; when cold add the spirit; allow to stand for an hour to coagulate, then filter. The product should measure 16 fluidounces.—*Br.*

The large quantity of fixed oil present in ergot is liable to be displaced by percolation with an alcoholic menstruum, but not with water. None of the pharmacopœias direct the removal of the oil; this may be accomplished by exhausting the ergot with ether or petroleum benzin. By evaporating the liquid extract of the Br. P. to the consistence of a soft extract, a preparation agreeing with the ergotin of the French Codex is obtained.

Medical Uses.—This preparation represents the totality of the active elements of ergot. In cases of *uterine inertia* it may be prescribed in the *dose* of half a fluidrachm to a fluidrachm (Gm. 2–4), repeated every 15 or 20 minutes. To counteract the effects of *spinal hyperæmia* the commencing dose should not be less than 2 drachms (Gm. 8), three times a day, and it may be increased to three, or even four, times that quantity.

EXTRACTUM ERYTHROXYLI FLUIDUM, *U. S.*—FLUID EXTRACT OF ERYTHROXYLON.

Extractum cocæ fluidum.—*Extrait liquide de coca*, Fr.; *Flüssiges Cocaextrakt*, G.

Preparation.—Erythroxylon, in No. 30 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 45 Gm. (11¼ oz. av. or 11¾ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the erythroxylon is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract was recommended by Kennedy (1878) to be made with a mixture of 3 measures of alcohol to 1 of water, but experience has shown that with diluted alcohol an unobjectionable preparation is obtained. It is of a deep-brown or olive-brown color, and has the astringent bitter and slightly aromatic taste of the leaves.

Medical Uses.—This should be an active preparation of coca, but it may be suspected that its effects are modified by its alcoholic menstruum. The dose is stated to be from 1 to 4 fluidrachms (Gm. 4–16).

EXTRACTUM EUCALYPTI FLUIDUM, *U. S.*—FLUID EXTRACT OF EUCALYPTUS.

Extrait liquide d'eucalyptus, Fr.; *Flüssiges Eukalyptusextrakt*, G.

Preparation.—Eucalyptus, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the eucalyptus is exhausted. Reserve the first 85 Ccm. (20⅜ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Alcohol is a good solvent for the valuable constituents of eucalyptus-leaves, but Mr. Alonzo Robbins found the fluid extract prepared with this menstruum to gradually deposit a moderate quantity of precipitate and a bulky greenish somewhat gelatinous matter, probably consisting of chlorophyll and waxy and fatty matter. A fluid extract made with a mixture of 3 parts of alcohol and 1 part of water remains free from the latter objection; this menstruum, being also sufficiently strong in alcohol for dissolving the medicinal principles, is therefore preferable. The fluid extract is greenish-brown, and has the characteristic odor and taste of the leaves.

Medical Uses.—This is probably the best form in which eucalyptus can be administered. *Dose*, 10 to 10 minims (Gm. 0.60–1.20).

EXTRACTUM EUONYMI, *U. S.*—EXTRACT OF EUONYMUS.

Extract of wahoo, E.; *Extrait d'écorce de fusain*, Fr.; *Spillbaumrinden-Extrakt*, G.

Preparation.—Euonymus, in No. 30 powder, 100 parts (20 oz. av.); Glycerin, Diluted Alcohol, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 8¼ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the euonymus is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The menstruum appears to be well chosen for extracting wahoo-bark. The extract is of a brown or yellowish-brown color.

Medical Uses.—Probably this preparation contains whatever virtues belong to euonymus. Dose, about 5 grains (Gm. 0.30).

EXTRACTUM EUPATORII FLUIDUM, *U. S.*—FLUID EXTRACT OF EUPATORIUM.

Fluid extract of bonesct, E.; *Extrait liquide d'eupatoire perfoliée*, Fr.; *Flüssiges Durchwachsdosten-Extrakt*, G.

Preparation.—Eupatorium, in No. 30 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces. Moisten the powder with 40 Gm. (10 oz. av. or 10⅜ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the eupatorium is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Although it has been prescribed to some extent, this fluid extract is now for the first time recognized by the Pharmacopœia. It is of a dark-greenish or brown-red color, and represents the virtues of the drug.

Medical Uses.—This preparation may be used to obtain the tonic effects of eupatorium, in the dose of a fluidrachm (Gm. 4).

EXTRACTUM FRANGULÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF FRANGULA.

Extrait liquide d'écorce de bourdaine, Fr.; *Flüssiges Faulbaumrinden-Extrakt*, G.

Preparation.—Frangula, in No 40 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 1 part of alcohol with 2 parts of water (or, by measure, 25 fluidounces of alcohol and 41 fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the frangula is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This is likewise newly introduced. The fluid extract has a dark brown-red color and the sweetish-bitter taste of the bark. Made from bark of a sufficient age, it appears to fairly represent the drug, but experience must determine whether a somewhat stronger alcohol may not be a more suitable menstruum.

EXTRACTUM RHAMNI FRANGULÆ, *Br.*—Macerate for two days frangula, in No. 40 powder, 1 pound, with rectified spirit 40 fluidounces; percolate with water to obtain 60 fluidounces, and evaporate. *Dose*, 15 to 60 grains (1–4 Gm.).—*Br.*

Extractum rhamni frangulæ liquidum. *Br.*—Boil frangula in coarse powder, 1 pound with three or four quantities of water, until exhausted; evaporate to 12 fluidounces, cool, add rectified spirit 4 fluidounces, and filter. *Dose*, 1 to 4 fluidrachms (4–16 Gm.).

Medical Uses.—The action of this laxative appears to be very uncertain. The *dose* of it is variously stated at ½ fluidrachm, and at half that quantity (Gm. 1–2).

EXTRACTUM GELSEMII FLUIDUM, *U. S.*—Fluid Extract of Gelsemium.

Extrait liquide de gelsemium, Fr.; *Flüssiges Gelsemienextrakt*, G.

Preparation.—Gelsemium, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the gelsemium is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Alcohol is well adapted for exhausting gelsemium. The fluid extract has a deep red-brown color and the strong odor and bitter taste of the drug. In 1870 the menstruum was alcohol sp. gr. .835, which furnished an unobjectionable preparation.

Extractum gelsemii alcoholicum, *Br.*, is made with rectified spirit. *Dose*, ½ to 2 grains (0.03–0.12 Gm.).

Medical Uses.—If used at all, for which there seems to be no necessity, great caution should be observed, on account of the profound and even fatal depression it has occasioned. The *dose* is from 5 to 10 minims (Gm. 0.30–0.60).

EXTRACTUM GENTIANÆ, *U. S., Br., P. G.*—Extract of Gentian.

Extrait de gentiane, Fr.; *Enzianextrakt*, G.

Preparation.—Gentian, in No. 20 powder, 100 parts (20 oz. av.); Water a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 7¾ fluidounces) of water, and let it macerate for 48 hours; then pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the gentian. Reduce the liquid to three-fourths of its weight by boiling, and strain; then by means of a water-bath evaporate to a pilular consistence.—*U. S.*

The British Pharmacopœia alone directs boiling with water for exhausting gentian-root, while the United States, French, and German Pharmacopœias exhaust with cold water, the albumen being removed from the infusion by boiling. The long-continued boiling directed by the U. S. P. until one-fourth of the solution has evaporated is not necessary. Cold water is preferable for exhausting gentian, since it dissolves all of the bitter principle without taking up the whole of the pectin compounds, which enter into solution in hot water. An extract prepared with the latter has a gelatinous appearance, though not in the same degree as if made by prolonged boiling with water. The yield by cold water approaches, or sometimes exceeds, 30 per cent. of the weight of the dry root, and the yellowish-brown extract yields with water a nearly clear solution.

Medical Uses.—This extract contains all the virtues of gentian in a form convenient for administration. It is, however, most generally used as an excipient for other tonics, and especially for iron and quinia. The *dose* is from 3 to 10 grains (Gm. 0.16–0.60).

EXTRACTUM GENTIANÆ FLUIDUM, *U. S.*—Fluid Extract of Gentian.

Extrait liquide de gentiane, Fr.; *Flüssiges Enzianextrakt*, G.

Preparation.—Gentian, in No. 30 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the gentian is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The use of glycerin, directed in 1870, has very properly been abandoned without detriment to the preparation, which is of a dark yellowish-brown color and bitter taste. The bitter principle of gentian is perfectly soluble in water, but a certain amount of alcohol is necessary for preventing fermentation.

Medical Uses.—It may be employed for all the purposes of the bitter tonics, but it is seldom prescribed alone. It may be used to reinforce the tonic properties of the compound tincture of gentian and other liquid tonic preparations. *Dose*, ½ fluidrachm (Gm. 2).

EXTRACTUM GERANII FLUIDUM, *U. S.*—Fluid Extract of Geranium.

Extrait liquide de géranium maculé, Fr.; *Flüssiges Fleckstorchschnabel-Extrakt*, G.

Preparation.—Geranium, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol, and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the geranium is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

It is a dark reddish-brown fluid extract of a strongly astringent taste. Compared with the formula of 1870, the glycerin has been reduced to one-third, without, however, obviating partial gelatinization. For this reason Mr. A. Robbins suggests, in place of diluted alcohol, a menstruum composed of 3 parts of alcohol and 1 part of water.

Medical Uses.—Fluid extract of geranium is an excellent substitute for the liquid preparations of catechu and other simple astringents. *Dose*, from ½ fluidrachm to 1 or 2 fluidrachms (Gm. 2–8).

EXTRACTUM GLYCYRRHIZÆ, *U. S.*—Extract of Glycyrrhiza.

Succus liquiritiæ, P. G.; *Extractum liquiritiæ.—Liquorice, Extract of liquorice*, E.; *Suc (jus) de réglisse*, *Sucre noir*, Fr.; *Lakriz*, *Lakrizensaft*, G.

The commercial extract of the root of Glycyrrhiza glabra, *Linné*.

Preparation.—Liquorice is prepared for commercial purposes in the southern portion of Europe and in this country. The fresh root is mostly employed, but the dried root will likewise answer the purpose. The root is crushed to a pulpy mass or broken into a coarse powder, and then boiled with water over a naked fire or by steam. The liquor is expressed, allowed to settle, and decanted, or, for the common qualities, together with the fine pulpy matter evaporated by boiling and continued stirring until the mass has attained the proper consistence to be rolled out into sticks of a certain weight, a portion of olive oil being used to prevent it from adhering to the hands and the table. The sticks are made of an adopted length and thickness, stamped with the initials or name of the manufacturer or of the town where the factory is located, and finally dried. Russian liquorice-root is likewise used in the manufacture of liquorice.

On exhausting the root with hot or cold water hygroscopic extracts are obtained, but on treating the root now with steam Delondre (1856) observed that a considerable amount of matter was dissolved, which, on evaporating the solution, was friable, without attracting moisture, and had a sweet taste without acridity. It is this substance, consisting of altered glycyrrhizin, together with the starch contained in the root, which gives firmness to the commercial extract. Previous to 1878 over 1,000,000 pounds of liquorice were annually imported into the United States. Since 1878 the quantity imported has varied between 692,919 and 874,044 pounds in 1881, and a considerable quantity is manufactured here.

Description.—Liquorice appears in commerce packed in boxes between layers of laurel-leaves (Laurus nobilis, *Linné*) to prevent the sticks from adhering; in Southern Russia oak-leaves are used for the same purpose. Besides the liquorice of American manufacture, two principal varieties are distinguished in our commerce, the *Sicilian* and *Calabrian* or *Spanish*. The former is in thin sticks, ¼ to ⅜ inch (6 to 9 Mm.) in diameter, of a dull-black color, frequently of an empyreumatic taste, and generally very impure. The latter variety is in larger sticks, ⅝ to 1 inch (15 to 25 Mm.) in diameter, 6 to 6¾ inches (15 to 17 Cm.) long, black, and somewhat glossy externally, slightly flexible except at a low temperature, and breaking with a sharp conchoidal and shining fracture; some small cavities may usually be found in the interior. The products of the different manufacturers of this liquorice differ from one another not only in the size of the sticks, but often by marked differences in their odor and taste; while some specimens are almost purely sweet, others are persistently acrid and empyreumatic. For medicinal purposes liquorice should be almost devoid of acridity.

Placed in cold water, a portion of the liquorice is dissolved, but the residue retains the shape of the sticks; after the addition of a little ammonia to the water, Rump (1855) observed the liquid to become again colored, and again to acquire a sweet taste from dissolving fresh portions of glycyrrhizin. The amount soluble in cold water varies considerably, and reaches in the best brands about 70 to 75 per cent. of the dried liquorice, but the percentage is usually a little less than this. "Not less than 60 per cent. of the extract should be soluble in cold water."—*U. S.* "After drying 100 parts of liquorice at 100° C. (212° F.) it should weigh at least 83 parts. On exhausting air-dry liquorice with water of not over 50° C. (122° F.), the residue dried in a water-bath should not exceed 25 per cent., and when examined under the microscope should not show any starch-granules." —*P. G.*

Under the name of *Italian liquorice* an impure article in thin sticks is met with, and the so-called *refined liquorice* of the shops is in still thinner cylindrical and glossy pieces, likewise impure and readily attacked by insects. *Pontefract cakes* are small liquorice lozenges which are much used in England. *Corigliano* and *Barracco* are the foreign brands most esteemed in the United States; *Solazzi* juice is highly valued in England.

Constituents.—Liquorice contains glycyrrhizin, free (soluble in ammonia) and in combination with ammonia (soluble in cold water); also starch, modified by long boiling, sugar, a little acrid resinous matter, from 8.4 to 17 per cent. of moisture, and from 6 to 9 per cent. of ash. Madsen (1881) treated the concentrated aqueous solution of liquorice with cold alkaline solution of copper, ignited the precipitate, and calculated the sugar from the cupric oxide obtained; the amount varied between 11 and 15 per cent., which is probably too high. For estimating the gum, the infusion was precipitated by alcohol, the well-washed precipitate dissolved in water, this solution precipitated by cupric sulphate and soda, the precipitate washed with dilute soda, dissolved in hydrochloric acid, and this solution precipitated by alcohol; good liquorice yielded from 1.5 to 4.4 per cent. of arabin.

Impurities and Adulterations.—Fragments of vegetable tissue are generally present to some extent; shreds of copper are sometimes also met with, and result from careless scraping of the evaporating-pans. The fraudulent additions usually consist of farinaceous matters, gum, glucose, and mineral compounds; the latter are estimated in the ash. Starch may sometimes be seen in little lumps in the interior of the sticks, and if not altered by heat may be recognized by the microscope. Gum added fraudulently is detected in the precipitate which takes place on the addition of an equal bulk of alcohol to the cold aqueous solution (see above). Grape-sugar will cause the solution of liquorice in cold water to be of a lighter color; it may be estimated after removing gum by alcohol and glycyrrhizin by sulphuric acid.

EXTRACTUM GLYCYRRHIZÆ PURUM, *U. S.*—PURE EXTRACT OF GLYCYRRHIZA.

Extrait de réglisse, Fr.; *Süssholzextrakt*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 100 parts (20 oz. av.); Water of Ammonia 15 parts (3 oz. av. or 3 fluidounces); Distilled Water a sufficient quantity. Mix the water of ammonia with 300 parts (60 oz. av. or 57½ fluidounces) of distilled water, and, having moistened the powder with 100 parts (20 oz. av. or 19¼ fluidounces) of the menstruum, let it macerate for 24 hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and then distilled water, until the glycyrrhiza is exhausted. Lastly, by means of a water-bath, evaporate the infusion to a pilular consistence.—*U. S.*

The ammonia is intended to dissolve any glycyrrhizin which may be present in the powdered root in the insoluble condition, and to prevent its becoming insoluble from the loss of ammonia during evaporation. The yield is from 16 to 20, or even 25, per cent. The extract is of a brown color and of a sweet taste; it is used for preparing Mistura glycyrrhizæ composita, *U. S.* It yields a clear solution with water, as does also the following:

Other Extracts of Liquorice.—Extractum glycyrrhizæ, *Br.;* Extractum liquiritiæ radicis, *P. G.* 1872. This extract is practically identical with that of the French Codex, except that the latter exhausts the root by displacement with distilled water at a temperature of 15° to 20° C. (59° to 68° F.); the following is the formula: Take of liquorice-root, in No. 20 powder, 1 pound; distilled water, 4 pints. Macerate the liquorice-root with 2 pints of the water for 12 hours, strain, and press; again macerate the pressed marc with the remainder of the water for 6 hours, strain, and press. Mix the strained liquors, heat them to 100° C. (212° F.), and strain through flannel; then evaporate by a water-bath until the extract is of a suitable consistence for forming pills.—*Br.*

Succus liquiritiæ depuratus, *P. G.*, s. Extractum glycyrrhizæ depuratum.—Purified liquorice, *E.;* Extrait de suc de réglisse, *Fr.;* Gereinigter Lakriz, *G.*—It is recognized by several European pharmacopœias, and is made by alternately placing layers of washed straw and broken liquorice in a soluble vessel and covering the material with cold water. As the water becomes saturated it is withdrawn through a faucet below, and replaced by fresh water until but little color and taste are imparted to it. The perfectly clear liquids are then evaporated to the consistence of an extract, which should yield a clear solution with water. The yield is 50 to 60 per cent. For convenience in dispensing, a concentrated solution of definite strength is often kept on hand. To remove the resinous matter, which imparts a disagreeable acrid taste, Ungewitter (1875) suggests the digesting of the stick liquorice in strong alcohol and afterward exhausting it with cold water.

Elixir e succo liquiritiæ, *P. G.* Purified liquorice 10 parts is dissolved in 30 parts of fennel-water; the solution is mixed with anisated spirit of ammonia 10 parts.

Off. Prep.—1. *Of pure extract of liquorice:* Confectio sennæ, Decoct. aloes comp., Mistura sennæ comp., Tinct. aloes, Troch. opii, *Br.* 2. *Of liquorice:* Pil. ferri iodidi, Tinct. aloes, Troch. cubebæ, Troch. glycyrr. et opii, *U. S.*

Medical Uses.—Extract of liquorice is lenitive and demulcent; it also excites the secretions of the fauces, and perhaps of the larynx. It is chiefly employed in irritable conditions of these parts, in *sore throat*, *laryngitis*, and *bronchitis.* It may be conveniently used by allowing small fragments of it to dissolve in the mouth, or by adding it to the various syrups, lozenges, and mixtures appropriate to these objects. It sometimes appears to prevent *flatulence* depending upon fermentation of the food, for which purpose a piece as large as a grain of wheat may be taken after meals. "Pure extract of liquorice" (*U. S. P.* 1880) is still more appropriate to the purposes designated than the ordinary extract.

EXTRACTUM GLYCYRRHIZÆ FLUIDUM.—Fluid Extract of Glycyrrhiza.

Extractum glycyrrhizæ liquidum, Br. Add.—*Liquid extract of liquorice-root*, E.; *Extrait liquide de réglisse*, Fr.; *Flüssiges Süssholz-Extrakt*, G.

Preparation.—Glycyrrhiza, in No. 40 powder, 100 Gm. (25 oz. av.); Water of Ammonia, Diluted Alcohol, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts (1 oz. av. or 1 fluidounce) of water of ammonia with 97 parts (32⅓ oz. av. or 33½ fluidounces) of diluted alcohol, and, having moistened the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the glycyrrhiza is exhausted. Reserve the first 75 Ccm. (18 fluidounces) of the percolate, and, having added 3 Gm. (¾ oz. av. or 6 fluidrachms) of water of ammonia to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Take of liquorice-root, in No. 20 powder, 1 pound; distilled water 4 pints. Macerate the liquorice-root with 2 pints of the water for 12 hours, strain, and press; again macerate the pressed marc with the remainder of the water for 6 hours, strain, and press. Mix the strained liquors, heat them to 212° F., and strain through flannel; then evaporate by a water-bath until it has acquired, when cold, a specific gravity of 1.160; add to this one-sixth of its volume of rectified spirit; let the mixture stand for 12 hours, and filter.—*Br.*

Both formulas yield fluid extracts containing the peculiar sweet taste of the liquorice-root. Prof. Remington (1878) suggested a menstruum composed of alcohol 4 fluidounces, glycerin 3 fluidounces, water 8 fluidounces, and stronger ammonia-water 1 fluidounce; this, even without the glycerin, appears to be preferable to that of the U. S. P., as being less alcoholic. The ammonia serves to dissolve any glycyrrhizin which may have been present in the insoluble condition; the fluid extract should be devoid of ammoniacal odor, and should have a very sweet taste, without bitterness. The preparation was recommended by Joseph Harrop (1869) for disguising the bitter taste of quinine.

AROMATIC ELIXIR OF LIQUORICE-ROOT. Dissolve oil of cloves 10 minims, oil of cinnamon 5 minims, and oil of nutmegs 12 minims in alcohol 4 fluidounces, and add syrup 6 fluidounces, fluid extract of liquorice-root 2 fluidounces, and water 4 fluidounces (Remington, 1878).

Medical Uses.—The fluid extract of liquorice-root is a very agreeable substitute for the simple extract of liquorice in flavoring cough medicines and concealing acrid tastes. The aromatic elixir is too stimulating to be used in the former, but may be used advantageously in the latter, manner.

EXTRACTUM GOSSYPII RADICIS FLUIDUM, *U. S.*—FLUID EXTRACT OF COTTON-ROOT.

Extrait liquide d'écorce de cotonnier, Fr.; *Flüssiges Baumwollwurzel-Extrakt*, G.

Preparation.—Cotton-Root, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 35 Gm. (8¾ oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 65 Gm. (16¼ oz. av. or 19 fluidounces) of alcohol, and, having moistened the powder with 50 Gm. (12½ oz. av. or 13½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, and when the liquid in the percolator has disappeared from the surface gradually pour on alcohol, and continue the percolation until the cotton-root is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Fresh or recently-dried bark appears to yield a more effectual preparation than old bark. The fluid extract has a bright brownish-red color, but, like that of 1870, it will gelatinize, though not to the same extent. Mr. A. Robbins (1883) considers this due to the large amount of glycerin, and proposes to reduce it from 35 to 20 per cent., when the preparation will deposit only a moderate precipitate, and retain its red color without showing any signs of gelatinization. Prof. J. U. Lloyd (1876) proposed to use a mixture of 10 fluidounces of alcohol and 3 each of glycerin and water, and finish percolation with a menstruum composed of 10 fluidounces of alcohol and 6 of water.

Medical Uses.—It is used chiefly as a substitute for ergot, as an oxytocic and emmenagogue, and may be given in the *dose* of ½ fluidrachm (Gm. 2) or more.

EXTRACTUM GRINDELIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF GRINDELIA.

Extrait liquide de grindélia, Fr.; *Flüssiges Grindelienextrakt*, G.

Preparation.—Grindelia, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol and 10 fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 8¼ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the grindelia is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces). —*U. S.*

This fluid extract is of a brown-green color, but it does not appear to be as perfect a preparation as is desirable. In the previous editions of this work we suggested strong alcohol as the proper menstruum, which has yielded an unobjectionable fluid extract of a rich green color; the observations of Mr. A. Robbins (1883) coincide with this experience. The active principles are, most likely, volatile oil and resin, and these require alcohol for solution.

Dose, from 10 to 20 minims (Gm. 0.60–1.20).

EXTRACTUM GUARANÆ FLUIDUM, *U. S.*—Fluid Extract of Guarana.

Extrait liquide de guarana, Fr.; *Flüssiges Guaranaextrakt*, G.

Preparation.—Guarana, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 20 Gm. (5 oz. av. or 5½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the guarana is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

A fluid extract of guarana has been in use for a number of years, but in the endeavor to obtain it as little alcoholic as possible many of the preparations formerly used gradually formed heavy deposits. This may be obviated by increasing the alcoholic strength; but Mr. A Robbins (1883) has found a menstruum consisting of 2 parts by weight of alcohol and 1 part of water to be sufficiently strong for this purpose. Mr. J. H. Feemster (*Proc. Amer. Phar. Assoc.*, 1882, p. 570) recommends a mixture made of 8 parts by measure of alcohol and 4 parts each of glycerin and water as being free from the objections stated above. The fluid extract is of a deep red-brown color and has an astringent and bitter taste. The commercial fluid extract was found by E. Hosack (1883) to contain between 1.10 and 1.68 per cent. of caffeine, or one-third to one-fourth the amount present in guarana.

Dose, from 10 to 20 minims (Gm. 0.60–1.20) and upward.

EXTRACTUM HÆMATOXYLI, *U. S.*, *Br.*—Hæmatoxylon.

Extractum ligni campechiani.—Extract of logwood, E.; *Extrait de bois de Campêche*, Fr.; *Campecheholz-Extrakt*, G.

Preparation.—Hæmatoxylon, rasped, 100 parts (1 pound); Water, 1000 parts (10 pounds). Macerate the hæmatoxylon with the water for 48 hours. Then boil, avoiding the use of metallic vessels, until one-half of the water has evaporated; strain the decoction while hot, and evaporate to dryness.—*U. S.*

The present process has been somewhat altered, so as to correspond with that of the British Pharmacopœia, which now orders infusion in boiling distilled water for 24 hours, boiling to one-half, and finally evaporation by a water-bath, stirring with a wooden spatula. The yield is about 12 per cent., occasionally as low as 6 per cent. The extract is not hygroscopic; it is of a red-brown color and a sweet afterward astringent taste. It yields with water a red and almost clear solution. It is prepared on a large scale for uses in the arts. (For composition compare Hæmatoxylon.)

Medical Uses.—The extract has the medicinal qualities of the wood, and does not lose them by keeping. It may be administered in *doses* of 10 grains (Gm. 0.60) or more, and in solution rather than in pills, which in time grow very hard.

EXTRACTUM HAMAMELIDIS FLUIDUM, *U. S.*—Fluid Extract of Hamamelis.

Extrait liquide de hamamélis, Fr.; *Flüssiges Hamamelisextrakt*, G.

Preparation.—Hamamelis, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 1 part of alcohol with 2 parts of water (or, by measure, 25 fluidounces of alcohol with 41 fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hamamelis is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract appears for the first time in the Pharmacopœia. It is of a brown color, and has the astringent and bitter taste of the leaves. The substitution of glycerin for a portion of the water will probably give a better menstruum and yield a more permanent preparation.

Dose, from 10 to 20 minims (Gm. 0.60–1.20).

EXTRACTUM HYDRASTIS FLUIDUM, *U. S.*—Fluid Extract of Hydrastis.

Extrait liquide de hydrastis, Fr.; *Flüssiges Hydrastisextrakt*, G.

Preparation.—Hydrastis, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 8¼ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hydrastis is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The fluid extract has a deep brown-yellow color and the strongly bitter taste of the root. The present menstruum is more alcoholic than that ordered by the U. S. P. 1870, and contains no glycerin; the addition of a small quantity of the latter appears to be of advantage.

Medical Uses.—This is a convenient and efficient form of the medicine. *Dose*, a fluidrachm (Gm. 4), two or three times a day.

EXTRACTUM HYOSCYAMI ALCOHOLICUM, *U. S., Br.*—Alcoholic Extract of Hyoscyamus.

Extrait alcoolique de feuilles de jusquiame, Fr.; *Spirituöses Bilsenkraut-Extrakt*, G.

Preparation.—Hyoscyamus, recently dried and in No. 60 powder, 100 parts (20 oz. av.); Alcohol 200 parts (40 oz. av. or 47 fluidounces); Water 100 parts (20 oz. av. or 19¼ fluidounces); Diluted Alcohol a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 40 parts (8 oz. av. or 8¼ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the hyoscyamus is exhausted. Reserve the first 90 parts (18 oz. av. or about 18 fluidounces) of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, to a pilular consistence.—*U. S.*

A stronger alcohol is now directed than in 1870, when the proportion was 2 measures of alcohol sp. gr. .835 to 1 measure of water. The present menstruum is somewhat stronger than that of the French Codex, which is alcohol of 60 per cent. by volume. The extract has a green-brown color and the heavy odor of hyoscyamus. The leaves yield from 20 to 26 per cent. of extract, the seed about 16 per cent.; the latter extract is used to some extent in Europe.

EXTRACTUM HYOSCYAMI, *Br.*, *P. G.*, is the inspissated juice of the fresh leaves and branches prepared like the inspissated juices of other narcotic herbs. The yield varies from 2.5 to 3.5 or 4 per cent. The color of the extract is brown-green (*Br.*) or greenish-brown (*P. G.*).

The crystals observed in old extracts, according to Attfield (1862), are potassium nitrate.

Medical Uses.—This preparation, like the former simple extract, is one of the most variable in strength of all narcotic extracts. Its minimum *dose*, of 2 grains (Gm. 0.10), should be rapidly increased until the characteristic effects of the medicine are produced.

EXTRACTUM HYOSCYAMI FLUIDUM, *U. S.*—FLUID EXTRACT OF HYOSCYAMUS.

Extrait liquide de jusquiame, Fr.; *Flüssiges Bilsenkraut-Extrakt*, G.

Preparation.—Hyoscyamus, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 40 Gm. (10 oz. av. or 11 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the hyoscyamus is exhausted. Reserve the first 90 Ccm. (or 21½ fluidounces) of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Glycerin, which formed part of the menstruum in 1870, has now been omitted and the alcohol increased in strength. The fluid extract is of a deep green-brown color, has the heavy odor of the drug, and keeps well.

Medical Uses.—The fluid extract is a good representative of hyoscyamus, and may be prescribed in *doses* of from 5 to 10 minims (Gm. 0.30–0.60), and increased if necessary.

EXTRACTUM IPECACUANHÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF IPECAC.

Extrait liquide d'ipécacuanha, Fr.; *Flüssiges Ipecacuanha-Extrakt*, G.

Preparation.—Ipecac, in No. 80 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 10¼ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed until the ipecac is exhausted. By means of a water-bath distil off the alcohol from the tincture until the residue measures 50 Ccm. (12 fluidounces), and add to it 100 Ccm. (24 fluidounces) of water. Evaporate the mixture to 75 Ccm. (18 fluidounces), let cool, and filter. Wash the precipitated resin upon the filter with water until the latter passes through tasteless, evaporate the filtrate and washings to 50 Ccm. (12 fluidounces), allow to cool, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract offers peculiar difficulties if the preparation is to be completely soluble in an aqueous menstruum; hence numerous papers on this subject have appeared in American journals during the last twenty years, and the pharmacopœial formula has been altered in each edition, the present one being similar to that of 1860, but contains no acetic acid. The difficulty arises from a compound erroneously called resin, but which we believe is a decomposition-product of the peculiar pectin compound of the root, perhaps associated with some coloring matter. These constituents vary to some extent, as is indicated already by the color and other physical properties of the drug, and while one sample of the latter may yield a fluid extract having the above-mentioned desirable quality, another may give more or less different results. In our experience, heat is one of the chief causes of the changes produced in this inert principle. During the first evaporation ordered by the pharmacopœial formula the full heat of a water-bath may be used; the liquid should then be cooled, if possible, to near 5° C. (41° F.), and after several hours filtered, when the filtrate should be concentrated at a moderate heat. The concentrated aqueous liquid is preserved against decomposition by alcohol; the Pharmacopœia of 1860 ordered glycerin, which will answer the purpose equally well. It will be observed that in the hands of the apothecary the conditions named are best carried out with operations upon a moderate quantity of the root.

Off. Prep.—Syrupus ipecacuanhæ, Tinctura ipecacuanhæ et opii, Vinum ipecacuanhæ, *U. S.*

Medical Uses.—Fluid extract of ipecacuanha is a convenient addition to expectorant mixtures, but hardly as much so as the syrup, to the preparation of which, indeed, it is essential. The *dose*, as an emetic, is about 20 or 30 minims (Gm. 1.20–2.00); as an expectorant, 5 minims (Gm. 0.30).

EXTRACTUM IRIDIS, *U. S.*—EXTRACT OF IRIS.

Extract of blue flag, E.; *Extrait d'iris varié*, Fr.; *Schwertelextrakt*, G.

Preparation.—Iris, in No. 60 powder, 100 parts (20 oz. av.); Alcohol 225 parts (45 oz. av. or 52¾ fluidounces); Water 75 parts (15 oz. av. or 14½ fluidounces); Diluted Alcohol a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 40 parts (8 oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the iris is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.—*U. S.*

From what is known of the constituents of the drug, the menstruum should be efficient for extracting the active constituents. The extract is of a dark-brown color.

Dose, 2 or 3 grains (Gm. 0.12–0.20).

EXTRACTUM IRIDIS FLUIDUM, *U. S.*—FLUID EXTRACT OF IRIS.

Fluid extract of blue flag, E.; *Extrait liquide d'iris varié*, Fr.; *Flüssiges Schwertelextrakt*, G.

Preparation.—Iris, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (24 oz. av.). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 40 Gm. (10 oz. av. or 11 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the iris is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder, on a water-bath, to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The menstruum used is the same as for the preceding preparation. The fluid extract is of a deep red-brown color. Using alcohol for exhausting the drug, W. E. Jenks (1881) obtained a dark reddish-brown *oleoresin* of a thick viscid consistence and of a peculiar odor; by dissolving this in ether, filtering, and evaporating, it became comparatively free from astringency.

Dose, from 10 to 20 minims (Gm. 0.60–1.20).

EXTRACTUM JALAPÆ, *Br.*—EXTRACT OF JALAP.

Extrait de jalap, Fr.; *Jalapen-Extrakt*, G.

Preparation.—Jalap, in coarse powder, 1 pound; Rectified Spirit 4 pints; Distilled Water 1 gallon. Macerate the jalap in the spirit for 7 days, press out the tincture, then filter, and distil off the spirit, leaving a soft extract. Again macerate the residual jalap in the water for 4 hours, express, strain through flannel, and evaporate by a water-bath to a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F. until it has acquired a suitable consistence for forming pills.—*Br.*

No advantage whatever results from treating jalap with water after it has been exhausted by alcohol. 240 grains of such an aqueous extract were taken by A. B. Taylor (1864) in the course of 8 hours without producing any noticeable effect. Alcohol alone will yield between 12 and 18 or 22 per cent. of active extract, and cold water will subsequently extract 30 to 35 per cent. of inert matter, with which the officinal extract is uselessly diluted and encumbered. The supposed advantage is due to an erroneous conception of the statement that the aqueous extract was possessed of mild purgative and diuretic properties; this statement is correct as far as it applies to that portion of the aqueous extract soluble in alcohol, or, what is the same thing, to the aqueous extract of the alcoholic extract. Exhaustion with alcohol of about 70 per cent. would yield a much more efficient extract, but considerably less, and the dose would have to be correspondingly smaller. The *abstract of jalap* admitted into the U. S. P. 1880 fully represents the above extract in activity and dose, and does not form a tough mass like the latter; but the watery washing obtained in the preparation of resin of jalap when evaporated to the consistence of an extract would serve a useful purpose in the treatment of children and weak adults.

Medical Uses.—This preparation contains all the virtues of jalap in about half the bulk, and may be substituted for it in all prescriptions. The *dose* is from 10 to 20 grains (Gm. 0.60–1.30).

EXTRACTUM JUGLANDIS, *U. S.*—EXTRACT OF JUGLANS.

Extract of butternut, E.; *Extrait d'écorce de noyer gris*, Fr.; *Butternussrinden-Extrakt*, G.

Preparation.—Juglans, in No. 30 powder, 100 parts (20 oz. av.); Glycerin, Alcohol, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 9⅜ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts (60 oz. av. or about 4 pints) of tincture are obtained or the juglans is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The Pharmacopœia very properly discarded the use of water for exhausting butternut-bark, and avoids the temperature of boiling water, by which some of the nucin is volatilized; but it has not profited from the results obtained by B. F. Moise, Jr. (*Am. Jour. Phar.*, 1881, p. 153; *Proc. Am. Ph. A.*, 1881, p. 71), who distinctly states that the extract prepared with *diluted* alcohol is more efficient than that prepared with alcohol, and that the latter menstruum exhausts so much fixed oil that the extract retains a plastic consistency and does not adhere to the jar or spatula; the Pharmacopœia therefore errs also in ordering an admixture of glycerin. The yield is from 12 to 15 per cent.; the extract is of a blackish-brown color and bitter taste.

Medical Uses.—It is a mild cathartic in the dose of 20 or 30 grains (Gm. 1.30–2), and is said to be peculiarly appropriate for relieving habitual costiveness.

EXTRACTUM KRAMERIÆ, *U. S., Br.*—EXTRACT OF KRAMERIA.

Extractum ratanhæ.—Extract of rhatany, E.; *Extrait de ratanhia*, Fr.; *Ratanha-Extrakt*, G.

Preparation.—Krameria, in No. 40 powder, 100 parts (20 oz. av.); Water a sufficient quantity. Moisten the powder with 30 parts (6 oz. av. or 5¾ fluidounces) of water, pack it in a conical glass percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the astringency of the krameria. Heat the liquid to the boiling-point, strain, and by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), evaporate to dryness.—*U. S.*

The processes of the other pharmacopœias are practically identical with this, but the Br. P. and Fr. Cod. order distilled in place of common water.

It is important that the root be exhausted with *cold* water. Hot water will yield about 5 or 6 per cent. more extract, which, however, is but incompletely soluble in water, while the officinal extract yields a somewhat turbid solution with warm water, but a clear solution in the presence of sugar. The amount of extract obtainable depends on the size and the variety of rhatany-root used, the woody part of which contains but little soluble matter. The smaller branches of Peruvian rhatany yield about 12 per cent, of *dry* extract, but the thick main root yields only 5 or 6 per cent.; Savanilla and Para rhatany give a larger yield, about 12 to 15 per cent. The extract is of a red-brown color, glossy, resembling kino in appearance, and is not hygroscopic. Iron utensils must not be used in its preparation.

Off. Prep.—Trochisci krameriæ, *U. S.*

Medical Uses.—This extract is a convenient form of krameria in nearly all of the cases for which that medicine is appropriate. The *dose* is from 5 to 20 grains (Gm. 0.30–1.30), the smaller dose being frequently repeated.

EXTRACTUM KRAMERIÆ FLUIDUM, *U. S.*—Fluid Extract of Krameria.

Fluid extract of rhatany, E.; *Extrait liquide de ratanhia*, Fr.; *Flüssiges Ratanha-Extrakt*, G.

Preparation.—Krameria, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 20 Gm. (5 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 80 Gm. (20 oz. av. or 20¾ fluidounces) of diluted alcohol, and, having moistened the powder with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the krameria is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

With the exception of a very slight reduction of the glycerin, the present preparation is identical with that of 1870; according to Mr. A. Robbins, the glycerin may with advantage be reduced to one-half the present quantity, the fluid extract remaining thinner and equally free from precipitate. It is of a deep brownish-red color and strongly astringent taste.

Off. Prep.—Syrupus krameriæ, *U. S.*

Medical Uses.—It has the advantage over the tincture of being more astringent and less stimulant. *Dose*, ½ fluidrachm (Gm. 2).

EXTRACTUM LACTUCÆ, *Br.*—Extract of Lettuce.

Extractum lactucæ virosæ; Thridacium.—Extrait de feuilles de laitue vireuse. Fr.; *Giftlattich-Extrakt*, G.

Preparation.—The formula of the British Pharmacopœia is identical with that for the inspissated juices of the other narcotic herbs (see page 613). The extract contains the chlorophyll and is incompletely soluble in water. The French Codex directs the removal of the chlorophyll and albumen, and obtains an extract of a dark-brown color which yields with water a somewhat turbid solution. The yield is about 3 or 4 per cent.

Extrait de laitue, Thridace, *F. Cod.*, is made in the same manner from the cortical portion of the stem of cultivated lettuce, and is sometimes called *French lactucarium*; the yield is about 1½ per cent.

Medical Uses.—Like all the medicinal preparations of lettuce, it is an extremely feeble hypnotic. *Dose*, 5 or more grains (Gm. 0.30).

EXTRACTUM LACTUCARII FLUIDUM, *U. S.*—Fluid Extract of Lactucarium.

Extrait liquide de lactucarium, Fr.; *Flüssiges Lactucarium-Extrakt*, G.

Preparation.—Lactucarium, in coarse pieces, 100 Gm. (6¼ oz. av.); Ether 100 Gm. (6¼ oz. av. or 8 fluidounces); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (6 fluidounces). Add the lactucarium to the ether contained in a tared flask having the capacity of 600 Ccm. (36 fluidounces), and let it macerate for 24 hours; then add 300 Gm. (18¾ oz. av. or 18 fluidounces) of water, and shake the mixture well. Fit a bent glass tube into the neck of the flask, and, having immersed the flask in hot water, recover the ether by distillation. When all the ether has distilled over remove the tube, and, after thoroughly shaking the contents of the flask, continue the heat for half an hour. Let the mixture cool, add 100 Gm. (6¼ oz. av. or 7¼ fluidounces) of alcohol and enough water to make the whole mixture weigh 500 Gm. (31¼ oz. av.); after maceration for 24 hours, with occasional agitation, express and filter the liquid. Return the dregs to the flask, and macerate them with 200 Gm. (12½ oz. av. or 12 fluidounces) of a mixture of alcohol and water made in the proportion of 1 part (4 fluidounces) of alcohol to 3 parts (10 fluidounces) of water; repeat the maceration two or three times successively with fresh portions of the mixture until the dregs are tasteless or nearly so. Mix, and filter the liquids thus obtained, and concentrate them, by means of a water-bath (the first expressed liquid by itself), until the combined weight of the liquids is 60 Gm. (3¾ oz. av.); mix the liquids, add 40 Gm. (2½ oz. av. or 3 fluidounces) of alcohol, and let the mixture cool in the evaporating vessel, stirring the mixture frequently, and during the intervals keeping the vessel well covered. When cool, add enough alcohol to make the mixture weigh 100 Gm. (6¼ oz. av.); transfer the liquid to a flask, and add enough water to make the mixture measure 100 Ccm. (6 fluidounces), using the water so required to rinse the evaporating vessel. Shake the mixture occasionally during several hours, and frequently if a portion of the precipitate is found to be tenacious, and when a uniform mixture results set it aside for 24 hours, so that any precipitate formed may subside. Decant the clear liquid, transfer the precipitate to a filter, and, after thoroughly draining it into the decanted liquid, wash it with a mixture of alcohol and water made in the proportion of 3 parts (or 10 measures) of alcohol to 4 parts (11 measures) of water, until the washings pass tasteless. Concentrate the washings, by evaporation, to a syrupy consistence, mix with the decanted liquid, and add enough of the last-named mixture of alcohol and water to make the whole measure 100 Ccm. (24 fluidounces). Lastly, after 24 hours, and having meanwhile shaken the fluid extract occasionally, filter it through paper.—*U. S.*

This elaborate process for a preparation of limited importance yields a brown fluid extract which is miscible with watery liquids without turbidity. Ether dissolves the lactucerin and caoutchouc, which on the distillation of the ether in the presence of water are left in incoherent, crummy particles, from which the bitter principles may be more readily extracted than from the lactucarium. A much simpler process, accomplishing the same end, was proposed by Lemberger (1875), benzin being used in place of ether, and the solution containing only inert principles being decanted; modified so as to correspond with the pharmacopœial fluid extract, the formula is as follows: Beat thoroughly 6¼ oz. av. of lactucarium, agitate it for 24 hours with 12 fluidounces of petroleum benzin; decant the liquid, and when the lactucarium is dry rub it with an equal bulk of clean sand; introduce the mixture into a percolator upon a layer of sand; macerate it with a menstruum composed of 10 measures of alcohol and 11 measures of water, and exhaust by percolation, reserving the first 4 fluidounces; evaporate the remaining tincture, dissolve in the reserved portion, and add sufficient menstruum to obtain 6 fluidounces.

Off. Prep.—Syrupus lactucarii, *U. S.*

Dose, a fluidrachm, more or less (Gm. 4).

EXTRACTUM LEPTANDRÆ, *U. S.*—Extract of Leptandra.

Extrait de leptandra, Fr.; *Leptandraextrakt*, G.

Preparation.—Leptandra, in No. 40 powder, 100 parts (20 oz. av.); Alcohol 200 parts (40 oz. av. or 47 fluidounces); Water 100 parts (20 oz. av. or 19¼ fluidounces); Glycerin, Diluted Alcohol, each a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 40 parts (8 oz. av. or 8⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the leptandra is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

This extract is evidently intended to take the place of the so-called leptandrin of commerce, which is of variable composition. By simply evaporating a tincture of leptandra it is extremely difficult to obtain a pulverizable extract, as pointed out by Dr. Greve and by Prof. Lloyd (1880), owing to the large amount of glucose present; the incorporation of glycerin, though not objectionable, is scarcely required. The yield is about 10 per cent. The extract is of a blackish-brown color, and is partly soluble in water, yielding a dark-brown, very bitter solution.

Dose, 2 to 4 grains (Gm. 0.12–0.24).

EXTRACTUM LEPTANDRÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF LEPTANDRA.

Extrait liquide de leptandra, Fr.; *Flüssiges Leptandraextrakt*, G.

Preparation.—Leptandra, in No. 60 powder, 100 Gm. (25 oz. av.); Glycerin 15 Gm. (3¾ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 85 Gm. (21¼ oz. av. or 22 fluidounces) of diluted alcohol, and, having moistened the powder with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding first the remainder of the menstruum, and afterward diluted alcohol, until the leptandra is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

It is not clear why a weaker alcoholic menstruum should be desirable for making a liquid preparation than was deemed necessary for preparing the extract of the same drug. The menstruum chosen for the latter—viz. 2 parts of alcohol to 1 part of water—was found by Alonzo Robbins to furnish a fluid extract which will keep unaltered for several years, even without the addition of glycerin. It is of a dark red-brown color and has a very bitter taste.

Dose, 30 to 60 minims (Gm. 2–4).

EXTRACTUM LOBELIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF LOBELIA.

Extrait liquide de lobélie enflée, Fr.; *Flüssiges Lobelienextrakt*, G.

Preparation.—Lobelia, in No. 60 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the lobelia is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This new pharmacopœial preparation is of a deep green-brown color, has the unpleasant acrid taste of the drug, and if properly made and kept remains in good condition.

Medical Uses.—*Dose*, as an emetic, 10 to 20 minims (Gm. 0.60–1.30); as an expectorant, 1 to 5 minims (Gm. 0.06–0.30).

EXTRACTUM LUPULI, *Br.*—Extract of Hop.

Extractum humuli.—Extrait de houblon, Fr.; *Hopfenextrakt*, G.

Preparation.—Take of Hop 1 pound; Rectified Spirit 1½ pints; Distilled Water 1 gallon. Macerate the hop in the spirit for 7 days, press out the tincture; filter, and distil off the spirit, leaving a soft extract. Boil the residual hop with the water for 1 hour, press out the liquor, strain, and evaporate by a water-bath to the consistence of a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F., until it has acquired a suitable consistence for forming pills.—*Br.*

Alcohol is required for exhausting the lupulin of hops, and would also exhaust hops if used in sufficient quantity; the subsequent use of water is a saving of alcohol. The extract of the French Codex, which is made with alcohol of 60 per cent. by volume, is preferable. The yield is about 20 per cent.

Medical Uses.—This preparation represents pretty well the virtues of hop. *Dose*, 5 grains (Gm. 0.30) or more.

EXTRACTUM LUPULINÆ FLUIDUM, *U. S.*—Fluid Extract of Lupulin.

Extrait liquide de lupuline, Fr.; *Flüssiges Lupulin-Extrakt*, G.

Preparation.—Lupulin 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the lupulin with 20 Gm. (5 oz. av. or 5⅞ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the lupulin and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the lupulin is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The use of alcohol is necessary to keep the volatile oil and resinous matter in solution, and the preparation fairly represents the drug. Mr. Alonzo Robbins suggests the lupulin to be packed without previously moistening it, as then the percolation proceeds evenly and without any difficulty, while the moistened powder is apt to form a tough mass difficult to percolate. The fluid extract is of a deep red-brown color and of the odor and taste of the drug.

Medical Uses.—It affords a convenient mode of administering lupulin. The *dose* is 15 or 20 minims (Gm. 1.00–1.30), which should be mixed with syrup or brandy and afterward diluted with water.

EXTRACTUM MALTI, *U. S.*—Extract of Malt.

Essence (Extrait) de malt, Fr.; *Malzextrakt*, G.

Preparation.—Malt, in coarse powder, not finer than No. 12, 100 parts (100 oz. av.); Water a sufficient quantity. Upon the powder, contained in a suitable vessel, pour 100 parts of water, and macerate for 6 hours. Then add 400 parts (400 oz. av. or 24 pints) of water heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath or vacuum-apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey. Keep the product in well-closed vessels in a cool place.—*U. S.*

In making this extract, which is now for the first time admitted into the Pharmacopœia, it is of the utmost importance that the temperature should never exceed 65° C. (149° F.), and it is safer, for the preservation of the diastase, to keep it at or below 55° C. (131° F.) until the starch of the malt has been converted into glucose and dextrin. According to Payen and Persoz, good malt contains 2 per cent of diastase, and since 1 part of this compound is estimated to convert 2000 parts of starch, it is obvious that properly-prepared malt extract should contain nearly the entire amount of diastase which was originally present in the malt. This is only accomplished by the rapid evaporation of the infusion at a temperature which does not act injuriously upon diastase, as is directed in the pharmacopœial process. The yield is from 65 to 75 per cent.

Properties.—Extract of malt is a brown-yellow or light amber-colored, thick liquid or semi-fluid mass, having a slight peculiar odor, a sweet mucilaginous taste, and a distinct acid reaction to litmus-paper. It dissolves in water in all proportions, yielding a nearly transparent solution, in which alcohol produces a milky turbidity, after a short time becoming clear, with the separation of a flocculent precipitate. The aqueous solution also yields precipitates with picric acid, tannin, most alkaloidal reagents, and mercuric chloride and other metallic salts. When the extract is added to starch-paste, this is gradually liquefied, and will finally not acquire a blue color on the addition of iodine solution. On heating the extract it is decomposed, giving off the odor of burning sugar, and finally leaving a small amount of ash.

Constituents.—Good extract of malt contains about 30 per cent. of water, 60 of maltose and dextrin, 8 of nitrogenated principles, and 1½ of ash. Maltose and dextrin are usually present in nearly equal proportion, the former somewhat predominating. A minute amount of free lactic and perhaps of other acids is likewise present.

Valuation.—(For valuable papers on the analysis of malt-extract consult W. H. Dunstan and A. F. Dimmock in *Phar. Jour. and Transactions*, March, 1879, p. 734, and J. F. C. Jungk in *Amer. Jour. Phar.*, June, 1883, p. 289.) The amount of solid matter may be determined from the specific gravity, which is not identical with that of a solution containing the same percentage of cane-sugar. Hager has constructed the annexed table, which gives the density at 17.5° C. (63.5° F.) and the amount of solids dried at 110° C. (230° F.):

Table of Specific Gravity at 17.5° C. and Percentage of Solids, Dried at 110° C., of Extract of Malt.

Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.
1	1.0035	11	1.0448	21	1.0866	31	1.1305	41	1.1792
2	1.0072	12	1.0490	22	1.0908	32	1.1353	42	1.1844
3	1.0112	13	1.0532	23	1.0950	33	1.1401	43	1.1897
4	1.0154	14	1.0574	24	1.0991	34	1.1449	44	1.1952
5	1.0197	15	1.0616	25	1.1033	35	1.1497	45	1.2007
6	1.0238	16	1.0658	26	1.1075	36	1.1545	46	1.2062
7	1.0279	17	1.0700	27	1.1117	37	1.1594	47	1.2119
8	1.0321	18	1.0741	28	1.1159	38	1.1643	48	1.2178
9	1.0363	19	1.0782	29	1.1202	39	1.1692	49	1.2239
10	1.0406	20	1.0824	30	1.1258	40	1.1741	50	1.2303

Should the extract be too thick, it is to be dissolved in an equal weight of distilled water. According to Jungk, 5 Gm. of the extract are mixed with 20 Gm. of well-washed and dried sand, and the mixture is dried at 100° C.; the loss in weight indicates the water. The dry powder is, in a small percolator, exhausted with ether, the loss being resin of hops if present. A mixture of 2 volumes of strong alcohol and 1 volume of ether will next take up glycerin; then the maltose is dissolved by alcohol, and afterward the dextrin by boiling water. On heating the sand to redness, the albuminates are burned, and estimated by loss of weight. The diastatic strength of extract of malt is determined by forming starch into paste with about 20 parts of boiling water, and digesting it with the extract. According to Jungk, properly-prepared extract of malt should convert its own weight of starch at 16.6° C. (62° F.) in 40 minutes, or at 37.8° C. (100° F.) in 10 minutes, or at 65.5° C. (150° F.) in 3 minutes. The proteids may be estimated, according to Hager, by digesting for 30 minutes 10 Gm. of extract of malt with 100 Gm. of aqueous solution of picric acid saturated in the cold, washing the precipitate, and drying; one-half the weight is about equal to the albuminoids, of which from 3 to 3.25 per cent. should be present (Jungk).

Some commercial malt extracts are scarcely superior to glucose; others consist of a stronger or weaker beer.

Pharmaceutical Uses.—Extract of malt is serviceable in emulsionizing fixed oil and as a vehicle for various medicaments.

EXTRACTUM MALTI FERRATUM (*P. G.* 1872) is made by dissolving 2 parts of pyrophosphate of iron in 3 parts of water, and incorporating the solution with 95 parts of extract of malt. Hager (1876) recommends instead the use of 3 parts of saccharated iron rubbed up with 7 of glycerin and 90 of extract of malt.

If quinine is combined with malt, the neutral tannate of quinine is best employed. Hops may be used with it in the form of fluid extract of lupulin. A combination with pepsin should be made extemporaneously, since the taste is gradually modified.

EXTRACTUM MALTI FLUIDUM, suggested by Prof. Lloyd, may be made by macerating and percolating 4 parts of ground malt with a mixture of 1 part of alcohol and 4 parts of water until 3 parts of percolate are obtained. It is a thin yellow or brownish liquid, containing the malt-sugar and diastase, the latter being destroyed on the application of heat.

Medical Uses.—(See Maltum.) It is a condiment and digestive whose *dose* must vary with individual cases.

EXTRACTUM MATICO FLUIDUM, *U. S.*—Fluid Extract of Matico.

Extrait liquide de matico, Fr.; *Flüssiges Matico-Extrakt*, G.

Preparation.—Matico, in No. 40 powder, 100 Gm. (25 oz. av.); Glycerin, 10 Gm. (2½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 75 Gm. (18¾ oz. av. or 22 fluidounces) of alcohol and 25 Gm. (6¼ oz. av. or 6 fluidounces) of water, and, having moistened the powder with 30 Gm. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water made in the proportion of 3 parts (37 measures) of alcohol to 1 part (10 measures) of water, until the matico is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Compared with the formula of 1870, the glycerin has been reduced to one-third the former quantity, and the alcohol increased in strength. The deep brown-green fluid extract contains the virtues of the drug well preserved.

Medical Uses.—The utility of this preparation consists in the facility with which it is absorbed. It may be given in *dose* of from ½ fluidrachm to 2 fluidrachms (Gm. 2–8).

EXTRACTUM MEZEREI, *U. S.*—Extract of Mezereum.

Extrait de garou, Fr.; *Seidelbast-Extrakt*, G.

Preparation.—Mezereum, in No. 30 powder, 100 parts (20 oz. av.); Alcohol a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 9⅜ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 24 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts (60 oz. av. or about 68 fluidounces) of tincture are obtained or the mezereum is exhausted. Reserve the first 90 parts (18 oz. av. or about 20 fluidounces) of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts (2 oz. av.); mix this with the reserved portion and evaporate, at or below the before-mentioned temperature, in a porcelain capsule on a water-bath, to a pilular consistence.—*U. S.*

Mezereon containing no volatile principle, and the constituents not being injured at the temperature of boiling alcohol, there is no reason why most of the alcohol should not be recovered by distillation, as directed by other pharmacopœias. It is simply impossible to obtain this extract of a pilular consistence. The yield is from 10 to 12 per cent. This, like the following extract, is of a green color and insoluble in water.

Off. Prep.—Linimentum sinapis compositum, *U. S.*

Extractum mezerei æthereum, *Br.*, *F. Cod.*—Extrait éthéré de garou (de mézéréon), *Fr.;* Ætherisches Seidelbast-Extrakt, *G.*—The alcoholic tincture is distilled until a soft extract remains; this is agitated with ether, the ethereal solution decanted, the ether recovered by distillation, and the residue converted into a soft extract. The yield is 6 or 7 per cent. This extract retains the consistence of honey.

Medical Uses.—It is a powerful irritant, and may be added to stimulant and rubefacient liniments and ointments to increase their power. It is an ingredient of the compound liniment of mustard, *Br. P.*

EXTRACTUM MEZEREI FLUIDUM, *U. S.*—Fluid Extract of Mezereum.

Extrait liquide de mézéréon (*de garou*), Fr.; *Flüssiges Seidelbast-Extrakt*, G.

Preparation.—Mezereum, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (10 oz. av. or 11¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the mezereum is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract, which is of a green color and very acrid, is used in the preparation of Unguentum mezerei, for which purpose it is very convenient. Except in manipulation no change has been made in the formula. As in the preceding case, the alcohol may be recovered by distillation without detriment to the preparation.

Medical Uses.—Diluted, this extract may take the place of decoction of mezereon. But as an overdose of it, undiluted, may give rise to violent and even fatal effects, this mode of administration is ineligible. The *dose* is nominally from 1 to 5 or 10 minims (Gm. 0.06–0.60). Its chief use is its external application to maintain a discharge from blistered surfaces.

EXTRACTUM NUCIS VOMICÆ, *U. S., Br.*—Extract of Nux Vomica.

Extractum strychni, P. G.; *Extractum nucum vomicarum spirituosum* (*vel alcoholicum*).—*Extrait de noix vomique*, Fr.; *Strychnossamen-Extrakt*, *Krähenaugen-Extrakt*, G.

Preparation.—Nux Vomica, in No. 60 powder, 100 parts (20 oz. av.); Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 8 parts (50 fluidounces) of alcohol with 1 part (5⅛ fluidounces) of water, and, having moistened the powder with 100 parts (20 oz. av. or 23 fluidounces) of the mixture, let it macerate in a closed vessel in a warm place for 48 hours. Then pack it in a cylindrical percolator, and gradually pour menstruum upon it until the tincture passes but slightly imbued with bitterness. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—*U. S.*

Prepare tincture from nux vomica 1 pound and alcohol (sp. gr. .875) 80 fluidounces; evaporate 1 fluidounce almost to dryness; dissolve in chloroform ¼ fluidounce and dilute sulphuric acid ½ fluidounce, agitate and warm gently; draw off the chloroform; add to acid liquid ammonia in excess and chloroform ½ fl. oz.; agitate, gently warm, evaporate the chloroform in a weighed dish, dry at 100° C., and weigh the cooled alkaloids. Take of the tincture as much as contains 131¼ gr. of total alkaloid; distill, and evaporate to 2 oz.—*Br.*

The French Codex directs maceration with alcohol of 80 per cent. by volume sp. gr. .864; the German Pharmacopœia, digestion with alcohol sp. grav. .894. The menstruum of the U. S. P. has the density .846.

Nux vomica is exceeding difficult to powder; the object is best accomplished on a small scale by somewhat crushing the seeds and drying them well by heat, or by heating them with a little water until they become soft enough to be bruised, while still warm, into a pulpy mass, with which a little alcohol is incorporated, when they should be thoroughly dried and powdered for displacement. Where steam is available for the softening of the seeds we would recommend that they be crushed or bruised while hot. In this way the rapid drying will be facilitated. The fatty matter contained in the seeds is taken up by the alcohol, and retains a portion of the alkaloids in solution; it is evidently not intended by either pharmacopœia that it should be removed. Its incorporation with the extract is hastened if the tincture is evaporated to a thin syrupy consistence, when hot water should be added with constant stirring, and the mixture then evaporated with continual agitation. The extract will be somewhat greasy; to avoid this the oil may be removed, but since it contains notable quantities of the alkaloids, it should be repeatedly agitated with fresh portions of alcohol of about .880 or .890 spec. grav. until it has nearly lost its bitter taste, and the alcoholic liquid should be added to and evaporated with the remaining extract. If the pharmacopœias would direct alcohol of the strength indicated, all of the alkaloids, with but little of the fat, would be dissolved, and the extract could be evaporated to dryness and powdered. The officinal extract is of a yellowish-brown color and of an intensely bitter taste. The yield is variable; with alcohol sp. gr. .835 we have obtained from 8 to 11.3 per cent. of the weight of the seeds; with weaker alcohol the yield is increased. It contains about 6 per cent. of strychnine, but this percentage must necessarily vary. The Br. P. extract contains 15 per cent. of total alkaloid.

EXTRACTUM STRYCHNI (NUCIS VOMICÆ) AQUOSUM is prepared from coarsely-powdered nux vomica by digesting it with hot water and evaporating the infusion to dryness. The yield is about 16 per cent., and the extract contains about 2 or 3 per cent. of strychnine.

Medical Uses.—It is chiefly used as an ingredient of pills intended to overcome habitual atonic constipation. The primary *dose* is about ½ grain (Gm. 0.03); it may gradually be increased to 2 or 3 grains (Gm. 0.10–0.20) when the specific action of the drug is sought.

EXTRACTUM NUCIS VOMICÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF NUX VOMICA.

Extrait liquide de noix vomique, Fr.; *Flüssiges Strychnossamen-Extrakt*, G.

Preparation.—Nux Vomica, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 8 parts (40 oz. av. or 47 fluidounces) of alcohol with 1 part (5 oz. av. or 4¾ fluidounces) of water, and, having moistened the powder with 100 Ccm. (24 fluidounces) of the mixture, let it macerate in a closed vessel in a warm place for 48 hours. Then pack it in a cylindrical percolator, and gradually pour menstruum upon it until the tincture passes but slightly imbued with bitterness. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

(For remarks on the manipulation we refer to the preceding article.) The menstruum being of precisely the same strength as that directed for the abstract, extract, and tincture, this fluid extract would seem to be adapted for the extemporaneous preparation of these.

Medical Uses.—On account of its intense bitterness, this is an ineligible preparation. It should be largely diluted with water. *Dose*, from 1 minim to 5 or more, cautiously increased.

EXTRACTUM OPII, *U. S., Br., P. G.*—EXTRACT OF OPIUM.

Extractum thebaicum.—Extrait d'opium, Extrait thebaïque, Fr.; *Opiumextrakt*, G.

Preparation.—Opium, 100 parts (1 lb. av.); Water 750 parts (7½ lbs. av. or 7 pints); Glycerin a sufficient quantity. Cut the opium into small pieces, let it macerate for 24 hours in 150 parts (1½ lbs. av. or 23 fluidounces) of the water, and reduce it to a soft mass by trituration. Express the liquid from it, and treat the residue again in the same manner with 150 parts (1½ lbs. av. or 23 fluidounces) of the water. Repeat the maceration and expression three times more, using a fresh portion of the water each time. Having mixed the liquids, filter the mixture, and evaporate by means of a water-bath to a pilular consistence. Lastly, weigh the extract and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The pharmacopœias agree in ordering cold water for the extraction of crude opium; only the German Pharmacopœia directs the use of powdered opium, and the U. S. P. alone orders common water, the other authorities directing distilled water. The manipulation does not differ materially except in the number of macerations and the proportion of water used. For 1 part of opium two macerations are directed with 8 and 4 parts, *F. Cod.* (with 5 and 2½ parts, *P. G.*), of water; three macerations each with 2½ parts of water, *Br.*, and five macerations each with 1½ parts of water, *U. S.* The latter process could be improved by using for the first maceration 3 parts of water, and shortening the time for the subsequent macerations to 12 hours each. The macerations should be effected at a low temperature, say about 60° F. At a higher temperature a larger amount of extract is obtained, more largely contaminated with narcotine and other principles, and of an inferior quality. The expressed liquids may be set aside for some time to settle, and then at once passed through a well-moistened filter without waiting until the maceration is completed with the whole amount of water. A flannel strainer is well adapted for the purpose if it is thoroughly moistened with water and the filtrate returned upon the strainer as long as it passes turbid. The evaporation is completed in the water-bath, and might be continued until a dry extract remains, which may be rubbed into a reddish-brown powder, as directed by the P. G.; the other pharmacopœias require it to be of the proper consistence of an extract, to preserve which the addition of glycerin will be useful. The yield is 55 to 60 per cent. of the *dry* opium employed, and the extract should contain not less than 20 per cent. of morphine, to correspond with opium of 12 per cent. morphine strength.

Denarcotized extract of opium is still occasionally employed. It may be obtained by agitating the concentrated infusion with 2 portions of ether, each time allowing the mixture to settle, and decanting the ether, which dissolves the narcotine, but not the morphine; the aqueous liquid is then evaporated as before. This extract is probably in no way superior to the officinal preparation.

Pharmaceutical Uses.—Unguentum opiatum. Unguentum opii, opium ointment, is made by triturating 1 part of extract of opium with 1 part of water and adding 18 parts of simple ointment, *P. G.* 1872.

Off. Prep.—Emplast. opii, *U. S.;* Extract. opii liquid., *Br.;* Trochisci glycyrrh. et opii, *U. S.;* Troch. opii, Vinum opii, *Br.*

Medical Uses.—This preparation is essentially opium purified from its inert constituents. Its average *dose* is about ½ grain (Gm. 0.03).

EXTRACTUM OPII LIQUIDUM, *Br.*—Liquid Extract of Opium.

Extrait liquide d'opium, Fr.; *Flüssiges Opiumextrakt*, G.

Preparation.—Extract of Opium 1 ounce; Distilled Water 16 fluidounces; Rectified Spirit 4 fluidounces. Macerate the extract of opium in the water for an hour, stirring frequently; then add the spirit and filter. The product should measure 1 pint (Imperial). It contains 22 grains of extract of opium (nearly) in 1 fluidounce.—*Br.*

This is somewhat stronger in opium than the tincture of opium, *Br.*, and scarcely deserves to be classed with the fluid extracts; it is analogous to the Tinctura opii deodorata, *U. S.* The specific gravity varies between .985 and .995.

Medical Uses.—Essentially a solution of the watery extract of opium, this preparation is probably less apt to nauseate and constipate than laudanum. *Dose*, from 10 to 30 minims (Gm. 0.60–2.00).

EXTRACTUM PAPAVERIS, *Br.*—Extract of Poppies.

Extrait de pavot (capsules), Fr.; *Mohnextrakt*, G.

Preparation.—Poppy-Capsules, dried, freed from the seeds, and coarsely powdered, 1 pound; Rectified Spirit 2 ounces; Boiling Distilled Water a sufficiency. Mix the poppy-capsules with two pints of the water and infuse for 24 hours, stirring them frequently; then pack them in a percolator, and, adding more of the water, allow the liquor slowly to pass until about a gallon has been collected or the poppies are exhausted. Evaporate the liquor by a water-bath until it is reduced to a pint, and when cold add the spirit. Let the mixture stand for 24 hours, then separate the clear liquor by filtration, and evaporate this by a water-bath until the extract has acquired a suitable consistence for forming pills.—*Br.*

Warm water extracts, with the medicinal principles, also the mucilaginous matters, which are but imperfectly precipitated by the small quantity of alcohol added. The yield is about 30 per cent. The French Codex directs extraction with 60 per cent. alcohol, which yields about 15 per cent. of extract.

Medical Uses.—This extract appears to be unnecessary. It has no virtues that are not more decided in the various preparations of opium. *Dose*, from 2 to 5 grains (Gm. 0.10–0.30).

EXTRACTUM PAREIRÆ, *Br.*—Extract of Pareira.

Extrait de pareira brava, Fr.; *Pareira-Extrakt*, G.

Preparation.—Pareira-Root, in coarse powder, 1 pound; Boiling Distilled Water 1 gallon or a sufficiency. Digest the pareira with a pint of the water for 24 hours, then pack in a percolator, and, adding more of the water, allow the liquor slowly to pass until a gallon has been collected or the pareira is exhausted. Evaporate the liquor by a water-bath until the extract has acquired a suitable consistence for forming pills. —*Br.*

The use of boiling water, followed by prolonged digestion, must result in the solution of the starch, which is but imperfectly removed by the subsequent percolation. A diluted alcohol would seem to be a very appropriate menstruum for exhausting pareira.

Medical Uses.—The solid form of a medicine intended to act upon the mucous membrane of the urinary passages cannot be an eligible one. The fluid extract and the decoction are greatly preferable. *Dose*, from 10 to 20 grains (Gm. 0.60–1.20).

EXTRACTUM PAREIRÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF PAREIRA.

Extractum pareiræ liquidum, Br.—*Liquid extract of pareira*, E.; *Extrait liquide de pareira brava*, Fr.; *Flüssiges Pareira-Extrakt*, G.

Preparation.—Pareira, in No. 40 powder, 100 Gm. (25 oz. av.); Glycerin 20 Gm. (5 oz. av.); Diluted Alcohol a sufficient quantity, to make 100 Ccm. (24 fluidounces). Mix the glycerin with 80 Gm. (20 oz. av. or 20¾ fluidounces) of diluted alcohol, and, having moistened the powder with 40 Gm. (10 oz. av. or 10⅜ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the pareira is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Take of Extract of Pareira, Distilled Water, Rectified Spirit, of each a sufficiency. Dissolve 4 parts of the extract in a sufficient quantity of a mixture of 1 fluid part of rectified spirit and 3 parts of water to form 16 fluid parts of liquid extract. Filter if necessary.—*Br.*

The second preparation is really a concentrated infusion preserved by ⅓ its volume of alcohol. The root is more readily and advantageously extracted by an alcoholic menstruum; that directed by the first formula differs but little from the one ordered in 1870, except in the reduction of the glycerin to two-thirds of the former quantity, but would be improved by using in place of diluted alcohol a mixture of 2, or, as suggested by Mr. Robbins, of 3, parts of alcohol and 1 part of water. The fluid extract is of a brown color, and possesses the peculiar bitter taste of the root in a marked degree.

Medical Uses.—This preparation probably contains all the medicinal qualities of pareira brava. It may be given in teaspoonful *doses* (Gm. 4) three times a day, largely diluted.

EXTRACTUM PHYSOSTIGMATIS, *U. S.*, *Br.*—EXTRACT OF PHYSOSTIGMA.

Extractum fabæ Calabaricæ.—*Extrait alcoolique de fève de Calabar*, Fr.; *Kalabarbohnenextrakt*, *Physostigmaextrakt*, G.

Preparation.—Physostigma, in No. 40 powder, 100 parts (20 oz. av.); Alcohol a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 9⅜ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 300 parts (60 oz. av. or about 68 fluidounces) of tincture are obtained or the physostigma is exhausted. Reserve the first 90 parts (18 oz. av. or 20 fluidounces) of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts (2 oz. av.); mix this with the reserved portion, and evaporate in a porcelain capsule on a water-bath to a pilular consistence.—*U. S.*

The British Pharmacopœia directs maceration and percolation with alcohol spec. grav. .838; the French Codex orders digestion for 2 hours, followed by percolation with hot alcohol spec. grav. .864; the former German Pharmacopœia employed alcohol spec. gr. .893, and exhausted by maceration. Strong alcohol yields only 2½ or 3 per cent. of extract, which, owing to the resinous and oily constituents, is obtainable of a homogeneous condition only by constant stirring during the latter part of the process. By the use of weaker alcohol a more uniform and less oily extract is obtained, and the yield is increased to 10 or 12 per cent. It is evident from this that the strict adherence to the menstruum directed by the pharmacopœias is of primary importance. The extract is of a greenish-brown color. Kennedy (1875) suggested the addition of glycerin to keep it soft and to render it more convenient for dispensing.

Medical Uses.—The extract represents all the active constituents of Calabar bean. Its average *dose* may be stated at $\frac{1}{10}$ grain (Gm. 0.006). Hiller used, to overcome constipation with flatulent distension of the bowel, the following: Ext. Calabar bean Gm. 0.10; Glycerin 30 Gm.—M. S. 10 drops, equal to about $\frac{1}{50}$ grain, three or four times a day.

EXTRACTUM PILOCARPI FLUIDUM, *U. S.*—Fluid Extract of Pilocarpus.

Fluid extract of jaborandi, E.; *Extrait liquide de jaborandi*, Fr.; *Flüssiges Jaborandiextrakt*, G.

Preparation.—Pilocarpus, in No. 40 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the pilocarpus is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This is essentially the process recommended by Dr. F. V. Greene (1877), who also called attention to the difficulty of packing powdered pilocarpus-leaves properly for percolation, owing to the strong fibres of the veins and the tough epidermal tissue; for which reason he suggested placing a rather thick layer of sand upon the powder. The fluid extract is of a greenish-red-brown color. A somewhat more aqueous menstruum has been suggested by Mr. Alonzo Robbins as preserving the properties equally well.

Extractum jaborandi, *Br.*, is made with proof spirit. *Dose*, 2 to 10 grains (Gm. 0.12–0.66).

Medical Uses.—This preparation is far inferior in promptness and efficiency of action to pilocarpine administered hypodermically, but is preferable to the other liquid preparations of jaborandi. *Dose*, 10 to 15 minims (Gm. 0.60–1), gradually increased, at short intervals, until its specific operation is manifested.

EXTRACTUM PODOPHYLLI, *U. S.*—Extract of Podophyllum.

Extract of May-apple or of mandrake, E.; *Extrait de podophylle*, Fr.; *Podophyllumextrakt*, G.

Preparation.—Podophyllum, in No. 60 powder, 100 parts (20 oz. av.); Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 3 parts (or 22 fluidounces) of alcohol with 1 part (or 6 fluidounces) of water, and, having moistened the powder with 30 parts (6 oz. av. or 6½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until 500 parts (100 oz. av.) of tincture have passed. By means of a water-bath distil off the alcohol from the tincture, and evaporate the residue to a pilular consistence.—*U. S.*

The menstruum is sufficiently alcoholic for the extraction of the medicinally valuable principles, and for not dissolving those least desirable. The extract is of a deep-brown color, and is not disposed to mould, as was the case with the former extracts, which were prepared with alcohol followed by diluted alcohol or water.

Medical Uses.—The operation of this medicine closely resembles that of extract of jalap; it may be used for the same purpose in the *dose* of from 5 to 20 grains (Gm. 0.30–1.20).

EXTRACTUM PODOPHYLLI FLUIDUM.—Fluid Extract of Podophyllum.

Fluid extract of May-apple or of mandrake, E.; *Extrait liquide de podophylle*, Fr.; *Flüssiges Podophyllumextrakt*, G.

Preparation.—Podophyllum, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts (or 70¼ fluidounces) of alcohol with 1 part (or 19¼ fluidounces) of water, and, having moistened the powder with 30 Gm. (6 oz. av. or 6½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the podophyllum is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder; dissolve the residue in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract is of a dark brown-red color. Being prepared with the same menstruum, it may be used for the extemporaneous preparation of the preceding extract.

Medical Uses.—It is inferior to the solid extract for most of the purposes for which podophyllum is used. *Dose*, 10 to 20 minims (Gm. 0.60–1.20).

EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM.—Fluid Extract of Wild Cherry.

Extrait liquide d'écorce de cerisier de Virginie, Fr.; *Flüssiges Wildkirschenrinden-Extrakt*, G.

Preparation.—Wild Cherry, in No. 20 powder, 100 Gm. (25 oz. av.); Diluted Alcohol, Glycerin, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts (8⅜ oz. av. or 8 fluidounces) of water with 1 part (4¼ oz. av.) of glycerin, and, having moistened the powder with 50 Gm. (12½ oz. av.) of the mixture, pack it loosely in a cylindrical percolator, cover the latter well, and set it aside for 48 hours. Then pack the damp powder firmly in the percolator, and pour on enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the wild cherry is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate and set it aside; collect the next 120 Ccm. (30 oz. av. or 30 fluidounces) separately, and evaporate to a thin syrup. By means of a water-bath distil off the alcohol from the remainder of the percolate and evaporate the residue to a thin syrup. Unite the two syrupy liquids and evaporate them on a water-bath to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This is one of those troublesome fluid extracts the formula of which has been changed since its introduction in each subsequent edition of the Pharmacopœia. The one suggested by Prof. Procter in 1859, in which the bark was exhausted by alcohol, and after the evaporation of the menstruum the decomposition of amygdalin was effected by emulsion of almonds, was an efficient and elegant preparation, but objected to on account of troublesome manipulation. The present formula is based upon that of 1870, the main difference being a reduction of glycerin and the final displacement with diluted alcohol in the place of alcohol. While the present menstruum dissolves little or none of the resinous matter, the fluid extract, though it yields clear mixtures with aqueous liquids, is open to the objection that was urged against that of 1870—of depositing considerable precipitate. A preparation which is nearly free from this objection is made by the following process, elaborated by Mr. Alonzo Robbins in 1879 and published in 1883: 100 parts (25 oz. av.) of wild cherry, in No. 40 powder, are moistened with 50 parts (12½ oz. av. or 12 fluidounces) of water and set aside for 24 hours: 20 parts (5 oz.

av.) of sugar are then mixed with the damp powder, and the whole packed in a percolator and saturated with a mixture of 1 part (1 measure) of alcohol and 6 parts (5 measures) of water, and allowed to macerate for 48 hours; then the percolation is allowed to proceed, adding the same mixture of alcohol and water, until the wild cherry is exhausted. The first 80 parts (19¼ fluidounces) of the percolate are reserved; 10 parts (2½ oz. av.) of glycerin are added to the remainder, which is then evaporated to a soft extract; this is dissolved in the reserved portion, and a sufficient quantity of the menstruum added to make 100 parts (24 fluidounces).

The fluid extract is of a deep brownish-red color, and when recently made has the bitter-almond odor in a marked degree, and possesses also the astringent and pleasantly bitter taste of the bark; the odor diminishes in the course of time, and finally disappears.

Medical Uses.—If well prepared, this extract represents more fully and in a more convenient form than any other preparation the virtues of wild-cherry-bark. It is an excellent adjuvant to cough mixtures in chronic *pulmonary* affections, and a palliative of *nervous* disorder of the heart's action. The *dose* is from 30 minims to a fluidrachm (Gm. 2–4), and should be gradually increased.

EXTRACTUM QUASSIÆ, *U. S., Br., P. G.*—EXTRACT OF QUASSIA.

Extrait de quassie (bois amer), Fr.; *Quassienextrakt*, G.

Preparation.—Quassia, in No. 20 powder, 100 parts (20 oz. av.); Glycerin, Water, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 7¾ fluidounces) of water, pack it firmly in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its weight by boiling and strain; then by means of a water-bath evaporate to a pilular consistence. Lastly, weigh the extract, and thoroughly incorporate with it, while still warm, 5 per cent. of glycerin.—*U. S.*

The British, French, and German Pharmacopœias unite in ordering distilled water; the latter alone orders hot digestion. With cold water the yield varies between 2½ and 5 per cent. J. S. Whall (1874) observed that 1 part of quassia is practically exhausted by obtaining from it 4 parts of percolate, and will yield rather less than 3½ per cent. of extract if water, or a little more if diluted alcohol, is used; the latter is considered preferable. The yield is increased to about 6 or 7 per cent. if boiling water is used, but the extract has a jelly-like appearance, probably from pectin compounds, and after some time contains a considerable quantity of crystals. The concentrated infusion should be filtered before final evaporation, as directed by the British Pharmacopœia.

Medical Uses.—The intense bitterness of this preparation denotes its possession of the virtues of quassia in a concentrated state. Like all other bitter extracts, it should not be given in that form unless in a very small *dose*, such as 1 or 2 grains (Gm. 0.06–0.12). It is usually associated with tonics of another order—*e. g.* quinine, iron, etc.

EXTRACTUM QUASSIÆ FLUIDUM.—FLUID EXTRACT OF QUASSIA.

Extrait liquide de quassie, Fr.; *Flüssiges Quassienextrakt*, G.

Preparation.—Quassia, in No. 60 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 40 Gm. (10 oz. av. or 10⅜ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the quassia is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Diluted alcohol is a good menstruum for permanently dissolving the bitter principle of quassia. The fluid extract has a brown-yellow color and a persistently bitter taste.

Medical Uses.—The intense bitterness of this preparation renders it ineligible as an internal medicine unless it is largely diluted. It may be used as an addition to various bitter tonic mixtures. *Dose*, 5 to 20 minims (Gm. 0.30–1.30).

EXTRACTUM RHEI, *U. S., Br., P. G.*—Extract of Rhubarb.

Extractum rhei alcoholicum.—Extrait de rhubarbe, Fr.; *Rhabarberextrakt*, G.

Preparation.—Rhubarb, in No. 30 powder, 100 parts (20 oz. av.); Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 3 parts (or 37 fluidounces) of alcohol and 1 part (or 10 fluidounces) of water, and, having moistened the powder with 40 parts (8 oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a conical percolator; then gradually pour the menstruum upon it until the tincture passes nearly tasteless. Reserve the first 100 parts (20 oz. av. or about 20 fluidounces) of the percolate, and set it aside in a warm place until it is reduced by spontaneous evaporation to 50 parts (10 oz. av.) Evaporate the remainder of the percolate in a porcelain vessel by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup; mix this with the reserved portion, and continue the evaporation until the mixture is reduced to a pilular consistence.—*U. S.*

The other pharmacopœias prepare this extract by maceration, and employ a menstruum composed of 2 parts of alcohol sp. gr. .832 and 3 parts of water, *P. G.;* proof spirit, 4 fluid parts, followed by distilled water, *Br.;* cold distilled water, *F. Cod.* Each of these liquids gives an efficient extract, the yield of which necessarily varies with the quality of the root, it being from 35 to 40 per cent. when made with cold water, and from 40 to 50 per cent. if prepared with an alcoholic liquid. The extract is yellowish-brown, bitter, has the odor of rhubarb, and yields with water a turbid solution.

Extractum rhei compositum, *P. G.* Extract of rhubarb 30 parts, extract of aloes 10 parts, resin of jalap 5 parts, and soap 20 parts; triturate together, moisten with diluted alcohol, mix well, and dry. It is of a blackish-brown color, and is also known as *Extractum catholicum* s. *panchymagogum.*

Medical Uses.—Owing to the difficulty of obtaining this preparation of proper quality, it is scarcely to be preferred to good rhubarb-root. Its *dose*, as a purgative, is from 10 to 15 grains (Gm. 0.60–1).

EXTRACTUM RHEI FLUIDUM, *U. S.*—Fluid Extract of Rhubarb.

Extrait liquide de rhubarbe, Fr.; *Flüssiges Rhabarber-Extrakt*, G.

Preparation.—Rhubarb, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts (60 oz. av. or 70¼ fluidounces) of alcohol with 1 part (20 oz. av. or 19¼ fluidounces) of water, and, having moistened the powder with 40 Gm. (10 oz. av. or 11 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the rhubarb is exhausted. Reserve the first 75 Ccm. (18 fluidounces) of the percolate, and evaporate the remainder at a temperature not exceeding 70° C. (158° F.) to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This fluid extract has undergone considerable modifications. The root, exhausted by an alcoholic menstruum, and the liquid, after the evaporation of the alcohol, preserved by sugar, resulted in a fluid extract which was very thick and deposited considerably. A fluid extract prepared with cold water and preserved by sugar, as recommended by Geo. Bille (1872), is free from the last-named objection, but, it was claimed, though fairly active, not to contain *all* the purgative principles of rhubarb. The use of glycerin with an alcoholic menstruum proved a failure with the fluid extract, as it did with the tincture, the liquids, although clear for a time, precipitating more copiously afterward. The present menstruum yields a fluid extract which precipitates very slightly, but becomes thick and loses its uniformity. But by using a menstruum composed of 4 parts (or nearly 5 measures) of alcohol and 1 part (or 1 measure) of water, Alonzo Robbins (*Am. Jour. Phar.*, 1883, p. 184) obtained a preparation which for nearly four years retained its fluidity and deposited only a very slight precipitate. None of these different fluid extracts will yield clear mixtures with aqueous liquids unless an alkali be added. Fluid extract of rhubarb is of a blackish red-brown color, and has the odor and taste of the drug.

Off. Prep.—Mistura rhei et sodæ, *U. S.*

Medical Uses.—This preparation is not often used as a purgative, but its *dose* may be stated at from 10 to 30 minims (Gm. 0.60–2.00).

EXTRACTUM RHOIS GLABRÆ FLUIDUM, *U. S.*—Fluid Extract of Rhus Glabra.

Fluid extract of sumach-berries, E.; *Extrait liquide de fruit de sumac*, Fr.; *Flüssiges Sumachbeerenextrakt*, G.

Preparation.—Rhus Glabra, in No. 40 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol, and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the rhus glabra is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

As originally suggested by Prof. Remington (1874), this fluid extract contained about 25 per cent. of glycerin and a slightly weaker alcohol than the above, and kept well for a long time. Mr. A. Robbins suggests a still weaker alcohol, by using 1 part of alcohol to 2 parts of water (or 25 to 41 measures), 80 parts of which menstruum are to be mixed with 20 parts of glycerin. The fluid extract is of a deep-red color, and has a pleasant acidulous and astringent taste.

Medical Uses.—The fluid extract may sometimes be more convenient than the infusion of sumach-berries treated of elsewhere. (See Rhus Glabrum.) Diluted with water, it forms an excellent detergent and stimulating gargle and mouth-wash.

EXTRACTUM ROSÆ FLUIDUM, *U. S.*—Fluid Extract of Rose.

Fluid extract of red rose, E.; *Extrait liquide de rose rouge*, Fr.; *Flüssiges Essigrosenextrakt*, G.

Preparation.—Red Rose, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol, and, having moistened the powder with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the red rose is exhausted. Reserve the first 75 Ccm. (18 fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This newly-recognized fluid extract is of a deep-red color, of an agreeable odor of rose, and of a pleasant mildly-astringent taste.

Off. Prep.—Syrupus rosæ, *U. S.*

Medical Uses.—An agreeable ingredient of gargles and mouth-washes. It may take the place of rose-leaves in the compound infusion of rose; it masks the taste of solutions of Epsom and Glauber salts, and imparts a pleasing color to many magistral mixtures.

EXTRACTUM RUBI FLUIDUM, *U. S.*—Fluid Extract of Rubus.

Fluid extract of blackberry-bark, E.; *Extrait liquide d'écorce de ronce*, Fr.; *Flüssiges Brombeerrinden-Extrakt*, G.

Preparation.—Rubus, in No. 60 powder, 100 Gm. (25 oz. av.); Glycerin 20 Gm. (5 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 45 Gm. (11¼ oz. av. or 13¼ fluidounces) of alcohol and 35 Gm. (8¾ oz. av. or 8⅜ fluidounces) of water, and, having moistened the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water made in the proportion of 9 parts (or 36 measures) of alcohol to 7 parts (or 23 measures) of water until the rubus is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the last-named proportions, to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The formula of 1870, which yielded a fairly permanent preparation, contained 50 per cent. more of glycerin, but was somewhat weaker in alcohol. A nearly permanent fluid extract, giving in three years only a very slight deposit, was obtained by Mr. A. Robbins with a mixture of 2 parts (or 22 measures) of alcohol and 1 part (or 9 measures) of water, using 10 parts of glycerin with the first 90 parts of the mixture. The deep-brown liquid has a decidedly astringent taste.

Off. Prep.—Syrupus rubi, *U. S.*

Medical Uses.—It is a good astringent, and well suited for the treatment of mild cases of *diarrhœa* in children after a sufficient evacuation of the bowels. The *dose* is from ½ fluidrachm to 2 fluidrachms (Gm. 2–8). It may, like other vegetable astringents, be added to the chalk mixture.

EXTRACTUM RUMICIS FLUIDUM, *U. S.*—Fluid Extract of Rumex.

Fluid extract of yellow dock, E.; *Extrait liquide de patience frisée*, Fr.; *Flüssiges Grindwurzextrakt*, G.

Preparation.—Rumex, in No. 40 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 35 Gm. (8¾ oz. av. or 9 fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the rumex is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This is a newly-introduced fluid extract, and has a deep red-brown color and the bitter and astringent taste of the root, which is thoroughly exhausted by the menstruum.

Dose, about a fluidrachm (Gm. 4).

EXTRACTUM SABINÆ FLUIDUM, *U. S.*—Fluid Extract of Savine.

Extrait liquide de sabine, Fr.; *Flüssiges Sadebaum-Extrakt*, G.

Preparation.—Savine, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 25 Gm. (6¼ oz. av. or 7⅝ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the savine is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The process does not differ from that of 1870, except in manipulation. The brown-green liquid contains the volatile oil, resin, and tannin of the drug, and is not only well adapted for making the officinal Ceratum sabinæ (*U. S.*), but it offers likewise a convenient way for administering savine.

Extractum sabinæ is made with 60 per cent. alcohol (*F. P.*) or with a mixture of 2 parts of alcohol and 1 part of water (*P. G.*), the tincture being evaporated to the proper consistence; it has a greenish-brown color. The yield is 19 or 20 per cent.

Medical Uses.—The fluid extract appears to contain all the virtues of savine. *Dose*, from 5 to 15 minims (Gm. 0.30–1.00).

EXTRACTUM SANGUINARIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SANGUINARIA.

Fluid extract of blood-root, E.; *Extrait liquide de sanguinaire*, Fr.; *Flüssiges Blutwurz-extrakt*, G.

Preparation.—Sanguinaria, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the sanguinaria is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This new fluid extract, which is of a dark-red color, will probably require considerable experimentation before it is obtained in a permanent form. Liquid preparations of sanguinaria deposit a brownish-red precipitate, which was shown by F. L. Slocum (1881) to contain notable quantities of sanguinarine. Whether the precipitate occurring in the strongly alcoholic fluid extract consists only of inert coloring matter, or likewise contains sanguinarine, requires investigation. Probably the addition of a little tartaric or other vegetable acid may prevent the loss of alkaloid.

Medical Uses.—*Dose*, as an emetic, from 10 to 60 minims (Gm. 0.60–4); as a nauseant, from 3 to 5 minims (Gm. 0.20–0.30). In this concentrated form sanguinaria should be cautiously used.

EXTRACTUM SARSAPARILLÆ COMPOSITUM FLUIDUM, *U. S.*—COMPOUND FLUID EXTRACT OF SARSAPARILLA.

Extrait liquide de salsepareille composé, Fr.; *Zusammengesetztes flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 75 Gm. (18¾ oz. av.); Glycyrrhiza, in No. 30 powder, 12 Gm. (3 oz. av.); Sassafras-Bark, in No. 30 powder, 10 Gm. (2½ oz. av.); Mezereum, in No. 30 powder, 3 Gm. (¾ oz. av.); Glycerin 10 Gm. (2½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix the glycerin with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol and 60 Gm. (15 oz. av. or 14⅜ fluidounces) of water, and, having moistened the mixed powders with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 1 part (or 14 measures) of alcohol to 2 parts (or 23 measures) of water, until the powder is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the last-named proportions, to make the fluid extract measure 100 Ccm. (24 fluidounces). —*U. S.*

This formula differs from that of 1870 chiefly in the reduction of the glycerin and of the alcoholic strength of the menstruum. The preparation is fairly permanent. The frequent use which is made of the above combination of drugs probably renders such a fluid extract desirable, though it seems to be unnecessary, since the introduction of concentrated preparations of liquorice-root and mezereum affords the opportunity of giving these and sarsaparilla in any proportion that may be desired.

Medical Uses.—The only active ingredient in this preparation besides the sarsaparilla is mezereum. It would appear to be a less eligible medicine than the compound decoction of sarsaparilla, which contains also guaiacum, and whose efficiency is established. *Dose*, from 30 minims to a fluidrachm (Gm. 2–4).

EXTRACTUM SARSAPARILLÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SARSAPARILLA.

Extractum sarsæ liquidum, Br.; *Liquid extract of sarsaparilla*, E.—*Extrait liquide de salsepareille*, Fr.; *Flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin, 10 Gm. (2½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm (24 fluidounces). Mix the glycerin with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol and 60 Gm. (15 oz. av. or 14⅝ fluidounces) of water, and, having moistened the powder with 40 Gm. (10 oz. av. or 10 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum and afterward a mixture of alcohol and water made in the proportion of 1 part (or 14 measures) of alcohol to 2 parts (or 23 measures) of water, until the sarsaparilla is exhausted. Reserve the first 80 Ccm (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the last-named proportions, to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Mix Jamaica sarsaparilla, in No. 40 powder, 40 ounces, with proof spirit 40 fluidounces; macerate in a closed vessel for ten days; press out 20 fluidounces of liquor and set this aside. Mix the pressed residue with 12 pints (Imperial) of water and macerate at 71.1° C. (160° F.) for sixteen hours, then strain and press out the liquid; dissolve the sugar in this, and evaporate in a water-bath to about 18 fluidounces. Mix the two liquids, and make up the volume to 40 fluidounces by the addition of distilled water.—*Br.*

The relative strength of the two fluid extracts is practically alike. The first process appears to be well adapted for exhausting the root and preserving the fluid extract, which contains about one-third its measure of alcohol; an increase of the glycerin would probably improve it. The second formula is an improvement of that of the former Br. P.; the exhaustion of the root is more complete, but the long exposure in the evaporation of 240 to 18 fluidounces could be materially reduced by percolating the powdered root.

Medical Uses.—It probably contains whatever active elements belong to sarsaparilla, and serves as a basis or as a vehicle for other medicines. *Dose*, from 30 minims to a fluidrachm (Gm. 2–4).

EXTRACTUM SCILLÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SQUILL.

Extrait liquide de scille, Fr.; *Flüssiges Meerzwiebel-Extrakt*, G.

Preparation.—Squill, in No. 20 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 20 Gm. (5 oz. av. or 5⅞ fluidounces) of alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the squill is exhausted. Reserve the first 75 Ccm. (18 fluidounces) of the percolate and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Squill yields with cold water from 55 to 65 per cent., and with diluted alcohol from 35 to 45 or 50 per cent., of extract. Alcohol which does not dissolve the gummy matter yields much less, but appears to be a solvent for all the medicinally-valuable principles. It is preferable for percolation to a more aqueous menstruum, which would cause the powder to swell. The fluid extract is of a dark brown-red color, and has the bitter and acrid taste of the drug.

EXTRACTUM SCILLÆ, *F. Cod.*, *P. G.*, is made with alcohol sp. gr. .914 (*F. Cod.*) or sp. gr. .894 (*P. G.*). It is brown-yellow and soluble in water and diluted alcohol.

Medical Uses.—This preparation is a concentrated and convenient form of squill. It is especially adapted for use as a diuretic. *Dose*, 3 or more minims (Gm. 0.20), largely diluted.

EXTRACTUM SCUTELLARIÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SCUTELLARIA.

Fluid extract of skull-cap, E.; *Extrait liquide de scutellaire*, Fr.; *Flüssiges Helmkraut-extrakt*, G.

Preparation.—Scutellaria, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 1 part of alcohol with 2 parts of water (or, by measure, 25 fluidounces of alcohol with 41 fluidounces of water), and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the scutellaria is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces). —*U. S.*

Made with the pharmacopœial menstruum, this newly-introduced fluid extract is of a brown color, and on keeping produces a bulky precipitate, which may be lessened by using as a menstruum 2 parts (or 22 measures) of alcohol and 1 part (or 9 measures) of water; the fluid extract will have a green-brown color.

The *dose* is stated at 1 or 2 fluidrachms (Gm. 4–8).

EXTRACTUM SENEGÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF SENEGA.

Extrait liquide de polygale de Virginie, Fr.; *Flüssiges Senegaextrakt*, G.

Preparation.—Senega, in No. 40 powder, 100 Gm. (25 oz. av.); Water of Ammonia 2 Gm. (½ oz. av. or 250 minims); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 1 part of water (or, by measure, 50 fluidounces of alcohol and 20½ fluidounces of water), and, having moistened the powder with 45 Gm. (11¼ oz. av. or 12 fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the senega is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add, first, the water of ammonia, afterward enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Water is a better solvent for senegin than a strongly alcoholic menstruum, but it has also the disadvantage of dissolving a considerable proportion of various pectin compounds, which are apt after some time to convert the liquid into a gelatinous mass. This tendency to gelatinizing is lessened by the pharmacopœial menstruum, with which the root may be exhausted without difficulty, and it is prevented by the subsequent addition of an alkali; for which purpose Dr. Squibb (1871) proposed about 2½ drachms of ammonia-water, and H. N. Rittenhouse the same quantity of bicarbonate of sodium, to a pint of the fluid extract. This is dark-brown in color, and has the characteristic odor and acrid taste of the root.

Off. Prep.—Syrupus senegæ, *U. S.*

EXTRACTUM SENEGÆ.—Extract of senega, E.; Extrait de polygale, Extrait de sénéca, Fr.; Senegaextrakt, G.—This has been dismissed from the U. S. P. and P. G., which authorities prepared it with diluted alcohol, obtaining about 30 per cent. of extract. The French Codex orders alcohol sp. gr. .914, which yields from 16 to 20 per cent. of extract. It may be prepared extemporaneously by evaporating the fluid extract to the proper consistence.

Medical Uses.—The special object of this preparation is apparently to supersede the decoction, all of whose virtues it possesses. *Dose*, 5 to 20 minims (Gm. 0.30–1.30).

EXTRACTUM SENNÆ FLUIDUM, *U. S.*—Fluid Extract of Senna.

Extrait liquide de séné, Fr.; *Flüssiges Sennaextrakt*, G.

Preparation.—Senna, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 4 parts of water (or, by measure, 30 fluidounces of alcohol with 32¾ fluidounces of water), and, having moistened the powder with 40 Gm. (10 oz. av. or 10¼ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the senna is exhausted. Reserve the first 80 Ccm. (19¼ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The fluid extract of 1850 was a thick syrup flavored with oil of fennel and Hoffmann's anodyne, the latter added to prevent fermentation. In 1860 these additions were dropped, and in 1870 glycerin was substituted for sugar. Properly prepared, these fluid extracts kept well, although a deposit took place, but they were inconveniently thick. The present formula yields a thinner fluid extract, which separates insoluble inert matter on the sides and bottom of the bottle. From the observation of Mr. Alonzo Robbins (1883), it appears that the addition of glycerin to the menstruum causes the precipitate to collect at the bottom. Freed from the precipitate, the fluid extract is of a dark-brown color and has the odor and taste of senna-leaves.

Medical Uses.—This fluid extract may be prescribed as a laxative in *doses* of a fluidrachm (Gm. 4), and as a purgative in doses of 2 or more fluidrachms (Gm. 8). It is apt to gripe severely without the addition of a carminative, such as oil of anise or oil of peppermint.

EXTRACTUM SERPENTARIÆ FLUIDUM, *U. S.*—Fluid Extract of Serpentaria.

Extrait liquide de serpentaire, Fr.; *Flüssiges Schlangenwurz-Extrakt*, G.

Preparation.—Serpentaria, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 22 fluidounces of alcohol with 6 fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 8¼ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the serpentaria is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

There is scarcely any difference in the results obtained with this and with the formula of 1870. The virtues of serpentaria are well exhausted and properly preserved by this process. The fluid extract has a red-brown color and the peculiar odor and bitter taste of the drug.

Medical Uses.—It is a convenient and efficient substitute for the infusion of serpentaria. *Dose*, ½ fluidrachm (Gm. 2).

EXTRACTUM SPIGELIÆ FLUIDUM, *U. S.*—Fluid Extract of Spigelia.

Extrait liquide de spigélie, Fr.; *Flüssiges Spigelienextrakt*, G.

Preparation.—Spigelia, in No. 60 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 7¾ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the spigelia is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Originally, the fluid extract was saccharine, and in 1870 the sugar was replaced by glycerin. It was found, however, that it will keep unaltered in the form of a concentrated tincture, as by the present formula. It is a dark-brown liquid, fully representing the virtues of spigelia.

Extractum spigeliæ et sennæ fluidum.—Fluid extract of spigelia and senna, *E.;* Extrait liquide de spigélie et séné, *Fr.;* Flüssiges Spigelien- und Senna-Extrakt. *G.*—After 1860 this preparation was made by mixing fluid extract of spigelia 10 fluidounces with fluid extract of senna 6 fluidounces and oils of caraway and of anise each 20 minims. A more elegant and satisfactory preparation, however, is obtained, according to Mr. Alonzo Robbins (1883), by preparing it from the drugs, as originally suggested by Procter (1848), omitting the alkali; the proportions are—spigelia 60 parts (15 oz. av.), senna 30 parts (7½ oz. av.), anise and caraway each 5 parts (1¼ oz. av.); the menstruum is diluted alcohol, and the yield is 100 parts by measure (24 fluidounces).

Medical Uses.—It possesses fully the virtues of spigelia, and may be given in the *dose* of a fluidrachm (Gm. 4) and upward.

Fluid extract of spigelia and senna represents in a concentrated form the well-tried and popular remedy "worm tea." It should be prescribed in *doses* of 1 or more fluidrachms (Gm. 4), at intervals of an hour, until it begins to purge.

EXTRACTUM STILLINGIÆ FLUIDUM, *U. S.*—Fluid Extract of Stillingia.

Extrait liquide de stillingie, Fr.; *Flüssiges Stillingienextrakt*, G.

Preparation.—Stillingia, in No. 40 powder, 100 Gm. (25 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 7¾ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the stillingia is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Except in the absence of glycerin, this fluid extract differs scarcely from that of 1870. It is of a dark red-brown color and has the bitterish, pungent taste of the root. A somewhat stronger alcoholic menstruum seems to improve it.

Medical Uses.—It may be employed in various chronic diseases, and especially scrofula, diseases of the skin, syphilis, etc. *Dose*, ½ fluidrachm (Gm. 2).

EXTRACTUM STRAMONII, *U. S., Br.*—Extract of Stramonium.

Extractum stramonii seminis, U. S. 1870.—*Extract of stramonium-seed*, E.; *Extrait de semences de stramoine*, Fr.; *Stechapfelsamen-Extrakt*, G.

Preparation.—Stramonium-seed, in No. 40 powder, 100 parts (20 oz. av); Diluted Alcohol a sufficient quantity. Moisten the powder with 30 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 300 parts (60 oz. av. or about 60 fluidounces) of tincture are obtained or the stramonium-seed is exhausted. Reserve the first 90 parts (18 oz. av. or about 18 fluidounces) of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 10 parts (2 oz. av.), mix the residue with the reserved portion in a porcelain capsule, and by means of a water-bath evaporate, at or below the before-mentioned temperature, to a pilular consistence.—*U. S.*

According to the British Pharmacopœia, the coarsely-powdered seeds are first exhausted with washed ether—in place of which petroleum benzin might be used—for removing the fixed oil; the residue is then percolated with proof spirit sp. gr. .920, the tincture distilled to recover the alcohol, and finally evaporated to the proper consistence. The yield is about 12½ per cent. The extract of the French Codex is made by digestion with alcohol spec. grav. .914; after distilling and evaporating the tincture the residue is dissolved in four times its weight of distilled water, filtered to remove oily and resinous matter, and the filtrate evaporated to the proper consistence. The yield is about 7 per cent.

Off. Prep.—Unguentum stramonii, *U. S.*

Extractum stramonii foliorum, *U. S. P.* 1870, was prepared from the dry leaves with alcohol and diluted alcohol; the yield is about 20 per cent. Extractum stramonii, *P. G.* 1872, was the inspissated juice of the fresh plant; yield, 3–3½ per cent.

Medical Uses.—Its commencing *dose* should not exceed ¼ grain (Gm. 0.016).

EXTRACTUM STRAMONII FLUIDUM, *U. S.*—Fluid Extract of Stramonium.

Fluid extract of stramonium-seed, E.; *Extrait liquide de semences de stramoine*, Fr.; *Flüssiges Stechapfelsamen-Extrakt*, G.

Preparation.—Stramonium-seed, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 3 parts of alcohol with 1 part of water (or, by measure, 37 fluidounces of alcohol with 10 fluidounces of water), and, having moistened the powder with 20 Gm. (5 oz. av. or 5½ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the stramonium-seed is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

This is a new pharmacopœial preparation, of a brown color and the taste of the seed. Since the menstruum ordered displaces some of the fixed oil of the seed, the latter should be removed, as stated above.

Medical Uses.—The commencing *dose* should not exceed 1 or 2 minims (Gm. 0.06–0.12).

EXTRACTUM TARAXACI, *U. S., Br., P. G.*—Extract of Taraxacum.

Extract of dandelion, E.; *Extrait de pissenlit* (*de dent de lion*), Fr.; *Löwenzahn-Extrakt*, G.

Preparation.—Fresh Taraxacum, gathered in September, a convenient quantity; Water a sufficient quantity. Slice the taraxacum and bruise it in a stone mortar, sprinkling on it a little water, until reduced to a pulp; then express and strain the juice, and evaporate it in a vacuum-apparatus or in a shallow porcelain dish, by means of a water-bath, to a pilular consistence.—*U. S.*

Take of fresh dandelion-root 4 pounds. Crush the root, press out the juice, and allow it to deposit; heat the clear liquor to 212° F., and maintain the temperature for 10 minutes; then strain, and evaporate by a water-bath, at a temperature not exceeding 160° F., until the extract has acquired a suitable consistence for forming pills.—*Br.*

The juice of taraxacum contains albumen, which is very properly removed in the second process by heating the juice for a short time to the boiling-point and straining from the coagulum. Collected in the autumn, the fresh root yields 8 to 10 per cent. of extract; the fresh spring root, with the leaves, yields a smaller amount, varying between 4½ and 6 per cent., and, after drying by exhaustion with cold water, from 25 to 40 per cent. This is the extract recognized by the German Pharmacopœia, that of the French Codex being made from the fresh leaves, with a yield of 2½ to 3 per cent. The extract is of a brown color, and should yield a nearly clear solution with water.

Medical Uses.—Owing to its liability to spoil, this extract is not an eligible preparation. It may be prescribed in the *dose* of 10 grains (Gm. 0.60) and upward, dissolved in some aromatic water and taken after meals.

EXTRACTUM TARAXACI FLUIDUM, *U. S.*—FLUID EXTRACT OF TARAXACUM.

Extrait liquide de pissenlit, Fr.; *Flüssiges Löwenzahn-Extrakt*, G.

Preparation.—Taraxacum, in No. 30 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts of alcohol with 3 parts of water (or, by measure, 22 fluidounces of alcohol with 27 fluidounces of water), and, having moistened the powder with 30 Gm. (7½ oz. av. or 7⅝ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the taraxacum is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The present fluid extract is similar to that of 1860, except that it contains a stronger alcohol; that of 1870 contained one-fourth its measure of glycerin. On keeping, these preparations deposit a slight precipitate of inert matter. Prepared from good dandelion-root, the fluid extract is an efficient preparation, of a reddish-brown color and bitterish-sweet taste. We have seen commercial fluid extracts bearing this name which, to judge from their appearance and their more decided bitterness, were evidently made from chicory-root.

EXTR. TARAXACI LIQUIDUM, *Br.*, contains half its measure of proof spirit.

Medical Uses.—It is a more permanent preparation than the decoction of dandelion, and at the same time quite as operative. *Dose*, 1 or more fluidrachms (Gm. 4), largely diluted.

EXTRACTUM TRITICI FLUIDUM, *U. S.*—FLUID EXTRACT OF TRITICUM.

Fluid extract of couch-grass, E.; *Extrait liquide de chiendent*, Fr.; *Flüssiges Quecken-extrakt*, G.

Preparation.—Triticum, finely cut, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Pack the triticum in a cylindrical percolator and pour boiling water upon it until it is exhausted. Evaporate the percolate to 80 Ccm. (19¼ fluidounces), and, having added to it 20 Ccm. (4¾ fluidounces) of alcohol, mix well and set it aside for 48 hours. Then filter the liquid, and add to the filtrate enough of a mixture composed of 4 parts (or 13 measures) of water and 1 part (or 4 measures) of alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

The manipulation for preparing this new fluid extract will be successful only if suitable provision be made to let the liquid pass from the percolator in drops, the drug being too coarse and unyielding to permit its packing like most of the other powders. We consider digestion preferable to percolation, since the drug is thus easily exhausted, and by shortening the process fermentation of the strongly saccharine liquid is prevented. For the reason stated, the liquid should be rapidly concentrated. The fluid extract is of a brown color and sweet taste.

EXTRACTUM GRAMINIS, *P. G.* Couch-grass 1 part, boiling water 5 parts; digest for 6 hours, strain, boil down to 3 parts, filter, and evaporate to the proper consistence. The yield varies between 25 and 35 per cent. The French Codex directs exhaustion with cold water, boiling, straining, and evaporating; the yield is stated to be 9 or 10 per cent.

Medical Uses.—The fluid extract diluted with water or added to some emollient infusion, such as that of flaxseed or of barley, may be freely used in irritations of the genito-urinary tract, of the intestinal canal, of the bronchia, etc. A decoction of the fresh plant is to be preferred.

EXTRACTUM UVÆ URSI FLUIDUM, *U. S.*—FLUID EXTRACT OF UVA URSI.

Extrait liquide de busserole, Fr.; *Flüssiges Bärentraubenblätter-Extrakt*, G.

Preparation.—Uva Ursi, in No. 30 powder, 100 Gm. (25 oz. av.); Glycerin 10 Gm. (2½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces).

Mix the glycerin with 90 Gm. (22½ oz. av. or 23¼ fluidounces) of diluted alcohol, and, having moistened the powder with 35 Gm. (8¾ oz. av. or 8¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the uva ursi is exhausted. Reserve the first 70 Ccm. (16¾ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Except in the reduction of the glycerin and a slight increase of the alcoholic strength, this fluid extract does not differ from that of 1870. It is of a dark-brown color and has the bitter and astringent taste of the leaves.

Medical Uses.—It probably possesses all the virtues of the plant. Like nearly all medicines intended to act upon the urinary organs, it should be given largely diluted. *Dose*, a fluidrachm (Gm. 4).

EXTRACTUM VALERIANÆ FLUIDUM, *U. S.*—Fluid Extract of Valerian.

Extrait liquide de valériane, Fr.; *Flüssiges Baldrian-Extrakt*, G.

Preparation.—Valerian, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts (22 fluidounces) of alcohol with 1 part (9 fluidounces) of water, and, having moistened the powder with 30 Gm. (7½ oz. av. or 7¾ fluidounces) of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the valerian is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Experience has shown that the stronger alcoholic menstruum of the previous pharmacopœias is not necessary for the preservation of this fluid extract. As now made, it is of a deep red-brown color and of the characteristic odor and taste of valerian. If the percolation and the evaporation of the weak tincture have been well managed, but little loss of volatile oil will occur.

Extractum valerianæ has been dismissed from most pharmacopœias. The French Codex directs it to be made with alcohol sp. gr. .914; the yield is 19 or 20 per cent. It may be readily prepared by concentrating the fluid extract at the heat of a water-bath.

Medical Uses.—An efficient preparation of this valuable drug. *Dose*, 1 fluidrachm (Gm. 4).

EXTRACTUM VERATRI VIRIDIS FLUIDUM, *U. S.*—Fluid Extract of Veratrum Viride.

Fluid extract of American veratrum, E.; *Extrait liquide de vératre américain*, Fr.; *Flüssiges Grüngermer-Extrakt*, G.

Preparation.—Veratrum Viride, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 30 Gm. (7½ oz. av. or 8¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the veratrum viride is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

No change has been made except in manipulation. The resins and alkaloids are readily taken up and held in solution by the menstruum directed, and the fluid extract is therefore about double the strength of the tincture of the same drug.

Medical Uses.—This preparation is a very potent depressor of the heart's action. *Dose*, 1 to 3 minims (Gm. 0.05–0.15).

EXTRACTUM VIBURNI FLUIDUM, *U. S.*—Fluid Extract of Viburnum.

Fluid extract of blackhaw-bark, E.; *Extrait liquide de viburne*, Fr.; *Flüssiges Viburnumextrakt*, G.

Preparation.—Viburnum, in No. 60 powder, 100 Gm. (25 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 Ccm. (24 fluidounces). Mix 2 parts (22 fluidounces) of alcohol with 1 part (9 fluidounces) of water, and, having moistened the powder with 30 Gm. (7½ oz. av. or 8 fluidounces) of menstruum, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding menstruum, until the viburnum is exhausted. Reserve the first 85 Ccm. (20½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

A newly-introduced fluid extract of a deep brown-red color and of the astringent and bitter taste of the bark.

Medical Uses.—Doubtless this preparation represents the undetermined virtues of viburnum. *Dose*, 30 to 60 minims (Gm. 2–4).

EXTRACTUM XANTHOXYLI FLUIDUM, *U. S.*—Fluid Extract of Xanthoxylum.

Fluid extract of prickly ash, E.; *Extrait liquide d'écorce de clavalier*, Fr.; *Flüssiges Zahnwehrindenextrakt*, G.

Preparation.—Xanthoxylum, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 25 Gm. (6¾ oz. av. or 7⅝ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the xanthoxylum is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

A newly-introduced fluid extract of a reddish-brown color, and possessing the acrid taste of the bark.

Medical Uses.—It is probable that this preparation contains all the active constituents of xanthoxylum. Its *dose* is stated to be from ½ to 1 fluidrachm (Gm. 2–4).

EXTRACTUM ZINGIBERIS FLUIDUM, *U. S.*—Fluid Extract of Ginger.

Extrait liquide de gingembre, Fr.; *Flüssiges Ingwer-Extrakt*, G.

Preparation.—Ginger, in No. 40 powder, 100 Gm. (25 oz. av.); Alcohol a sufficient quantity; to make 100 Ccm. (24 fluidounces). Moisten the powder with 25 Gm. (6¾ oz. av. or 7⅝ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until the ginger is exhausted. Reserve the first 90 Ccm. (21½ fluidounces) of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 100 Ccm. (24 fluidounces).—*U. S.*

Ginger is readily exhausted by alcohol; the brownish-red fluid extract is between five and six times stronger than the tincture of ginger, and has the same sensible properties, but in a higher degree. It is used in preparing Syrupus zingiberis, *U. S.*

Medical Uses.—It is a convenient substitute for the tincture on account of its greater strength, and for the infusion on account of its small bulk. *Dose*, 10 or more minims (Gm. 0.60).

FARINA TRITICI, *Br.*—WHEATEN FLOUR.

Wheat flour, E.; *Farine de froment*, *Farine de blé*, Fr.; *Weizenmehl*, G.

The grain of wheat, Triticum vulgare, *Villars*, s. Tr. sativum, *Lamarck*, ground and sifted. Bentley and Trimen, *Med. Plants*, 294.

Nat. Ord.—Graminaceæ.

Origin.—An annual or biennial herbaceous plant which, though now unknown in the wild state, is probably indigenous to Central Asia, but has been under cultivation from a very early period, and is at present raised in most countries of the temperate zones. The smooth and jointed stem (culm) is 3 to 5 feet (0.9 to 1.5 M.) high; the leaves are long, linear, somewhat rough; the terminal spikes are 3 to 4 inches (37 to 50 Mm.) long, with a flat and finely hairy axis (rachis), and four- or five-flowered, flattened spikelets, producing usually three fruits, which are oval-oblong, obtuse, grooved on the upper side, and of a yellowish or brownish color. Numerous varieties have been produced by cultivation, some having the chaff awnless or the lower paleæ more or less awned and the fruit of a white or reddish color. Spring or summer wheat (Tr. æstivum) is awned or bearded, winter wheat (Tr. hybernum) mostly awnless.

Of other species of wheat which are cultivated the following may be mentioned: Trit. turgidum, *Linné*, of which Tr. compositum, or Egyptian wheat, is a variety with compound spikes; Tr. durum, *Desfontaines*, or *horny wheat*, with long awns, including the varieties villosum, hordeiforme, and others; Tr. Spelta, *Linné*, or *spelt*, with triangular ovate and obtuse grains, which are little mealy, and Tr. monococcum, *Linné*, or *one-grained wheat*, with small spikes and three flowers in each spikelet, two being barren, the third one producing a somewhat triangular grain.

Wheat grain, like the similar graminaceous fruits, has the integuments of the fruit and seed united; underneath this covering is a layer of cells containing *gluten*, and then follows the cellular tissue of the so-called albumen or perisperm, this being filled with numerous *starch*-granules. Wheat is most generally prepared for food by grinding, and separating by means of sieves the broken integuments, or *bran*, from the fine amylaceous white portion, or *flour*.

Description.—Wheaten flour is a very fine white powder, without odor and of an insipid taste. The starch-granules, which largely compose it, have been described on page 195.

Composition.—Air-dry wheat contains, according to Millon (1854), 12 to 17 per cent. of water, 8 to 16 per cent. of gluten, about 2 per cent. of fat, about 2 per cent. of cellulose, and 1½ to 2 per cent. of ash. Older analyses of different kinds of wheat were principally made by A. Vogel (1818), Proust (1820), and Henry and Vauquelin (1822). The amount of starch varies between 60 and 70 per cent., and the weight of nitrogen between 1.6 and 2.7 per cent. A small quantity of saccharine matter is also present, and the ash contains nearly 50 per cent. of phosphoric acid. The inorganic constituents are mostly found in the bran, to the extent of over 7 per cent., while the nitrogenated principles enter chiefly the flour. If the latter be kneaded with cold water as long as the liquid becomes milky, a yellowish-gray elastic and glutinous mass remains, which is the *gluten* of Beccaria, retains about 70 per cent. of water, and consists, according to Von Bibra, in the dry state of about 70 per cent. *vegetable fibrin*, 3.8 to 9.3 *vegetable casein*, 7.5 to 19.5 *glutin*, and 4.6 to 8.2 per cent. of fat. When fresh it dissolves in dilute phosphoric acid and in solution of potassa. On drying it assumes a hornlike appearance and partly loses its solubility. According to Boussingault, it contains 15 per cent. of nitrogen.

To purify it, Ritthausen (1862–67) dissolves it in cold very dilute potassa solution (1 to 1000 parts of water), decants from the undissolved starch, and precipitates with acetic acid. The precipitate is repeatedly treated with fresh portions of alcohol, commencing with spec. gr. .914, and increasing the strength finally to absolute alcohol. After another washing with ether the insoluble portion constitutes *gluten-casein*, which is slightly soluble in acetic acid, freely soluble in potassa, and becomes insoluble by heat. On evaporating the united alcoholic liquids to one-half and cooling, *gluten-fibrin* is separated, which is freed from adhering casein by dissolving it repeatedly in 60 and 70 per cent. alcohol. It is freely soluble in dilute acetic acid, and when boiled with water, in which it is insoluble, it is converted into a jelly. After the separation of gluten-fibrin the greater portion of the alcohol is evaporated; the precipitate appearing on cooling is treated with a little alcohol, washed with ether, dissolved in a little 65 per cent. alcohol, and precipitated by absolute alcohol. The precipitate is *mucedin;* the solution contains *glutin* or *gliadin.* The former yields with cold or boiling water a milk-like liquid; the latter is soluble in water, alcohol, acetic acid, potassa, etc., the aqueous solution being precipitated by the salts of the heavier metals; glutin contains sulphur and 18 per cent. of nitrogen. These principles are the most important ones of the *vegetable protein compounds.*

Off. Prep.—Cataplasma fermenti, *Br.*

Medical Uses.—Wheaten flour is often used as a dusting-powder to allay the heat and pain of local inflammations, such as superficial *burns* and *scalds*, *erysipelas*, *erythema*, *intertrigo*, *prickly heat*, etc. But it is very far inferior for such purposes to powdered starch. Its dietetic uses need not here be considered, but one among them, which is also partly medicinal, is worthy of notice: it is the administration of an uncooked paste made from wheaten flour in many cases of *diarrhœa*, and especially in those depending upon debility. The summer diarrhœas of this climate are usually curable by this simple remedy if the patient rests and abstains from other food.

FEL BOVIS, *U. S.*—OX-GALL.

Fel bovinum, *Fel tauri*, *Bilis bubula.*—*Ox-bile*, E.; *Fiel (Bile) de bœuf*, Fr.; *Ochsengalle*, *Rindsgalle*, G.

The fresh gall of Bos Taurus, *Linné.*

Class Mammalia. Order Ruminantia.

Origin and Properties.—Bile is a green or brownish-green viscid, transparent, or more frequently translucent, liquid which is separated by the liver in the gall-bladder; it has a peculiar odor, which becomes prominent on heating, a nauseous, sweet, and bitter taste, a specific gravity of about 1.02, a slight alkaline or sometimes a neutral reaction, and dissolves completely when agitated with water. On warming it becomes thinner, and may then be readily strained through moistened muslin, whereby fragments of tissue, epithelial cells, etc. are removed. When mixed with its own weight or twice its bulk of alcohol a precipitate is produced in fresh bile consisting almost exclusively of mucilaginous matter, and the liquid filtered from it and freed from alcohol by evaporation resists putrefaction for a long time.

Constituents.—The principal coloring matter of bile appears to be *bilirubin*, formerly called *colepyrrhin*, $C_{16}H_{18}N_2O_3$, which is slightly soluble in alcohol and ether, but dissolves in chloroform, bisulphide of carbon, and benzol; it forms an amorphous or crystalline orange-colored or red powder. It is accompanied by *bilifuscin*, a dark olive-brown powder soluble in alcohol and in hot chloroform; *biliprasin*, a green-black powder insoluble in chloroform, soluble in alcohol, with a green, or in the presence of ammonia with a brown, color; and *bilihumin*, a blackish powder insoluble in simple solvents and often found in biliary concretions. *Biliverdin*, formed by the oxidation of bilirubin, is a dark-green powder soluble in alcohol with a green color and insoluble in water, ether, and chloroform (Städeler, 1864). The fatty matter of bile is chiefly *cholesterin*, $C_{26}H_{44}O$, which is also an ingredient of the brain, the nerves, the yelk of eggs, etc. It crystallizes in colorless laminæ or prisms, is unchanged by boiling potassa, dissolves in ether, chloroform, and hot alcohol, and is chemically a monatomic alcohol. Ox-gall contains about 3 per cent. each of the sodium salts of two peculiar acids, named *glycocholic* (the *cholic acid* of some older authors) and *taurocholic* (Strecker's *choleic*) *acid*, a part of the former of which, together with the remaining pigments, is precipitated by neutral acetate of lead from fresh bile previously decolorized by animal charcoal. When to the filtrate from this precipitate subacetate of lead is carefully added until the insoluble compound formed has a white color, the precipitate will consist of glycocholate and taurocholate of lead, and the filtrate contains only taurocholic acid, which is precipitated on the further addition of basic acetate of lead. Hüfner (1874) observed that glycocholic acid usually crystallizes out when fresh beef-gall is mixed with an excess of hydrochloric acid and ether. Emich (1882) prefers the use of benzol in the place of ether, and ascertained that in those cases where crystals are not obtained by this treatment the glycocholate has been reduced to about ¾ per cent. and the taurocholate increased to about 5½ per cent. Glycocholic acid, $C_{26}H_{43}NO_6$, is in very fine white needles of a silky lustre and a sweetish-bitter taste. At 20° C. (68° F.) it requires for solution 11,100 parts of benzol, 9090 parts of chloroform, 1075 parts of ether, 36.3 parts of 50 per cent. alcohol or 3030 parts of water, but is much more soluble in solutions of taurocholic acid. On being boiled with acids it is converted into insoluble *paraglycocholic acid*, melting at 183° C. (361.4° F.), while glycocholic acid melts at 132° C. (269.6° F.). Its salts have a sweet taste and are mostly soluble in water and alcohol. Boiled with alkalies, it takes up 1 molecule of water and splits into *glycocol* (*glycin* or *amidoacetic acid*), $C_2H_5NO_2$, and *cholic acid* (*cholalic acid* of Strecker), $C_{24}H_{40}O_5$, which has a bitter and afterward sweetish taste. *Taurocholic acid*, $C_{26}H_{45}NSO_7$, is in silky acicular crystals easily soluble in water and alcohol, and when boiled with alkalies decomposed into *cholic acid* and *taurin* (*amido-isethionic acid*), $C_2H_7NSO_3$.

Ox-bile contains the two biliary acids in nearly equal proportions; human bile mainly taurocholic acid, which is found in dog-bile almost to the exclusion of other acids. Both acids, dissolved in water and mixed with a little syrup and afterward with oil of vitriol, acquire a red color, changing to carmine, purple, and violet (*Pettenkofer's test for bile*). Using syrupy phosphoric in place of sulphuric acid, Drechsel (1881) observed that the reaction is less interfered with by an excess of sugar. Cholic acid shows a similar behavior, and the coloration is also obtained with unpurified bile, and with glucose as well as cane-sugar; according to Van den Broek (1846), the principal constituents of bile give the reaction with sulphuric acid without the previous addition of sugar.

Pharmaceutical Preparations.—FEL BOVIS INSPISSATUM, *U. S.;* EXTRACTUM FELLIS BOVINI.—Inspissated ox-gall, *E.;* Fiel épaissi, Extrait de bile de bœuf, *Fr.;* Eingedickte Rindsgalle, *G.*—Fresh ox-gall 100 parts; to make 15 parts. Heat the ox-gall to a temperature not exceeding 80° C. (176° F.); strain it through muslin, and evaporate the strained liquid, on a water-bath in a porcelain capsule, to 15 parts.—*U. S.* By this process the fragments of tissue present in bile are strained off and the water is mostly evaporated. Following strictly the letter of the pharmacopœial directions, the product must vary in consistence and permanence. The French Codex more properly directs the evaporation to be continued until a firm extract is obtained; the yield is from 11 to 13, or sometimes 15, per cent.

FEL BOVIS PURIFICATUM, *U. S.;* FEL BOVINUM PURIFICATUM, *Br.;* FEL TAURI DEPURATUM.—Purified ox-gall or ox-bile, *E.;* Fiel de bœuf purifié, Bile purifié, *Fr.;* Gereinigte Ochsengalle, *G.*—Fresh ox-gall 3 parts (30 oz. av.); Alcohol 1 part (10 oz. av. or 11¾ fluidounces). Evaporate the ox-gall in a porcelain capsule on the water-bath to 1 part (10 oz. av.); then add to it the alcohol, agitate the mixture thoroughly, and let it stand, well covered, for 24 hours. Decant the clear solution, filter the remainder, and, having mixed the liquids and distilled off the alcohol, evaporate to a pilular consistence.—*U. S.* The British Pharmacopœia directs fresh ox-bile 1 pint to be evaporated to 5 fluidounces, and precipitated with 10 fluidounces of rectified spirit; the remainder of the process is identical with the foregoing. The object is the removal of the mucilage, whereby ox-gall is rendered less prone to change.

Both preparations are deep yellowish-green extract-like masses having the peculiar odor, taste, and behavior of bile, and being completely soluble in water. Only purified ox-gall is completely soluble in spirit, and its aqueous solution is not precipitated by alcohol.

The German Pharmacopœia of 1872 directed a still purer article, from which, besides the mucilage, the biliary coloring matters also have been removed; the decolorization is effected after the removal of the mucilage by distilling off the alcohol and then adding to the residue recently-purified and well-washed still moist animal charcoal; 8 to 10 parts of it will be sufficient for 100 parts of bile. The mixture is occasionally agitated, and when the liquid shows only a slight yellow color it is passed through a moistened filter, evaporated in a porcelain capsule by means of a water-bath, and then completely exsiccated in a drying closet or by means of a sand-bath, the heat of which must not be allowed to rise above 100° C. (212° F.). If spread upon glass plates it may be scaled, or the dry mass is reduced to powder and preserved in small well-corked vials. The yield is nearly 7 per cent. It forms a yellow or yellowish-white powder, which attracts moisture from the atmosphere and dissolves completely in water and alcohol, the solutions being of a yellowish color and of the sweet and bitter taste of bile. When heated to redness it burns, leaving a small amount of a white alkaline ash. This preparation is sometimes sold as *choleate* or *choleinate of sodium*.

Physiological Action.—The function of the bile is far from being thoroughly understood, for its composition is exceedingly complex, but, along with the pancreatic juice, it seems intended to neutralize the acidity of the chyme received by the duodenum from the stomach, and at the same time to emulsify the fatty matters which the acid secretions of the stomach are not fitted to prepare for absorption. It is further probable that the excess of bile not so employed tends to quicken the peristaltic movements of the bowels. It is at least pretty certain that when the bile is profusely secreted it occasions diarrhœa. It is quite certain that in doses of from half an ounce to an ounce fresh ox-bile acts as a laxative, and that if its use be persisted in it is very apt to excite a burning sensation in the rectum and to induce hæmorrhoids. On the other hand, it is a familiar fact that when from any cause bile enters the stomach from the intestine it occasions loss of appetite, nausea, and even vomiting—for the reason, doubtless, that it neutralizes the gastric juice, which during healthy digestion is always strongly acid. In this way, probably, it may impair or wholly prevent the gastric digestion of starchy food. There is no physiological probability nor any clinical evidence to show that bile, however introduced into the stomach, can promote in any way the digestion of food in that organ. That when administered medicinally it may, on reaching the duodenum, reinforce the action of the bile secreted there, is indeed probable. When the latter secretion, therefore, is deficient, it may tend to prevent the fermentative and putrefactive decomposition of the food, aid in the solution of its fatty constituents, promote the peristaltic action of the intestine, and in a sufficient dose provoke purgation.

Medical Uses.—Ox-gall (or pig-gall, which is supposed to be more analogous to human bile) is thought to be an efficient remedy for habitual *constipation* depending upon atony of the intestine. After its use the bowel is not so apt to become torpid as after the use of ordinary purgatives. It is perhaps of some interest to note that the medicine which most nearly resembles it in this respect is aloes, which, like bile, is very bitter and tends to irritate the rectum. The *dyspeptic* derangements which are apt to attend constipation, and which often depend upon a distended colon compressing the liver or its ducts, usually subside under purgation of any kind. It is very doubtful if ox-gall exhibits any of the special virtues which have been attributed to it under these circumstances. In *jaundice* depending upon catarrh of the bile-ducts this medicine is sometimes found advantageous, probably in virtue both of its purgative operation and of its supplying for duodenal digestion the agent which the liver fails to secrete. The objection to its use, that it will be absorbed into the blood already overcharged with bile, is more specious than sound. Bile has been used as a *vermifuge* for lumbricoid ascarides. As a topical remedy it has been applied with alleged success to the treatment of various *glandular* hypertrophies and indurations, but this method has not been accepted.

The administration of bile in a liquid state is too disgusting to be recommended. It may be given in the form of inspissated bile, which is officinal. 5 grains of this preparation are estimated to be equal to 100 grains of fresh bile. It may be made into pills coated with gelatin or enclosed in gelatin capsules. If taken after meals this coating delays the escape of the bile until the food is ready to pass through the pylorus. About 10 grains (Gm. 0.60) may be given at a dose.

FERRI ARSENIAS, *Br.*—Arseniate of Iron.

Ferrum arsenicicum, *Arsenias ferrosus.—Ferrous arseniate*, E.; *Arséniate de fer*, Fr.; *Arsensaures Eisen*, G.

Formula $3Fe(FeO)AsO_4.16H_2O$. Molecular weight 1088.1.

Preparation.—Dissolve Arseniate of Sodium, 15¾ ounces, in about 5 pints, and Sulphate of Iron, 20¾ ounces, in about 6 pints, of boiling Distilled Water; mix the two solutions, and add Bicarbonate of Sodium, 4½ ounces, dissolved in a little distilled water; stir thoroughly; collect the white precipitate which has formed on a calico filter, and wash until the washings cease to be affected by a dilute solution of chloride of barium. Squeeze the washed precipitate between folds of strong linen in a screw press, and dry it on porous bricks in a warm air-chamber whose temperature shall not exceed 100° F.—*Br.*

The reaction takes place between 3 mol. of ferrous sulphate and 2 mol. of sodium arseniate, which corresponds with the quantities of the crystallized salts given above. The Pharmacopœia directs 15¾ ounces of the sodium salt, dried at 300° F., which is an excess of about 66 per cent. On mixing the two solutions, ferrous arseniate ($Fe_3As_2O_8$) is precipitated, but a portion remains dissolved in the acid liquid, and is recovered by nearly neutralizing with sodium bicarbonate, carbonic acid gas being evolved. The white precipitate is very bulky, and while being washed to free it from the mother-liquor and dried it is oxidized and converted into ferroso-ferric arseniate of the formula given above (Wittstein, 1866). The change is indicated by the gradual disappearance of the white color until the salt finally becomes olive-green or blue-green. In the reaction and final result the process corresponds nearly with the one for the blue phosphate of iron.

Properties.—Arseniate of iron is a green or blue-green amorphous powder insoluble in water and alcohol, but dissolving readily in dilute hydrochloric acid, yielding a bright-yellow solution in which blue precipitates are produced with both ferrocyanide and ferridcyanide of potassium, and which yields with sulphuretted hydrogen first a milkiness (sulphur) and afterward a yellow precipitate of sulphide of arsenic. It contains 31.68 per cent. of As_2O_5 and 26.4 per cent. of water, most of which is expelled when heated to 100° C. (212° F.), the remainder being given off at a red heat without loss of arsenic. It may be distinguished from phosphate of iron, which resembles it in appearance, by boiling a small portion with an excess of caustic soda, filtering and neutralizing exactly with nitric acid, when a brick-red precipitate of arseniate of silver will be produced on the addition of silver nitrate. Phosphate of iron similarly treated yields a yellow precipitate. To determine the amount of ferrous salt, which theoretically corresponds to 19.82 per cent. of ferrous oxide, the British Pharmacopœia directs the dissolving of 100 grains in an excess of diluted sulphuric acid, and adding thereto gradually volumetric solution of bichromate of potassium until a drop of the acid liquid ceases to give a blue precipitate with potassium ferricyanide; at least 225 grain-measures of the test-solution should be required for the purpose, indicating 3.78 per cent. of iron in the ferrous state.

Medical Action and Uses.—It is difficult to conjecture on what grounds this compound was made officinal, since the proportion of iron contained in $\frac{1}{16}$ gr. (Gm. 0.004), the dose of it recommended, is too inconsiderable to have any curative action. Iron and arsenic are, both of them, medicines the dose of which must vary greatly and frequently with the nature of the disease and the special condition of the patient, and it is better that they should be given separately. To any liquid preparation of iron the solution of potassium arsenite may be added at the time of administration. The arseniate of iron may be given in a pill, and in the *dose* of $\frac{1}{20}$ grain (Gm. 0.003), gradually increased to ½ grain (Gm. 0.03).

FERRI BROMIDUM.—Bromide of Iron.

Ferrum bromatum.—Ferrous bromide, E.; *Bromure ferreux*, Fr.; *Eisenbromür, Ferrobromid*, G.

Formula $FeBr_2$. Molecular weight 215.5.

Preparation and Properties.—It is prepared by gradually adding 2 parts of bromine to 1 part of iron filings or wire and 10 parts of water, and digesting until the liquid has a greenish color, when it is filtered and evaporated in an iron dish to dryness. It forms a grayish-black mass which, on exposure to air, acquires a brown color through oxidation. From its hot concentrated solution in water it may be obtained in transparent pale-green rhombic plates of the composition $FeBr_2.6H_2O$. On being heated to redness in contact with the atmosphere it is converted into ferric oxide and ferric bromide, the latter subliming in yellow scales. An aqueous solution of bromide of iron, preserved by sugar, has been proposed as a convenient preparation. (See Syrupus Ferri Bromidi.)

Physiological Action and Medical Uses.—5 grains of this substance dissolved in 2 drachms of water and injected into a dog's jugular vein occasioned dilated pupils, spasmodic twitching, and death in 10 minutes; 10 grains introduced in the same manner produced a general tetanic spasm, in which the animal died. In both cases the veins were engorged, the heart was distended with coagula, and its irritability was very faint. Half a drachm thrown into the stomach brought on violent vomiting, dilatation of the pupils, rapid pulse and respiration, and diarrhœa with dark stools. Signs of inflammation were found in the lungs and stomach.

It may seem singular that two agents so physiologically antagonistic as iron and bromine should have been united in the same medicine, since the one tends to produce what the other is employed to subdue. Practically, however, the bromine of the compound is its only active element, as may be inferred from the experiments just related. This preparation has been recommended as an energetic astringent and anti-strumous medicine, and has been prescribed in *hypertrophy* of the heart and uterus, for *scrofulous glandular swellings*, both topically and internally, in *spermatorrhœa*, *blenorrhœa*, *leucorrhœa*, *hysteria*, *chorea*, and pulmonary *phthisis*. It has been given in doses of from ½ grain to 2 grains (Gm. 0.3–0.12). There is not the slightest evidence of its ever having been useful as a medicine, and, as it is dangerously poisonous, it ought never to be used internally. It is now, says Husemann, entirely obsolete, and Trousseau and Pidoux pronounce it unworthy of special notice.

FERRI CARBONAS SACCHARATUS, *U. S., Br.*—SACCHARATED CARBONATE OF IRON.

Ferrum carbonicum saccharatum, P. G.; *Carbonas ferrosus saccharatus.—Saccharated ferrous carbonate*, E.; *Saccharure de proto-carbonate de fer (de carbonate ferreux)*, Fr.; *Zuckerhaltiges Ferrocarbonat*, G.

Formula of ferrous carbonate $FeCO_3.H_2O$. Molecular weight 133.9.

The mixture of ferrous carbonate with sugar contains 20.5 per cent. *Br.*, 10 per cent. *P. G.*, 9.67 per cent. *U. S.*, of iron.

Preparation.—Sulphate of iron 10 parts; Bicarbonate of Sodium 7 parts; Sugar, in fine powder, 16 parts; Distilled Water a sufficient quantity. Dissolve the sulphate of iron in 40 parts of hot distilled water and the bicarbonate of sodium in 100 parts of warm distilled water, filter the solutions separately and allow them to cool. Add the solution of sulphate of iron gradually to the solution of bicarbonate of sodium contained in a capacious flask, and mix thoroughly by shaking. Fill up the flask with boiling distilled water and set the mixture aside for 2 hours. Draw off the supernatant liquid from the precipitate by means of a siphon, and then fill the flask again with hot distilled water and shake it. Pour off the clear liquid, and repeat the operation until the decanted liquid gives but a slight turbidity with test solution of chloride of barium. Transfer the drained precipitate to a porcelain capsule containing the powdered sugar, and mix intimately; evaporate the mixture to dryness by means of a water-bath, and reduce the product to powder. Keep the powder in small, well-stopped vials.—*U. S.* Using ounces for parts, the yield will be 20¾ ounces.

Both the British and German Pharmacopœias mix the iron and alkali solutions while hot, and thereby avoid absorption of oxygen during cooling; in other respects the manipulation does not materially differ. For 10 parts of ferrous sulphate there are ordered 7 parts of sodium bicarbonate, *P. G.*, 6¼ parts of ammonium carbonate, *Br.*; and the ferrous carbonate thus obtained is mixed with sugar 5 parts, *Br.* (yield 9¾ parts)—first with milk-sugar 2 parts and sugar 6 parts—and when dry with sufficient sugar to make 20 parts, *P. G.*

Ferrous sulphate and sodium bicarbonate decompose each other, forming ferrous carbonate, carbonic acid gas, and sodium sulphate; thus: $FeSO_4 + 2NaHCO_3 = FeCO_3 + CO_2 + H_2O + Na_2SO_4$. The operation must be performed with the air as much excluded as possible; hence the importance of employing boiling water from which the air has been expelled, of generating carbonic acid gas during the operation by the use of sodium bicarbonate, of performing the washing by decantation in deep cylindrical and well-covered vessels, and of collecting and draining, or, as directed by the Br. P., expressing the precipitate rapidly; the subsequent addition of the sugar will, in a measure, protect it against oxidation until it has been finally dried.

Properties.—Ferrous carbonate forms small lumps or a gray or greenish-gray inodorous powder having a neutral reaction to moistened litmus-paper and a sweet taste like that of sugar, followed by a very feeble chalybeate taste. On exposure to dry air it is slowly, or in damp air rapidly, oxidized, and is therefore best preserved in small well-filled and sealed vials; if it has changed to a brown color and effervesces only slightly with acids, it should be rejected. When heated in contact with the air it becomes black, evolving the odor of burning sugar, and is finally converted into red-brown ferric oxide. Water dissolves only the sugar, but the powder is completely dissolved with effervescence in dilute hydrochloric acid, and this solution gives blue precipitate with both potassium ferricyanide and ferrocyanide, showing the presence of ferrous and of ferric salt. Pure ferrous carbonate contains 53.7 per cent. of ferrous oxide; the anhydrous salt, $FeCO_3$ (mol. weight 115.9), represents 62.07 per cent. of the oxide.

Tests.—The powder, placed upon moistened red litmus-paper, should not change the red color to blue (absence of alkali). The solution in diluted hydrochloric acid should yield no precipitate or but a slight turbidity with chloride of barium, indicating only traces of sulphate left behind from the mother-liquor. "If 8 Gm. of the saccharated carbonate of iron be dissolved in water with an excess of hydrochloric acid, and the solution mixed with 33 Ccm. of the volumetric solution of bichromate of potassium, the mixture should still afford a blue color or precipitate with test-solution of ferricyanide of potassium (presence of at least 15 per cent. of anhydrous ferrous carbonate)."—*U. S.*

The quality indicated requires, however, 34.5 (not 33) Ccm. of the volumetric solution. The Br. P. demands about one-third of anhydrous ferrous carbonate, and that 3 Gm. are oxidized by at least 28.75 Ccm. of the volumetric solution of potassium bichromate, indicating not less than 16.1 per cent. iron or 28.32 per cent. carbonate. If none of the iron had been peroxidized, the powder would contain 20.09 per cent. *U. S.*, 20.85 per cent. *P. G.*, 42.8 per cent. *Br.*, of anhydrous ferrous carbonate. The German Pharmacopœia determines the total iron only.

Off. Prep.—Pilula ferri carbonatis, *Br.*

Medical Action and Uses.—This preparation is intended to take the place of the subcarbonate, one of the oldest pharmaceutical preparations of iron, and which was intended to be a substitute for rust of iron, which from time immemorial had been used in medicine. It is one of the most employed members of its class, and may be recommended in all forms of *anæmia* and *anæmic chlorosis*, and in *neuralgia*, *chorea*, and other nervous affections depending upon a deficiency of red corpuscles in the blood. In large doses, mixed with water, it may be resorted to when the hydrated peroxide cannot be procured in cases of poisoning by *arsenious acid.* The *dose* is 5 grains (Gm. 0.30) and upward.

FERRI CHLORIDUM, *U. S.*—CHLORIDE OF IRON.

Ferrum sesquichloratum, P. G.; *Ferrum muriaticum oxydatum*, *Chloridum vel Chloruretum ferricum*, *Ferri perchloridum.*—*Sesquichloride (Perchloride) of iron*, *Ferric chloride*, E.; *Perchlorure de fer*, *Chlorure ferrique*, Fr.; *Eisenchlorid*, G.

Formula $Fe_2Cl_6.12H_2O$. Molecular weight 540.2.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 15 parts (1¾ oz. av.); Hydrochloric Acid 86 parts (9½ oz. av.); Nitric Acid, Distilled Water, each a sufficient quantity. Put the iron wire into a flask capable of holding double the volume of the intended product; pour upon it 54 parts (6 oz. av.) of hydrochloric acid previously diluted with 25 parts (2¾ oz. av.) of water, and let the mixture stand until effervescence ceases; then heat it to the boiling-point, filter through paper, and, having rinsed the flask and iron wire with a little boiling distilled water, pass the rinsings through the filter. To the filtered liquid add 27 parts (3 oz. av.) of hydrochloric acid, and pour the mixture slowly and gradually, in a stream, into 8 parts (1 oz. av.) of nitric acid contained in a capacious porcelain vessel. After effervescence ceases apply heat, by means of a sand-bath, until the liquid is freed from nitrous odor and ceases to yield a blue precipitate with test solution of ferricyanide of potassium. Should this reagent produce a blue color, add a little more nitric acid and evaporate off the excess. Then add the remaining 5 parts (½ oz. av.) of hydrochloric acid and enough distilled water to make the whole weigh 60 parts (6¾ oz. av.), and set this aside, covered with glass, until it forms a solid crystalline mass. Lastly, break it into pieces, and keep the fragments in a glass-stoppered bottle, protected from light.—*U. S.*

In making this salt an excess of iron is advantageously used to facilitate the saturation of the first portion of hydrochloric acid; the metal, in combining with the chlorine of the acid, will produce ferrous chloride, $FeCl_2$, hydrogen being given off. The whole liquid should be passed through a paper filter, and the filtrate at once mixed with hydrochloric acid, exactly equal to one-half of the first portion, to prevent the deposition of ferric oxychloride, which would be formed by the oxidizing influence of the atmospheric air. The mixture may now be heated to near boiling, and the nitric acid poured in small portions down the side of the porcelain capsule, and the mixture continually stirred; or, to avoid loss of hydrochloric acid, the cold acid solution is now directed to be poured into nitric acid, when effervescence will commence and the oxidation be completed on applying heat. The extrication of the red vapors causes the liquid to froth considerably, hence the necessity of using a capsule holding at least three times the measure of the liquid. Diehl (1867) prefers to heat about three-fourths of the nitric acid, and to add to it gradually the hot mixture of ferrous chloride and hydrochloric acid, afterward more nitric acid as required; frothing is avoided by this manipulation. The object of this part of the process is to transform the ferrous into ferric chloride; the hydrochloric and nitric acids react upon each other, with the production of chlorine, which unites with the ferrous chloride, and of nitric oxide, which escapes, water being formed at the same time, according to the equation $6FeCl_2 + 6HCl + 2HNO_3 = 3Fe_2Cl_6 + 2NO + 4H_2O$. The liquid should now be tested for ferrous salt by placing a drop upon a porcelain plate and adding a drop of freshly-dissolved potassium ferricyanide. If a blue color or precipitate is produced a little more nitric acid is required. Should the brown color be merely darkened, the iron has been all oxidized; but there may be an excess of nitric acid, which is detected by placing a drop of the liquid upon a plate in contact with a little ferrous sulphate and adding a drop of strong sulphuric acid. The production of a black color indicates the presence of free nitric acid, which cannot be completely removed by boiling, but requires the addition of a little hydrochloric acid and the application of heat to expel the nitric oxide and chlorine formed, until no more nitric acid is shown by the test. During this and the subsequent operation the use of iron spatulas or stirrers must be carefully avoided; only porcelain or glass should be used.

On evaporating a solution of ferric chloride to the crystallizing point, vapors containing hydrochloric acid are given off as soon as the temperature reaches a certain point, which varies with the strength of the solution; and if the heat is raised to the boiling-point ferric chloride is mechanically carried off. Should evaporation become necessary, it should be done at a gentle heat, and it will be found of advantage to have a slight excess of hydrochloric acid at the beginning of the evaporation. If this acid has been of the officinal strength, about 63 parts (7 oz. av.) of crystallized ferric chloride will be finally obtained. The crystallization may be effected by keeping the capsule in a warm place until the contents solidify, but the crystals will then be very damp from enclosed moisture. It is far better to follow the directions of the Pharmacopœia, and have the liquid of less weight than the expected salt; on cooling, the mass will now remain liquid, and is set aside loosely covered to protect it from dust and other impurities, and at the same time to admit the atmosphere, from which it will attract moisture and gradually crystallize. The crystals begin to form as small circular nodules having a radiated appearance, floating upon the liquid, and increasing in size until the entire liquid forms a solid mass, which adheres firmly to the vessel. By warming it slightly the mass is readily detached, and should be at once broken into pieces, and put into dry, well-stopped bottles.

Properties.—The officinal ferric chloride forms orange-colored wart-like pieces which have a crystalline texture and a slight odor of hydrochloric acid, are very deliquescent, forming a thick red-brown liquid having a density of about 1.55, and formerly known as *Oleum martis per deliquium.* The salt is readily and completely soluble in water, alcohol, and ether, yielding yellowish-brown solutions of an acid reaction and a strongly styptic ferruginous taste. The crystals fuse, according to Ordway, at 35.5° C. (96° F.); at a higher temperature they are partly decomposed and volatilized. The aqueous solution shows the reactions of ferric salts and chlorides in yielding a red-brown precipitate with ammonia-water or other alkalies, a blue one with potassium ferrocyanide, and a white one, insoluble in nitric acid, with silver nitrate.

Tests.—The complete solubility in the solvents mentioned is generally an indication of the absence of other metallic salts. The presence of nitric acid or of ferrous salt is detected as described above. A few drops of an aqueous solution of the salt, to which a small crystal of ferrous sulphate has been added, should, on the addition of a drop of strong sulphuric acid, not show a black or brown-black color, and a few drops of a similar solution should, on the addition of a drop of freshly-prepared solution of potassium ferricyanide, produce an olive-brown color, without a trace of blue. A solution of the chloride in water should not be precipitated by barium chloride (absence of sulphate), and when precipitated by an excess of ammonia the filtrate, on evaporation to dryness, should leave only ammonium chloride, which is completely volatilized at a red heat (absence of alkalies, alkaline earths, zinc, etc.). Copper, if present, is detected by the black precipitate formed in the ammoniacal filtrate with sulphuretted hydrogen, and zinc by the white precipitate formed under the same condition. A 1 per cent. solution of the salt in distilled water when heated to boiling in a test-tube should remain clear (absence of oxychloride); the hot liquid is of a dark red-brown color, and is precipitated by sodium chloride, the precipitate being soluble again in pure water, but on continuing the heat the liquid becomes permanently turbid (Krecke, *Jour. Prak. Chem.*, 1871, iii. p. 286).

Allied Salt.—FERRUM CHLORATUM, *P. G.* 1872; Ferrum muriaticum oxydulatum, Chloridum ferrosum.—Ferrous chloride, *E.;* Protochlorure de fer, *Fr.;* Eisenchlorür, *G.* Formula $FeCl_2.2H_2O$. Molecular weight 162.7—520 parts of hydrochloric acid are allowed to act upon 110 parts of iron wire, finally with the application of heat, until hydrogen gas ceases to be given off, when the solution is rapidly filtered. If now 1 part of hydrochloric acid and sufficient distilled water to make the whole weigh 1000 parts are added, *Liquor ferri chlorati* (s. *muriatici oxydulati*) is obtained. The salt is prepared by evaporating the solution immediately after filtration, and very rapidly, until a pellicle is formed, when 1 part of hydrochloric acid is added, and the evaporation continued with stirring until the mass becomes rather stiff; the capsule is now removed from the fire, and the salt, after it has solidified, is powdered. It is a greenish-white powder, and dissolves in its own weight of water, affording a green solution, which, on being mixed with three times its measure of alcohol, yields no precipitate (absence of ferrous sulphate, etc.). Since ferrous chloride is very easily oxidized on exposure to air, Hager recommended to deoxidize the recently-prepared and powdered salt by exposing it in a thin layer for several hours to the direct sunlight. It contains 34.3 per cent. of iron, 43.6 of chlorine, and 22.1 of water of crystallization. Its concentrated aqueous solution yields crystals containing $4H_2O$ = 36.2 per cent., which are deliquescent in moist air and on exposure rapidly turn yellowish-green.

Medical Action and Uses.—Chloride of iron is a powerful astringent and hæmostatic. It is chiefly used topically for stanching *hæmorrhage*, as in epistaxis, in hæmoptysis (by inhaling an atomized solution), in bleeding from leech-bites, from the jaw after the extraction of teeth, from the tonsils, from ulcers of the neck of the uterus, from the umbilical cord, from the uterus during and subsequent to abortion, from fungous tumors of various parts, etc. It is reported to have acted favorably as a caustic upon *lupoid* or *scrofulous* ulcers when dissolved in 2 parts of water, and upon various chronic *diseases of the skin* when applied in an ointment (1 : 20). St. Germain claims to have cured vascular *nævi* by injecting them once a week with a single drop of a solution made with 5 parts of "perchloride of iron," 3 parts of chloride of sodium, and 12 parts of distilled water (*Practitioner*, xxvi. 361). Chloride of iron, if kept in a bottle, gradually deliquesces, and may then be applied with a glass rod or brush. As a hæmostatic, 5 parts of the chloride may be dissolved in 100 parts of distilled water and applied on lint.

(A more detailed account of the action and uses of this preparation will be found in the article on SOLUTION OF CHLORIDE OF IRON.)

Ferrous chloride, it is stated by German authorities, may be given internally in doses of from 1 to 4 grains (Gm. 0.06–0.20).

FERRI CITRAS, *U. S.*—CITRATE OF IRON.

Ferrum citricum, *Citras ferricus.*—*Ferric citrate*, E.; *Citrate de sesquioxyde de fer*, *Citrate ferrique*, Fr.; *Citronensaures Eisenoxyd*, *Ferricitrat*, G.

Formula $Fe_2 2C_6H_5O_7.6H_2O$. Molecular weight 597.8.

Preparation.—Solution of Citrate of Iron a convenient quantity. Evaporate the solution at a temperature not exceeding 60° C. (140° F.) to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.—*U. S.*

At a higher temperature than indicated by the formula the salt is slowly reduced to ferrous compound. When the solution is concentrated to a thick, syrupy liquid it is spread on plates, and then dried in a dry or warm place. Failure in scaling is usually due to the incomplete saturation of the citric acid with ferric hydrate, occasionally to the presence of saline impurities retained by the negligently washed hydrate. The yield is near 44 per cent.

Properties.—If of the proper composition, the salt readily comes off the plates in the form of thin, transparent, garnet-red scales which yield a red-brown powder, are permanent in the air, inodorous, and have a faint ferruginous taste and an acid reaction. It is insoluble in alcohol, and dissolves completely but slowly in cold water, and easily in boiling water. Its solution is darkened, but not precipitated, by ammonia. When strongly heated the salt is decomposed, emitting fumes having the odor of burnt sugar and leaving an ash consisting of ferric oxide, weighing 26.73 (26, *U. S.*) per cent. Wittstein obtained from the dry salt, by ignition, 29.5 to 30 per cent. of oxide of iron; and this result agrees with the statement of Rother (1883), that the scales lose only 10 per cent. of water; this would make the formula $Fe_2(C_6H_5O_7)_2.3H_2O$ and the molecular weight 543.8. On being boiled with an excess of potassa solution the salt or its solution yields a precipitate of ferric hydrate, and the filtrate, on being neutralized with acetic acid and then boiled with test solution of calcium chloride, gives a white granular precipitate of calcium citrate.

Tests.—Ferric citrate is not liable to adulteration. The presence of tartaric acid would be detected by acidulating the solution with a few drops of hydrochloric acid, and then adding some potassium acetate, when cream of tartar would be precipitated. The ash obtained by incinerating the salt should not have an alkaline reaction (absence of fixed alkalies).

Ammonio-citrate of iron is sometimes sold as *soluble citrate of iron;* it resembles the former in appearance and behavior, except that it has a neutral reaction, is more readily soluble in cold water, gives off the odor of ammonia when heated with an excess of potassa solution, and does not strike a blue color on mixing its solution with potassium ferrocyanide unless it be acidulated with hydrochloric acid.

Medical Uses.—This is a mild preparation, and suitable for children and persons of a delicate stomach. It should be given in a watery solution, and in the *dose* of from 5 to 20 grains (Gm. 0.30–1.20).

FERRI ET AMMONII CITRAS, *U. S.*, *Br.*—CITRATE OF IRON AND AMMONIUM.

Citras ammonico-ferricus, F. Cod.; *Ferrum citricum ammoniatum*, *Ferri ammonio-citras*, *Ferro-ammonium citricum.—Ammonio-ferric citrate*, *Ammonio-citrate of iron*, *Soluble citrate of iron*, E.; *Citrate de fer et d'ammoniaque* (*de fer ammoniacal*), *Citrate ferrique ammoniacal*, Fr.; *Ferriammoncitrat*, *Citronensaures Eisenoxyd-Ammonium* (*Ammoniak*), G.

Preparation.—Take of Solution of Citrate of Iron 3 parts (21 oz. av. or a pint); Water of Ammonia 1 part (7 oz. av. or 7 fluidounces). Mix the solution of citrate of iron with the water of ammonia, evaporate the mixture, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

Mix 16 fl. oz. of solution of ammonia with 40 oz. of distilled water, and to this add gradually 10 fl. oz. of solution of persulphate of iron, previously diluted with 40 oz. of distilled water, stirring them constantly and briskly, and taking care that the ammonia is, even finally, in slight excess, as indicated by the odor. Let the mixture stand for two hours, stirring it occasionally; then put it on a calico filter, and when the liquor has drained away wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium. Dissolve 4 oz. of citric acid in 4 oz. of distilled water, and, having applied the heat of a water-bath, add the ferric hydrate, previously well drained, and stir them together until nearly the whole of the hydrate has dissolved, or until the citric acid is saturated (more ferric hydrate being added if necessary). Let the solution cool, add 5½ fl. oz. of solution of ammonia, filter through flannel (adding some distilled water if necessary), evaporate to the consistency of a syrup, the presence of a very slight excess of ammonia being maintained, and dry in thin layers on flat porcelain or glass plates at a temperature not exceeding 37.8° C. (100° F.). Remove the dry salt in flakes, and keep it in a stoppered bottle.—*Br.*

The second formula requires the preparation of hydrate of iron by decomposing ferric sulphate with ammonia. It is washed, and then dissolved in citric acid to obtain a solution of ferric citrate, which, without being filtered, is mixed with ammonia. The turbid liquid at once becomes deeper-colored, and is filtered and concentrated. The United States Pharmacopœia, recognizing a solution of ferric citrate, simply requires it to be mixed with ammonia and concentrated.

Properties.—The salt closely resembles citrate of iron in appearance and behavior, except as stated above. Impurities, if present, may be determined in the same manner. On ignition the salt yields 25 per cent. *U. S.*, or about 30 per cent. *Br.*, of ferric oxide. Being made from normal ferric citrate with the addition of ammonia, it is probably a mixture or compound of ammonio-ferric citrate with ferric oxycitrate.

Off. Prep.—Ferri et strychninæ citras, Liq. ferri et quininæ citratis, *U. S.*; Vinum ferri citratis, *U. S.*, *Br.*

Medical Uses.—The advantages of an iron salt containing ammonia are more than contestable upon theoretical grounds, and there is no clinical evidence of its special value. The addition to a solution of the salt of a solution of citric acid causes effervescence. The *dose* is 5 or more grains (Gm. 0.30).

FERRI ET AMMONII SULPHAS, *U. S.*—SULPHATE OF IRON AND AMMONIUM.

Ferrum sulfuricum oxydatum ammoniatum, *Ferrum ammonio-sulphuricum*, *Ferri ammonio-sulphas*, *Sulphas ammonico-ferricus*, *Alumen ammoniacale ferricum.—Ammonio-ferric sulphate*, *Ammonio-ferric alum*, E.; *Sulfate de fer et d'ammoniaque*, *Sulfate ferrique ammoniacal*, *Alun de fer ammoniacal*, Fr.; *Ferriammonsulfat*, *Schwefelsaures Eisenoxyd-Ammonium*, *Ammoniakalischer Eisenalaun*, G.

Formula $(NH_4)_2Fe_2(SO_4)_4.24H_2O$. Molecular weight 963.8.

Preparation.—Take of Solution of Tersulphate of Iron 2 pints; Sulphate of Ammonium 4½ troyounces. Heat the solution of tersulphate of iron to the boiling-point, add the sulphate of ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air.—*U. S.* 1870.

On dissolving the ammonium sulphate in the liquid with the aid of heat a double salt is formed which crystallizes on cooling; the mother-liquor will yield another crop of crystals on being concentrated to about one-half. If the solution of ferric sulphate happens to be slightly deficient in acid, the crystals may be of an unsightly appearance; they should then be redissolved in the mother-liquor by heat and a small quantity of sulphuric acid added before crystallizing.

Properties.—This salt crystallizes like alum in regular octahedrons, which are transparent and colorless or of a pale amethyst or violet color, particularly if crystallized from a solution containing a little free acid. They have the spec. grav. 1.712, are inodorous, of an acid and strongly astringent taste, and efflorescent on exposure to air. The salt suffers decomposition when continually heated in the water-bath or kept in the melted state, even in closed vessels. On the application of heat it melts, parts with its water of crystallization, and is further decomposed, leaving ultimately a light-brown or red-brown residue. The salt is insoluble in alcohol and ether; at 15° C. (59° F.) it requires 3 parts, and at the boiling temperature 0.8 part, of water for solution. The aqueous solution has an acid reaction and is of a brown-yellow color, which gradually changes to red, a basic salt being afterward deposited, and the decomposition being hastened by continued boiling of the solution. This shows the chemical reactions of ferric salts, sulphuric acid, and ammonia, yielding a blue precipitate with potassium ferrocyanide, a white one insoluble in hydrochloric acid with barium chloride, and a red-brown one with potassa solution, an excess of which on heating causing the evolution of vapors of ammonia.

Tests.—If the solution be boiled with an excess of potassa solution, and the colorless alkaline filtrate heated with excess of ammonium chloride, or neutralized with hydrochloric acid and again rendered alkaline by ammonia, it should not yield a white gelatinous precipitate of aluminium hydrate.

Medical Action and Uses.—Like most of the compounds of sulphuric acid with metals, this one is astringent, but its astringency appears to be modified by the ammonia in its composition. It may be advantageously used in chronic *mucous fluxes* of the bowels, vagina, and bronchia when these affections are prolonged by general feebleness and a relaxation of the tissues. *Dose*, from 5 to 15 grains (Gm. 0.30–1.0).

FERRI ET AMMONII TARTRAS, *U. S.*—TARTRATE OF IRON AND AMMONIUM.

Ferri ammonio-tartras, Ferrum tartaricum ammoniatum.—Ammonio-ferric tartrate, Ammonio-tartrate of iron, E.; *Tartrate de fer et d'ammoniaque, Tartrate ferrique ammoniacal*, Fr.; *Ferriammontartrat, Weinsaures Eisenoxyd-Ammonium*, G.

Formula $2(FeO)NH_4C_4H_4O_6.5H_2O$. Molecular weight 565.8.

Preparation.—Solution of Tersulphate of Iron 90 parts (18 oz. av. or 13¾ fluidounces); Tartaric Acid 60 parts (12 oz. av.); Water of Ammonia 72 parts (14½ oz. av. or 14½ fluidounces); Carbonate of Ammonium, Distilled Water, Water, each a sufficient quantity. To the water of ammonia, previously diluted with 180 parts (36 oz. av. or 34½ fluidounces) of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 900 parts (180 oz. av. or 10¾ pints) of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with 1000 parts (200 oz. av. or 12 pints) of cold water. Again drain it on the strainer, and repeat the operation once or oftener until the washings cause but a slight cloudiness with test solution of chloride of barium. Then allow the precipitate to drain completely. Dissolve one-half of the tartaric acid in 130 parts (26 oz. av. or 25 fluidounces) of distilled water, neutralize the solution exactly with carbonate of ammonium, then add the other half of the tartaric acid, and dissolve by the application of a gentle heat. Then, whilst continuing the heat, which should not exceed 60° C. (140° F.), add the magma of hydrated oxide of iron in small portions at a time until it is no longer dissolved. Filter the solution, evaporate it, at the before-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

This formula is essentially that suggested by Prof. Procter (1841). By neutralizing one-half of the tartaric acid with ammonium carbonate, ammonium tartrate is formed, which is converted into the acid salt by the addition of the reserved tartaric acid. On digesting this with ferric hydrate a solution is obtained, which, by careful evaporation and drying upon plates, yields the officinal salt in scales.

Properties.—It is in transparent, garnet-red, inodorous scales of a sweetish and slightly ferruginous taste, and yields a rust-colored powder. The Pharmacopœia permits the salt if of a yellowish-brown color. In dry air it is permanent; in a moist atmosphere it is hygroscopic, but scarcely deliquescent. When heated it gives off water and ammonia, is then charred, with the odor of burning sugar, and finally leaves 27.9 per cent. (25 per cent. *U. S.*) of ferric oxide, which amount corresponds with the formula given above. It is very probable, however, that compounds of somewhat different composition may be formed by the officinal process. The salt is not soluble in alcohol or ether, but dissolves slowly and freely in glycerin and water. The latter solution is neutral to test-paper, is darkened but not precipitated by ammonia or by cold solutions of fixed alkalies or their carbonates, and is not colored blue by potassium ferrocyanide unless acidulated. When acidulated with hydrochloric acid and mixed with potassium acetate, potassium bitartrate is precipitated. When heated with potassa solution in excess, a red-brown precipitate of ferric hydrate is deposited, ammonia is given off, and the colorless filtrate, when cooled and strongly acidulated with acetic acid, yields a white crystalline precipitate of potassium bitartrate.

Tests.—The ash obtained on incineration should not have an alkaline reaction; this test readily distinguishes this salt from the next.

Medical Uses.—The only advantage of this salt is the one it shares with the other ammonium salts—viz. that of great solubility. In proportion to its bulk, like them also, it contains but little iron. Its *dose* is from 10 to 30 grains (Gm. 0.60–2.0).

FERRI ET POTASSII TARTRAS, *U. S.*—TARTRATE OF IRON AND POTASSIUM.

Ferrum tartaratum, Br.; *Ferri potassio-tartras*, *Ferri-kali tartaricum*, *Ferrum tartarizatum*, *Tartras ferrico-potassicus*, *s. potassico-ferricus*, *s. ferrico-kalicus.*—*Potassio-ferric tartrate*, *Tartarated (tartarized) iron*, *Ferro-tartrate of potassium*, E.; *Tartrate de fer et de potasse*, *Tartrate ferrico-potassique*, *Tartre chalybé*, *Tartre martial*, Fr.; *Ferrikalitartrat*, *Weinsaures Eisenoxyd-Kali*, *Eisenweinstein*, G.

Preparation.—Solution of Tersulphate of Iron 12 parts (18 oz. av. or 13¾ fluidounces); Bitartrate of Potassium 4 parts (6 oz. av.); Distilled Water 32 parts (48 oz. av. or 46 fluidounces); Water of Ammonia, Water, each a sufficient quantity. To 10 parts (15 oz.) of water of ammonia, diluted with 20 parts (30 oz. av. or 28¾ fluidounces) of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 100 parts (150 oz. av. or 9 pints) of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix intimately with 120 parts (180 oz. av. or 10¾ pints) of cold water. Again drain on the strainer, and repeat the operation once or oftener until the washings produce but a slight cloudiness with test solution of chloride of barium. Put the drained precipitate into a stone or porcelain vessel, add to it 32 parts (48 oz. av. or 46 fluidounces) of distilled water, heat the mixture on a water-bath to a temperature not exceeding 60° C. (140° F.), add the bitartrate of potassium, and stir until the hydrated oxide of iron is dissolved. Filter while hot, and let the filtrate stand in a cool, dark place for 24 hours; then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just enough water of ammonia to dissolve the precipitate, evaporate the solution in a porcelain vessel to the consistence of thick syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place. —*U. S.*

The formula of the British Pharmacopœia is like the above, the proportions used being solution of persulphate of iron 6 fluidounces, solution of ammonia 11 fluidounces, and acid tartrate of potassium 2 ounces. As in the preceding case, ferric hydrate is first formed, and this is used for saturating the potassium salt. A salt of the formula $K_6Fe_26C_4H_4O_6$ is probably first formed, which would yield somewhat over 12 per cent. (Dulk found 12.78 per cent.) of ferric oxide; the British Pharmacopœia requires about 30; Soubeiran and Capitaine obtained 30.8 per cent. of ferric oxide, and regarded the salt as having the composition $K(FeO)C_4H_4O_6$. It is likely that different basic compounds may be formed by prolonged digestion. To render the salt perfectly and readily soluble in water, the U. S. P. now directs the addition of a little ammonia-water to the filtered solution before evaporation—a course recommended for this and analogous salts by Mr. G. H. C. Klie in 1876.

Properties.—In its physical properties, as well as in its behavior to solvents, alkalies, and potassium ferrocyanide, it resembles tartrate of iron and ammonium, from which it differs in giving off a slight odor of ammonia when heated with potassa solution, and, when incinerated, in leaving an ash which has an alkaline reaction to test-paper and effervesces on the addition of hydrochloric acid.

TARTARUS FERRATUS, *s. Tartarus martiatus*, is made by digesting 1 part of iron filings and 5 parts of commercial cream of tartar with water until a small portion of it is found to be almost wholly soluble in water when it is dried and powdered. It is a dirty-greenish powder, gradually turning brown, and is almost wholly soluble in 16 parts of cold water. It consists chiefly of potassio-ferrous tartrate, but is rarely used now, having been superseded by the potassio-ferric salt.

GLOBULI MARTIS, *s. Glob. tartari ferruginosi.*—Iron balls, Steel balls, *E.*; Boules de Mars, B. de Nancy, *Fr.*; Stahlkugeln, *G.*—As made by the French Codex, they are an impure tartrate of iron and potassium, made by digesting iron filings and crude tartar in a strained decoction of *vulnerary species* (consisting of twenty different herbs and flowers), and after evaporation, with the aid of a little gum-arabic, forming the mass into balls weighing about 30 Gm. (1 oz.). Other formulas omit the herbs.

Medical Uses.—This salt is one of the richest in iron, the most agreeable to the taste, the least irritating to the bowels and oppressive to the stomach, and the least apt to occasion constipation, of all the soluble ferruginous preparations. *Dose*, from 5 to 20 grains (Gm. 0.30–1.20) three times a day, before meals.

Tartarus ferratus, as above stated, is made into balls which in France are known as *boules de Mars* and *boules de Nancy*, and, dissolved in hot water, are added to baths as a substitute for natural chalybeate waters. It is also given internally in carbonated water, sherry wine, or syrup.

FERRI ET QUININÆ CITRAS, *U. S., Br.*—CITRATE OF IRON AND QUININE.

Ferri et quiniæ citras, Br., U. S. 1870; *Chininum ferro-citricum*, P. G.; *Citras ferrico-quinicus.*—*Citrate de fer et de quinine*, Fr.; *Ferrichinincitrat*, *Citronsaures Eisen-Chinin*, G.

Preparation.—Citrate of Iron 88 parts (5½ oz. av.); Quinine, dried at 100° C. (212° F.) until it ceases to lose weight, 12 parts (¾ oz. av.); Distilled Water a sufficient quantity; to make 100 parts (6¼ oz. av.). Dissolve the citrate of iron in 160 parts (10 oz. av. or 9⅝ fluidounces) of distilled water by heating on a water-bath, at a temperature not exceeding 60° C. (140° F.). To this solution add the quinine, and stir constantly until it is dissolved. Lastly, evaporate this solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

Take of solution of persulphate of iron 4½ fluidounces; sulphate of quinia 1 ounce; diluted sulphuric acid 12 fluidrachms; citric acid 3 oz. 30 gr.; solution of ammonia, distilled water, each a sufficiency. Mix 8 fluidounces of the solution of ammonia with 2 pints of distilled water, and to this add the solution of persulphate of iron, previously diluted with 2 pints of distilled water, stirring them constantly and briskly. Let the mixture stand for 2 hours, stirring it occasionally, then put it on a calico filter, and when the liquid has drained away wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium. Mix the sulphate of quinia with 8 ounces of distilled water, add the diluted sulphuric acid, and when the salt is dissolved precipitate the quinia with a slight excess of solution of ammonia. Collect the precipitate on a filter and wash it with 1½ pints of distilled water. Dissolve the citric acid in 5 ounces of distilled water, and, having applied the heat of a water-bath, add the oxide of iron previously well drained; stir them together, and when the oxide has dissolved add the precipitated quinia, continuing the agitation until this also has dissolved. Let the solution cool, then add, in small quantities at a time, 12 fluidrachms of solution of ammonia diluted with 2 fluidounces of distilled water, stirring the solution briskly, and allowing the quinia, which separates with each addition of ammonia, to dissolve before the next addition is made. Filter the solution, evaporate it to the consistence of a thin syrup, and then dry it in thin layers on flat porcelain or glass plates at a temperature of 100° F. Remove the dry salt in flakes and keep it in a stoppered bottle.—*Br.*

The process of the U. S. Pharmacopœia consists simply in dissolving quinine in solution of ferric citrate. The apparently complicated process of the British Pharmacopœia in its first part directs the preparation of ferric hydrate and quinine, which are successively dissolved in citric acid; but it differs very materially in the subsequent addition of ammonia and in the formation of ammonium citrate, by which the physical properties of the resulting scales are changed.

The corresponding salt of the German Pharmacopœia again differs in containing, besides quinine, both ferric and ferrous salt, but no ammonia; it is made by digesting powdered iron 3 parts with citric acid 6 parts and water 500 parts, adding afterward quinine 1 part, freshly precipitated by soda solution from 1.3 parts of quinine sulphate; the solution is then evaporated and sealed.

Properties.—The product of the first process is in transparent, inodorous scales of a yellowish green-brown to reddish-brown color, varying according to their thickness. When heated to near redness, like other citrates it emits fumes having the odor of burnt sugar, and it finally leaves a brown ash free from alkaline reaction to test-paper. The salt is permanent in the air, or, according to the U. S. P., slowly deliquescent on exposure; it dissolves slowly in cold, more readily in hot, water, is slightly soluble in alcohol, and insoluble in ether. The solution is slightly acid to test-paper, has a bitter and mildly chalybeate taste, and yields with tannin a grayish-black precipitate consisting of the mixed tannates of iron and quinine. On the addition of ammonia the liquid darkens in color, yields a white curdy precipitate of quinine, and the filtrate gives a blue precipitate with potassium ferrocyanide after the addition of hydrochloric acid. The solution of the salt on being heated with excess of potassa solution gives a precipitate of ferric hydrate and quinine, without evolving vapors of ammonia, and the filtrate after the addition of calcium chloride, again filtering, and then boiling, yields a white granular precipitate of calcium citrate.

The product of the British Pharmacopœia corresponds with the behavior and tests described above, except that it is readily soluble in cold water; it is of a greenish golden-yellow color and in the air somewhat deliquescent.

Tests.—"Dissolve 4 Gm. of the scales in 30 Ccm. of water in a capsule with the aid of heat. Cool, and transfer the solution to a glass separator, rinsing the capsule; add an aqueous solution of 0.5 Gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 Ccm. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule on the water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 Gm."—*U. S.* "50 grains dissolved in a fluidounce of water and treated with a slight excess of ammonia give a white precipitate which, when dissolved by chloroform, and this evaporated, weighs 8 grains; the precipitate is almost entirely soluble in ether, and when burned leaves but a minute residue."—*Br.* "If the solution of 1 Gm. of the salt in 4 Ccm. of water be precipitated with soda solution, and then agitated with 10 parts of ether, the ethereal liquid on being evaporated should leave behind at least 0.09 Gm. of quinine."—*P. G.* The salt contains 16 per cent. *Br.*, 12 per cent. *U. S.*, 10 per cent. *P. G.*, of quinine. It might be added that its solution in dilute sulphuric acid shows the characteristic behavior of quinine solutions. (See Quininæ Sulphas.)

Medical Uses.—This preparation has no demonstrable advantage over an extemporaneous union of its components except from the convenience of dispensing it. 5 parts of it contain about 1 part of quinia, and it may be prescribed in pill or solution, before meals, in the *dose* of about 5 grains (Gm. 0.30).

FERRI ET STRYCHNINÆ CITRAS, *U. S.*—Citrate of Iron and Strychnine.

Ferri et strychniæ citras, U. S. 1870.—*Citrate de fer et de strychnine*, Fr.; *Citronensaures Eisen-Strychnin*, G.

Preparation.—Citrate of Iron and Ammonium 98 parts (490 grains); Strychnine 1 part (5 grains); Citric Acid 1 part (5 grains); Distilled Water 120 parts (600 grains or 10½ fluidrachms); to make 100 parts (500 grains). Dissolve the citrate of iron and ammonium in 100 parts of distilled water, and the strychnine, together with the citric acid, in 20 parts of distilled water. Mix the two solutions, evaporate the mixture by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

This is simply a mixture of citrate of strychnine with ammonio-ferric citrate, scaled in precisely the same manner as the other iron preparations.

Properties.—It closely resembles ammonio-citrate of iron in appearance, and has the same behavior to reagents as described above, but differs from it in the distinctly bitter taste and in the white precipitate produced by ammonia, the precipitate being soluble in boiling alcohol, from which, if the solution is sufficiently concentrated, crystals will be obtained giving the peculiar reactions of strychnine. The alkaloid will also be obtained by adding potassa solution to the solution of the salt, agitating with chloroform, and evaporating the chloroform solution.

Test.—If 1 Gm. of the salt be dissolved in 4 Ccm. of distilled water, and this liquid mixed with 1 Ccm. of potassa solution, and the mixture be well agitated with fresh portions of chloroform until exhausted, the mixed chloroform solutions on being evaporated should leave a residue weighing between 0.009 and 0.01 Gm.

Medical Uses.—This very unnecessary officinal compound may be prescribed in *doses* of 1 or 2 grains (Gm. 0.05–0.10) and cautiously increased.

FERRI FERROCYANIDUM.—Ferrocyanide of Iron.

Ferri ferrocyanuretum, Ferrum ferrocyanatum (s. borussicum, s. zooticum), Ferrocyanidum ferricum, Cyanuretum ferroso-ferricum, Cœruleum borussicum.—Ferrocyanuret of iron, Prussian blue, Williamson's blue, Paris blue, E.; *Ferrocyanure (Prussiate, Cyanure) de fer, Bleu de Prusse (de Berlin),* Fr.; *Ferrocyaneisen, Berliner Blau,* G.

Formula, $Fe_4(FeCy_6)_3 = Fe_43Fe(CN)_6$. Molecular weight 859.3.

Preparation.—Take of Ferrocyanide of Potassium 9 troyounces; Solution of Tersulphate of Iron a pint; Water 3 pints. Dissolve the ferrocyanide of potassium in 2 pints of the water, and add the solution gradually to the solution of tersulphate of iron previously diluted with the remainder of the water, stirring the mixture during the addition. Then filter the liquid, and wash the precipitate on the filter with boiling water until the washings pass nearly tasteless. Lastly, dry it and rub it into powder.—*U. S.* 1870.

The process is one of simple decomposition, the basylous radicals exchanging their acids; thus, $3K_4FeCy_6 + 2Fe_2(SO_4)_3 = 6K_2SO_4 + Fe_4(FeCy_6)_3$. The precipitate requires considerable washing to free it from the potassium salt, and when dried at a temperature of about 40° C. (104° F.) or less it retains $18H_2O$ in combination, which it gradually loses at a higher temperature.

For uses in the arts Prussian blue is made by precipitating ferrous sulphate with potassium ferrocyanide, and exposing the bluish-white precipitate to the air or treating it with oxidizing agents until it has acquired the proper shade; the commoner varieties contain alumina and other impurities. The pigment was accidentally discovered by Diesbach, a manufacturer of colors in Berlin, and a notice of the discovery published in 1710; but processes for preparing it were first published by Woodward, John Brown, and Stephane F. Geoffroy (1724–25); most of the noted chemists of the past and of the early part of the present century were engaged in the investigation of its composition and of that of allied compounds.

Properties.—Ferric ferrocyanide is in hard dark-blue masses which exhibit upon the fresh somewhat conchoidal fracture a reddish metallic lustre and yield a deep-blue powder. It is inodorous, tasteless, insoluble in water, alcohol, and dilute mineral acids, but dissolves while moist in solution of ammonium nitrate with a violet-blue color, and yields with oxalic acid, equal to one-sixth or upward of its own weight, a powder which dissolves completely in water, and which has been used as *wash-blue* and *blue ink;* the residue left on evaporating the solution to dryness has been known as *Bleu Suisse* or *Swiss blue.* Commercial Prussian blue should be previously purified for this purpose by treating it with dilute hydrochloric or sulphuric acid and washing it with water. Concentrated mineral acids decompose it, with the liberation of hydrocyanic acid; when boiled with alkalies ferric hydrate is separated and alkaline ferrocyanide dissolved; and when heated in contact with air ammoniacal vapors are given off and a rust-colored residue is left containing ferric oxide and potassium cyanate, the latter resulting from potassium compounds present in the pigment. Prussian blue is hygroscopic, and contains about 28 per cent. of water.

Impurities and Adulterations.—On boiling impure Prussian blue with dilute hydrochloric acid, the presence of carbonates will be indicated by effervescence, and the potassium sulphate, alumina, and ferric hydrate will enter into solution. Ammonia-water added to the solution will precipitate some of these impurities, and the filtrate may be tested for calcium by oxalic acid or evaporated to dryness and ignited, when no residue should be left. The ammonia, if any, is evolved when boiled with potassa solution, which leaves ferric hydrate behind, and, if alumina should have been present, the clear liquid will yield a white precipitate on being neutralized with hydrochloric acid and again rendered alkaline by ammonia. On incinerating Prussian blue and treating the residue with strong hydrochloric acid, barium sulphate (heavy spar) will be left undissolved, and the clear acid filtrate, when diluted with water, will yield a black precipitate with sulphuretted hydrogen should lead or allied metals have been present.

Allied Compounds.—SOLUBLE PRUSSIAN BLUE. On adding a solution of a ferric salt (anhydrous ferric chloride 1 part) to a solution of potassium ferrocyanide 3 parts (not the reverse), keeping the latter in excess, the deep blue precipitate will become soluble in water as soon as the greater portion of the foreign salts has been washed out; the precipitate is *potassium ferri-ferrocyanide* $K_2Fe_2'''(Fe''Cy_6)_2$. A similar soluble precipitate is obtained by adding a ferrous salt (ferrous sulphate 11 parts) to a solution of red prussiate of potash (potassium ferricyanide), but it has the composition $K_2F_2''(Fe_2'''Cy_{12})$, and is *potassium ferro-ferricyanide.*

TURNBULL'S BLUE, FERRICYANIDUM FERROSUM, $Fe_3(Fe_2Cy_{12})$, was discovered by Gmelin (1827), and is obtained by adding potassium ferricyanide to the solution of a ferrous salt.

Medical Uses.—The daily *dose* of this preparation is stated by certain authorities to be from ½ drachm to 5 drachms (Gm. 2–20). It is probably inert. To this statement, contained in the first edition of the present work, may be added the more recent conclusions of Hayem from a series of careful and minute observations. Ferrocyanide of potassium is valueless as a chalybeate, and has no influence in regenerating the blood. Its iron remains inert, and the elements of the cyanogen exert no poisonous action. It may be taken for weeks or months in the daily dose of several Gm. without in the least affecting the health, and in doses of from 2 to 6 Gm. it neither alters the quantity of the urine nor the elimination of urea. Cases of anæmia which, after a prolonged trial it failed entirely to benefit, were readily and permanently cured by the soluble salts of iron—the chloride, for example.

FERRI HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF IRON.

Ferrum hypophosphorosum, Hypophosphis ferricus.—Ferric hypophosphite, E.; *Hypophosphite de fer*, Fr.; *Ferrihypophosphit, Unterphosphorigsaures Eisenoxyd*, G.

Formula $Fe_26PH_2O_2$. Molecular weight 501.8.

Preparation.—A solution of hyphosphite of sodium which is free from carbonate is added to a solution of ferric chloride or ferric sulphate, which should not contain any excess of acid. The precipitate is well washed with distilled water and dried with a moderate heat. It is a process of double decomposition between the sodium and ferric salts. The presence of carbonate in the former would contaminate the salt with a corresponding quantity of ferric hydrate, while an excess of acid would occasion loss by preventing the ferric hyphosphite from being precipitated.

Properties.—It is a white or grayish powder, inodorous, nearly tasteless, slightly soluble in water, more so in hypophosphorous acid, but freely so in hydrochloric acid. Like other insoluble or sparingly-soluble ferric salts, it dissolves in solutions of an alkali citrate, with a green color. It is readily oxidized by nitric acid and other oxidizing agents, and when heated in the dry state evolves inflammable hydrogen phosphide and leaves ferric pyrophosphate. Its formula is given above; it contains, in addition, water of hydration, the amount of which has not been determined.

Tests.—It should be completely soluble in dilute acetic acid, which leaves white ferric phosphate undissolved. This solution should not be precipitated by oxalate of ammonium (absence of calcium salt).

Medical Action.—It is theoretically assumed to possess virtues belonging to phosphorus as well as iron—an assumption which nothing justifies. It may be given in *doses* of from 5 to 10 grains (Gm. 0.30–0.60).

FERRI IODIDUM SACCHARATUM, *U. S.*—SACCHARATED IODIDE OF IRON.

Ferrum iodatum saccharatum.—Saccharated ferrous iodide, E.; *Saccharure d'iodure de fer*, Fr.; *Eisenjodürzucker*, G.

Formula of ferrous iodide FeI_2. Molecular weight 309.1.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 6 parts (30 grains); Iodine 17 parts (85 grains); Distilled Water 20 parts (100 grains or 1¾ fluid-drachms); Sugar of Milk 80 parts (400 grains). Mix the iron, iodine, and distilled water in a flask of thin glass; shake the mixture occasionally until the reaction ceases and the solution has acquired a green color and lost the smell of iodine; then filter it through a wetted filter into a porcelain capsule containing 40 parts of sugar of milk. Rinse the flask and iron wire with a little distilled water, pass the rinsings through the filter into the capsule, and evaporate on a water-bath, constantly stirring, until a dry mass remains. Transfer the mass quickly to a heated iron mortar containing the remainder of the sugar of milk, and reduce the whole to powder. Transfer the powder at once to small, well-dried bottles, which must be securely stopped and kept in a cool and dark place.—*U. S.*

This is the process of the German Pharmacopœia of 1872, modified only by slightly increasing the iodine, so that the finished preparation may contain fully 20 per cent. of ferrous iodide. Iodine unites with the iron in the presence of water, heat being produced, which may increase to such an extent that some iodine may be volatilized; should violet-colored vapors make their appearance in the flask, the violence of the reaction should be checked by immersing the flask in cold water; toward the end of the process it may, on the other hand, become necessary to hasten the combination of the last portions of iodine by the application of a gentle heat. Instead of bringing the whole of the iodine in contact with the whole amount of iron, as directed in the formula, it is better to add one of these in several portions, waiting after each addition until the reaction has nearly ceased. In warm weather especially it will be preferable, in order to avoid loss by evaporation, to introduce the iodine and water into the flask and to add the iron gradually. The green liquid, being a very concentrated solution of ferrous iodide, should be passed through a small wetted filter, and the flask and filter should be well rinsed twice with a small quantity of distilled water to recover all the iodide. 17 parts of iodine yield 20¾ parts of ferrous iodide, and this quantity, mixed with 80 parts of milk-sugar, will give a mixture containing 20.6 per cent. of ferrous iodide if all loss has been avoided.

Properties.—Saccharated ferrous iodide is a yellowish or grayish-white powder, very hygroscopic, odorless, having a sweetish ferruginous taste and a slightly acid reaction. It is soluble in 7 parts of water at 15° C. (59° F.), forming an almost clear and nearly colorless solution, and is only partially soluble in alcohol. When strongly heated the compound swells up, chars, evolves the odor of iodine and of burnt sugar, and on ignition leaves a residue which should yield nothing soluble to water (absence of alkali salts). The aqueous solution yields a light-greenish precipitate with ammonia, and a blue precipitate with test solution of ferricyanide of potassium. If mixed with some gelatinized starch, and afterward with a little chlorine-water, the solution assumes a blue color.

Tests.—The aqueous solution of saccharated ferrous iodide should not be colored blue on the addition of gelatinized starch (absence of free iodine). "On mixing an aqueous solution of 5 Gm. of saccharated iodide of iron with a solution of 1 Gm. of nitrate of silver and filtering, the filtrate should still produce a precipitate or cloudiness with test solution of nitrate of silver (presence of at least 20 per cent of ferrous iodide)."—*U. S.* This is an error; the test, as stated, indicates more than 18.214 per cent. of ferrous iodide. While it may perhaps be perfectly admissible to regard the percentage stated as the lowest limit, the test was better adapted to the product of the P. G. 1872, which contained only 19.5 per cent. of ferrous iodide.

Allied Preparations.—FERRI IODIDUM, Ferrum iodatum, *P. G.;* Iodnretum ferrosum.—Iodide of iron, Ferrous iodide, *E.;* Iodure de fer, *Fr.;* Eisenjodür, *G.*—This unstable salt has been dismissed from the Pharmacopœia. It may be made by uniting iodine and iron in the proportion given above and in the presence of water, filtering the green solution, and evaporating it rapidly in a dish of polished iron until a drop of the solution taken out on the end of an iron wire solidifies on cooling. The liquid should now be poured out on a porcelain dish, and as soon as it has solidified should be broken into fragments and enclosed in a well-stopped bottle. The solution of ferrous iodide, on evaporation, is readily oxidized; hence the direction to evaporate in a polished iron dish, which, however, cannot prevent the formation of oxide, or possibly oxy-iodide, of iron. The residuary salt is therefore never completely soluble in water. The German Pharmacopœia orders the salt to be prepared extemporaneously by combining iodine 82 parts and powdered iron 30 parts under distilled water 100 parts; the filtered liquid contains 100 parts of ferrous iodide, and is used in this condition for liquid preparations, or if required in pills the solution is rapidly evaporated in an iron dish.

According to De Luca, pure anhydrous ferrous iodide is white, and in the presence of moisture greenish. The Pharmacopœias require it to be green with a tinge of brown. By the above process, however, it is usually obtained as a steel-gray laminated mass, with a metallic lustre, fusing at about 177° C. (350° F.) and evolving vapors of iodine. It is deliquescent when pure, dissolves readily with a green color in water, also in glycerin and alcohol, the solution yielding a dark-blue precipitate with potassium ferricyanide, and separating iodine on the addition of a little chlorine-water, when on the further addition of mucilage of starch a blue color will be produced.

Solid ferrous iodide is at best a very unsatisfactory medicinal preparation, owing to the unavoidable changes occurring under ordinary circumstances. It would be better, by far, when ferrous iodide is desired in a solid form, to evaporate a definite quantity of the officinal syrup, and convert that at once into pills by the addition of some vegetable powder. The saccharated ferrous iodide is to a certain extent, though not indefinitely, protected by the sugar.

Medical Action and Uses.—They are sufficiently described under SYRUPUS FERRI IODIDI, which, with *Pilulæ ferri iodidi*, is the only other officinal preparation (*U. S. P.*) that contains iodine and iron in combination. The *dose* of this iodide may be stated at 5 grains (Gm. 30), three times a day. It should be prescribed in pilular form and taken after meals.

FERRI LACTAS, *U. S.*—LACTATE OF IRON.

Ferrum lacticum, P. G.; *Lactas ferrosus.—Ferrous lactate*, E.; *Lactate ferreux*, *Lactate de fer*, Fr.; *Ferrolaktat*, *Eisenlactat*, *Milchsaures Eisenoxydul*, G.

Formula $Fe2C_3H_5O_3.3H_2O$. Molecular weight 287.9.

Preparation.—A formula for the preparation of this salt was given by the U. S. P. 1870: a fluidounce of lactic acid diluted with a pint of distilled water is digested in an iron vessel with ½ ounce of iron filings until the action has ceased, when the hot solution is filtered and crystallized. In this process the iron unites directly with the acid, displacing the basylous hydrogen, the solution of ferrous lactate merely requiring to be evaporated and crystallized. It may also be prepared from crystalline calcium lactate, $Ca(C_3H_5O_3)_2.5H_2O$, obtained in the preparation of lactic acid (see page 71) by dissolving 31 parts of it in 750 or 800 parts of water, and mixing this with a solution of 28 parts of crystallized ferrous sulphate; by double decomposition ferrous lactate is formed and remains in solution, while most of the calcium sulphate is precipitated, the remainder being removed by mixing the liquid with one-tenth volume of alcohol; the filtrate is finally evaporated and crystallized. A similar process has been adopted by the French Codex.

Both these processes involve considerable evaporation, which may be avoided, according to Pagenstecher (1842), by mixing an alcoholic solution of sodium lactate (see Boutron and Frémy's process for lactic acid, page 71) with a freshly-prepared solution of ferrous chloride, when nearly the whole of the ferrous lactate will crystallize out, and the alcohol used may be recovered by distilling the mother-liquor. Thus prepared, the salt is less prone to oxidation.

Properties.—Ferrous lactate forms a greenish-white or yellowish crystalline powder or crusts consisting of small needle-shaped crystals containing 19 per cent. of water of crystallization, and having a slight peculiar odor, a sweetish and mild chalybeate taste, and a slightly acid reaction. The dry salt is nearly permanent in dry air, but in a damp atmosphere is gradually converted into ferric salt. It is almost insoluble in cold alcohol, but may be crystallized from boiling diluted alcohol; it dissolves slowly at 10° C. (50° F.) in 48 parts, and at 15° C. (59° F.) in 40 parts, *U. S.*, in 38.2 parts, *P. G.*, of water, and in 12 parts of boiling water, the solutions being of a greenish-yellow color, and it is freely soluble with a green color in solutions of alkali citrates. On the application of heat it turns brown and black, and then, with frothing, emits white acid vapors having the odor of burnt sugar, and finally leaves brownish-red ferric oxide, amounting to 27.7 (about 27 *P. G.*) per cent. The aqueous solution yields a dark-blue precipitate with potassium ferricyanide, and a light-blue one with potassium ferrocyanide; in contact with the air it turns speedily brown, forming ferric lactate, and then yields at once a dark-blue precipitate with potassium ferrocyanide. The salt, boiled for 15 minutes with an excess of nitric acid diluted with an equal bulk of water, yields on cooling white granules of mucic acid.

Tests.—The salt is not liable to be contaminated with impurities except ferric salt, the formation of which is difficult to prevent by processes requiring much evaporation. Accidental and wilful adulterations are detected by adding to the cold aqueous solution neutral acetate of lead, which should scarcely cause a slight turbidity (absence of more than traces of chlorides, sulphates, citrates, malates, or tartrates). The cold aqueous solution, acidulated with nitric acid, should remain clear or become merely opalescent with silver nitrate (chloride) or barium chloride (sulphate), and if acidulated with hydrochloric acid should with hydrosulphuric acid merely become opalescent from the separation of sulphur by ferric salt, but should not be precipitated or acquire a dark color (absence of heavy metals). A mixture of the salt with strong sulphuric acid should not evolve the odor of butyric acid, nor should it acquire a brown or black color (absence of gum, sugars, and other foreign organic matter). For the detection of cane-sugar the aqueous solution, acidulated with sulphuric acid, should be boiled for 10 to 15 minutes, then rendered alkaline by soda solution, and warmed with test solution of potassio-cupric tartrate, which would then yield a red precipitate of cuprous oxide. The ash obtained by incinerating the salt should not have an alkaline reaction (absence of alkalies).

Off. Prep.—Syrupus hypophosphitum cum ferro, *U. S.*

Medical Action and Uses.—Lactate of iron has been alleged to be more assimilable than other ferruginous salts, upon the ground that lactic acid is a normal secretion of the stomach. Admitting this ground to be settled, the inference is illogical. Clinically, it may be said that lactate of iron is a very unirritating salt, and that owing to its feeble flavor it is taken without repugnance. The statements made of its curative powers are neither more nor less than may be made of other mild salts of iron. It may be given in the *dose* of 1 or more grains (Gm. 0.06) in pill or in solution. Owing to its difficult solution in water and its liability to oxidation, it is not readily dispensed in a liquid form, but it may be dissolved in hot syrup to the extent of about 4 grains to the fluidounce. Attempts have been made to cure *erectile tumors* by injecting them with a solution of "8 grains of lactate of iron to a drachm of distilled water." The statement is incorrect, since the salt requires 48 parts of cold water to dissolve it.

FERRI OXALAS, *U. S.*—Oxalate of Iron.

Ferrum oxalicum, Oxalas ferrosus.—Ferrous oxalate, E.; *Oxalate ferreux, Oxalate de fer*, Fr.; *Ferrooxalat, Oxalsaures Eisenoxydul*, G.

Formula $FeC_2O_4.H_2O$. Molecular weight 161.9.

Preparation.—Take of Sulphate of Iron 2 troyounces; Oxalic Acid 436 grains; Distilled Water a sufficient quantity. Dissolve the sulphate of iron in 30 fluidounces, and the oxalic acid in 15 fluidounces, of distilled water. Filter the solutions, and having mixed them with agitation, set aside the mixture until the precipitate is deposited. Decant the clear liquid, wash the precipitate until the washings cease to redden litmus, and dry it with a gentle heat.—*U. S.* 1870.

On adding a solution of oxalic acid to a solution of ferrous salt the acid of the latter is liberated, while the iron unites with the former to ferrous oxalate, which, being almost insoluble, is deposited.

Properties.—It is a pale almost lemon-yellow, inodorous, crystalline powder, requiring 4500 parts of cold and nearly the same quantity of boiling water for solution. Owing to this sparing solubility, the salt is almost tasteless and but little prone to oxidation in the air. It dissolves in cold concentrated hydrochloric and in hot diluted sulphuric acid, but is scarcely soluble in oxalic acid. Alkalies and their carbonates decompose it, with the formation of alkaline oxalates and ferrous hydrate or carbonate; the precipitate, when rapidly collected, washed, and dissolved in diluted hydrochloric acid, yields a dark-blue precipitate with test solution of potassium ferricyanide, while the filtrate from the precipitate, on being supersaturated with acetic acid, gives with calcium chloride a white precipitate of calcium oxalate soluble in hydrochloric acid. When heated to about 155° C. (311° F.) it loses its water of crystallization, and at a higher temperature is completely decomposed, with a faint combustion, yielding in contact with the air 49.3 per cent. of ferric oxide. This corresponds with the formula given above, the correctness of which was proved (1861) by H. Croft and E. Reynold. Formerly it was assumed to contain double the amount of water ($2H_2O$).

Medical Uses.—The special therapeutical uses of this preparation are unknown to us. The *dose* is stated to be 2 or 3 grains (Gm. 0.10–0.15).

FERRI OXIDUM HYDRATUM, *U. S.*—Hydrated Oxide of Iron.

Ferri peroxidum humidum, Hydras ferricus.—Moist peroxide of iron, Ferric hydrate, E.; *Sesquioxyde (Peroxyde) de fer hydraté humide; Hydrate de peroxyde de fer gélatineux,* Fr; *Feuchtes Eisenoxydhydrat,* G.

Formula of freshly-prepared ferric hydrate $Fe_2(HO)_6$. Molecular weight 213.8.

Preparation.—Solution of Tersulphate of Iron 10 parts (5 oz. av. or $3\frac{5}{8}$ fluidounces); Water of Ammonia 8 parts (4 oz. av. or 4 fluidounces); Water a sufficient quantity. To the water of ammonia, previously diluted with 20 parts (10 oz. av. or $9\frac{1}{2}$ fluidounces) of cold water, add, constantly stirring, the solution of tersulphate of iron previously diluted with 100 parts (50 oz. av. or 3 pints) of cold water. Pour the whole on a wet muslin strainer, and allow the precipitate to drain; then return it to the vessel and mix it intimately with 120 parts (60 oz. av. or $3\frac{5}{8}$ pints) of cold water. Again drain it on the strainer, and repeat the operation. Lastly, mix the precipitate with enough cold water to make the mixture weigh 20 parts (10 oz. av.).

When hydrated oxide of iron is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by pressing the strainer forcibly with the hands until no more liquid passes, and then adding enough water to make the whole weigh about 20 parts (10 oz. av.). *Note.*—The ingredients for preparing hydrated oxide of iron as an antidote should always be kept on hand, in a special place, in bottles holding respectively about 10 troyounces or 300 Gm. of solution of tersulphate of iron and about 8 troyounces or 240 Gm. of water of ammonia.—*U. S.*

Ferric hydrate is prepared from the solution of the sulphate by decomposing the salt with ammonia (*U. S. P.*), or with soda (*Br.* 1867), the latter authority ordering 4 fluidounces of its solution of persulphate after diluting with a pint (Imp.) of distilled water, to be gradually poured into 33 fluidounces of soda solution, and to set aside for 2 hours before straining and washing the precipitate upon the strainer. In the one case ammonium sulphate, in the other sodium sulphate, is formed—salts which are readily soluble in water and almost completely removed by washing and decantation, as directed above. The brown ferric hydrate remaining behind has the formula $Fe_2 6HO$. It combines very easily with weak acids, and for this reason is an effectual antidote to arsenic, which forms with it an insoluble salt. It cannot be dried without losing water and being converted into oxyhydrate of the formula $Fe_2O_2 2HO$, which has a more decided reddish tint and combines less readily with acids, and not at all with arsenious acid. This change is retarded by keeping the hydrate, as obtained by the above process, mixed with water in the form of a magma; but after some time it parts with half its water of hydration, forming the reddish-brown ferric oxyhydrate, $Fe_2O_3.Fe_2 6HO$, which has lost the power of combining with weak acids, such as arsenious or acetic acid. A similar effect may be wholly or partly obtained during the preparation of the hydrate if the mixture be allowed to become hot. Its effectiveness as an antidote is due to two conditions—the making of the hydrate at the *ordinary*, not at an elevated, temperature, and its *recent* preparation; the magma with water should be smooth, not granular, and should be easily soluble in acetic acid without effervescence; if insoluble, it is not effectual as an antidote to arsenic.

But since the apothecary does not receive previous notice when the antidote will be required, it is best to make it fresh, when needed, by a process which will occupy but a few minutes. This may be accomplished by at once collecting upon a strainer and expressing as directed by the United States Pharmacopœia; the mixture will then contain some ammonium sulphate and a little ammonia; the latter, however, should be scarcely recognizable by the odor. The same object is attained extemporaneously by substituting magnesia for the more caustic ammonia or soda. (See Ferri Oxid. Hydrat. c. Magn., p. 690.)

Off. Prep.—Emplastrum ferri, Trochisci ferri, *U. S.;* for these purposes the above magma is to be dried at a temperature not exceeding 80° C. (176° F.).

Other Forms of Ferric Oxide.—Ferri peroxidum hydratum, *Br.:* Ferrum oxydatum fuscum, Ferrum hydricum, Oxydum ferricum hydratum, Ferrugo, Rubigo.—Hydrated peroxide of iron, Ferric hydrate, *E.:* Hydrate ferrique, Sesquioxyde de fer hydraté, Hydrate de sesquioxyde de fer sec, *Fr.:* Eisenoxydhydrat, Ferrihydrat, *G.* Formula $Fe_2O_3.H_2O = Fe_2O_2 2HO$. Molecular weight 177.8.—It is obtained by drying the moist ferric hydrate described above at a temperature not exceeding 100° C. (212° F.), and is identical with the ferric hydrate used by the U. S. P. for preparing iron plaster and troches of iron. It is of a dark red-brown color, and is nearly insoluble in acetic acid, but should dissolve freely and without effervescence in diluted hydrochloric acid, and when heated to dull redness should yield about 10 per cent. of moisture.

Ferri subcarbonas, *U. S.* 1870, Crocus martis aperitivus (aperiens).—Subcarbonate of iron, *E.;* Safran de mars apéritif, *Fr.;* Eisensafran, *G.*—It is prepared by mixing solutions of 8 ounces of ferrous sulphate and 9 ounces of sodium carbonate, washing thoroughly with water, and drying without heat. The French Codex directs ferrous sulphate 15 parts and sodium carbonate 18 parts.

On mixing a solution of sodium carbonate with a solution of pure ferrous sulphate in boiled water, a white precipitate of ferrous carbonate is obtained, which in contact with the air rapidly darkens, changing in color through various shades of green, blue, and olive into brown, carbonic acid gas being at the same time given off. This change of color is accompanied with its conversion into ferric hydrate, with the exception of small and variable proportions of ferrous carbonate, which escape oxidation. This preparation must therefore be regarded as identical, or nearly so, with ferric hydrate.

It is an amorphous reddish-brown powder, inodorous and almost tasteless, and closely resembling ferric hydrate. Dilute hydrochloric acid dissolves it with slight effervescence, the yellow liquid yielding blue precipitates with ferricyanide (difference from pure ferric hydrate) and ferrocyanide of potassium, but not with barium chloride (absence of sulphates). If it has been dried at an elevated temperature it is of a brighter red color, does not readily dissolve in warm dilute hydrochloric acid, and consists mainly of the oxyhydrate, $Fe_2O_3.H_2O$. Dried at ordinary temperature, it consists chiefly of the oxyhydrate, $Fe_2O_3.Fe_26HO$.

Ferri oxidum rubrum, Crocus martis adstringens, Colcothar, Caput mortuum.—Ferric oxide, *E.;* Colcothar, Safran de mars astringent, *Fr.;* Eisenoxyd, Rother Eisensafran, Englisch-Roth, Todtenkopf, *G.*—It is obtained by heating to redness either one of the above hydrates or by igniting ferrous sulphate in contact with air, when the salt is decomposed, water and sulphuric and sulphurous acids being given off. It is brown-red, more or less gritty, inodorous, tasteless, and insoluble in diluted acids. It is no longer employed medicinally, the ferric hydrate being used instead, but it is extensively used in the arts. It forms the main constituent of iron paint, which is sold as *English red, Berlin red* (Minium de fer, *Fr.;* Eisenmennige, *G.*), and under various other names, and usually consists of ferric oxide mixed with from 5 to 50 per cent. of alumina or other insoluble compound. When obtained as a fine powder by elutriation it is known as *polishing rouge, terre douce de vitriol, rouge anglais, Polirroth,* and employed for polishing metals. The mineral *hematite* or *red hematite, ferret d'Espagne, sanguine, Blutstein,* is ferric oxide, while the various *brown hematites* are different ferric hydrates.

Ferrum oxidatum saccharatum solubile, *P. G.*—Soluble saccharated oxide of iron, Saccharated iron, *E.;* Saccharate de fer, Saccharure d'oxyde de fer soluble, *Fr.;* Eisenzucker, Lösliches Eisenoxyd, *G.*—Dissolve sugar 9 parts in distilled water 9 parts; add solution of ferric chloride (spec. grav. 1.281) 30 parts, and afterward, with continued stirring, a cold solution prepared of sodium carbonate 24 parts and hot water 48 parts; after the extrication of most of the carbonic acid gas add soda solution (sp. gr. 1.160) 24 parts, and when the precipitate has dissolved add powdered sodium bicarbonate 9 parts, followed by boiling water 600 parts, and set aside; decant the clear liquid, and wash the precipitate twice with boiling water 400 parts by decantation, and afterward upon a strainer, until the filtrate becomes merely opalescent with test solution of silver nitrate; express, mix the residue with powdered sugar 50 parts, dry at the heat of a steam-bath, add sufficient sugar to make the weight of the mixture 100 parts, and rub into a uniform powder. —*P. G.*

Ferric salts yield with alkali carbonates precipitates of ferric hydrate, but in the presence of sugar a compound with the latter is produced which is soluble in pure water and in caustic alkalies, but not in saline solutions. The solution of this precipitate in caustic soda and its reprecipitation by sodium bicarbonate and the immediate addition of boiling water, effects its separation in a denser condition, in which it may be more readily washed. The washing is not continued until all the carbonate and chloride of sodium has been removed, since the water would then dissolve the ferric compound. The last portions of the mother-liquor are removed by pressure, and the residue is mixed with sugar and dried as directed. It is a reddish-brown powder, has a sweet and mild chalybeate taste, and is entirely soluble in distilled water, yielding a deep reddish-brown solution of a feeble alkaline reaction. It contains 3 per cent. of metallic iron. The aqueous solution is not altered by potassium ferrocyanide, except after the addition of hydrochloric acid, when it is colored a dingy green, then dark-blue, a precipitate being slowly produced.

Syrupus ferri oxydati solubilis, *P. G.*—Syrup of soluble ferric oxide, *E.;* Sirop d'oxyde de fer soluble, Sirop de saccharate de fer, *Fr.;* Eisensyrup, *G.*—Soluble saccharated oxide of iron, distilled water, and simple syrup, of each equal parts; dissolve. It is of a deep red-brown color and contains 1 per cent. of iron.

Medical Action and Uses.—Hydrated oxide of iron is chiefly used as an antidote to arsenic. But although the chemical relations of an arsenical solution may favor the precipitation of its arsenic by freshly-prepared hydrated oxide of iron, there is good reason to suppose that in ordinary cases of arsenical poisoning the greater part of the poison remains in the stomach undissolved, and that the iron, in so far as it is useful, operates chiefly as a mechanical antidote by enveloping the arsenic and shielding the stomach until the bulk of the mass or an emetic causes its discharge, in the same manner as the subcarbonate of iron does in similar cases. This statement is inferred from the fact that a very large excess of the oxide is essential to its efficiency.

The *subcarbonate of iron* of the previous editions of the Pharmacopœia seems to have been discarded on account of its speedily losing its original character by the action of the oxygen of the atmosphere. Whether or not that change impairs its therapeutic virtues is perhaps not so readily determined. At all events, it is one of the oldest pharmaceutical preparations of iron, and was intended to imitate and take the place of rust of iron, which from time immemorial had been used in medicine. It continues to be one of the most employed members of its class, but is ineligible whenever it is desired to introduce a large amount of iron into the blood. It has been recommended in all forms of *anæmia* and *anæmic chlorosis*, and in *neuralgia*, *chorea*, and other nervous affections depending upon a deficiency of red corpuscles in the blood. In a disease of a different order, *tetanus*, a number of cures have been attributed to this medicine, but of late years it has been entirely supplanted by other means, and the question of its utility is unsettled. Subcarbonate of iron in large doses, mixed with water, may be resorted to when the hydrated peroxide cannot be procured in cases of poisoning by *arsenious acid*. Four grave cases of poisoning by very large doses of arsenious acid were treated in this manner by Leale, and all recovered (*Amer. Jour. of Med. Sci.*, Jan. 1880, p. 80). The *dose* of subcarbonate of iron is from 5 grains (Gm. 0.30) upward. In some cases of neuralgia it has been taken by the teaspoonful. Caution should be exercised, lest it accumulate in the bowels and obstruct them.

For the reasons now given the subcarbonate has been supplanted by the oxide of iron, protected by the sugar surrounding it from peroxidation. It is probable that from this cause it more readily enters into combination with the acids of the stomach and enters the circulation, so that for all the purposes above mentioned it is more suitable than the old subcarbonate of iron, the case of arsenical poisoning alone excepted. In that case the subcarbonate no doubt acts partly by its mass in a mechanical manner, and partly by combining with the arsenious acid. The soluble saccharated carbonate is one of the most efficient of all the ferruginous preparations, and one of the most acceptable to the stomach. It should be taken a short time before meals to ensure its thorough solution and absorption, and in doses of from 3 to 10 or 15 grains (Gm. 0.20–1). Powdered "subcarbonate of iron" is one of the many dry powders which have been used in the treatment of indolent *ulcers*. *Syrup of soluble oxide of iron* is a convenient form for the administration of iron to children, and in teaspoonful doses.

FERRI OXIDUM HYDRATUM CUM MAGNESIA.—Hydrated Oxide of Iron with Magnesia.

Antidotum arsenici, P. G.—*Antidote to arsenic*, E.; *Contre-poison de l'arsenic*, Fr.; *Gegengift des Arseniks*, G.

Preparation.—Solution of Tersulphate of Iron 1000 grains (65 Gm. or 13¼ fluidrachms); Magnesia 150 grains (10.0 Gm.); Water a sufficient quantity. Mix the solution of tersulphate of iron with twice its weight (4½ fluidounces) of water, and keep the mixture in a well-stopped bottle. Rub the magnesia with water to a smooth and thin mixture; transfer this to a bottle capable of holding 32 fluidounces or about 1 liter, and fill it up with water. When the preparation is wanted for use, mix the two liquids by adding the magnesia mixture gradually to the iron solution, and shake them together until a homogeneous mass results. *Note.*—The diluted solution of tersulphate of iron and the mixture of magnesia with water should always be kept on hand, ready for immediate use.—*U. S.*

A similar preparation has been contained in the German Pharmacopœia, which now orders solution of ferric sulphate (sp. gr. 1.429) 100 parts with water 250 parts, and magnesia 15 parts with water 250 parts. These proportions agree nearly with the older formula. There does not appear to be any necessity for mixing the magnesia with about 100 times its weight of water; about 15 times its weight (or, for the above quantity, 8 or 9 fluidounces) of water would be sufficient. This is conveniently kept in a quart bottle, and when needed the diluted iron solution should be gradually added, with vigorous shaking, to the magnesia mixture, so as to prevent the formation of a basic insoluble iron salt. The magnesia is used in excess, more than is necessary for separating all the ferric hydrate, and the mixture is prevented from becoming heated by the previous diffusion of the magnesia in water. Neither filtration nor straining is requisite, the compounds of the mixture being ferric and magnesium hydrates and magnesium sulphate, none of which has any caustic or otherwise injurious effect nor forms a soluble compound with arsenic. The mixture being made only when needed, the ferric hydrate is in that condition in which it readily combines with arsenious acid and has not become inert for the purpose by long keeping.

Action and Uses.—If freshly made and promptly administered in large doses, it is probable that this mixture is a more efficient antidote to arsenic than either of its ingredients would be alone.

FERRI OXIDUM MAGNETICUM.—MAGNETIC OXIDE OF IRON.

Ferrum oxydatum magneticum, Oxydum ferroso-ferricum.—Black oxide of iron, E.; *Oxyde ferroso-ferrique, Oxyde de fer noir (magnétique), Ethiops martial,* Fr.; *Magneteisen, Ferroferrioxyd, Eisenoxyd-Oxydul,* G.

Formula $Fe_3O_4 = FeO.Fe_2O_3$. Molecular weight 231.7.

Preparation.—Take of Solution of Persulphate of Iron 5½ fluidounces; Sulphate of Iron 2 ounces; Solution of Soda 4 pints; Distilled Water a sufficiency. Dissolve the sulphate of iron in 2 pints of the water, and add to it the solution of persulphate of iron; then mix this with the solution of soda, stirring them well together. Boil the mixture; let it stand for 2 hours, stirring it occasionally; then put it on a calico filter, and when the liquid has drained away, wash the precipitate with distilled water until what passes through the filter ceases to give a precipitate with chloride of barium. Lastly, dry the precipitate at a temperature not exceeding 120° F.—*Br.* 1867.

Magnetic oxide, which is found in Sweden as magnetic iron ore, consists of 1 molecule each of ferrous and ferric oxides. When solutions of ferrous and ferric salts are mixed in molecular proportions, and then precipitated by a caustic alkali, the same compound is thrown down in a hydrated condition. The mixture should without delay be boiled for some time until the precipitate has become denser and settles readily. It may then without difficulty be washed by decantation, and finally upon the filter, without being prone to oxidation, as before the boiling.

Properties.—It is an inodorous and tasteless brownish-black powder, which is strongly attracted by the magnet and dissolves without effervescence in warm hydrochloric acid diluted with half its volume of water. This solution yields blue precipitates with both ferrocyanide and ferricyanide of potassium. When heated in a test-tube it gives off moisture, and when the heat is continued in contact with the air red ferric oxide is left. Lefort (1852) found magnetic oxide of iron to contain 1 molecule, or 7.2 per cent., of water. According to the British Pharmacopœia, it contains about 20 per cent.

Its purity is ascertained by the tests given, and by sulphuretted hydrogen added to the dilute solution in hydrochloric acid, which should produce only a white turbidity from separated sulphur, but not a black precipitate (absence of copper, etc.). Should it have been insufficiently washed, the alkaline sulphates or chlorides may be detected in the distilled water shaken with a portion of the oxide.

Under the name of *Æthiops martialis* various pharmacopœias formerly recognized black ferroso-ferric oxide, which varied in composition according to the different methods of preparation.

Medical Action and Uses.—This preparation has been but little used of late, owing to the want of uniformity in its composition. It is, however, rich in iron, and may be prescribed in all cases for which the subcarbonate is employed. The *dose* is from 5 to 20 grains (Gm. 0.30–1.30), and should be taken after meals.

FERRI PHOSPHAS, *U. S.*—PHOSPHATE OF IRON.

Ferri et sodii citro-phosphas; Ferrum phosphoricum cum natrio citrico.—Soluble ferric phosphate, Sodio-ferric citro-phosphate, E.; *Citro-phosphate de fer et de soude,* Fr.; *Natrium-ferricitrophosphat,* G.

Preparation.—Citrate of Iron 5 parts (5 oz. av.); Phosphate of Sodium 6 parts (6 oz. av.); Distilled Water 10 parts (10 oz. av. or 9⅝ fluidounces). Dissolve the citrate of iron in the distilled water by heating on a water-bath. To this solution add the phosphate of sodium, and stir constantly until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

The pharmacopœial names for this compound are incorrect, and should be changed, although analogous to those of the medicinal pyrophosphate of iron; both might very appropriately be designated as *soluble* ferric phosphate and pyrophosphate, to distinguish them from these salts, which are insoluble in water. Ferric citrate and sodium phosphate are mixed in the proportion of their molecular weights as given by the Pharmacopœia; the dark-red color of the liquid changes to green, when on evaporation the amorphous double salt is left behind and obtained in scales. The yield is 7 parts (7 oz. av.).

Properties.—Sodio-ferric citro-phosphate is in "thin, bright-green, transparent scales, permanent in dry air when excluded from the light, but turning dark on exposure to light, odorless, having an acidulous, slightly saline taste and a slightly acid reaction; freely and completely soluble in water, but insoluble in alcohol. The aqueous solution of the salt is rendered blue by test solution of ferrocyanide of potassium, but does not yield a blue precipitate with this reagent unless it has been acidulated with hydrochloric acid. When heated with solution of potassa in excess a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a light-yellow precipitate with test solution of nitrate of silver (difference from pyrophosphate). 100 parts of the salt represent about 13.5 parts of metallic iron."—*U. S.*

Composition.—According to R. Rother, the salt contains 1 molecule of water, and its formula is $FePO_4.Na_2HC_6H_5O_7.H_2O$, the molecular weight being 405. (See papers by R. Rother on this and allied compounds in *Amer. Jour. Phar.*, 1876, p. 171, and 1883, p. 165.)

Off. Prep.—Syrupus ferri quininæ et strychninæ phosphatum. *U. S.*

True Phosphates of Iron.—Ferri phosphas, *Br.*—Ferrum phosphoricum, Phosphas ferroso-ferricus.—Phosphate of iron, Ferroso-ferric phosphate, *E.;* Phosphate de fer, Phosphate ferroso-ferrique, *Fr.;* Ferroferriphosphat, Phosphorsaures Eisenoxydul-Oxyd, *G.* Formula $Fe_32PO_4.FePO_4.12H_2O$; molecular weight 724.6.—Dissolve 3 ounces of sulphate of iron in 30 ounces of boiling distilled water, and 2¾ ounces of phosphate of sodium in a similar quantity of water. When each solution has cooled to between 37.8° and 54.4° C. (100° and 130° F.) add the latter to the former, pouring in also a solution of ¾ ounce of bicarbonate of sodium in a little distilled water. Mix thoroughly. Transfer the precipitate to a calico filter, and wash it with hot distilled water till the filtrate ceases to give a precipitate with chloride of barium. Finally, dry the precipitate at a temperature not exceeding 48.9° C. (120° F.).—*Br.*

The mineral *vivianite*, which forms pale-blue crystals, is mainly ferrous phosphate. On bringing together solutions of ferrous sulphate and sodium phosphate a white precipitate of ferrous phosphate is produced, which on exposure and during the washing is oxidized, and acquires a more or less blue, greenish-blue, or grayish-blue color. During the reaction a portion of the sulphuric acid is set free, and retains phosphate of iron in solution, to obtain which sodium acetate is added, which, reacting with the free sulphuric acid, forms sodium sulphate and free acetic acid, in which the phosphates of iron are insoluble. Or the free acid may be nearly neutralized with sodium carbonate or bicarbonate, as directed above. The washing of the precipitate must be continued until the filtrate fails to give a reaction for sulphuric acid.

Thus prepared, it is a tasteless and inodorous bluish powder, varying somewhat in shade. It is insoluble in water, but dissolves in hydrochloric acid, yielding a yellow solution in which dark-blue precipitates are produced by both ferro- and ferricyanide of potassium. If the acid solution is treated with sufficient tartaric acid, and then with an excess of ammonia, no precipitate is produced, but on the addition of sulphate of magnesium a white precipitate of ammonio-magnesium phosphate falls. When the powder is boiled with caustic soda the filtrate, after being neutralized, yields a yellow precipitate with nitrate of silver. Both precipitates indicate phosphoric acid. The chemical composition varies to some extent, and is influenced by its exposure to the atmosphere while moist, the temperature at which it is dried, etc. The above formula is that of Rammelsberg. Wittstein obtained a somewhat different result. The British Pharmacopœia regards it as containing at least 47 per cent. of ferrous phosphate ($Fe_3P_2O_8 8H_2O$); 3 Gm. dissolved in hydrochloric acid should require for complete oxidation not less than 27.9 Ccm. of the volumetric solution of potassium bichromate, which indicates 46.7 per cent. of the ferrous salt.

The salt should yield nothing to hot distilled water (insufficient washing), and the solution in hydrochloric acid should yield only a white turbidity of sulphur with sulphuretted hydrogen, but not a black (copper, etc.) or a yellow (arsenic) precipitate. The same solution, digested with bright copper, should not form a dark deposit of arsenic upon the metal.

Ferri phosphas albus, Phosphas ferricus.—Ferric phosphate, White phosphate of iron, *E.;* Phosphate ferrique, *Fr.;* Ferriphosphat, *G.* $Fe_22PO_4.4H_2O$; molecular weight 373.8.—On mixing 4 fluidounces of solution of tersulphate of iron with the solution of 1 ounce of sodium acetate, and adding solution of sodium phosphate, a white precipitate of ferric phosphate is obtained. After washing and drying at 100° C. it is a white or yellowish-white tasteless powder having the composition stated, is decomposed by alkalies, and dissolves readily in dilute mineral acids, in citric and tartaric acid, and in alkaline citrates, the latter solutions having a green color. The freshly precipitated and washed salt, mixed with water until the mixture contains 1.0 or 1.2 per cent. of ferric phosphate, has been used under the name of *Lac ferri, milk of iron.*

Medical Action and Uses.—Owing to its insolubility in water phosphate of iron must be given in pill or in powder, of which the latter is preferable, in the *dose* of from 5 to 10 grains (Gm. 0.30–0.60). It is extremely doubtful whether the phosphoric acid in its composition confers any special virtues upon it.

FERRI PYROPHOSPHAS, *U. S.*—Pyrophosphate of Iron.

Ferri et sodii citro-pyrophosphas, Ferrum pyrophosphoricum cum sodio citrico, Pyrophosphas ferricus cum citrate sodico.—Pyrophosphate of iron with sodium citrate, Sodio-ferric citro-pyrophosphate, E.; *Citro-pyrophosphate de fer et de soude*, Fr.; *Pyrophosphorsaures Eisenoxyd mit Citronensaurem Natron*, G.

Preparation.—Citrate of Iron 9 parts (9 oz. av.); Pyrophosphate of Sodium 10 parts (10 oz. av.); Distilled Water 18 parts (18 oz. av. or 17¼ fluidounces). Dissolve the citrate of iron in the distilled water by heating on a water-bath. To this solution add the pyrophosphate of sodium, and stir constantly until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.—*U. S.*

On precipitating a solution of sodium pyrophosphate by ferric sulphate a white precipitate of *ferric pyrophosphate*, $Fe_4 3P_2O_7$, is obtained, which, like other insoluble ferric salts, is readily soluble in alkaline citrates, forming green solutions. Formerly ammonium citrate was used for this purpose, but, owing to the slow volatilization of the ammonia, the salt gradually became insoluble. Sodium phosphate is not subject to the same disadvantage. The present formula also proceeds inversely from the former one, and instead of dissolving the ferric pyrophosphate in the alkaline citrate now adopts the suggestion of Mr. Rother (1876), and directs the alkali pyrophosphate to be mixed with ferric citrate, when, practically, the same compound will be produced. The relative proportions, however, have been changed, the salts being used in the approximate proportions of 2 molecules of ferric citrate and 3 of crystallized sodium pyrophosphate. The yield is 14½ parts (14½ oz. av.).

Properties.—The salt is obtained in inodorous transparent apple-green scales, which are permanent in dry air when excluded from the light, but turn dark on exposure to light. The salt has an acidulous, slightly saline, and scarcely chalybeate taste and a slightly acid reaction, is insoluble in alcohol, but dissolves freely in water, yielding a greenish solution; this gives with potassium ferrocyanide a blue color, but no precipitate unless acidulated with hydrochloric acid. Excess of ammonia produces no precipitate, but boiling with caustic potassa yields a yellowish-white, and if an excess of the latter be used a red-brown, precipitate; and the filtrate separated from this precipitate, after being supersaturated with acetic acid, yields a white precipitate with test solution of nitrate of silver (difference from phosphate). 100 parts of the salt represent about 11.5 parts of metallic iron, *U. S.*

Composition.—This preparation is evidently of a complex nature. Regarding the chemical composition of this and similar preparations two views have been entertained. According to the one, they are double salts of ferric pyrophosphate and alkali citrate; according to the other, which has been advocated by Rother (1876), they should be regarded as mixtures of alkali-ferric pyrophosphate, $Fe_4 3P_2O_7.3Na_4P_2O_7$, with alkali-ferric citrate and ferric citrate. The formula given for the double pyrophosphate corresponds with that of Gladstone for sodio-ferric pyrophosphate, for which Fleitmann and Persoz (1848) give the formula $Fe_4(P_2O_7)_3.2Na_4P_2O_7$.

Allied Salt.—Ferri et sodii pyrophosphas, Natrium pyrophosphoricum ferratum.—Sodio-ferric pyrophosphate, *E.;* Pyrophosphate de fer et de soude, *Fr.;* Natrium ferri-pyrophosphat, *G.*—It is prepared by adding to a solution of 200 parts of sodium pyrophosphate in 400 parts of water so much ferric chloride in aqueous solution that a permanent precipitate is not produced, and mixing with the greenish liquid 1000 parts of alcohol. A white amorphous powder is thus obtained, which, according to Fleitmann, contains 7 molecules (9 per cent.) of water, and dissolves slowly in water, yielding a greenish solution; this on boiling separates a white precipitate, acquires with ammonia a red color, is not precipitated by alkaline carbonates, phosphates, or acetates, but with chloride of sodium yields a precipitate of the double salt, while the addition of ferric chloride causes the precipitation of ferric pyrophosphate.

Medical Action and Uses.—The tastelessness, solubility, and richness in iron of this salt render it one of the best ferruginous preparations. *Dose*, from 2 to 5 grains (Gm. 0.12–0.30). The dose of pyrophosphate of iron and sodium is stated at from 2 to 5 grains (Gm. 0.10–0.30).

Salicylate of iron has had attributed to it qualities which are unlike those of any other iron salt, such as "promoting secretion and stimulating the skin," while it "promotes perspiration, lowers the temperature, and reduces the pulse." It has been recommended for *diphtheria*, *aphthæ*, *erysipelas*, etc. (White, *Glasgow Med. Jour.*, Aug. 1879).

FERRI SULPHAS, *U. S., Br.*—Sulphate of Iron.

Ferrum sulfuricum, P. G.; *Sulfas ferrosus*, *Ferrum vitriolatum purum*, *Vitriolum martis purum.*—*Ferrous sulphate*, E.; *Sulfate (Protosulfate) de fer*, *Sulfate ferreux*, Fr.; *Ferrosulfat*, *Schwefelsaures Eisenoxydul*, G.

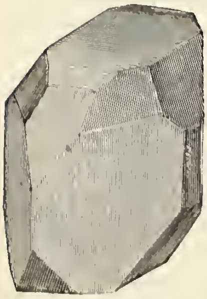
Formula of crystallized or precipitated ferrous sulphate $FeSO_4.7H_2O$; molecular weight 277.9; of exsiccated ferrous sulphate $FeSO_4.H_2O$; mol. weight 169.9.

Preparation.—Take of Iron Wire 4 ounces; Sulphuric Acid 4 fluidounces; Distilled Water 1½ pints. Pour the water on the iron placed in a porcelain dish, add the sulphuric acid, and when the disengagemant of gas has nearly ceased boil for 10 minutes. Filter now through paper, and after the lapse of 24 hours separate the crystals which have been deposited from the solution. Let these be dried on filtering-paper placed on porous bricks, and preserved in a stoppered bottle.—*Br.*

Ferrous sulphate is obtained on a large scale from alum shale and by roasting iron pyrites, exposing it to the air, and exhausting the mass with water; also by passing solutions of copper sulphate over scraps of iron, whereby copper is precipitated, the iron entering into solution. It is also obtained as a by-product in various manufactures where sulphuric acid is used for the purpose of purifying certain products. The article thus obtained is usually impure and not fit for medicinal purposes, except for disinfecting, and in this impure state is known in commerce as *copperas*, or *green vitriol* (Couperose verte, Vitriol vert, *Fr.;* Kupferwasser, Grüner Vitriol, *G.*). For medicinal use it should be prepared directly from sulphuric acid acting upon iron wire or clean iron filings in the presence of water, when hydrogen is evolved, ferrous sulphate remaining in solution; $Fe_2 + 2H_2SO_4$ yields $2H_2 + 2FeSO_4$. The salt is prone to oxidation if its chemically neutral solution is evaporated to crystallization, but in the presence of some free sulphuric acid yields crystals which are far more permanent. This explains the necessity of having some free sulphuric acid in the liquid from which ferrous sulphate is crystallized. The crystals are collected upon a diaphragm, washed rapidly with a little water, and, according to the French Codex, with a little alcohol, to remove the mother-liquor, and then dried.

Properties.—Ferrous sulphate is in transparent bluish-green monoclinic prisms, or sometimes in rhombic crystals having the specific gravity 1.9. When crystallized from neutral solutions the salt is pale-green, and in the presence of ferric salt of a deeper, more emerald-green, color. It is inodorous, has a styptic and somewhat saline taste, a slight acid reaction, melts by heat in its water of crystallization, leaving finally a whitish residue, and when exposed to the air effloresces and is gradually oxidized; the efflorescence takes place more rapidly above 35° C. (95° F.), and when finally heated to 115° C. (239° F.) the loss of water of crystallization amounts to 38.86 per cent. The salt is insoluble in alcohol and ether, but dissolves at 10° C. (50° F.) in 1.64, at 30° C. (86° F.) in 0.7, and at 100° C. (212° F.) in 0.3, parts of water; according to Schiff (1857), the solution, saturated at 15° C. (59° F.), contains 1 part of the crystallized salt to 1.71 parts of water. The aqueous solution yields a white precipitate insoluble in hydrochloric acid with barium chloride, a dark-blue one with potassium ferricyanide, and a bluish-white one with potassium ferrocyanide.

Fig. 123.



Crystal of Ferrous Sulphate.

Tests.—Impurities are rarely present if the salt has been prepared from iron and sulphuric acid. The aqueous solution treated with hydrosulphuric acid should yield not more than a faint white turbidity of sulphur (limit of ferric salt), should not give a blackish precipitate (copper, etc.), and when completely precipitated by sulphydrate of ammonium the filtrate on evaporation and ignition should leave no residue (magnesium, alkalies). The aqueous solution, after being oxidized with nitric acid and supersaturated with ammonia, should yield a filtrate which is not affected by sulphuretted hydrogen (zinc, manganese); and if the oxidized liquid be supersaturated with potassa solution, the filtrate neutralized with hydrochloric acid and again supersaturated with ammonia, no precipitate (alumina) should occur. "If 4.167 Gm. of sulphate of iron are dissolved in water acidified with diluted sulphuric acid, and the solution treated with volumetric solution of bichromate of potassium until a drop no longer gives a blue color with test-solution of ferricyanide of potassium, the required number of Ccm. of the volumetric solution multiplied by 2 equals the percentage of unoxidized ferrous sulphate in crystals."—*U. S.*

Pharmaceutical Uses.—Nearly all the officinal compounds of iron, with the exception of the chloride, iodide, sulphide, and nitrate, are prepared from the sulphate, either directly or indirectly. Ferrous sulphate is used in preparing Mistura ferri comp., *U. S.*, *Br.;* Pil. aloes et ferri, *Br.;* Massa ferri carbonatis, Pil. ferri comp., *U. S.*

Ferri sulphas præcipitatus, *U. S.;* Ferri sulphas granulata, *Br.*—Precipitated or granulated sulphate of iron or ferrous sulphate, *E.;* Sulfate ferreux précipité, *Fr.;* Præcipitirtes Ferrosulfat, *G.*—Sulphate of iron 100 parts (12½ oz. av.); distilled water 170 parts (21¼ oz. av. or 20⅝ fluidounces); sulphuric acid 4 parts (½ oz. av.); alcohol a sufficient quantity. Dissolve the sulphate of iron in the distilled water, previously mixed with the sulphuric acid, and filter the solution. Allow the filtrate to become cold, pour it gradually and while stirring into an equal volume (26 fluidounces) of alcohol, and set the mixture aside for 1 day in a well-covered vessel. Drain the crystalline powder which has settled in a funnel, wash it with alcohol until the washings cease to redden blue litmus-paper, fold it in a piece of muslin, and press it gently. Finally, spread the powder on bibulous paper and dry it quickly in the sunlight or in a dry-room at the ordinary temperature, and keep it in well-stopped bottles.—*U. S.*

The British Pharmacopœia gives the same directions as for the crystallized salt, except that on filtering the solution is collected in a jar containing 8 fluidounces of alcohol, which quantity is insufficient for precipitating all the ferrous sulphate. The German Pharmacopœia likewise directs the salt to be prepared from iron wire, but uses about an equal volume of alcohol for precipitating the warm aqueous solution. The salt thus prepared is a very pale bluish-green powder, which, if it has been properly dried, is less readily oxidized on exposure than the crystals, but in other respects shows precisely the same behavior as the crystallized salt, and is tested in the same manner.

Ferri sulphas exsiccatus, *U. S.*, *Br.;* Ferrum sulfuricum siccum, *P. G.*—Dried (exsiccated) sulphate of iron or ferrous sulphate, *E.;* Sulfate ferreux desséché, *Fr.;* Entwässertes Ferrosulfat, *G.*—Sulphate of iron, in coarse powder, a convenient quantity. Expose the sulphate of iron in an unglazed earthen vessel to a moderate heat, occasionally stirring, until it has effloresced. Then increase the heat to 149° C. (300° F.), and maintain it at that temperature until the salt ceases to lose weight. Lastly, reduce the residue to fine powder and keep it in well-stopped bottles.—*U. S.*

The British Pharmacopœia directs the use of a porcelain or iron dish, and the heat to be raised only to 100° C. (212° F.). At a somewhat higher temperature the yield is about 61 per cent. The German Pharmacopœia employs only the heat of a water-bath, at which the loss amounts to 35 or 36 per cent. Crystallized ferrous sulphate contains 45.3 per cent. of water of crystallization, a portion of which is lost in a dry atmosphere at the ordinary temperature, the remainder, except 1 molecule, at 115° C. (239° F.). The last molecule of water is expelled only at about 280° C. (536° F.), and, if proper care be taken, without the loss of sulphuric acid.

Exsiccated ferrous sulphate forms a grayish-white powder which dissolves slowly in cold, more rapidly in hot, water, leaving only a small quantity of ferric oxysulphate. Otherwise, the behavior and tests of purity are the same as for the crystalline salt, nearly 10 parts of which are represented by 6 parts of the exsiccated salt.

Medical Action and Uses.—The intense astringency of the sulphates of iron renders them, as a rule, ineligible for internal administration, except when it is intended to exert a directly constringing action upon the capillaries, not only of the alimentary canal, but of remote organs. If the dose much exceeds 1 or 2 grains (Gm. 0.06–0.12) it is apt to occasion gastric pain and vomiting, and the prolonged use of even smaller doses is not free from the risk of impairing the digestive function. Besides passive *hæmorrhages*, it is well adapted to control excessive secretions produced by debility, as *sweating*, *chronic diarrhœa*, *leucorrhœa*, *gleet*, and *hydruria*. Externally, it has been used as an application to the skin in superficial traumatic *erysipelas*, but it is quite useless in the idiopathic form of the disease. A solution of ½ ounce (Gm. 16) of the salt in a pint of water, or an ointment containing 2 drachms (Gm. 8) to the ounce of lard, may be employed in the former affection. An ointment made with 1 or 2 parts of the dried sulphate to 30 of lard is a useful application in cases of obstinate local *diseases of the skin*, such as eczema, intertrigo, and impetigo. It may also aid in healing the sores occasioned by *rupia*, *ecthyma*, *syphilis*, and *scrofula*, but has no advantage over zinc ointment for this purpose.

FERRI SULPHURETUM.—SULPHURET OF IRON.

Sulphuretum ferrosum.—Sulphide of iron, E.; *Sulfure de fer*, Fr.; *Schwefeleisen*, G.
Formula FeS. Molecular weight 87.9.

Preparation.—Iron unites with sulphur in various proportions, some of the compounds, like iron pyrites, FeS_2, being found in nature. The monosulphide, which is employed for generating sulphuretted hydrogen, is made by mixing 3 parts of iron filings with 2 parts of sublimed sulphur, introducing the mixture in *small* portions into a crucible heated to bright redness and kept covered after each addition; or, a rod of iron is raised nearly to a white heat and then brought into contact with sulphur; ferrous sulphuret will at once form and melt, and should be permitted to drop into cold water to solidify.

Properties.—It is in yellowish-black or blackish masses or irregular pieces, which have a metallic lustre and are permanent in dry air, but are oxidized when kept in a damp atmosphere. It dissolves readily in dilute sulphuric or hydrochloric acid, with the evolution of sulphuretted hydrogen, and without leaving any residue when the sulphuret is pure. As met with, it sometimes contains an excess of sulphur, but usually has an excess of iron, and the sulphuretted hydrogen evolved is mixed with hydrogen.

Sulphuretted hydrogen, *hydrogen sulphide*, or *hydrosulphuric acid* is a colorless gas having a disgusting odor suggesting that of rotten eggs. Its specific gravity is 1.19; water dissolves three times its volume of the gas; the solution is not permanent in the air, but is oxidized, water being formed and white sulphur deposited. The formula of sulphuretted hydrogen is H_2S, its molecular weight 34.

This compound has no direct medicinal value. It is used for the production of hydrosulphuric acid.

FERRI VALERIANAS, *U. S.*—VALERIANATE OF IRON.

Ferrum valerianicum.—Ferric valerianate, E.; *Valérianate de fer*, Fr.; *Ferrivalerianat*, *Baldriansaures Eisenoxyd*, G.

Preparation.—This salt is best obtained by adding to a cold solution of ferric sulphate or ferric chloride a cold solution of sodium valerianate as long as a precipitate is produced, collecting this upon a filter, washing it with a little water, and drying it at a temperature not exceeding 20° C. (68° F.). The salt is formed by double decomposition, sodium sulphate or chloride remaining in solution, while ferric valerianate is precipitated. An elevated temperature and continued washing should be avoided, since valerianic acid would be removed and a more basic salt remain behind.

Properties.—The salt is a dark brick-red light amorphous powder which has a slight odor and a taste of valerianic acid. When slowly heated it gradually parts with all its acid without melting, but when rapidly heated it fuses and gives off dense inflammable vapors having only a faint odor of valerianic acid, but a strong odor of butyric acid. The salt is with difficulty moistened with cold water, but boiling water decomposes it, gradually setting free all the acid and leaving ferric hydrate. The salt is easily soluble in hydrochloric acid (Wittstein, 1845). On treating freshly-precipitated ferric hydrate with valerianic acid, Ludwig (1849) obtained a granular dark red-brown powder which was only partly soluble in alcohol, leaving a basic salt behind.

Composition.—The formula given by the Pharmacopœia, $Fe_2(C_5H_9O_2)_6$, mol. weight 717.8, requires 22.26 per cent. Fe_2O_3. Ludwig's alcoholic solution when spontaneously evaporated left a salt yielding 21.5 per cent. Fe_2O_3; the formula $Fe_2(C_5H_9O_2)_6.H_2O$ requires 21.72 per cent. Dried at 50° C. (122° F.), the same salt yielded 30 per cent., and Wittstein's salt, dried at 20° C. (68° F.), gave 27 per cent. Fe_2O_3; the formula $Fe_2(C_5H_9O_2)_6.FeOC_5H_9O_2$ requires 27.34 per cent. The salt is evidently of variable composition, depending on the process, the care with which it has been washed, and the temperature at which it has been dried.

Medical Action and Uses.—It was expressly stated, when this preparation was first introduced into medicine, that it would be an error to regard it as a true anti-spasmodic, on account of the valerianic acid in its composition, and that its value depended mainly upon the iron it contained, the acid acting only as an adjuvant. It should have been added that the iron might be introduced into the system under many more eligible forms and in more suitable doses than were recommended for this salt. It is probably but little used, even for the affections for which it was originally recommended, and which were described as "chlorosis with hysterical or epileptiform attacks." It was prescribed in pills in the *dose* of from 1 to 3 grains (Gm. 0.05–0.15) several times a day.

FERRUM, *U. S., Br.*—IRON.

Mars.—*Fer*, Fr.; *Eisen*, G.

Symbol Fe. Atomicity bivalent and sexivalent (Fe_2). Atomic weight 55.9.

Metallic iron, in the form of fine, bright, and non-elastic wire, *U. S.;* wrought iron in the form of wire or nails free from oxide, *Br.*

Origin.—Iron is the most useful and one of the most widely-diffused metals in nature, being present in most rocks and soils, and generally forming one of the constituents of the ashes of plants and animals. It is rarely found in the metallic state. It is often combined with sulphur, as *iron pyrites*, more frequently oxidized, as *magnetic iron*, *spathic iron*, *hematite*, and other ores, and likewise in combination with mineral acids. It is found in large quantities in several states of North America and in Great Britain, Sweden, Germany, France, and other European countries.

The manufacture of metallic iron must of necessity vary with the nature of the ore, but the principle is in all cases the same. The ore frequently requires roasting or calcination, mainly for the purpose of rendering it more porous and better adapted for the smelting process; this process is conducted in blast-furnaces, the ore being mixed with carbonaceous matter—coke and the like—some flux, either lime or clay, being added at the same time, whereby a more readily fusible silicate of aluminium and calcium is formed, which on cooling forms the glass-like slag. The crude iron obtained from the blast-furnace is called *pig* or *cast iron*, and contains various proportions of carbon, silicon, sulphur, phosphorus, and other impurities, from which it must be purified to adapt it for various uses in the arts. In the *refining* or *puddling* process it is fused, and by stirring brought into contact with a blast of air, by which the impurities are oxidized, or the oxidation is effected with the aid of an impure oxide of iron (iron scales). The slag still remaining in the iron is then at a white heat pressed out under a steam-hammer, and the iron thus purified rolled out into bars. For many purposes a further purification is requisite.

Properties.—Iron is a grayish metal of the spec. grav. 7.7 to 7.9. Its tenacity or strength is nearly twice as great as that of any other metal commonly used, and when heated to redness it possesses a ductility admitting of its being drawn into the thinnest wire. At a white heat it becomes pasty and may be welded, but it can be fused only by the full heat of a blast-furnace, and on congealing it expands somewhat in volume. Iron remains unchanged in dry air, but in the presence of moisture its surface becomes covered with brown-red oxide (*rust*). It enters into combination with nearly all the elements, and forms the base of two important series of salts, the *ferrous* and *ferric*, in the former of which it is a dyad, Fe'', in the latter a hexad $(Fe_2)^{VI}$.

Ferrous salts, when anhydrous, are mostly white, and bluish-green in the hydrated state; the oxalate is yellow. When moist or in solution they are easily oxidized on exposure to the air or under the influence of oxidizing agents. Their aqueous solutions are colored brownish-black by nitric oxide, and yield black precipitates with sulphydrate of ammonium, and white ones, changing to green, black, and brown, with alkalies and their carbonates; the precipitation, particularly with ammonia, is incomplete. Soluble phosphates precipitate white ferrous phosphate, changing to greenish-blue; potassium ferrocyanide produces a bluish-white precipitate, changing to dark-blue, and potassium ferricyanide a dark-blue one. Ferrous solutions free from ferric salt are not affected by potassium sulphocyanide or tannin. The soluble normal ferrous salts have an acid reaction to test-paper; those insoluble in water dissolve in hydrochloric acid.

Ferric salts are either normal or basic: the normal salts, when soluble, have an acid reaction, are mostly white when anhydrous, and brown or brown-yellow when hydrated:

the basic salts are of a darker brown or reddish-brown color. Those insoluble in water dissolve in hydrochloric acid. Sulphuretted hydrogen reduces ferric to ferrous salts, sulphur being separated; ammonium sulphydrate produces the same reduction, and afterward a black precipitate. Alkalies and alkaline carbonates added in excess separate brown ferric hydrate, in the latter case with the evolution of carbonic acid; the precipitation is prevented by the presence of tartaric acid and some other organic compounds. Alkali acetate, added in the cold, colors the solutions deep brown-red, the color disappearing on the addition of hydrochloric acid; on boiling a brown precipitate of basic ferric acetate or ferric hydrate is deposited. Solutions of ferric salts treated with metallic iron, sulphurous acid, or other deoxidizing agents are reduced to ferrous salts. Sodium phosphate precipitates white ferric phosphate, which is insoluble in acetic acid, becomes brown by ammonia, and if excess of sodium phosphate be present dissolves in ammonia with a red-brown color. Arseniate of sodium has a behavior similar to that of the phosphate. Gallo-tannic acid causes a blue-black color and precipitate (writing ink). Meconic acid and sulphocyanides color the solutions blood-red, the color produced by the latter reagent being destroyed by corrosive sublimate and by strong mineral acids. Potassium ferricyanide darkens the solutions of ferric salts to an olive-brown color; potassium ferrocyanide precipitates Prussian blue.

Pharmaceutical Uses.—Besides the salts of iron treated of elsewhere, the following may be noticed:

FERRI BENZOAS.—Benzoate of iron, *E.* $Fe_26C_7H_5O_2.6H_2O$; mol. weight 945.8.—Solution of tersulphate of iron is precipitated by a concentrated solution of benzoate of sodium or of ammonium, the precipitate collected on a filter, washed with a little cold water, pressed, and dried. It is a brownish orange-colored powder having little taste, and turning brown when heated to about 135° C. (275° F.), with the loss of water; at a higher temperature benzoic acid sublimes and the salt is decomposed. Water and alcohol dissolve a portion of the compound, leaving a basic salt. Basic ferric benzoates of a reddish or pale-brownish color are obtained from solution of subsulphate of iron or of ferric chloride mixed with ammonia-water insufficient in quantity for precipitation by adding solution of benzoate of ammonium.

FERRI TANNAS.—Tannate of iron, *E.*—Ferric tannates, free from gallate and containing but little of ferrous compound, are produced by precipitating cold solutions of ferric salts with tannin; a mixture of ferrous salt and tannin exposed to the air likewise deposits ferric tannate. Wittstein (1847) found these precipitates to contain between 8.4 and 56.25 per cent. of ferric oxide, the nature of the iron salt and the order of mixing the solutions influencing the composition of the precipitate. A compound containing about one-third its weight of ferric oxide is obtained by preparing the hydrated oxide from 3 fluidounces of solution of tersulphate of iron and triturating the washed and pressed precipitate with 1 troyounce of tannin and sufficient alcohol, after which it is dried in a water-bath. Tannate of iron is a black or bluish-black powder which is decomposed by mineral and the stronger organic acids. When boiled with water the ferric is reduced to ferrous salt.

FERRI MALAS.—Malate of iron, *E.*—Impure malate of iron is recognized by several European pharmacopœias as EXTRACTUM FERRI POMATUM, which is prepared by digesting the expressed juice of sour apples with 3 or 4 per cent. of iron filings until the reaction has ceased, filtering, and evaporating. It has a blackish-green color, and contains a variable quantity of iron, sometimes as much as 8 per cent. 1 part of it dissolved in 9 parts of cinnamon-water, containing one-tenth its weight of alcohol, is known as TINCTURA FERRI POMATA, *P. G.*

Off. Prep.—Besides Ferrum reductum the following *chemical* compounds and mixtures are officinal: Ferri arsenias, *Br.*; Ferri carbonas saccharatus, *U. S.*, *Br.*; Ferri chloridum, Ferri citras, *U. S.*; Ferri et ammon. citras, *U. S.*, *Br.*; Ferri et ammon. sulphas, Ferri et ammon. tartras, *U. S.*; Ferri et potass. tartras (Ferrum tartaratum), Ferri et quininæ citras, *U. S.*, *Br.*; Ferri et strychninæ citras, Ferri hypophosphis, *U. S.*; Ferri iodidum, *Br.*; Ferri iodidum saccharatum, Ferri lactas, Ferri oxalas, *U. S.*; Ferri oxidum humidum (hydratum), *U. S.*, *Br.*; Ferri oxidum magneticum, Ferri peroxidum hydratum, *Br.*; Ferri oxid. hydrat. c. magnesia, Ferri phosphas, *U. S.*, *Br.*; Ferri pyrophosphas, *U. S.*; Ferri sulphas, Ferri sulphas exsiccatus, *Br.*; Ferri sulphas præcipitatus (granulata), *U. S.*, *Br.*; Ferri valerianas, *U. S.*

The following are solutions of iron salts in water, syrup, alcohol, or wine: Liquor ferri acetatis, Liq. ferri chloridi, Liq. ferri citratis, Liq. ferri et quininæ citrat., *U. S.*; Liq. ferri nitratis (pernitratis), *U. S.*, *Br.*; Liq. ferri perchloridi, Liq. ferri perchlor. fortior, *Br.;* Liq. ferri subsulphatis, *U. S.;* Liq. ferri tersulphatis (persulphatis), Syrupus ferri iodidi, *U. S.*, *Br.;* Syr. ferri bromidi, Syr. ferri quininæ et strychninæ phosphatum, Syr. hypophosphitum cum ferro, *U. S.;* Syrupus ferri phosphatis, *Br.;* Tinctura ferri acetatis, Tinct. ferri chloridi (perchloridi), *U. S.*, *Br.;* Vinum ferri, *Br.;* Vin. ferri amarum, *U. S.;* Vin. ferri citratis, *U. S.*, *Br.*

The following pharmaceutical preparations contain iron in various forms: Emplastr. ferri, *U. S.*, *Br.;* Mistura ferri aromatica, *Br.;* Mistura ferri et ammonii acetatis, *U. S.;* Mistura ferri comp., Pil. aloes et ferri, Pil. ferri iodidi, *U. S.*, *Br.;* Pil. ferri carbon, *Br.;* Pil. ferri comp., *U. S.;* Trochisci ferri redacti, *Br.;* Troch. ferri, *U. S.*

Physiological Action.—*On Animals:* Iron is an essential constituent of the animal economy, and is chiefly found in the red corpuscles of the blood, rendering them fit vehicles for carrying oxygen to every part of the economy. The animals in whose blood the proportion of iron approaches most nearly to that of man are the ox, the dog, the goose, and the hog. By experiment it has been proved that the quantity of iron in the blood, the bile, and the milk may be increased by administering various preparations of the metal with the food. Very curious conclusions have been reached by Drs. Meyer and Williams, and especially by the latter (*Archiv f. exper. Pathol., etc.*, xiii. 70; *Boston Med. and Surg. Jour.*, Aug. 1882, p. 105)—viz.: "That iron has without doubt poisonous qualities; that the symptoms which it causes come chiefly from the alimentary canal, and that in fatal doses it diminishes the amount of carbonic acid in the blood; that the action of iron on the economy probably resembles that of arsenic and platinum; and that we are justified in believing that the action of iron on man in excessive doses would be similar to that observed in animals." It is true that the experiments which led to this judgment were performed upon frogs, rabbits, cats, and dogs, and generally by venous injections. In corroboration of their conclusions one of the authors observes: "But, more than this, it has been observed in healthy men that very large doses of iron caused weakness, a disposition to sleep, colicky pains in the region of the stomach, and vomiting;" upon which remark the commentary may be suggested that precisely such symptoms are habitually observed in healthy men who have eaten more food than they require.

On Man: In medicinal doses, varying greatly according to the preparation employed, iron does not produce any immediate effects, but after a variable interval it gives rise to a condition of plethora with characteristic phenomena. In large doses it is apt to derange the digestion, causing oppression after eating, and sometimes gastralgia and pyrosis, and, if continued, the dyspeptic derangements increase and the tongue becomes coated, while a feverish condition is induced, and constipation alternating with diarrhœa. The fæces are blackened, either by the formation of salts of iron with the tannic acid of the food or by the sulphur derived from its decomposition. But preparations which are insoluble in the stomach, and the potassio-tartrate, have not this effect. A small portion only is excreted with the urine, yet enough in some instances to become a constituent of urinary calculi and also to provoke a genito-urinary irritation. Doubtless also, in appropriate morbid conditions, iron may stimulate the sexual function, as it does all others, by increasing the organic vigor. It augments the excretion of urea and raises the animal temperature. Some of the preparations are more or less irritant, especially the chlorides, the sulphates, and the iodides, and have occasioned death by their local action on the stomach—an effect due chiefly to the acid or the iodine associated with the metal. There is little doubt that the whole physiological and therapeutical action of iron depends upon its power of absorbing oxygen from the air in the lungs and carrying it to the various organs and tissues. Its proportion in the blood is therefore, other things being equal, a measure of vital activity and energy. It appears that a point of saturation may be reached beyond which the use of iron may, on the one hand, produce plethora, or, on the other, be eliminated from the economy as superfluous. But plethora, it must be remembered, is an exaggerated degree of a normal state.

It is admitted, as Hayem points out (*Bull. de thérap.*, c. 289), that the hæmoglobin of the blood carries oxygen to the tissues by means of the iron it contains. Originally, the red corpuscles are much smaller than when mature, and hence the mere enumeration of them does not represent the amount, nor even the proportion, of hæmoglobin in the blood. Their number varies with sex, age, constitution, food, the state of pregnancy, menstruation, etc. It is of singular interest that the colorless lymph and chyle are richer in hæmoglobin than the blood itself. Indeed, it would seem that the color of the red corpuscles is due to oxidation, effected chiefly, if not exclusively, in the lungs. It is also remarkable that during the administration of iron an amount of it nearly equal to that which is taken may be recovered from the feces. Notwithstanding elaborate and long-continued experiments, the form and manner in which iron is absorbed from the alimentary canal are quite undetermined; but it is probably both absorbed and secreted by the stomach, and is eliminated by the intestinal, and indeed by all, secretions and excretions.

Hayem has insisted upon a capital point in the estimation of the red corpuscles of the blood—viz. that their number alone is not an accurate measure of the richness of this fluid, which, besides mature corpuscles, contains a large proportion of immature, or even of embryonic, cells, in which the proportion of the ferruginous element is far less than in the perfected red corpuscles, and which, if they do not receive appropriate nourishment, never reach their maturity. (Compare Willcocks, *Practitioner*, xxxi. 7, 94.) He found that a Cmm. of blood drawn from the finger of a healthy person contains about 5,000,000 red corpuscles (*Bull. de thérap.*, c. 294), and that in anæmia produced by lead-poisoning the absolute number remained about the same, though their size was altered, and they contained only half the normal proportion of hæmoglobin. The statement of Baxter and Willcocks is not in apparent accord with that of Hayem. They allege that iron first increases the number of the corpuscles, whilst their functional value remains at its original level, or may even sink below it. "The patient's symptoms are always relieved when the number of corpuscles attains its normal level, even though their individual value shows no corresponding improvement" (*Practitioner*, xxiv. 446).

Medical Uses.—Naturally, iron is indicated chiefly when the proportion of red corpuscles in the blood is permanently diminished. Their transient loss by hæmorrhage is better repaired by food, out of which the constituents of the blood are normally elaborated, supposing that the assimilative functions are not impaired. But when such impairment exists the speediest and the surest cure is brought about by the introduction of iron into the economy. By its means the proportion of red corpuscles in the blood appears to be, if it is not actually, increased, and their condition, as seen under the microscope, is changed from pale and shrivelled to red and full; through them more oxygen is introduced into the system, and a more active assimilation of nutriment, as well as a more perfect renewal of tissue, is secured. The cases in which *anæmia* may be thus remedied comprise those associated or not with chlorosis, hypochondria, convalescence from prolonged and exhausting diseases, malarial and saturnine, and some other cachexiæ attended with imperfect elaboration of the blood or its habitual waste, certain varieties of dyspepsia, some forms of albuminuria, etc. But in these and other diseases which do not involve incurable organic lesions it often happens that iron remains inoperative—in all probability because it is not digested, and not received, if at all, into the system in such a form as to make it an efficient oxygen-bearer in the blood. It has been proved that in such cases the inhalation of oxygen gas exerts a powerful although a transient stimulating influence upon the nutritive and animal functions, and that to render its action more permanent a prolonged systematic treatment by iron is essential. Conversely, it is a fact familiar to practitioners that the mere administration of iron forms but one element of the treatment in all cases of chronic anæmia. What may be accomplished medicinally by means of oxygen is more effectually and certainly attained by those various hygienic measures, including exercise, active and passive, change of scene, etc., which increase the activity of the respiratory act while stimulating the whole nervous system. Although in the greater number of *chronic nervous diseases* distinguished by morbid susceptibility the condition of the blood is impaired, and the restoration of this fluid to its normal state is an essential element of the cure, yet it often happens that the disorder is apparently limited to the nervous system, especially when the latter has been directly affected by the morbid cause. In such cases the use of iron is more prejudicial than profitable; it oppresses and does not invigorate; it impairs the appetite, constipates the bowels, and induces a dangerous plethora. Such a mode of action doubtless explains the injurious effect of iron in the greater number of cases of *epilepsy*—a disease which experience shows to be benefited, as a rule, by agents that diminish the amount of blood in the brain (vegetable diet, belladonna, bromide of potassium), and not by those which, like iron, increase it. There may be cases of the disease in which the attacks are rendered more frequent by a morbid susceptibility of the nervous system induced by sexual, and especially by unnatural sexual, excitement, and an associated anæmia; in these it is quite intelligible that iron should be salutary, especially in conjunction with appropriate hygienic measures. It was probably such cases that Gowers has reported to have been ameliorated or cured by means of iron (*Times and Gaz.*, April, 1880, p. 447). When anæmia constitutes only one out of many symptoms of a disease, the use of iron will be more or less efficient in proportion as the anæmia depends or not upon removable causes. The anæmia of tuberculosis, of cancer, the interstitial form of Bright's disease, and some other affections is subordinate to an incurable lesion, and iron can therefore act only as a palliative. In these, and indeed in nearly all forms of anæmia, iron is food, and, like other food, must be productive of good or evil according to the patient's need of it and his power of assimilating it.

Scanty as well as excessive *menstruation* may be appropriately treated by iron, for either may be due to a deficiency of normal blood. When the catamenia are profuse but watery they are diminished by iron and the proportion of solids in the discharge is increased; on the other hand, when they are both scanty and pale iron is the best agent for increasing them. The former case is the more hopeful one, because it shows a certain energy, with a due supply of material; the latter, in its chronic type, is usually a sign of progressive and incurable exhaustion, but sometimes also it results from uterine congestion, which must first be treated before iron can be of much avail. This object is usually sought by means of aloetic purges and other stimulant and derivative agencies. In all cases of active *uterine hæmorrhage*, if there be any such independently of disease of the womb, iron should not be given internally, no matter how great may be the anæmia which excessive and repeated losses occasion; but when the flow is passive the case enters the category of passive hæmorrhages generally; and for these, whether they take place from the organ named, from the rectum, bladder, kidneys, or other part, iron becomes one of the best remedies—not, however, as iron, but in combination with a mineral acid, in which compound the astringency is derived from the acid compound rather than from the ferruginous base. The combinations of hydrochloric and of sulphuric acid with iron are in this respect the most efficient. The stimulant action of iron salts renders them less appropriate for *pulmonary* than for other internal hæmorrhages, except in the form of atomized solutions. Iron is useful in regulating the *heart* when it becomes irregular through weakness, whether or not the condition be aggravated by valvular disease. By giving tone to this, as well as to other organs, it sometimes promotes the removal of dropsies dependent upon cardiac obstruction.

Various *nervous disorders* more or less dependent upon impoverishment of the blood may be cured by iron. Of these the most directly amenable to its operation is *neuralgia*, especially of the fifth pair, and next to this of the gastric nerves, and *chorea*, which very often, like neuralgia, is the result of debility and, remotely, of impoverishment of the blood. Among other nervous affections for which iron is appropriate are various irritations of the bladder and urethra tending to occasion *retention* or *incontinence of urine*, in which the tincture of chloride or the syrup of iodide of iron may be used with much confidence in its virtues. *Seminal emissions* in weak, nervous, and excitable persons may sometimes be prevented by the same agent, especially if associated with belladonna or ergot, which, indeed, renders the cure more prompt and certain. The same is true of the use of iron in certain cases of *incontinence of urine.*

The cure of *insanity* and of *whooping cough* may be promoted by iron, like that of neuralgia and chorea, when they depend upon exhaustion of the nervous system. One of the most valuable results of recent experience in regard to insanity consists in the proof that good food and other hygienic means are essential elements in its proper treatment. In like manner, iron is not a specific for whooping cough; it only destroys the soil in which that disease tends to gain strength. Iron is contraindicated in *epilepsy*, with the proviso above mentioned; that is to say, when the patient's condition, upon other grounds, requires the use of chalybeate medicines.

Intermittent fever is cured by iron only when the disease is prolonged by exhaustion of the system and impoverishment of the blood, and this occurs especially when the sick remain in malarial localities and when an appropriate anti-periodic treatment has not been employed. Hence the use of quinine after a course of iron is found to be more efficient than before it in the cases alluded to. Enlargement of the *spleen* may be rapidly lessened by iron if the affection be not inveterate. In a word, the efficacy of iron in malarial affections is wholly subordinate to its renovating action upon the blood.

The same statement is, in the main, true respecting the use of iron in *dyspepsia*. The medicine acts chiefly by improving the blood, and thereby increasing the secretion of gastric juice and the muscular power of the stomach. But if acid preparations are used they act also as local stimulants. Hence the latter should be given immediately before meals, but other martial preparations either along with the food or directly after meals. In either case cinchona and its derivatives are important adjuvants.

The salutary action of iron in *albuminuria* probably is mainly due to its lessening the destruction of the red blood-disks, and in a subordinate degree to its local action upon the kidneys. The latter is, however, less probable than the former, since it is alleged that the iron cannot be detected in the urine. It nevertheless lessens the proportion of albumen discharged, and in the desquamative forms of Bright's disease often effects a stable cure. This is particularly evident in albuminuria and dropsy occurring after scarlatina or from the action of cold and dampness upon the skin. But the medicine is still the best even in granular and in amyloid degeneration of the kidney. The form in which iron is administered is of secondary importance, but probably the best is a solution of muriated tincture of iron in acetate of ammonia, with an excess of acetic acid.

Iron is one of the most important aids to a proper diet in the treatment of *diabetes;* it tends to sustain the general health even when it does not directly cause a diminution in the proportion of sugar excreted. Basham's mixture (which represents the solution mentioned in the last paragraph) appears to be the best form for its administration. In chronic *mucous fluxes* of every description iron is invaluable—in those of the bowels, by its direct application partly, and in the rest by its influence upon the blood, and perhaps also by constringing the capillary vessels. It is of great value in the treatment of intestinal *worms*—not so much, probably, by directly destroying them as by rendering the intestinal secretions more healthy, and thereby depriving the parasites of their nidus. Among mucous profluvia, *chronic bronchitis* is often cured by iron, especially when the sputa are muco-purulent. Hence the reputation of the compound iron mixture as an anti-hectic medicine, and hence also the error of applying the same treatment to consumption of the lungs. True pulmonary *phthisis*, with tissue-degeneration, is benefited by iron mainly in so far as its use is proportioned to the diminished blood-formation belonging to that affection. It may be not only tolerated, but useful, while active exercise can be taken, but unless great care is exercised it increases the tendency to hæmoptysis and hastens the progress of the disease. It is most readily tolerated by the dull and lymphatic, when there is but little tendency to febrile irritation, and when the consumption is essentially chronic. As iron is a constituent of the body, and by its function in the blood one of its most important constituents, the amount of it consumed in food or medicine must bear a certain relation to the needs of the economy. It is just as possible to create a surfeit of iron as of meat and drink, of fatty food, or of cod-liver oil. Doubtless in every case there is a physical reason for the repugnance which one may acquire for certain articles of diet; and in the case of iron it is evident that if the demand for it is not sustained by such a physiological tissue-waste as exercise, etc. produce, it will more or less speedily induce an oppressive and dangerous plethora. Iron is more appropriate in *scrofula*, a disease histologically allied to, but clinically quite different from, phthisis; but even in this affection its value, except to meet incidental conditions, such as anæmia and dyspepsia, is not great. The iodide of iron is probably useful in glandular scrofula in virtue of the iodine it contains. In *syphilis* and *cancer*, for which iron has been recommended, it has no other virtues than arise from its power of sustaining the general health, or, in the case of the former disease, of mitigating the mischiefs of an excessive use of mercury.

The most efficient remedy in idiopathic *erysipelas* is the tincture of the chloride of iron given in full and repeated doses, such as from 20 to 40 drops (Gm. 1.30–2.60) every two or three hours, properly diluted. Smaller doses are quite useless. Its action is probably to constringe the capillary blood-vessels, although its acid element may directly tend to antagonize the febrile poison.

The same preparation has been reported to act very favorably in low forms of *scarlatina*, *measles*, and *puerperal fever*, but, although there is no reason to reject its use, there is not enough to recommend it. The use of iron as an internal remedy in *diphtheria* has been highly commended by several physicians, but a critical examination of their reports demonstrates that there is no more reason to attribute the measure of success they achieved to the tincture of the chloride or the subsulphate of iron they employed, the one internally and the other topically, than to the quinine and chlorate of potassium and inhalations of lime-water that were used at the same time. While there are good grounds, therefore, for using this compound treatment, there are none whatever for assigning to iron a definite share in the results obtained. The sulphuret of iron has been proposed as an antidote to constitutional *poisoning by lead* and as a means of neutralizing the salts of *mercury*, *lead*, *antimony*, *copper*, and especially *arsenic*, in the stomach. For the last named the hydrated oxide is generally employed, but, as elsewhere stated, it probably acts by mechanically enveloping the particles of arsenic rather than as a chemical antidote. The same remark applies to the insoluble saccharated oxide of iron, and less absolutely to the hydrated oxide of iron with magnesia.

The *contraindications* to the use of iron it is essential to keep in mind. The one which surpasses all others in importance is feverishness. Almost the only exception to this statement is that tincture of chloride of iron cures *erysipelas*, but it doubtless acts, not as an hæmatic, but as a powerful astringent. In nearly all other cases fever, or even feverishness, should exclude iron, whether it be produced by chronic disease or phthisis, or by local irritations, such as *dyspepsia* with *constipation*. In this affection the complexion is often muddy and the tongue coated, not by continuous or any other "sympathy" with the gastro-intestinal disorder, but because the local affection produces general feverishness. Under such circumstances purgation is an essential preliminary to the favorable action of iron, and hence the saline chalybeate mineral waters are very efficient in curing this condition.

The local therapeutical uses of iron are numerous, but they owe their value to the astringency of the acid compounds of the metal rather than to the metal itself. Solutions and ointments of the sulphate have been applied with apparent advantage in traumatic *erysipelas*, in *phlegmasia alba*, and in various chronic eruptions of the *skin* occurring in persons in whom these affections tend to ulcerate or to persist unchanged. The subsulphate, in strong solution, has been applied to the cure of nasal, aural, and other *polypi*, and in weak solution to arrest chronic *mucous discharges* from the urethra, vagina, etc. Solution of chloride of iron represses *fungous granulations* in cases of *ingrown toe-nail*, *ulcerated gums*, etc.

Like other astringents, mineral salts of iron are used in treating varicose or simply dilated blood-vessels of the *conjunctiva* and relaxed conditions of the *fauces*. Solution of chloride of iron is said to be useful as a local application in *diphtheria*, and it probably is so when the exudation is in its forming stage and of limited extent. It is worse than useless when the false membrane is extensive and thick. In the decline of the disease gargles containing a small proportion of the solution tend to constringe the part and renew its healthy action. The subsulphate has been applied in the same manner. The chlorides and the sulphates of iron are hæmostatics, and have often arrested threatening *hæmorrhage* in epistaxis, hæmorrhage from the stomach, from the extraction of teeth, leech-bites, the excision of tonsils, cancerous ulceration, and after delivery. In the last case it has been sufficiently diluted with water and carefully pumped into the uterine cavity. In pulmonary hæmorrhage an atomized weak solution (1 part of the tincture to 10 parts of water) has been inhaled with prompt effect. The injection of solutions of the lactate, the perchloride, and other salts of iron into varicose and other *aneurisms* would form an eligible method of treatment if it were not extremely dangerous. In a number of instances the operation has been speedily followed by the patient's death, either suddenly by embolism or later by ulceration.

Tannate of iron is an astringent resembling, but milder than, sulphate of iron. *Malate* of iron and its tincture are adapted to cases requiring the use of mild chalybeates, and their taste renders them suitable to children and fastidious females. They do not stain the teeth. The former is recommended to be given in doses of 4 or 5 grains (Gm. 0.20–0.30), and the latter in doses of 20 or more drops (Gm. 1.20).

In this place may perhaps be most conveniently mentioned the relative value of different preparations of iron used by subcutaneous injection. The experiments of Neuss upon this subject led him to the following conclusions: "The citro-sodic pyrophosphate of iron is superior to all other preparations of iron for this purpose. It contains 26.6 per cent. of iron, is soluble in 6 parts of distilled water, causes no annoyance, and may be detected in the urine within half an hour. Next in value comes Friedlander's albuminate, which contains less iron, however, and is more apt to undergo decomposition. After these must be ranked pyrophosphate of iron with citrate of ammonia, which, at least in one patient out of three, occasioned considerable irritation. According to these experiments, the following compounds are unfit for hypodermic use: the oxycitrate of iron, the citrate of iron and quinine, the soluble saccharate of iron oxide, and dialyzed iron (glycerinated)" (*Zeitschrift f. klin. Med.*, iii. 9).

FERRUM DIALYSATUM.—Dialyzed Iron.

Liquor ferri oxychlorati, P. G.; *Liquor ferri dialysatus*, Br.—*Liquid ferric oxychloride*, E.; *Fer dialysé*, *Solution dialytique d'hydrate de fer*, Fr.; *Flüssiges Ferrioxychlorid*, *Dialysirtes Eisen*, G.

Preparation.—Dialyzed iron is made by saturating an aqueous solution of ferric chloride with ferric hydrate, putting the liquid into a dialysator, and suspending this in water, which is often renewed—as long, indeed, as it acquires an acid reaction. Very little iron will pass through the parchment septum; when dialysis is completed the ferric solution is diluted, so that 100 grains of it, when evaporated and dried at a temperature not exceeding 100° C. (212° F.), will leave a solid residue weighing 5 grains. In France the following process has been adopted: 100 Gm. of solution of ferric chloride of 30° B. are mixed in small quantities with 35 Gm. of ammonia-water of 22° B. The precipitate dissolves at first rapidly, afterward very slowly. When the liquid has become transparent it is introduced into a dialysator and treated as stated before; 8 to 10 days are required in the preparation.

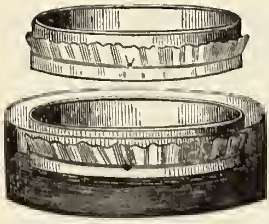
Similar solutions were obtained by Ordway (1858) and Béchamp (1859) by leaving pure ferric hydrate in contact with ferric chloride for a prolonged time. Th. Graham (1861) subjected this to dialysis, and succeeded in removing the acid until chlorine corresponding to 1.5 per cent. of HCl was left. Such a solution, however, which would correspond to $Fe_2Cl_6.95Fe_2O_3$, gelatinized ultimately. Hager (1868) found dialyzed iron to have the composition $Fe_2Cl_6.12Fe_2O_3$; Ordway's oxychloride was $Fe_2Cl_6.23Fe_2O_3$. H. Trimble (1878) has analyzed six samples met with in commerce, and found the saline portion to vary in amount between 2.51 and 4.83 per cent., and in composition between $Fe_2Cl_6.11Fe_2O_3$ and $Fe_2Cl_6.31Fe_2O_3$.

Prof. E. Scheffer (1878) showed that by precipitation with ammonia very basic oxychlorides of iron may be obtained, which, after having been thoroughly washed, will slowly dissolve in distilled water. The limits at which a soluble precipitate is obtained appear to have been reached on mixing 150 volumes of the officinal solution of ferric chloride with 91.5 volumes of ammonia-water. The washed precipitate contained 97.83 per cent. Fe_2O_3 to 2.17 per cent. Fe_2Cl_6, and required over 7 weeks for effecting solution in distilled water. The preparation known in some parts of Europe as *Ferrum catalyticum* is probably made by a similar process. The German Pharmacopœia has adopted the following process: Dilute solution of ferric chloride (spec. grav. 1.281) 35 parts with water 160 parts, and pour the mixture slowly into ammonia-water 35 parts, previously diluted with water 320 parts; wash the precipitate, express, and add hydrochloric acid (spec. grav. 1.124) 3 parts; agitate occasionally for 3 days, then warm gently until solution has been effected, and dilute with water until the liquid has the spec. grav. 1.050.

According to the Br. P., 6 fl. oz. of strong solution of iron perchloride are precipitated with ammonia; the washed and squeezed ferric hydrate is dissolved in 1 fl. oz. of the perchloride solution, the liquid filtered, dialyzed, and made to measure 28 fl. oz.

Owing to the retention of ammonia by ferric hydrate, solutions of the latter in acid or ferric chloride must vary somewhat in character, and therefore are properly subjected to dialysis for separating ammonium chloride and increasing the basic character of the ferric oxychloride.

Fig. 124.



a, dialyzer; *b*, the same in use.

The process of *dialysis* depends upon the difference in the diffusing power possessed by solid bodies when in solution. Graham (1861) ascertained that the power of diffusing from one liquid into another is greatest in those bodies which are capable of assuming a crystalline form, and that those which are amorphous and capable of forming with water a gelatinous mass are but very slightly and slowly diffusible. He distinguished the former as *crystalloids*, and the latter as *colloids*. When both are together in aqueous solution, and separated by a septum of animal membrane or parchment-paper from water, the crystalloids only will pass through the septum, and may thus be completely separated from the colloids. The dialyzer or dialysator is conveniently made from a section of a glass cylinder or a wooden hood, or from gutta-percha or similar insoluble material. The septum is made to cover one aperture of the short cylinder, and, after having been securely fastened, is permitted to project above. If the dialyzer is larger than about 10 or 12 inches in diameter, its sagging in the centre may be prevented by means of a net stretched over it or used for supporting it. The liquid should not be more than about ½ inch deep upon the septum, and should never be immersed below the surface of the water in the outer vessel; on the contrary, it is best to keep the surface of the dialyzing liquid higher, so as to prevent it from becoming too dilute by the upward dialysis of water. The water in the receiving vessel should be changed daily, or, if possible, provision should be made for a continuous supply of distilled water and for the simultaneous removal of the saline solution from the bottom. The extent of surface of the septum, depth of the dialyzing liquid, and the frequency of renewal of the water in the receiver are the main conditions which influence the success of the process. The dialysis of a solution of oxychloride of iron requires from 1 to 2 weeks, and is known to be finished when the liquid has lost its ferruginous taste and the dialysate or diffusate in the receiver shows merely traces of chlorides. The residue upon the septum is then assayed by evaporating 100 grains of it in a water-bath to complete dryness; from the weight obtained the amount of water which is necessary to bring the whole amount of the liquid to the standard of 5 per cent. is easily determined. If the process has been properly managed, evaporation will not be necessary, and should be avoided, as it interferes with the stability of the preparation.

The best material for the septum is *parchment-paper*, which is made by immersing unsized paper for a short time and at the ordinary temperature in sulphuric acid sp. grav. 1.56 to 1.60; the paper is afterward well washed with water. The parchment-paper may be folded like a filter, and this supported by a funnel, provision being made for a continuous supply of fresh water and for the removal of that which has become charged with crystalloids; or, as suggested by Klie (1878), it may be supported by a perforated funnel and thus suspended in a percolator or other suitable vessel. Huizinga (1878) prefers the parchment-paper in the form of a rectangular bag, the margins being pasted together with a solution containing 15 per cent of gelatin and 3 to 5 per cent. of potassium chromate; after exposure to the sunlight the paste is insoluble in water. Bladder may likewise be used, but is less efficient than parchment. A bladder may be completely filled with the solution of ferric oxychloride, well tied, and immersed in water; it must be strong enough to sustain a considerable amount of pressure caused by the dialysis of water into the iron solution.

Properties.—Liquid oxychloride or dialyzed iron is perfectly transparent in thin layers of a deep brown-red color, inodorous, and almost destitute of styptic taste. It is miscible with alcohol, glycerin, syrup, and distilled water, but not with spring water or other, even dilute saline, solutions. A small quantity of tannin merely darkens the liquid; a larger quantity causes a deep-brown gelatinous precipitate. A minute quantity of nitrate of silver will not disturb the liquid; a larger quantity will cause a gelatinous brown precipitate, which is again soluble in distilled water; but on adding first a slight excess of ammonia, filtering from the ferric hydrate, acidulating with nitric acid, and then testing with nitrate of silver, a white precipitate of chloride of silver is formed. "If to 1 Ccm. of the liquid, diluted with 19 Ccm. of distilled water, 1 drop of nitric acid be added and 2 drops of volumetric (decinormal) solution of silver nitrate, the mixture should be clear in transmitted light."—*P. G.* This test indicates the thorough washing of the ferric hydrate and the absence of ammonium chloride from the solution; a few drops more of either the acid or test solution will cause a turbidity or precipitate. Prepared by the P. G. process, it has the specific gravity 1.050, and contains nearly 3.5 per cent. of iron or about 7 per cent. of oxychloride, having approximately the composition $Fe_2Cl_6.8Fe_2(HO)_6$. A solution which, when evaporated on a water-bath until the residue is pulverulent and weighs 5 per cent., has, according to E. B. Shuttleworth (1877), the spec. grav. 1.034. If 5 per cent. of residue is left after completely drying in a water-bath, the spec. grav. is 1.040, and if the same amount of residue is left after ignition, the spec. grav. of the solution is 1.046. The British Pharmacopœia requires the spec. grav. 1.047.

Medical Action and Uses.—The merits of dialyzed iron are claimed to be that it has no styptic taste, mixes well with water in any proportion, and does not stain the teeth or cause constipation. On pharmaceutical grounds "the action of dialyzed iron upon animal products forbids us to suppose *a priori* that it acts like other ferruginous preparations" (Depaire). A very competent judge (Bouchardat) has declared that, "theoretically, dialyzed iron must be regarded as an inert, or at best a very feeble, preparation of iron." Personne has said concerning it, "It is completely insoluble in the gastric juices. When it was injected into a dog's stomach during active digestion, and an examination was made 2 hours later, flakes of oxide of iron adhered to the undigested food, and not a trace of iron was discoverable either in the gastric liquids or on the surface of the alimentary canal. Its inactivity may be inferred from its insolubility" (*Archives gén.*, 7 sér., iv. 491). We have found it utterly to fail in cases for which iron appeared to be the proper remedy and which other preparations caused to speedily improve. Dr. R. V. Mattison has shown that dialyzed iron is probably insoluble in the gastric secretions, for he attempted unsuccessfully to dissolve the precipitate of ferric hydrate in an artificial gastric juice. Neither could he find a trace of iron in the urine of patients who were taking dialyzed iron. On the other hand, Dr. Gowers of London ascertained, by counting the red corpuscles of the blood before and after the use of the medicine in *anæmia*, that they rose from 46 to 102 per cent. of the normal proportion in 34 days in one case, and in a second case from 26 per cent. of the normal proportion to 92 per cent. in 63 days. So Dr. Robert Amory of Boston reports that he also counted the red corpuscles in five anæmic cases treated by this preparation, and found the proportion increased in them severally as follows: No. 1, from 83 to 97 per cent.; No. 2, from 80 to 90 per cent.; No. 3, from 74 to 92 per cent.; No. 4, from 76 to 90 per cent.; and No. 5, from 76 to 83 per cent. In 1878, Dr. Da Costa used hypodermic injections of dialyzed iron in a case of *chlorotic anæmia.* 15 minims of the pure liquid were used without any unpleasant after-effects, and with a very rapid restoration of the patient to health (*Phila. Med. Times*, viii. 251). In one or two cases Dr. Lamadrid also reported the success of this treatment (*Med. Record*, xiv. 17). In 1879, Luton stated that 25 or 30 drops of the solution may be injected without producing the slightest disturbance; that it causes a diffusive sense of warmth, a determination of blood to the face, a sort of intoxication, in fine; and he compared its effects to those of transfusion of blood (*Mouvement Méd.*, Juin, 1879). In 1881, Neuss classed this preparation of iron among those unsuited to hypodermic use (*Zeitsch. f. klin. Med.*, iii. 9), and Kemp found alarming symptoms immediately following its use, and the subsequent formation of abscess at the point of puncture (*Med. Record*, xiii. 481). We cannot learn that any later experience has confirmed the very favorable judgment originally expressed of the hypodermic use of dialyzed iron. The observations on which that judgment rests would be conclusive of the hæmatogenous virtues of dialyzed iron had we not the positive declaration of Hayem, who pursued the very same method of investigation (see FERRUM), that, at least in saturnine anæmia, "iron does not influence the number, but only the development, of the red corpuscles." But in Dr. Prosser James's opinion, "The testimony of physicians to the activity of dialyzed iron is so abundant that it is unnecessary to add to it" (*Times and Gaz.*, Dec. 1882, p. 659). In relation to the value of iron employed hypodermically, it may be added that Glaevecke found the citrate of iron very efficient in *anæmia* when used in this manner in the *dose* of 2 grains (Gm. 0.10) (*Archiv. f. exper. Pathol., etc.*, xvii. 466).

Numerous cases have been published which appear to prove that dialyzed iron is an efficient antidote to the poisonous action of *arsenic* in the stomach. Dr. Mattison, having performed some experiments to determine the conditions of its efficacy, found—1, that a solution of dialyzed iron to be of value as an arsenical antidote must be precipitated by the action of some neutral or alkaline salt; 2, that such precipitation, and the consequent production of ferric hydrate, are accomplished when this preparation is taken into the stomach; and 3, that, therefore, the solution of dialyzed iron is a valuable antidote in arsenical poisoning; 4, that to ensure the formation from it of ferric hydrate its administration should be followed by that of a teaspoonful of common salt.

Dialyzed iron may be given internally in doses of from 5 to 30 or more drops (Gm. 0.30–2.0) several times a day, simply diluted with water or in some sweetened and aromatic vehicle.

FERRUM REDUCTUM, *U. S., P. G.*—REDUCED IRON.

Ferrum reductum, Br.; *Ferrum hydrogenio reductum*, *Ferrum ope hydrogenii paratum.*—*Iron reduced by hydrogen*, *Iron by hydrogen*, E.; *Fer réduit par l'hydrogène*, Fr.: *Reducirtes Eisen*, G.

Preparation.—Take of Hydrated Peroxide of Iron 1 ounce; Zinc, granulated, a sufficiency; Sulphuric Acid a sufficiency; Chloride of Calcium a sufficiency. Introduce the hydrated peroxide of iron into a gun-barrel, confining it to the middle part of the tube by plugs of asbestos. Pass the gun-barrel through a furnace, and when it has been raised to a strong red heat cause it to be traversed by a stream of hydrogen gas developed by the action on the zinc of some of the sulphuric acid diluted with eight times its volume of water. The gas before entering the gun-barrel must be rendered quite dry by being made to pass first through the remainder of the sulphuric acid, and then through a tube 18 inches long packed with small fragments of the chloride of calcium. The farther end of the gun-barrel is to be connected by a cork with a bent tube dipping under water, and when the hydrogen is observed to pass through the water at the same rate that it bubbles through the sulphuric acid the furnace is to be allowed to cool down to the temperature of the atmosphere, the current of hydrogen being still continued. The reduced iron is then to be withdrawn and enclosed in a dry, stoppered bottle.—*Br.* 1867.

The present process differs merely in the use of freshly-prepared peroxide of iron, and in all essential details is identical with the one of the U. S. P. 1870, which was elaborated by Prof. Procter. The drying of the hydrogen is unnecessary, but provision must be made to prevent the acid liquid in which hydrogen is generated from being mechanically carried over; this is effected by passing the gas through an empty vessel before it enters the reduction-tube, or through basic acetate of lead, which will retain also gaseous impurities with which the hydrogen may be contaminated from impurities of the zinc or acid. The reduction-tube, we think, should be filled with hydrogen gas before it is heated to redness, and the heat is best kept at dull redness, so as to obtain the metal in a finely-divided state, and not more or less granular, which would result from carrying on the operation at a bright-red heat. At the high temperature the ferric hydrate is converted into ferric oxide, and this is decomposed by the hydrogen, with the liberation of iron and the production of water; $Fe_2O_3 + 3H_2$ yields Fe_2 and $3H_2O$. That the reduction has been completed is ascertained from the absence of aqueous vapor in the bubbles breaking through the water, or from the uniform rapidity with which the bubbles pass both through the water and through the liquid placed between the generator and reduction-tube. After the fire is withdrawn the reduced iron would burn again to ferric oxide if it were allowed to come into contact with oxygen while warm; the hydrogen must therefore be continually passed through the reduction-tube until the temperature has been lowered to that of the surrounding atmosphere. Using 2 pounds of ferric hydrate, the process occupies from 5 to 8 hours. It is scarcely necessary to state that the ferric hydrate should have been well washed.

Various other methods have been suggested for obtaining reduced iron, but they do not appear to be used on a large scale. For reduction in a current of hydrogen Peligot (1844) proposed ferrous chloride, and Woehler (1855) ferrous oxalate, or an oxide obtained by strongly heating a mixture of ferrous sulphate and sodium chloride and washing out the soluble salt. A. Morgan (1854) recommended the calcination of a mixture of ferric oxide, potassium ferro cyanide,and potassium carbonate, each previously deprived of water. Zaengerle (1857) used ferrous oxalate instead of ferric oxide. After cooling, the mass requires to be well washed and dried. The metallic iron reduced by electricity from ferrous sulphate (Boettger, 1846), or from ferrous chloride (Collas), has no advantage over that prepared with hydrogen.

Properties.—Reduced iron is a very fine gray (grayish-black, *U. S.*, *Br.*) powder, free from metallic lustre, but exhibiting metallic streaks when rubbed with firm pressure in a mortar, and yielding a lustrous scale when struck on an anvil with a hammer. It is without odor or taste, and is not altered in dry air, but is gradually oxidized and becomes rust-colored in a damp atmosphere, and when touched with a lighted taper ignites and burns slowly to ferric oxide. It is strongly attracted by the magnet, and is insoluble in all simple solvents, but is wholly dissolved by dilute hydrochloric or sulphuric acid, with the evolution of hydrogen, the solution showing the reactions of ferrous salts.

Tests.—The hydrogen evolved on dissolving reduced iron in diluted hydrochloric acid should not at once impart to paper moistened with solution of silver nitrate a yellow or brown color (absence of arsenic and sulphur); the undissolved residue should not weigh more than 1 per cent. (carbon), *P. G.* The hydrogen should be free from noxious odor, and should not impart a black color to filtering-paper moistened with solution of lead acetate and stretched over the orifice of the test-tube; the black color would be due to the presence of sulphur, resulting from the sulphate which remains in incompletely-washed ferric hydrate. The solution in hydrochloric acid should not assume a red color when tested with sulphocyanide of potassium (absence of ferric or magnetic oxide). The presence of magnetic oxide is also indicated by the black instead of gray color of the powder. Treated with iodine or bromine, dissolved in solution of potassium iodide or bromide, the black oxide remains behind, and its weight should not exceed 50 per cent.; this residue should be completely soluble in hydrochloric acid.—*Br.* "If 1 Gm. of reduced iron be digested with 3.5 Gm. of iodine, 2.5 Gm. of iodide of potassium, and 50 Ccm. of distilled water for 2 hours, the resulting filtrate should have a green color, and should not be rendered blue by gelatinized starch (presence of at least 80 per cent. of metallic iron)."—*U. S.* If 0.3 Gm. of reduced iron be digested for 1 hour in a water-bath in a closed bottle with 50 Gm. of test solution of mercuric chloride, the liquid afterward diluted to 100 Ccm., and set aside until clear, 25 Ccm. of the liquid should require for oxidation not less than 38 Ccm. of volumetric solution of potassium permanganate (presence of at least 89.75 per cent. of metallic iron).—*P. G.* The metallic iron is dissolved as ferrous chloride, while a reduction of mercuric to mercurous chloride, and partly to mercury, takes place.

Mr. Creuse (*Proc. Amer. Phar. Assoc.*, 1874, p. 435) suggested to determine the amount of pure iron from the measure of the hydrogen given off; the presence of oxides, however, appears to interfere with the correctness of the results. Schacht (1877) regards the following as sufficient evidence of purity: It is "a very fine gray powder without gloss; when heated in the air it burns to ferric oxide. It is completely soluble in warm diluted pure hydrochloric acid, with the evolution of hydrogen, which is indifferent to lead-paper. When treated for half an hour, at the ordinary temperature and with occasional agitation, with twenty-five times its weight of solution of ferric chloride sp. gr. 1.30, it is completely dissolved."

FERRUM PULVERATUM, S. ALCOHOLISATUM, S. PORPHYRISATUM, *P. G.*, or *pulverized iron*, may be mistaken for reduced iron. It is made in Europe on a large scale from a good quality of cast iron, and therefore contains carbon. It has the general properties of reduced iron, from which it differs in being denser, having a distinct metallic lustre, and in not igniting when touched with a lighted taper; the hydrogen evolved by it has a distinct odor, but should contain traces only of sulphuretted hydrogen. The solution of iron in hydrochloric acid should not yield a dark color or precipitate with sulphuretted hydrogen (absence of lead, copper, etc.), and when oxidized with nitric acid and treated with ammonia in excess the filtrate should be colorless (copper, etc.), and not be rendered turbid by hydrosulphate of ammonium. A freshly-prepared solution of 0.1 Gm. of the powder in 15 Gm. of diluted sulphuric acid should require for complete oxidation not less than 55.5 Ccm. of the volumetric solution of potassium permanganate.—*P. G.*

Off. Prep.—Pil. ferri iodidi, *U. S.*

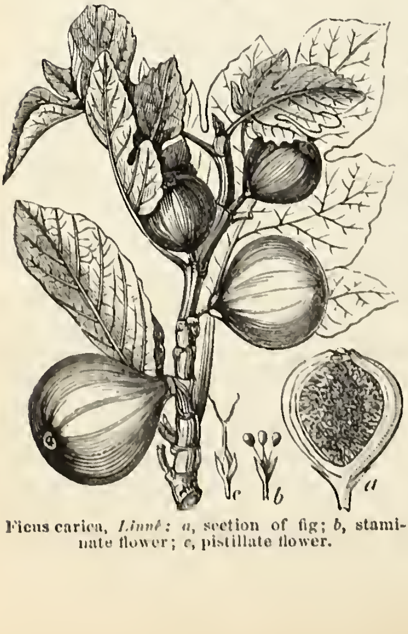
Medical Action and Uses.—This preparation was originally proposed as a substitute for subcarbonate of iron. It was less bulky, and therefore more likely to agree with the stomach; but not improbably there happened in this case what has often been observed when the nutritious elements of food are substituted for those forms of it which Nature has provided. In point of fact, it is even more likely to derange the stomach than the preparation mentioned, partly on account of the impurities it sometimes contains to the extent of 50 per cent., and partly because it is very apt to cause the formation in the stomach, and the eructation, of sulphuretted hydrogen. Moreover, when given in pills and pastilles they often escape the solvent power of the digestive juices, and are evacuated in the same form in which they were swallowed. The only way in which it can be administered with an assurance of its solution and absorption is to give it at meal-times or immediately afterward in a wafer or suspended in a little water. It may be prescribed in the *dose* of from 1 to 5 grains (Gm. 0.05–0.30).

FICUS, *U. S.*, *Br.*—FIG.

Caricæ; Ficus passa, Fici, Fructus caricæ.—Figue, Fr.; *Feige*, G.

The fleshy receptacle, bearing fruits upon its inner surface, of Ficus Carica, *Linné*. Steph. and Church, *Med. Bot.*, plate 154; Bentley and Trimen, *Med. Plants*, 228.

FIG. 125.



Ficus carica, *Linné*: *a*, section of fig; *b*, staminate flower; *c*, pistillate flower.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The fig tree is indigenous to Western Asia, from Asia Minor and Syria eastward to Lake Aral, and has been under cultivation from a very remote period. At present it is cultivated in most countries of the Old and New Worlds which lie in the warmer temperate regions, in many of which it is also found wild. It attains a height of about 25 feet (7.5 M.), is irregularly branched, has rough palmately-lobed, irregularly-toothed subcordate leaves, in the axils of which appear the fleshy hollow receptacles, upon the inner surface of which the minute flowers are situated, the few staminate flowers being placed near the mouth.

Description.—The receptacle, erroneously called fruit, is pear-shaped, short-stalked, or with a circular stalk-scar at the base, and about 3 inches (75 Mm.) long; in the green state it contains a milky, acrid juice, which changes to saccharine, the color of the receptacle becoming yellowish and purplish. The orifice is surrounded by several fleshy scales, and the greater portion of the inner surface is covered in the ripe fig by numerous small yellowish akenes, popularly called seeds. Figs have a peculiar fruity odor and a very sweet somewhat mucilaginous taste. A warm and dry climate is best adapted for growing figs with the view of preserving them in the dry state.

They are dried either by artificial heat or by exposure to the sun, and packed in this condition (*natural figs*), or they are rendered pliant by kneading and squeezing, and then packed and pressed into boxes (*pulled figs*). In the latter condition they are always of a very irregular shape, yellowish, somewhat translucent, and covered with effloresced sugar. The large pulpy figs are known as *Turkey* or *Smyrna figs*, the small and dried ones as *Greek figs*. In Italy the early figs which appear in the axils of the previous year's leaf-scars are known as *grossi* and *orni*, while those produced in the axils of leaves are known as *forniti* or as *cratiri*, the latter name being given to those which ripen after the fall of the leaves.

Constituents.—Exclusive of the akenes, which, together with the cellular tissue, Bley (1831) found to constitute about 15 per cent. of the weight of figs, he obtained 16 per cent. of water, 62.5 per cent. of sugar (glucose), the remainder being gum, fat, and saline constituents.

Off. Prep.—Conf. sennæ, *U. S.*, *Br.*

Allied Plants.—BROSIMUM ALICASTRUM, *Swartz.* This large tree bears a globular fruit of the size of a nutmeg, imbedded in the receptacle. The seeds are known in Jamaica as *bread-nuts*, and have a taste resembling that of chestnuts. The milk-juice of old branches is acrid.

BROSIMUM GALACTODENDRON, *Don*, s. Galactodendron utile, *Kunth*, is the *cow tree*, *palo de vaca*, or *palo de leche*, of tropical America. On making incisions into the bark it yields a milk-juice which resembles, and is used like, cow's milk; this contains, according to Boussingault, 58 per cent. of water and 42 per cent. of fixed matter, the latter consisting of wax and fat 32.2, sugar 2.8, proteids 1.7, salts 0.5, and undetermined substances 1.8 parts.

ARTOCARPUS INCISA, *Linné*, is indigenous to the Moluccas and the islands of the Southern Pacific. The nearly-ripe pistillate inflorescence, known as *bread-fruit*, forms a globular sorosis about 6 inches (15 Cm.) in diameter, and consists of a mealy and spongy receptacle in which the oblong angular akenes are imbedded. A similar product, known as *jack-fruit*, is yielded by Artocarpus integrifolia, *Linné;* it is nearly pear-shaped, and is largely used in India and the East Indian islands.

Medical Uses.—The saccharine and mucilaginous constituents of figs render them nutritive, and in their fresh state laxative. The latter operation of dried figs is mainly due to the indigestibility of their seeds and tough skins, which also tend to occasion flatulence. They form an agreeable addition to the various ptisans employed in *catarrhal affections* of the air-passages and other mucous canals, and roasted figs have from time immemorial formed convenient cataplasms for *gum-boils*, *abcesses* of the *anus*, *vulva*, etc. It is stated by Billroth that poultices made with dried figs and milk neutralized the *fetor* of cancerous and other ulcers which resisted all the usual deodorizers (*Med. Record*, xix. 308).

FŒNICULUM, *U. S.*—FENNEL.

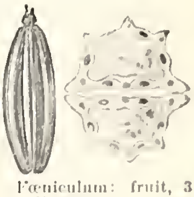
Fœniculi fructus, Br.; *Fructus fœniculi*, P. G.; *Semen fœniculi.*—*Fennel-fruit*, *Fennel-seed*, E.; *Fruits (Semences) de fenouil*, Fr.; *Fenchel*, G.

The fruit of Fœniculum vulgare, *Gaertner* (s. F. officinale, *Allioni*, s. F. capillaceum, *Gilibert*, s. Anethum (Meum, *Sprengel*) Fœniculum, *Linné*). Bentley and Trimen, *Med. Plants*, 123.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The fennel is indigenous to Southern Europe, and is frequently found wild in Western and South-eastern Europe and in Western Asia. Commerce is mainly supplied with the fruit from Germany and France, where the plant is extensively cultivated. It is an herbaceous annual or perennial, varying in cultivation considerably in size and in its fruit. The stem is 3 to 6 feet (0.9–1.8 M.) high, somewhat furrowed, green, and glaucous; the leaves are decompound or twice-pinnate, with the pinnæ very narrow; the umbels are at the top of the stem or branches, compound, large, and without involucre or involucel. All parts have an agreeable aromatic odor and a sweetish-aromatic taste. A little less than 250,000 pounds of fennel, fenugreek, and cumin are annually imported into the United States.

FIG. 126.



Fœniculum: fruit, 3 diameters; transverse section, 8 diameters.

Description.—FENNEL-FRUIT is about $\frac{1}{6}$ to $\frac{1}{3}$ inch (4–8 Mm.) long, oblong in shape, nearly cylindrical, and readily splitting at maturity into the two mericarps, which often become somewhat curved. The face is broad and flat, the back rounded, and has five prominent obtuse ribs of a light-brown color, the intervening furrows being almost blackish-brown. There are usually six oil-tubes, one under each furrow, and two, or in some varieties two pairs, on the face. The odor and taste of fennel are agreeably sweetish-aromatic and anise-like.

The commercial varieties are *Saxon* or *German fennel*, which is about $\frac{1}{4}$ inch (6 Mm.) long and of a brownish tint; and *Roman fennel*, which is nearly twice as large, mostly strongly curved, of a distinct greenish tint, with broader and rather sharper ribs, and of a stronger and more pleasant odor. The latter is often referred to Fœn. dulce, *De Candolle*, but appears to be merely a variety of F. vulgare, produced by cultivation.

FENNEL-ROOT is somewhat employed in Europe. It is 6 to 10 inches (15 to 25 Cm.) long, above nearly an inch (25 Mm.) thick, several-headed, cylindrical, little-branched, but beset with numerous thin and wrinkled radicles. The root is externally light-brown, annulate, and longitudinally wrinkled, internally white; the bark thick, fleshy, with several circles of brown resin-cells, and the meditullium yellowish and radially striate. It has an aromatic odor and a sweet fennel-like taste.

Constituents.—Fennel contains about 12.5 per cent. of fixed oil, some sugar, and from 2 to 4 per cent. of volatile oil, to which the sweet taste of the fruit is chiefly due. (See OLEUM FŒNICULI.) The root contains a small quantity of volatile oil, more sugar, and considerable starch.

Pharmaceutical Uses.—SYRUPUS FŒNICULI.—Syrup of fennel, *E.*—Digest for 3 hours 2 parts of bruised fennel with 12 parts of hot water in a closed vessel, and dissolve in 10 parts of the infusion 18 parts of sugar.—*P. G.* 1872.

Off. Prep.—Aqua fœniculi, *Br.;* Infus. sennæ comp., *U. S.*

Medical Action and Uses.—Employed by the ancients as a carminative and digestive stimulant and to promote the secretions, it continues to be used for like purposes at the present day. It is still alleged to increase the secretion of milk, urine, perspiration, and mucus, and to be an active emmenagogue. It is most commonly used as an ingredient in carminative compounds or as a simple infusion for the relief of *nausea* and of *colic.* It is very appropriate in hot infusion, as an adjuvant, in the treatment of *amenorrhœa* from uterine congestion and for re-establishing the *lacteal secretion* when suppressed. An infusion of fennel may be made with 60 grains (Gm. 4) of the bruised seed in half a pint (Gm. 250) of boiling water. Of this a teaspoonful may be given at short intervals to an infant and a wine-glassful to an adult.

FŒNUM GRÆCUM.—FENUGREEK.

Semen fœnugræci, P. G.; *Fenugrec*, *Sénégrain*, Fr.; *Bockshornsamen*, G.

The seeds of Trigonella Fœnum græcum, *Linné.* Bentley and Trimen, *Med. Plants*, 71.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Fenugreek is an annual herb indigenous to Western Asia and naturalized in India, Eastern and Northern Africa, and Southern Europe; it is extensively cultivated in Asia and Africa. The plant is about a foot (30 Cm.) high, nearly simple, has trifoliate leaves with articulated obovate or wedge-oblong denticulate leaflets, solitary sessile pale-yellowish flowers, and produces linear-curved compressed legumes with a slender beak and containing about sixteen seeds.

Description.—The seeds are $\frac{1}{8}$ inch (3 Mm.) long and broad, $\frac{1}{12}$ inch (2 Mm.) thick, of an oblique rhombic shape, flattened, pale brownish-yellow, on both flat surfaces with a deep groove extending in a diagonal direction, very hard, of a strong, unpleasantly aromatic odor, suggesting that of melilot, and a mucilaginous and bitterish taste. The thin hard testa encloses a yellowish embryo having a thick radicle, which is strongly bent upon the edges of the cotyledons and has its position externally indicated by the grooves. The embryo is surrounded by a colorless hornlike tissue, which is regarded as the inner seed-coat or by some authors as a thin layer of albumen.

Constituents.—Fenugreek was examined by Basson, who ascertained the presence of volatile and fixed oil, mucilage, and a bitter principle which was not obtained pure. The mucilage is contained in the integuments of the seeds, and amounts to about 28 per cent.; the fixed oil, about 6 per cent., resides in the embryo. Jahns obtained 3.4 per cent. of nitrogen, which would indicate 22 per cent. of albumen. A small amount of tannin is present in the testa, but no starch.

Adulterations.—Being usually kept in the ground condition, fenugreek is liable to be adulterated with farinaceous substances, in which case it will acquire a blue color on the addition of iodine.

Allied Plants.—The seeds of other species of Trigonella have similar properties, but are much smaller.

Medical Action and Uses.—Fœnum græcum is one of those simple medicines which figured largely in the materia medica of the Greeks and their successors, and which possessed hardly any other than emollient virtues. Like flaxseed, marshmallow, and slippery elm, it was used to prepare cataplasms for inflamed parts and soothing pessaries for the uterus and vagina; its decoction was similarly employed, and injected into the rectum, and formed a ptisan for affections of the throat and air-passages. Its oil, like linseed and olive oil, was applied to burns, excoriations, etc. It may be used in a decoction prepared with an ounce of the seed to a pint of water (Gm. 30 to Gm. 500). Poultices may be made of the ground seeds.

FRANGULA, *U. S.*—FRANGULA.

Rhamni frangulæ cortex, Br.; *Cortex frangulæ*, P. G.—*Alder buckthorn*, E.; *Écorce de Bourdaine, Bourgène*, Fr.; *Faulbaumrinde*, G.

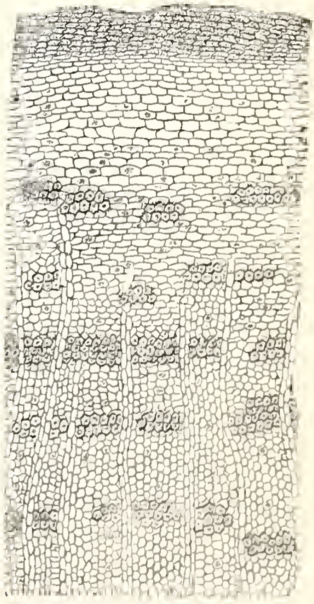
The bark of Rhamnus Frangula, *Linné*, s. Frangula vulgaris, *Reichenbach*, s. Frangula Alnus, *Miller*, collected at least one year before being used. Bentley and Trimen, *Med. Plants*, 65.

Nat. Ord.—Rhamnaceæ.

Origin.—The alder buckthorn is a shrub about 10 to 15 feet (3 to 4.5 M.) high, which grows in wet places from the northern coast of Africa throughout Europe, and extending eastward into Siberia. It has alternate elliptic, oval, or obovate entire leaves, which are obtuse or slightly pointed at the apex; greenish hermaphrodite flowers in axillary clusters of three or five, and red, finally black, berries of the size of a pea and containing two or three roundish-angular seeds. The bark is collected in the spring from the younger trunks and large branches. The Norwegian and the United States Pharmacopœias require it to be used not sooner than a year after it has been collected. The shrub is also known in different parts of Europe as *black alder*, *aune noir*, and *Schwarzerle*, which names are perhaps more properly restricted to species of Alnus (see page 155).

Description.—Frangula-bark is in small quills about $\frac{1}{25}$ or $\frac{1}{16}$ inch (1 or 1.5 Mm.) thick, externally gray or grayish-brown, or from the younger branches blackish-brown, marked with numerous small, whitish, transversely-elongated suberous warts; the inner surface is smooth, orange-yellow or brownish-yellow. When fresh it has a disagreeable odor and taste, but in the dried state it has scarcely any odor, a sweet and bitterish taste, and breaks in the inner layer with a fibrous fracture, showing the yellow bast-fibres, a greenish middle layer, and a purplish-colored corky layer. When moistened with lime-water it acquires a red color. With cold water it yields a yellow, and with hot water a brown, infusion, which is colored dark-brown, but not precipitated, by ferric chloride.

FIG. 127.



Frangula-bark: transverse section, magnified 80 diameters.

Constituents.—The bark was analyzed by Gerber (1828), Binswanger (1849), L. A. Buchner (1853), Casselmann (1857), Phipson (1859), and others. The constituent which possesses most interest is *frangulin* or *rhamnoxanthin*, $C_{20}H_{20}O_{10}$, which is extracted from the bark by carbon bisulphide and obtained pure by recrystallization from alcohol and ether. It is a lemon-yellow crystalline mass of a slightly silky lustre, without odor and taste; by sublimation it is obtained in yellow needles. It is insoluble in water, slightly soluble in cold alcohol and ether, and freely soluble in alkalies, with a bright-purple color. It dyes silk, wool, and cotton, and is resolved by acids into sugar and frangulic acid, $C_{14}H_{10}O_5$. The bark contains also a yellow resinous principle, tannin, an amorphous bitter principle which appears to have a purgative action, and various ordinary principles. It yields 5 or 6 per cent. of ash. The odor of the fresh bark is due to a volatile principle which has not been isolated. Liebermann and Waldstein (1876) obtained *emodin*, $C_{15}H_{10}O_5$, from old frangula-bark, by boiling with diluted sulphuric acid those constituents which are soluble in soda and are reprecipitated from this solution by hydrochloric acid. Kubly's *avornin* was impure frangulin.

Off. Prep.—Extract. frangulæ fluidum, *U. S.*

Allied Plants.—Rhamnus Purshiana, *De Candolle*, is found on the west coast of North America from the British possessions southward to California. It is a shrub or small tree, attaining a height of 15 to 20 feet (4.5 to 6 M.); has elliptic, mostly acute, at the base obtuse, denticulate, and somewhat pubescent leaves, rather large flowers in umbellate cymes, and broadly obovoid, three-lobed and three-seeded, black, baccate drupes. Like the next, it belongs to the sub-genus Frangula. The bark is known on the Pacific coast as *chittem-bark*, and has been introduced under the name of *cascara sagrada*, or *sacred bark*. It is met with in curved pieces or quills varying in size, externally smooth or nearly so, gray, sometimes with whitish patches, after the removal of the external layer brown or reddish-brown, the inner surface smooth and yellowish, and upon the transverse section radially striate and yellowish. It breaks with a nearly smooth fracture, is colored red by potassa, and has little odor and a bitterish taste. Prof. Prescott (1879) determined in it the presence of red resin colored brown by potassa; a resinous body not colored by potassa, but red-brown by sulphuric acid; a white sublimable crystalline compound; a brown resin colored purple-red by potassa; tannin, oxalic acid, malic acid, and other common vegetable principles. Rhamni Purshiani cortex is included in the new *Br. P.*

Rhamnus (Frangula, *Gray*) californica, *Eschscholtz*, is somewhat smaller than the preceding, has ovate-oblong or elliptical denticulate or nearly entire leaves, produces numerous, mostly abortive flowers, and has a blackish-purple two- or three-seeded fruit. It grows throughout California, and a variety with white tomentose leaves extends through Arizona to New Mexico.

Rhamnus (Frangula, *Gray*) caroliniana, *Walter* (*Southern buckthorn*), is a shrub or small tree growing in moist localities in the southern part of the United States, northward to Southern New York, and westward to Texas and the Rocky Mountains. It has oblong serrulate leaves, short-peduncled flowers, and purplish globose three-seeded fruits. The bark has been recently recommended as a substitute for the European frangula-bark.

Medical Action and Uses.—The fresh bark excites nausea, colic, vomiting, and violent purging, but by drying it loses in some degree its acrid qualities, and is then used in Germany as a domestic purgative. It gives a deep-yellow color to the feces and urine. It is stated to be employed as a substitute for rhubarb, but its action is much harsher, and indeed it may be ranked among the drastic cathartics. A decoction of it is sometimes used in *dropsy*, and the same preparation, as well as an ointment prepared with the fresh bark, is employed in treating the *itch*. The decoction may be prepared with half an ounce of the bark and half a pint of water (Gm. 15 to Gm. 250), and given in tablespoonful doses.

Rhamnus Purshiana is described as a mild laxative by Wolff, Stieren, Carter, and others. The fluid extract is usually employed as a purgative in the dose of a teaspoonful diluted with syrup, but some recommend it as a laxative in *doses* of 20 drops three times a day. Like several other purgatives, its action is not diminished, but increased rather, by repetition.

FRASERA.—American Calumba or Colombo.

Radix fraseræ, Radix colombo americanæ.—Racine de colombo de Mariette (*d'Amérique*), Fr.; *Fraserawurzel, Amerikanische Colombowurzel*, G.

The root of Frasera Walteri, *Michaux* (Fr. caroliniensis, *Walter*).

Nat. Ord.—Gentianaceæ.

Origin.—This is a tall biennial or triennial herbaceous plant indigenous to the United States, where it grows in rich and moist soil west of the Alleghany Mountains from New York southward, and in the Southern States. The plant is smooth, 5 to 10 feet (1.5 to 3 M.) high; the leaves are in whorls of about six, sessile, entire, oblong, and parallel-veined. The yellowish-white flowers form a large pyramidal panicle and bear a large roundish gland in the middle of each corolla-lobe; the fruit is a flattened capsule containing several seeds. The root should be collected in the autumn of the second year.

Description.—In general aspect American colombo resembles gentian-root, except that it is of a lighter and more distinctly yellow color internally and of a light orange-brown externally. When dried in transverse slices the outer layer of the bark projects above the shrunken tissue of the fleshy central portion, and this with the yellow tint gives it a faint resemblance to colombo, from which it is easily distinguished by the absence of the projecting vascular bundles in the interior and of the radiating zone near the cambium. It is now generally dried in longitudinal slices, the bark overlapping. The tissue upon transverse section is pretty uniform in appearance, the wood-bundles being nearly imperceptible in the fleshy parenchyma; the rather thick bark shows two different colored layers, and a dark-brown cambium-line separates it from the meditullium. When dry it has a slight odor; the odor of the infusion is similar to that of gentian; its taste is sweet and bitter and free from astringency.

Constituents.—Frasera-root was analyzed by J. W. Douglass (1840), W. R. Higinbotham (1857), and F. W. Thomas (1868), who proved the absence of starch and the presence of pectinaceous and saccharine compounds in it. Douglass noticed the dark coloration produced in the infusion by ferric salts, and attributed it to tannin. G. W. Kennedy (1873) obtained from the root *gentisic acid* and *gentiopicrin*. Prof. J. U. Lloyd (1880) obtained the coloring matter in tufts of lemon-yellow silky needles which are insoluble in cold water and cold alcohol, but dissolve freely in ether, chloroform, carbon disulphide, and boiling alcohol, and are soluble in nitric acid with a deep-red, and in sulphuric acid with a deep orange-red, color. Prof. Patch (*Proc. Amer. Phar. Assoc.*, 1881, p. 467) pointed out that the principle differs from gentisic acid of gentian in being less soluble in cold alcohol, more soluble in hot alcohol and in ether, in having a lower melting-point (187° F.), and in showing a different behavior with nitric and sulphuric acids. American colombo is therefore closely analogous to gentian, from which it appears to differ, chemically, in containing less of the bitter principle than the latter, and a larger proportion of a yellow coloring matter distinct from that of gentian, though resembling the latter in the brown color produced with ferric salts.

Medical Action and Uses.—When fresh it is said to have emetic and purgative properties, and has been compared in its action to rhubarb. The dried root is reputed to have the tonic properties of simple bitters, and may be given in an infusion made with an ounce of the root to a pint of boiling water. *Dose*, 1 to 2 fluidounces (Gm. 30–60).

FRAXINUS.—ASH.

Frêne, Fr.; *Esche*, G.

Nat. Ord.—Oleaceæ, Fraxineæ.

Description.—FRAXINUS EXCELSIOR, *Linné*, the European ash, which is sometimes cultivated in the United States as a shade tree, attains a height of 100 to 150 feet (30 to 45 M.), has a straight trunk, a tough, whitish, elastic wood, which is difficult to split and very durable, and lax racemes of polygamous flowers without calyx or corolla. *The bark*, which is collected from the branches in spring, is in quills having a gray or greenish-gray color externally, numerous small gray or brownish-white suberous warts, and a smooth inner surface of a yellowish or yellowish-brown color. It is inodorous, has a bitter, astringent taste, and breaks with a smooth and, in the inner layer, fibrous fracture. *The leaves* are pinnate, composed of eleven or thirteen nearly sessile leaflets, which are almost smooth, about 2 inches (5 Cm.) long, vary in shape between elliptic-oblong and oblong-lanceolate, have a wedge-shaped and entire base, and are sharply serrate above; in some varieties the leaves have a crisp margin or a whitish or variegated color. The *fruit* is a linear-oblong samara about 1½ inches (37 Mm.) long and ¼ inch (6 Mm.) broad, brownish, round at the base, at the apex extended into a long many-nerved somewhat oblique wing, and contains a single pendulous seed having an astringent, bitter and acrid taste.

FRAXINUS AMERICANA, *Linné*, s. FR. ALBA, *Marsh*, s. FR. EPIPTERA, *Michaux*, the North American *white ash*, is a handsome forest tree growing from Nova Scotia southward to the Mexican Gulf and westward to Lake Superior and Eastern Kansas. It attains a height of 60 to 80 feet (18 to 24 M.), has a durable, tough wood, seven or nine ovate-oblong, acuminate leaflets, and a terete fruit extended above into a spatulate-linear wing. The bark, which has been employed, is collected from the trunk and the root, the latter being preferred. It is ⅛ to ¼ inch (3 to 6 Mm.) in thickness, usually freed from the corky layer, whitish or yellowish, sometimes brownish, frequently with ridges of a warty cork adhering, and upon the inner surface yellowish and smooth; it breaks with a very fibrous fracture, and has a slight aromatic odor and a bitter and somewhat acrid taste.

Constituents.—The European ash contains in the bark tannin, the bitter glucoside *fraxin* (see HIPPOCASTANUM), and a crystalline principle obtained by Keller by a process similar to that by which salicin may be obtained; it was at first named *fraxinin*, but was recognized as mannit by Stenhouse and Rochleder. Garot (1853) found in the leaves malate of calcium; and in addition to this Gintl and Reinitzer (1882) obtained free malic acid, tannin, mannit, inosit, a little quercitrin, glucose, gum, and a volatile oil of the formula $C_{10}H_{20}O_2$. Mouchon's *fraxinit* is extract-like and said to be purgative. The *fruit* contains, according to Keller, a green oil of a disagreeable odor, an acrid resin, a bitter principle, tannin, and mucilaginous matter.

The *white-ash bark*, examined by Howard M. Edwards (1882), contains a mild aromatic volatile oil, an alkaloid which has not been investigated, resin, starch, sugar, and coloring matter producing a blue-black color with ferric chloride. J. M. Bradford (1882) believes that tannin is also present.

Pharmaceutical Uses.—Extractum fraxini americanæ. Made with alcohol, the yield is about 22 per cent.; with weaker alcohol 30 to 32 per cent. of extract may be obtained.

Extractum fraxini americanæ fluidum. Edwards proposed as the menstruum alcohol containing 20 per cent. of glycerin; it is of a blackish-red color.

Vinum fraxini americanæ has been made by T. S. Wiegand (1882) with sherry wine, and represents 4 troyounces of the bark in the pint.

Medical Action and Uses.—No accurate description of the operation of this medicine has been published. Infusions of the leaves are said to be either diaphoretic or diuretic. The bark at one time enjoyed a certain vogue in Europe as a remedy for *intermittent fever*, and there seems to be no doubt that it was often used with success in cases which had proved rebellious to cinchona, so that it may be included in the large class of succedanea for Peruvian bark and its derivatives. The leaves are more or less purgative, and are said to operate like senna, but their more important use appears to have been in the treatment of *gout*. There seems to be conclusive evidence of their efficacy when administered in an infusion made with 30 grains (Gm. 2) of the leaves in half a pint of water, strained and sweetened, and taken twice or thrice daily. A similar method is reported to be successful in *articular rheumatism* (Pouget and Peyraud, *Amer. Jour. of Med. Sci.*, April, 1853, p. 492). According to Pliny, serpents will avoid even the shadow of the ash, and he affirms as of his own knowledge that if a snake is enclosed in a circle of ash-leaves in the centre of which are burning coals, it will plunge into the fire rather than touch the leaves. A similar fact or superstition exists in regard to the white ash (F. americana). On the land where it grows no rattlesnake will be found, "and it is the practice of hunters and others having occasion to traverse the woods in the summer months to stuff their boots or shoes with white-ash leaves as a preventive of the bite of the rattlesnake." We have several times known this precaution to be taken with full faith in its efficacy. A vinous preparation of the white ash is alleged to be useful in *dysmenorrhœa* and associated uterine disorders.

FUCUS VESICULOSUS.—Bladder-wrack.

Quercus marina.—Sea-wrack, Kelp-ware, Blacktang, Cut-weed, E.; *Fucus (Varech) vésiculeux*, Fr.; *Blasentang, Seetang, Meereiche*, G.

Fucus vesiculosus, *Linné.* Bentley and Trimen, *Med. Plants*, 304.

Nat. Ord.—Algæ, Fucoideæ.

Description.—It grows on rocky shores of the North Atlantic and of the North Pacific Ocean, attains a length of 2 to 4 feet (0.6–1.2 M.), and has a flat branching thallus ½ to 1 inch (12–25 Mm.) wide, with the margin entire and a distinct midrib through its entire length. The air-vesicles are usually in pairs, separated by the midrib, spherical or oblong in shape, and occasionally attaining the size of a hazel-nut. The fructification is found at the end of the branches, forming more or less elongated receptacles, with many globular conceptacles containing the numerous minute oblong antheridia and few larger globose sporangia: In the fresh state bladder-wrack is of a brownish-green color, which becomes nearly black on drying. It has the peculiar odor of sea-weeds and a mucilaginous and saline taste.

Allied Species.—Fucus nodosus, *Linné* (Fucodium nodosum, *Agardh*), is 4 to 6 feet (1.2–1.8 M.) long, and has a narrower frond or thallus without midrib, and with single vesicles, which are ovate or oblong, and usually large.

Fucus serratus, *Linné*, has a veined and serrate frond without vesicles.

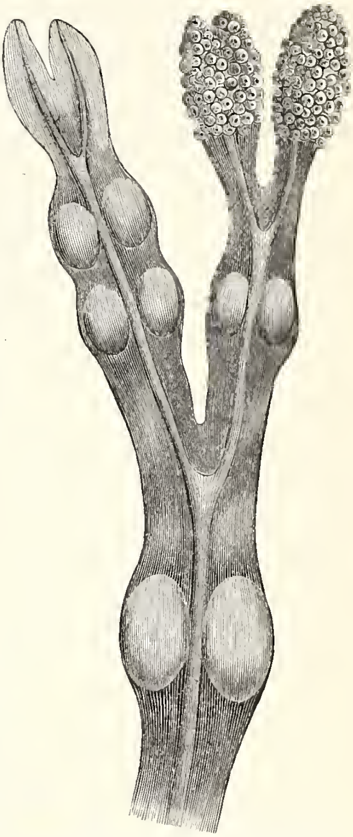
Fucus siliquosus, *Linné*, s. Cystoseira (Halidrys, *Lyngbye*) siliquosa, *Agardh*. The frond is very narrow, 2 to 4 feet (0.6–1.2 M.) long, with short branches, articulated vesicles of a pod-like appearance, and lanceolate flattened tubercular fructification.

Fucus natans, *Linné*, s. Sargassum bacciferum, *Agardh*, is the *Gulf-weed* of the Atlantic Ocean, and is often found in immense masses floating in the sea. The frond is terete, and has linear and serrate branches and globular aculeate and stipitate vesicles of the size of a pea.

Constituents.—These plants are very similar in composition. They contain mucilage, mannit, odorous oil, a bitter principle, and between 14 and 20 per cent. of ash, calculated for the dried plant. Gödechen, James, and others found the mineral constituents of the bladder-wrack, as collected from different places, to vary to the same extent. Marchand (1865) obtained from the ash of the bladder-wrack 0.719 per cent. of iodine and 0.603 of bromine, and from F. serratus 0.834 iodine and 1.007 bromine. Frisby (1880) obtained from anhydrous bladder-wrack .72 per cent. iodine, .84 bromine, and .47 chlorine; the ash amounted to 15.9 per cent.

Medical Action and Uses.—The medicinal virtues of F. vesiculosus depend apparently upon the iodine and bromine which it contains in common with the allied species of sea-weed. It has been applied externally, bruised, to enlarged *scrofulous* glands, and internally it was at one time recommended as a means of lessening *obesity*. It was administered chiefly in a decoction made with from 2 to 4 drachms (Gm. 8–16) of the plant in a pint of water, and was alleged not to occasion atrophy of the mammæ or testes, while it reduced the fat in a notable degree. For this purpose it had a brief vogue, but is now almost forgotten.

Fig 128.



Fucus vesiculosus, *Linné:* fruiting branch, natural size.

FUMARIA.—Fumitory.

Fumeterre, Fr.; *Erdrauch*, *Feldraute*, G.

Fumaria officinalis, *Linné.*
Nat. Ord.—Fumariaceæ.

Description.—Fumitory is a low annual about 12 inches (30 Cm.) high, and is common in the fields throughout Europe and more or less naturalized in most civilized countries. The entire plant is of a glaucous gray-green color; the stem is angular and much branched; the leaves are alternate, finely-dissected, compound, with spatulate or obovate-oblong rather acute lobes; the flowers are in terminal and axillary racemes, and have short, acute, and sharply-toothed sepals, and a pale-red and crimson or purplish corolla, which is one-spurred at the base. The fresh plant has a somewhat heavy odor and a saline, bitter, and rather acrid taste.

Constituents.—Winckler (1831) isolated *fumaric acid*, $C_4H_4O_4$, which had been obtained by Lassaigne (1819) from malic acid, $C_4H_6O_5$; the latter, heated to 150° C. (302° F.), is almost completely resolved into fumaric acid and water. Fumaric acid crystallizes in colorless prisms, volatilizes partly unaltered above 200° C. (392° F.), and when heated with hydriodic acid or under the influence of nascent hydrogen is converted into succinic acid. Peschier discovered the alkaloid *fumarine*. Pommier (1853) obtained it by exhausting the fresh herb with water acidulated with acetic acid and precipitating with ammonia. It is white, crystalline, bitter, not freely soluble in water, but soluble in alcohol. The analysis of Merck proved the presence of the usual constituents of herbs.

Medical Action and Uses.—This is one of many medicines reputed to be purifiers of the blood. Its bitter taste and its slightly laxative and diuretic qualities suggest its analogies with dandelion. Its reputation also is partly of the same kind as a remedy for *dyspeptic* derangements attributed to torpor of the liver, but generally due to constipation. But its greatest credit has been acquired in the treatment of diseases of the *skin* depending on scrofulous and other diathetic disorders. For *crusta lactea* a decoction of the plant in milk has been used topically. The expressed juice of the fresh plant is its most efficient preparation. A decoction or infusion may be made with an ounce of the herb to a pint of water (Gm. 32 to Gm. 500).

FUNGUS CHIRURGORUM, *P. G.*—Surgeon's Agaric.

Agaricus (*s. Boletus*) *chirurgorum*, *s. igniarius.*—*Spunk*, *Touchwood*, E.; *Agaric de chêne*, *Bolet amadouvier*, *Amadou non-salpêtré*, Fr.; *Wundschwamm*, *Feuerschwamm*, *Zunder*, G.

Polyporus (Boletus, *Linné*) fomentarius, *Fries.*
Nat. Ord.—Fungi, Polyporei.

Origin.—This fungus grows on beech and oak trees in Southern and Middle Europe; it is sessile, obliquely triangular, and hoof-shaped, 4 to 12 inches (10 to 30 Cm.) broad, at the base 2 to 4 inches (5–10 Cm.) thick, brown-gray or whitish externally and yellowish-brown internally; the hymenium on the lower side is in the form of small tubular pores. This and the hard rind are removed and the fungus is cut into thin slices, which are soaked in water, boiled in weak lye, washed, and beaten with mallets until soft. It is then ready for surgical purposes. For use as tinder it is soaked in a saturated solution of nitrate of potassium before it is dried.

Description.—Surgeon's agaric is in thin, flat pieces, tasteless, inodorous or of a faint odor, of a cinnamon-brown color, glossy, very soft and velvety. Under the microscope it is seen to consist of interlaced filiform cells. It readily absorbs twice its weight of water, and when this is expressed and evaporated only a minute residue should be left.

Polyporus (Boletus, *Linné*) igniarius and marginatus, *Fries*, yield a similar but harder product; the former grows on willows and other trees, and is internally rust-brown or dark cinnamon-brown, and very hard; the latter is found on oak and beech trees, and is internally yellowish, and not spongy.

Surgical Action and Uses.—On account of its combined lightness, elasticity, toughness, and porosity this substance has long been used to arrest *hæmorrhage* from slight wounds, and especially from leech-bites. It should be secured in its place by a bandage or other pressure. When prepared with nitrate or with chlorate of potassium it may be formed into cylinders and used as a *moxa.* Its physical qualities give it a superiority over all other substances to be insinuated between the ulcerated skin and an *ingrown toe-nail.* The success of this treatment depends upon preventing any movement of the parts by means of a narrow strip of adhesive plaster wound around the toe.

FUNGUS MUSCARIUS.—Fly Agaric.

Fly fungus, E.; *Agaric mouche*, *Fausse oronge*, Fr.; *Fliegenschwamm*, G.

Amanita muscaria, *Persoon*, s. Agaricus muscarius, *Linné.*
Nat. Ord.—Fungi, Agaricini.

Origin.—This European fungus grows in autumn, chiefly under pine trees; allied poisonous species are met with in most countries. Some species of the same genus are edible.

Description.—The stalk is tuberous at the base, 3 to 6 inches (7 to 15 Cm.) high, and about ¾ inch (18 Mm.) thick, white. The cap (pileus) is 4 to 6 inches (10–15 Cm.) broad, at first globular, afterward flattish or convex, scarlet or orange-red, more or less covered with white warts, internally yellowish, and on the under side with white lamellate gills (hymenium). It has a disagreeable odor and a burning, acrid taste. Infused with milk, it is used for poisoning flies; hence the name.

Constituents.—The poisonous principle, according to Apoiger (1851), is a crystallizable acid soluble in ether and precipitated by acetate of lead. Leteiller (1866) called it *amanitin*, which is a brown, amorphous, tasteless glucoside, insoluble in ether and not precipitated by lead salts or gallic acid. Schoonbrodt (1864) isolated a white crystalline powder, *agaricin*, by exhausting the alcoholic extract with 50 per cent. alcohol, evaporating and crystallizing from a mixture of alcohol and ether; it is insoluble in ether and sparingly soluble in water, and has at first an insipid, afterward sweet, bitter, and acrid taste. Sicard and Schoras (1865) announced that various toadstools contain a poisonous volatile alkaloid; the volatile alkaloid obtained by Apoiger had a very disagreeable odor, but was not poisonous. Schmiedeberg and Koppe (1869) separated a poisonous alkaloid, *muscarine*, $C_5H_{15}NO_3$, which is colorless, inodorous, crystalline, very deliquescent, insoluble in ether, and sparingly soluble in chloroform; it is a strong base, and yields deliquescent salts, which are precipitated by mercuric chloride, auric chloride, and potassio-mercuric iodide. It is accompanied by *choline*, $C_5H_{15}NO_2$, which was isolated by Harnack

(1876) as *amanitine*, and was afterward found by him identical with the choline of hog-bile.

Physiological Action.—*On Animals:* After subcutaneous injection of muscarine in a frog the heart loses by degrees its muscular force, and at last stands still in diastole. Although it cannot be stimulated, mechanically, to contract, its power may be restored by atropine, daturine, digitaline, duboisine, puturia, and pilocarpine. If the animal be already under the influence of atropine, muscarine will not produce its characteristic effects. In cats it causes increased salivary secretion, vomiting, diarrhœa, staggering gait, and the other symptoms mentioned below. In mammals generally large doses increase the frequency of the heart's pulsations while limiting their power, so that the organ grows more and more dilated and the blood-pressure declines. At the same time, as might be anticipated, the blood accumulates in the lungs and venous system, causing more or less cyanosis, with symptoms of asphyxia. Small doses, on the other hand, quicken without embarrassing respiration. In the latter cases the temperature is somewhat raised; in the former it is lowered. One of the most constant effects is salivation, which is proportioned to the dose administered; there may also be vomiting, with tardy diarrhœa, frequent defecation, and increased secretion of urine. The peristaltic action of the bowels is sometimes so vigorous as to be visible through the skin. The pupil is generally contracted.

On Man: In large doses it occasions violent and fatal symptoms. A case is on record in which several soldiers who had eaten of this fungus presented the following phenomena: anxiety, burning thirst, oppressed breathing, severe colic, a small and irregular pulse, lachrymation, cold sweats, sunken features, dimness of vision, contracted pupils, with a cyanotic hue of the nose, lips, hands, and feet; general twitching of the muscles, tetanoid or epileptoid spasms, distension of the abdomen, fetid evacuations from the bowels, delirium, and great anguish until death. Husemann relates that in 1859 five officers died from poisoning by this fungus, and states that the fatal termination may take place in from 5 to 12 hours, or not for 2 or 3 days (*Handbuch d. Toxicologie* (1862). p. 389). It is employed by many Siberian tribes to produce excitement and inebriation, and it imparts to the urine an intoxicating quality which continues for a considerable time after taking it. "A man, for example, may have intoxicated himself to-day by eating some of the fungus; by the next morning he will have slept himself sober, but by drinking a teacupful of his urine he will become as powerfully intoxicated as on the preceding day" (Pereira).

The toxical effects of Fungus muscarius resemble those of alcohol in some respects and of belladonna in others. Murrell quotes the following illustration (*Practitioner*, xxv. 89): "The natural inclinations of the individual become stimulated. The dancer executes a *pas d'extravagance*, the musician indulges in a song, the chatterer divulges all his secrets, the orator delivers himself of a philippic, and the mimic indulges in caricature. Erroneous impressions of size and distance are common occurrences: a straw lying in the road becomes a formidable object, to overcome which a leap is taken sufficient to clear a barrel of ale." It is stated by Cosserat "that a young woman who had eaten some of these fungi ran about the house in her night-gown, beating her head against the wall and screaming like one possessed." Some American species seem to occasion analogous effects, for a person poisoned by one of them is said to have been affected "with wild apprehensive delirium" (Evans, *Phila. Med. Times*, xiii. 327).

A very interesting case of poisoning by this fungus which occurred at Calcutta is related by Dr. Chevers. An accomplished gentleman, of temperate habits, having partaken of some mushrooms at breakfast, went to court, and was surprised to find that he could not control his actions; every thing and person appeared to him ludicrous; he laughed immoderately in open court, and ridiculed in an absurd way his superior officer. After some hours he recovered, but was naturally alarmed at his attack, of which he did not suspect the cause. His physician, to console him, promised to return to luncheon, at which, among other dishes, were stewed mushrooms. Of these he ate, and before the meal was finished he became very much excited; every person appeared ridiculous; the most ordinary remark seemed full of fun and wit, and his laughter was immoderate. Every object appeared to him perfectly beautiful. These exaggerated sensations continued for some hours, and were put an end to by the administration of ipecacuanha, which caused him to disgorge a considerable quantity of the fungi still undigested. No after ill effects were experienced. It will be observed that in this narrative there is absolutely nothing to suggest or to be explained by the results of the physiological experiments above described. But in the fatal cases above referred to the cyanotic phenomena corresponded to the effects produced in animals by lethal doses of muscarine.

The hypodermic injection of one-third of a grain of Merck's muscarine occasioned contraction of the pupil, profuse perspiration, free salivation, and running at the eyes and nose, and sometimes it purged and excited nausea and vomiting and a desire to pass urine. A like administration of one-thirteenth of a grain of pure muscarine produced these symptoms, with a sense of weight in, and determination of blood to, the head, flushed face, and giddiness. It is remarked as curious that while muscarine given internally contracts the pupil, its topical administration dilates it—in this respect resembling gelseminum (Murrell); and, as still more curious, and, indeed, as important in its bearing upon the relation of physiological results to therapeutics, "that pilocarpine, a sweater and salivator, which slows and weakens or arrests the frog's heart, should antagonize muscarine, which is also a sweater and a salivator and stops the heart."

Medical Uses.—At one time this fungus had a doubtful reputation for the cure of *epilepsy*. It was also used externally in the treatment of chronic *eruptions* and *ulcers* on the skin. Its most important use is to combat profuse *sweating*, for which purpose the related white agaric has long been employed, as is elsewhere stated. Dr. Murrell successfully used Agaricus muscarius in the treatment of twenty-six cases of the night-sweating of phthisis. He found that 5 minims of the 1 per cent. solution of the extract was the smallest dose on which reliance could be placed. It was given three times a day, or at intervals of about an hour before bed-time. It does not begin to act on the first night, but on each successive night becomes more efficient, and it stops the sweating without producing any abnormal dryness of the skin. Even in the dose of 15 minims it produced no bad effects. But care should be taken to test the activity of the preparation used by its power of arresting the action of the frog's heart (*loc. sup. cit.*).

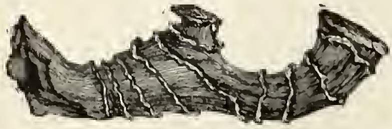
GALANGA.—GALANGAL.

Rhizoma (*Radix*) *galangæ*, P. G.; *Radix galangæ minoris.*—*Galanga*, Fr.; *Galgant*, G.
The rhizome of Alpinia officinarum, *Hance*. Bentley and Trimen, *Med. Plants*, 271.
Nat. Ord.—Zingiberaceæ.

Origin.—The galangal-plant resembles a flag, and has stems about 4 feet (1.2 M.) high, and white flowers, veined with red, in terminal racemes. It is indigenous to the island of Hainan in the south of China, and probably also to the adjacent mainland.

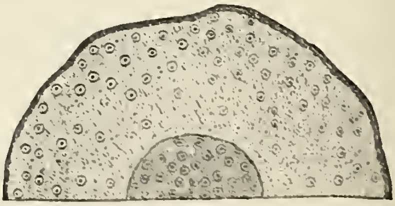
Description.—The rhizome appears in commerce in sections about 2 inches (5 Cm.) long, ¼ to ¾ inch (6–18 Mm.) in diameter, frequently with one or two short branches. It has externally a rust-brown color, and is longitudinally striate and transversely marked with the short remnants of the leaf-sheaths. It is rather tough, breaks with a somewhat fibrous fracture, is internally pale grayish-brown, and on transverse section shows the nucleus-sheath as a dark-colored circular line, enclosing a central portion of about the same width as the cortical layer; the tissue contains scattered oil-cells and wood-bundles, the latter being more numerous in the central portion. Galangal has an agreeable aromatic odor, which becomes more prominent on bruising the rhizome, and a pungent taste somewhat resembling that of ginger.

FIG. 129.



Galanga.

FIG. 130.



Galanga: transverse section, magnified 3 diam.

Constituents.—Galangal contains about ½ per cent. of a pale-yellow or brownish-yellow volatile oil which is lighter than water, and, according to Vogel (1844), has the composition $C_{10}H_{18}O$. The water distilled from galangal contains ammonium carbonate (Vogel). The pungent taste of the rhizome, according to Bucholz, is due to a soft resin which has not been further examined. Brandes (1839) obtained by means of ether a brown oleoresin containing crystals of *kæmpferid*, which, when pure, are yellowish, pearly, tasteless, and inodorous, and are colored by sulphuric acid first yellow, afterward dark-green. Mucilage, starch, fat, and extractive matter are likewise present.

Allied Drug.—ALPINIA GALANGA, *Willdenow*, of Java, yields the *greater galangal*, *Radix galangæ majoris*, which is rarely seen in our commerce. It resembles the preceding, but is longer and thicker, externally brown-red, internally grayish or buff-colored, and has a weaker odor and taste.

Medical Action and Uses.—Galangal is an aromatic, and therefore a local and general stimulant, resembling ginger in its qualities and effects. It was formerly held in high repute as a stomachic for promoting *digestion* and relieving *flatulence.* It was employed to correct nausea and prevent *vomiting* due to indigestible food, and also when they occurred in febrile diseases of a typhoid type. Its somewhat acrid taste renders it unsuitable for administration in powder, which may, however, be prescribed in the *dose* of 20 or 30 grains (Gm. 1.30–2.00). It may be given in an infusion made with an ounce (Gm. 32) of the bruised root to a pint of water. A tincture is also employed in the *dose* of a fluidrachm (Gm. 4).

GALBANUM, *U. S., Br., P. G.*—Galbanum.

Gummi-resina galbanum.—*Galbanum,* F.; *Mutterharz, Galban,* G.

The gum-resin obtained from Ferula galbaniflua, *Boissier et Buhse,* and probably from other allied plants. Bentley and Trimen, *Med. Plants,* 128.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This plant is indigenous to Northern Persia. The stem is about 5 feet (1.5 M.) high; the radical leaves are large, triangular, decompound-pinnate, and pinnatifid, with the ultimate sections linear and obtuse; the stem-leaves are small; the fruit is somewhat winged near the face of the mericarps; the ribs are prominent and slender, and the oil-tubes solitary in each groove and absent in the commissure, or often there are two narrow ones. The plant, with the one noticed below, was originally (1844) described by Boissier under the name of Fer. erubescens, subsequently (1856) as F. gummosa.

Fer. rubricaulis, *Boissier,* grows in Southern (and probably also in Northern) Persia, and has the leaves with wider segments and the oil-tubes narrower and more numerous than the preceding. Fer. Schair, *Borszczow,* a native of the Kirgheez country, yields also a gum-resin similar to galbanum, which, however, does not appear to be collected. The gum-resin exudes spontaneously, and, as far as known, no incisions are made to promote the exudation. It enters commerce chiefly through Russia and from the Levant.

Description.—The best quality of galbanum is met with in tears varying in size from a pin's head to a pea and larger; sometimes it is soft and semifluid. The tears adhere to one another, forming a more or less compact mass; they are of a reddish-, brownish-, or greenish-yellow color externally, internally whitish or yellowish, with a waxy gloss, and are somewhat translucent. It has a peculiar, unpleasant balsamic odor and a disagreeable, bitter, and acrid taste. Moistened with alcohol, a fine purple color will be produced on the addition of a little strong hydrochloric or nitric acid. Hydrochloric acid remaining in contact with galbanum for about an hour acquires a red color, and on the gradual addition of alcohol and warming the mixture to 60° C. (140° F.) becomes transiently dark violet-colored (difference from ammoniac, which is not colored). Water in contact with galbanum shows a blue fluorescence on the addition of a minute quantity of ammonia-water.

Lump galbanum consists sometimes of soft or harder masses, in which some tears are distinctly observed; sometimes a mass is offered which from its odor and behavior seems to be of a different origin.

For medicinal use galbanum should be exposed to a low temperature until brittle, then powdered, and by sifting freed from the impurities.—*P. G.*

Constituents.—According to the older analyses by Neumann, Pelletier, and others, galbanum contains 6 to 8.5 per cent. of volatile oil, 15 to 20 per cent. of gummy matter, and 60 to 66 per cent. of resin, besides 7 to 14 per cent. of impurities. Volatile fatty acids were found by Moessmer (1861) in the emulsion remaining after distilling off the volatile oil. The *volatile oil* is colorless, turns yellowish and thick on exposure, varies in specific gravity between .88 and .92, has the boiling-point 160° to 165° C. (320° to 329° F.), is dextrogyre, and consists of several hydrocarbons of the composition $C_{10}H_{16}$. The resin is yellowish-brown, soluble in ether, alcohol, carbon disulphide, and alkalies. On being heated it yields a beautiful indigo-blue volatile oil which, according to Kachler (1871), consists of a colorless oil, $C_{10}H_{16}$, boiling at 240° C. (364° F.), and of a deep-blue oil, $C_{30}H_{48}O_3$, which boils at 281° C. (538° F.), appears to be identical with the blue portion of the oil of German chamomile, and yields with potassium a hydrocarbon, $C_{30}H_{48}$, the solution of which in much aqueous ether gives with an ethereal solution of bromine an azure-blue color, changing to green and brown. Galbanum resin, treated with fusing potassa, yields several volatile fatty acids and *resorcin*, the solution of which is colored dark-purple by ferric chloride (Hlasiwetz and Barth, 1864).

An aqueous infusion of galbanum on the addition of ammonia assumes a blue fluorescence, which disappears again on the addition of an acid. This reaction is due to *umbelliferon*, $C_9H_6O_3$, which may be obtained in colorless needles by heating galbanum with hydrochloric acid to 100° C. (212° F.), agitating the liquid with ether or chloroform, and evaporating the latter solution. It was first obtained by C. Sommer (1859) from sumbul-root, and has since been procured from various umbelliferous resins and from mezereon. It crystallizes from hot water in colorless rhombic prisms which melt at 240° C. (464° F.) and sublime without decomposition. It is easily soluble in ether and alcohol, but dissolves sparingly in cold water, the latter solution showing a blue color in reflected light; when fused with potassa it yields resorcin.

Off. Prep.—Emplastrum asafœtidæ, *U. S.;* Empl. galbani, *U. S., Br.;* Pilula assafœtidæ comp., *Br.;* Pil. galbani comp., *U. S.*

Medical Action and Uses.—Galbanum is generally described as partaking of the virtues both of asafetida and ammoniac, affecting the nervous system like the former, and acting as a local irritant like the latter. Applied to the skin, it occasions a papular eruption, and, if the true skin is exposed, causes it to ulcerate. Upon the system generally it probably acts as a stimulant, for in large doses it is said to cause fulness of the head and tension of the pulse. Moreover, its therapeutical virtues are observed only in cases that call for stimulation; these are such as the resins and gum-resins are applicable to, and especially *chronic bronchitis, chronic intestinal, uterine, and vaginal catarrh, amenorrhœa*, etc. In most of these cases its effect is to lessen excessive mucous secretion. It is seldom given alone, and hence virtues are apt to be attributed to it that belong to its associated medicines. In the compound galbanum pill it is united with asafetida and myrrh. Even for external use it is associated with other irritants. The *dose* of galbanum is from 5 to 20 grains (Gm. 0.30–1.30). It is best administered in emulsion.

GALEGA.—Goat's Rue.

Herba rutæ capraria.—Galega, Rue de chèvre, Fr.; *Geisraute, G.*

Galega officinalis, *Linné.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—Goat's rue is found in the countries bordering on the Mediterranean and northward to Central Europe. It has a perennial several-headed root and an erect stem about 3 feet (90 Cm.) high; the smooth, oddly-pinnate leaves are furnished with six or eight pairs of lanceolate or ovate-lanceolate, obtuse, and finely mucronate leaflets ¾ to 2 inches (2–5 Cm.) long, and with lanceolate stipules, which are sagittate on one side. The purplish or whitish flowers are in axillary racemes, and produce narrow almost cylindrical legumes. The herb is inodorous and has a mucilaginous and somewhat bitter and astringent taste. Its constituents have not been investigated.

Medical Action and Uses.—Galega was at one time held to be diaphoretic, diuretic, and anthelmintic, and was used as a stimulant in nervous affections of an *hysterical* or *spasmodic* nature, in low *fevers*, and especially in the *plague*. It is said, also, to favor the *mammary secretion*. In Europe galega is no longer used, except in domestic medicine.

GALIUM.—Cleavers.

Bedstraw, E.; *Caille-lait, Gallait*, Fr.; *Labkraut*, G.

Nat. Ord.—Rubiaceæ, Stellatæ.

Description.—The following species have been used:

Galium Aparine, *Linné.*—Cleavers, *E.;* Grateron, Rièble, *Fr.;* Klebkraut, *G.*—It grows in thickets in North America, Europe, and Northern Asia, has a weak, retrorsely prickly, quadrangular stem 3 or 4 feet (0.9–1.2 M.) long; linear-lanceolate and mucronate leaves in whorls of six or eight, which are prickly, roughened on the midrib and margin; small whitish flowers, and fruits composed of two united one-seeded carpels, which are armed with hooked prickles.

G. triflorum, *Michaux.*—Sweet-scented bedstraw, *E.*—It is indigenous to North America, resembles the preceding, but has elliptic-lanceolate slightly rough leaves in whorls of six, three-flowered peduncles, and acquires an agreeable odor on drying.

G. mollugo, *Linné.*—Whiptongue, *E.;* Caille-lait blanc, *Fr.;* Waldstroh, *G.*—This plant is indigenous to Europe, somewhat naturalized in the United States, has a smooth stem, oblanceolate or oblong-linear, somewhat rough and mucronate leaves in whorls of eight, and long panicles of whitish flowers yielding smooth fruits.

G. VERUM, *Linné.*—Yellow bedstraw, *E.;* Caille-lait jaune, *Fr.;* Megerkraut, Liebfrauenstroh, *G.*:—This perennial herb has a light-reddish root, whorls of eight linear rough leaves, compact panicles of yellow flowers, and smooth fruits; it is a European plant sparingly naturalized in the United States.

Constituents.—The plants contain either *galitannic* or *aspertannic acid*, both producing green precipitates with iron salts. They likewise contain *citric*, *oxalic*, and *rubichloric acids*, a bitter principle, and the common principles of herbs (R. Schwarz; Vielguth). Von Cotzhausen (1876) determined the odorous principle of Galium triflorum to be *coumarin*, to which is also due the agreeable odor of the nearly-allied Asperula odorata, *Linné*, known in France as *aspérule odorante* and in Germany as *Waldmeister*. The roots of several species, like Galium tinctorium, *Linné*, contain red coloring matter resembling that of the allied Rubia tinctorum, *Linné*, and are popularly known as *wild madder*. The leaves of others, like Galium circæzans, *Michaux*, and G. lanceolatum, *Torrey*, have a sweet liquorice-like taste, and the plants are sometimes called *wild liquorice*.

Medical Action and Uses.—Galium verum has been used in Europe chiefly as a diuretic in *dropsy* and *jaundice*, and for *scaly skin diseases*, especially of a *scrofulous* nature. It has been alleged to cure *epilepsy* and *cancer* of the tongue. The fresh plant, reduced to a paste in a mortar, is used in Great Britain as a poultice for chronic *ulcers* (*Edinb. Med. Jour.*, xxix. 173). Notwithstanding the virtues attributed to it at various times, it does not seem to have established its claims to confidence. A decoction of galium is prepared with half an ounce of the plant to a pint of water (Gm. 16 to Gm. 500) and given in wine-glassful doses.

GALLA, *U. S., Br.*—NUTGALL.

Gallæ, P. G.; *Galla halepense*, *G. turcica*, *G. levantica*, *G. tinctoria*, *G. quercina.*—*Galls*, E.; *Noix de galle*, *Galle de chêne*, Fr.; *Galläpfel*, *Gallen*, G.

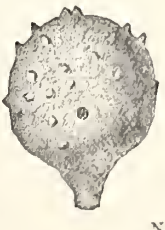
Excrescences on Quercus lusitanica, *Webb*, var. infectoria, *De Candolle* (Q. infectoria, *Olivier*), caused by the punctures and deposited ova of Cynips (Diplolepis, *Latreille*) Gallæ tinctoriæ, *Olivier* (Class Insecta, Order Hymenoptera). Steph. and Church, *Med. Bot.*, plate 152; Bentley and Trimen, *Med. Plants*, 249.

Nat. Ord.—Cupuliferæ.

Origin.—Quercus lusitanica is a polymorphous species indigenous to the basin of the Mediterranean, the leaves varying between ovate and obovate, mostly rounded at base and acute at apex, variously and either obtusely or acutely toothed or lobed. The dyer's oak is a small tree, or oftener a shrub, 4 to 6 feet (1.2–1.8 M.) high, and is found in the eastern section of the Mediterranean basin from Greece to Persia. The tender bark of the young branches is punctured by the female of the hymenopterous insect named above, and one or more eggs are deposited in the wound. The irritation produced by this operation causes the formation of an excrescence enclosing the larva, which undergoes therein its transformations. The term *gall* is generally used to designate such excrescences formed upon any part of a plant in consequence of the puncture of an insect.

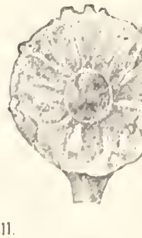
Description.—Nutgalls are nearly globular, about an inch (25 Mm.) or less in diameter, with a short stipe and a nearly smooth surface, or, more frequently, more or less tuberculated in the upper portion. They are dense, and in color externally of a deep blackish olive-green or blackish-gray; if the gall remains upon the branch, it gradually becomes lighter, and finally of a pale yellowish-brown tint, the texture becoming spongy and the weight decreasing at the same time. Galls are hard, but are readily broken with a hammer, exhibiting a more or less close granular fracture, which has sometimes a waxy lustre. Internally, they are yellowish- or pale brownish-gray, with a central nucleus or cavity containing either the more or less fully developed insect or pulverulent fragments of the cellular tissue. In the latter case the insect has usually escaped through a cylindrical canal which it has bored from the

FIG. 131.



Entire.

FIG. 132.

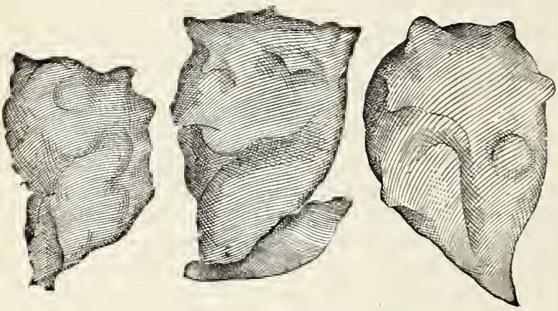


Section.

Nutgall.

cavity to the surface, the outer aperture being just below the middle and having a diameter of $\frac{1}{12}$ to $\frac{1}{8}$ inch (2–3 Mm.). The cellular tissue of the nucleus, if still present, is mostly filled with small starch-granules and surrounded by a layer of thick-walled cells forming a shell, on the outside of which is the cellular tissue containing the tannin. This tissue has often a radiated appearance near the shell, and contains toward the surface small scattered bundles of vascular tissue. Nutgalls are nearly inodorous and have a very astringent taste. Light, spongy, and whitish-colored nutgalls should be rejected.

Fig. 133.



Chinese Nutgalls.

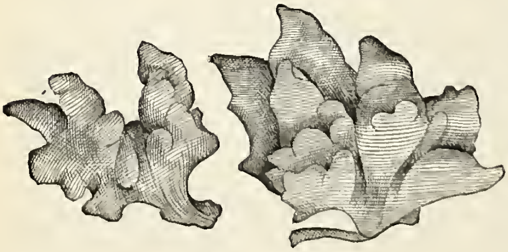
Nutgalls are distinguished in commerce according to their color, the *blue* or *black galls* of Syria (Aleppo) being preferred. *Smyrna galls* are usually of a grayish olive-green, more spongy in texture, and intermixed with *white galls;* the latter are the least valuable. *Sorian galls* are of the size of a pea, blackish, and internally not radiate. The galls which are produced upon the European oaks by different species of Cynips are of a lighter color and more spongy texture, but have an astringent taste and contain tannin.

Constituents.—The principal constituent of nutgalls is *tannin* or *gallotannic acid*, of which they contain about 60 per cent. Bowman (1869) assayed selected galls, finding 80 per cent., and in white galls only 30.7 per cent. 2 or 3 per cent. of gallic acid is likewise found, together with some sugar, resinous and albuminous matter, and, as stated before, starch in the nucleus.

Pharmaceutical Uses.—In the preparation of tannic and gallic acids, and for Tinct. gallæ, Unguent. gallæ, *U. S.*, *Br.*, and Unguent. gallæ cum opio, *Br.*

Allied Drugs.—Chinese and Japanese Galls, although known from a much earlier period, were not a regular article of commerce until Pereira (1844) directed attention to them again. They are produced upon the leaves or leafstalks of Rhus semialata, *Murray*, by an insect provisionally named Aphis chinensis, *Bell*, and usually contain between 70 and 80 per cent. of tannin. They are of a very irregular shape, mostly thin, as if stalked, toward the base, much inflated above, irregularly lobed, and with few or many protuberances; they are of a reddish-brown color, but densely covered with a gray down, consist of a thin fragile shell, and contain in the interior numerous small dead insects. The Japanese nutgalls agree in all essential characteristics with this description, but are usually more slender and have a larger number of lobes and protuberances; their origin has been referred to Rhus japonica, *Siebold*. C. Hartwich (1881) found also their pubescence quite dense and light-brown, and the tissue to contain unaltered starch-granules; while Chinese galls have the pubescence less dense and greenish-brown, and the starch is pasty.

Fig. 134.



Japanese Nutgalls.

Vallonea.—Valonia, Acorn-cups, *E.:* Valloné, Vélanède, Gallon, *Fr.:* Knoppern, Walonen, *G.*—Several varieties are occasionally met with. *Hungaria valonia* are the cups of Quercus Robur, *Linné*, rendered irregular in shape and more or less winged by the excrescences produced from the sting of Cynips Quercus calycis. *Oriental valonia* consist of the unaltered fruit-cups of Quercus Vallonea, *Kotschy*, and of several allied species or varieties of Qu. Ægilops, *Linné*, indigenous to South-eastern Europe and the Levant; they are about an inch (25 Mm.) or more in diameter, have thick spreading or recurved scales, possess a strongly astringent taste, and are largely employed for tanning. The cups of our indigenous species are likewise astringent.

American Nutgalls, as obtained from Quercus alba, *Linné*, and other species, are light and spongy, and generally not very rich in tannin. The galls from Quercus virens, *Aiton*, produced in Texas, are more analogous to Aleppo galls, but not tuberculate: they contain about 40 per cent. of tannin. The so-called *California oak-balls*, recently introduced, are derived from Quercus lobata, *Engelmann*, are about 2 inches (5 Cm.) in diameter, orange-brown and somewhat glossy externally, soft and spongy within, and appear to contain much tannin.

Tamarisk Galls are collected from Tamarix orientalis, *Forskal*, which grows in Southern and South-western Asia. They are ⅛ to ½ inch (3–12 Mm.) thick, subglobular, knotty, and are said to contain from 40 to 50 per cent. of tannin. Similar galls are obtained in Algeria and Morocco from Tam. africana, *Poiret*. The brown-red, fibrous, bitter, and astringent bark of Tam. gallica, *Linné*, and the leaves of the same plant, are used in Southern Europe.

Medical Action and Uses.—From the most ancient times nutgall has been used in medicine for its astringency. This property is due to gallotannic acid, but a bitter extractive ascribed to nutgall gives it a tonic action. These qualities account for its efficacy in the treatment of chronic *diarrhœa*. It has been used as an *antidote* to tartar emetic and poisonous vegetable alkaloids; and whatever degree of efficacy it then exerts is probably due to its constringing the stomach and delaying the absorption of its contents. An infusion made with from half an ounce to an ounce (Gm. 16–32) of coarsely-powdered nutgall in a pint (Gm. 500) of boiling water, may be given in the dose of a wine-glassful three or four times a day, for the purposes referred to; and it may be locally applied to the *relaxed mucous membrane* of the mouth, throat, vagina, and rectum.

GARCINIA.—Mangosteen.

Mangostane, Fr., G.

Several species of Garcinia.

Nat. Ord.—Guttiferæ (Clusiaceæ).

Origin.—The trees belonging to the genus Garcinia inhabit tropical countries, and are chiefly found in India and the East Indian islands. They have unisexual or subdiœcious flowers with four sepals, four petals, and numerous stamens, which in the pistillate flowers are often reduced to staminodes; the ovary is four- to ten-celled, each cell containing one seed; the fruit is a fleshy berry.

Description.—Garcinia mangostana, *Linné*, is a large tree with a bitter and very astringent bark, and glossy elliptic-oblong or oblong-lanceolate leaves. The fruit is of the size of an ordinary orange, of a brown or brown-gray color, mottled with yellow and crowned by the sessile four-lobed stigma. The pericarp is bitterish and astringent, somewhat spongy, and encloses six or eight seeds, which are covered with a white juicy pulp of a delicious odor and taste. W. Schmid (1855) isolated from the pericarp, besides tannin, golden-yellow *mangostin*, $C_{20}H_{22}O_5$, which crystallizes in scales, is fusible, soluble in alcohol and ether, and colored yellowish-brown by alkalies and green-black by ferric salts.

The fruit of Garcinia Kydia, *Roxburgh*, which is dark-yellow and of the size of a small orange, and of Garc. pedunculata, *Roxburgh*, which is much larger and of a yellow color, contain an acidulous pulp which is very inferior to that of the first species.

Garcinia indica, *Choisy*, s. G. purpurea, *Roxburgh*, s. Brindonia indica, *Du Petit-Thouars* (Bentley and Trimen, *Med. Plants*, 32), is a medium-sized tree, with oblong-lanceolate or oblong-oval, glabrous leaves, and with a dull-red or purplish fruit of the size of a small orange and containing from five to eight seeds imbedded in an acid purple pulp, which is used in India in curries and in the dried state. The seeds are about ½ inch (12 Mm.) long, oblong-reniform, somewhat compressed and wrinkled, and contain an oily embryo. After bruising the seeds and boiling them with water an oil collects on the surface, which is moulded by hand into egg-shaped balls, and is known as *kokum-butter* or *concrete oil of mangosteen* (Beurre de Kokum, Suif de Goa, *Fr.;* Kokum-butter, *G.*). This oil is in various-shaped cakes, has a whitish or yellowish color, and is firm, friable, and crystalline. J. Bouis and D'Oliveira Pimentel (1857) obtained from the seeds by ether 30 per cent. of oil, melting near 40° C. (104° F.), and containing about 50 per cent. of tristearin. Flückiger found after saponification also myristic and oleic acid. After filtration, whereby brown tannic matters are removed, the oil begins to melt at 42.5° C., fuses entirely at 45° C., and concretes again at 27.5° C. (*Pharmacographia*).

Allied Fruits.—Mammea americana, *Linné*, a guttiferous tree of the West Indies, has a brown-yellow, subglobular fruit about 5 inches (12 Cm.) in diameter and containing three or four ovate-oblong rough seeds. The fruit, which is known as *mammee-apple*, has a leathery bitter rind and contains a yellow aromatic pulp of a very agreeable taste. The fruit of Lucuma (Achras, *Linné*) mammosa, *Jussieu*, Nat. Ord. Sapotaceæ, is likewise known in the West Indies as *mammee:* it is an ovoid-oblong, rust-brown, and rough berry about 6 inches (15 Cm.) long, having a yellow or reddish sweet, mucilaginous pulp, and containing usually one large yellowish-brown polished seed.

Garcinia Kola, *Heckel*, is the *male kola* or *kola bitter* of Western Africa. The somewhat triangular seeds contain a yellowish-white embryo, which consists of a large radicle, and has a bitter, astringent, and somewhat coffee-like taste.

Medical Action and Uses.—The bark, the wood, and also the rind of the fruit of G. mangostana are very astringent, and have been employed in the treatment of *diarrhœa*, *dysentery*, *leucorrhœa*, and *gonorrhœa*, as a gargle in *tonsillitis*, in decoction as a lotion for foul *ulcers* and *prolapsus* of the *rectum* and *vagina*, etc. The concrete oil of G. indica has been chiefly used in some pharmaceutical preparations.

GAULTHERIA, *U. S.*—GAULTHERIA.

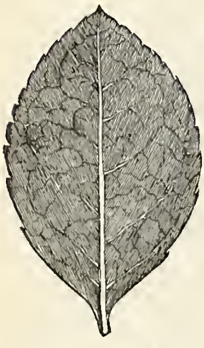
Folia gaultheriæ.—*Wintergreen*, *Teaberry*, *Partridgeberry*, *Boxberry*, *Checkerberry*, E.; *Feuilles de gaulthérie* (*de palommier*), *Thé du Canada*, *Thé de Terre-neuve*, Fr.; *Canadischer Thee*, *Bergthee*, G.

The leaves of Gaultheria procumbens, *Linné* (s. G. humilis, *Salisbury;* Gaultiera repens, *Rafinesque*). Bigelow, *Med. Bot.*, t. 22; Bentley and Trimen, *Med. Plants*, 164.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—Teaberry is found in cool damp woods, usually in the shade of evergreens, in Canada and the United States. The plant is a small shrub with a slender creeping stem and ascending branches, about 5 inches (12 Cm.) high, bearing the alternate evergreen leaves near the summit, axillary, nodding, whitish flowers, and five-celled berry-like pods, which are enclosed in the bright-red fleshy calyx. The leaves are collected late in summer or in autumn.

FIG. 135.



Leaf of Gaultheria procumbens, natural size.

Description.—The leaves are short-petiolate, about 1½ inches (4 Cm.) long and ¾ to 1 inch (18–25 Mm.) wide, obovate or roundish-oval in shape, with a wedge-shaped base, coriaceous in texture, mucronate and slightly toothed, the teeth having the elongated points appressed to the thickish margin; they are smooth, of a glossy-green color above, and paler beneath. The odor is agreeably aromatic, taste astringent and aromatic.

Constituents.—We are not acquainted with a complete analysis of the leaves. They contain a volatile oil (see OLEUM GAULTHERIÆ) and tannin. Jefferson Oxley (1872) found, besides grape-sugar, gum, coloring matter, and a principle analogous to gallic acid, *arbutin*, *urson*, and *ericolin*—principles which are likewise present in the leaves of chimaphila and in uva ursi.

Medical Action and Uses.—Gaultheria is stimulant and somewhat astringent. It has sometimes been employed as a substitute for Chinese tea in country places, where it is also popularly used as an *emmenagogue* and *galactagogue* and in chronic *bowel complaints*. In the former cases a hot infusion of the leaves is best; in the latter a cold infusion, made with about an ounce of the leaves to a pint of water (Gm. 32 to Gm. 500) may be taken freely. The action and most important uses of gaultheria are described in connection with its oil.

GELATINA.—GELATIN.

Gelatine, Fr.; *Gelatin*, G.

Origin and Preparation.—When bone-cartilage, animal skin, tendons, and ligaments are boiled for a long time with water, they become soluble therein, and on cooling the solution forms a jelly. During the boiling the animal tissues are placed upon a sieve or perforated diaphragm which is inserted above the bottom of the boiler. When sufficiently saturated the solution is drawn off and allowed to cool, the jelly being then cut into thin cakes, and these are placed upon nettings to dry. When made from carefully-selected material (fresh bones) it constitutes the *gelatin* of commerce, known also as *artificial isinglass*. The offal of slaughter-houses and of tanneries yields an impurer gelatin, known as *colla*, s. *colla animalis*, s. *glutinum*—glue, *E.;* colle, colle forte, *Fr.;* Leim, *G.* The importation into the United States of gelatin has increased from 139,000 pounds in 1876 to 476,000 pounds in 1882.

Properties.—Gelatin is met with in commerce in very thin, rectangular, transparent pieces bearing the impressions of the netting upon which it has been dried, or in smooth sheets which are either thin and transparent, or thicker, more or less porous, and opaque. It is not unfrequently cut into shreds, and the transparent kind is often variously colored.

Glue is in similar pieces, but usually thicker, and varies in color between pale-yellowish and dark-brown, or nearly black in the commonest varieties, and has an offensive animal odor, which is more apparent after it has been dissolved in hot water. To be adapted for dietetic or pharmaceutical purposes gelatin should not alter in color after being digested in hot water, and the solution should be free from smell.

It is to a small extent soluble in cold glycerin, dissolves freely in hot water, forming on cooling a tremulous transparent jelly, and is insoluble in alcohol and ether. Its solution in water is not precipitated by dilute solutions of alum, ferric chloride, or subacetate of lead (distinction from *chondrin*), but yields precipitates with tannin, chlorine-water, corrosive sublimate, and platinic chloride. The tissues yielding gelatin likewise unite with tannin, forming leather. Gelatin dissolves in acetic and in dilute mineral acids, the solutions being known as *liquid glue*. When its solution in water is boiled for a long time it loses the property of gelatinizing on cooling. By dry distillation gelatin yields carbonate of ammonium and a number of volatile bases, which are contained in *Dippel's animal oil*. Boiled with solution of potassa or with sulphuric acid, ammonia, *glycocoll*, $C_4H_9NO_2$, and *leucin*, $C_6H_{13}NO_2$, are obtained among other products.

Composition.—Gelatin, also called *glutin*, consists of about 50 per cent. of carbon, 18 of nitrogen, 6.5 of hydrogen, 25 of oxygen, and 0.5 of sulphur.

Chondrin, which is obtained from the permanent cartilages by boiling with water, has a similar composition, but contains less nitrogen and more oxygen. In addition to the differences pointed out above, it is distinguished from gelatin by being precipitated by acetic and the mineral acids.

Pharmaceutical Uses.—Gelatin is employed as a reagent for *estimating tannin*, a convenient solution for the purpose being made by dissolving about 50 Gm. of it, together with 8 or 10 Gm. of alum, in a liter of distilled water; before use the strength of the solution must be determined with a fresh solution of pure tannin (see p. 104). It should, however, be remembered that the different tannins require for complete precipitation different amounts of gelatin, so that the results obtained are not absolutely correct. The pectic acid of oak-bark, according to P. Büchner (1867), is likewise precipitated by a solution containing both gelatin and alum.

Gelatin is used for preparing the ordinary *court plaster* (see p. 569) and for the coating of pills. (See PILULÆ.) Dried in very thin layers, it has been recommended, under the name of *devorative* or *folding capsules*, for the administration of powders, the thin sheets being used in precisely the same manner as paper, except that after the introduction of the powder they are permanently closed by moistening the edges, and are swallowed, together with the powder, after having been softened by being dipped in water. *Medicated gelatin* is prepared by pouring a concentrated solution of gelatin, in which the medicinal substance has been dissolved, upon a polished and perfectly level surface; the sheet thus obtained is then divided into squares or disks in such a manner that each represents a definite weight of the medicine. *Gelatin capsules* are made by dipping oblong moulds of the desired size and shape into a gelatin solution; after the surface has been sufficiently coated, the capsule, while still pliant, is removed, filled with the powder or liquid, and the orifice closed by a drop of solidifying gelatin; or for extemporaneous use an empty capsule is slipped over the open end of another containing the medicine.

Within a few years so-called *medicinal pearls*, containing ether or other liquid, have been introduced. Hager recommends them to be made of gelatin, gum-arabic, sugar, and honey rolled out into sheets, one of which, while still rather soft, is placed upon an iron plate containing suitable cavities, into which the mass sinks; the liquid is then introduced, the orifices are closed by another sheet of the gelatin compound, the whole covered by a second iron plate having depressions exactly corresponding to those of the first, and after screwing the plates together their position is reversed. The pearls are finally separated by subjecting the entire arrangement to powerful pressure.

Gelatin has also been used as a base for the preparation of *medicated suppositories*, vaginal as well as rectal, and for *bougies*. The material consists of about 3 parts of gelatin, which, after having been soaked in water, is dissolved in 7 parts of glycerin. The medicating substance should be soluble in the vehicle. Substances containing tannin are evidently not adapted for this mode of medication.

Liquid glue may be made in various ways, either by dissolving glue in acetic acid or by adding to a strong aqueous solution of glue, nitric acid, equal to one-sixth or one-seventh of the weight of the glue. A solution of glue in spirit of nitrous ether is stated to be very serviceable, particularly if a little caoutchouc has been added to it. A solution of phosphoric acid in water, nearly neutralized by ammonium carbonate, has likewise been recommended for preparing liquid glue. The glue becomes water-proof by the addition of about 2 per cent. of potassium bichromate immediately preceding the application of its solution, and afterward exposing to the sunlight.

Gelatin also forms the chief constituent of the mass of which *hectographs* are made: 40 parts of gelatin or light-colored glue, after having been softened by water, are dissolved with the aid of heat in 100 parts of glycerin, to which 10 parts of simple syrup and 5 parts of mucilage of gum-arabic have been added; the scum is removed and the mass poured out. Finely-powdered whiting or terra-alba is sometimes added to the mass. *Hectograph inks* are made by dissolving 1 part of aniline violet or other similar compound in 10 parts each of acetic acid and water. After copying, the ink which is still adhering to the mass is removed with a sponge moistened with diluted vinegar.

Medical Action and Uses.—Physiological experiments prove that gelatin alone cannot support animal life, but that it may become nutritious when combined with other substances, as in soup prepared from meat. In the form of calves'-feet jelly it is employed during convalescence from acute disease, but its utility probably depends in great part upon the sugar, wine, and spices that season it. Solutions of gelatin are sometimes used to allay the irritation of the mouth, stomach, etc. produced by *corrosive poisons*. It has been given by enema as a lenitive in *ulceration of the rectum*, and a coating of it has been applied to *cutaneous eruptions* to protect them from the air. It is also dissolved in baths for chronic diseases of the skin, to remove the crusts or epidermic scales or simply to render the skin soft and pliable. For this purpose about a pound (Gm. 500) of gelatin dissolved by boiling in water is added to the bath when it is taken. Gelatin has also been used in the same manner as starch to prepare an immovable apparatus for *fractures*, etc. Catti has proposed the introduction of gelatinous cylinders or pencils charged with astringent or disinfecting agents into the nostrils in the treatment of chronic *coryza*, *ozæna*, etc.; and Pick strongly advocates the use of medicated gelatin, instead of ointments, in the treatment of *diseases of the skin*, and especially of *eczema* (*Centralb. f. Ther.*, i. 147).

GELSEMIUM, *U. S., Br.*—GELSEMIUM.

Radix gelsemii.—*Yellow jessamine or jasmine*, E.; *Racine de gelsemium, Jasmin sauvage*, Fr.; *Gelsemienwurzel, Giftjasmin*, G.

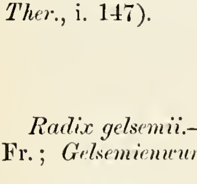
The rhizome and roots of Gelsemium (Bignonia, *Linné*; Lisianthus, *Miller*; Anonymos, *Walter*) sempervirens, *Aiton*, s. Gels. nitidum, *Michaux*, s. G. lucidum, *Poiret*. Bentley and Trimen, *Med. Plants*, 181; Meehan, *Native Flowers*, i. 9.

Nat. Ord.—Loganiaceæ, Gelsemieæ.

Origin.—The yellow jessamine is indigenous to the Southern United States, growing in moist woods from Virginia to Florida and Alabama, and flowering early in spring, beginning to bloom in Florida in January, and farther north in March or April. It has a high climbing stem with opposite, ovate-lanceolate, entire, smooth, and coriaceous leaves, and solitary or axillary clusters of very fragrant flowers, which have a bright-yellow, funnel-form, five-lobed corolla 1 to 1½ inches (25–38 Mm.) long, and produce a flattened two-celled fruit containing four to six winged seeds in each cell. The root and the subterraneous stem are the parts used in medicine.

Description.—The rhizome is about an inch (25 Mm.) or more in diameter, is externally brown-yellow with purplish-brown longitudinal lines, and breaks with a tough splintery fracture, showing silky bast-fibres in the inner closely-adhering bark, a porous yellowish wood which is traversed by whitish medullary rays, and a darker-colored central pith. The roots are thinner, similar in color externally, beset with numerous thin fibres, and marked by irregular longitudinal wrinkles and small scars. A transverse section shows a thin yellowish-brown bark covering a hard, pale-yellowish meditullium without a central pith, but radially striate by numerous whitish medullary rays. Fragments of the thin purplish over-ground stem are occasionally present in the commercial article. The drug has a peculiar heavy aromatic odor, which is more marked when a larger quantity is examined. The taste of the bark is not unpleasantly bitter; that of the wood is but slight.

FIG. 136.



Gelsemium sempervirens, *Aiton*: transverse section of root.

Constituents.—An analysis made by M. H. Kollock (1855) proved the existence of an alkaloid, *gelsemine*, besides volatile oil, starch, and gummy pectinaceous and resinous principles. The existence of the alkaloid was corroborated by C. L. Eberle (1868) and Prof. Wormley (1870); the latter obtained it (1877) by acidulating a concentrated tincture with acetic acid, precipitating the resin by water, concentrating the aqueous filtrate, removing from the solution *gelsemic* or *gelseminic acid* by ether, liberating the alkaloid by carbonate of sodium, and extracting it by ether or chloroform. Dragendorff (1878) recommended a similar process, removing gelsemic acid from the acid liquid by chloroform, and, after rendering the liquid alkaline, extracting the alkaloid with benzin and chloroform. It is amorphous, white, intensely bitter, strongly alkaline, and slightly soluble in cold water, in which its salts dissolve quite readily. Sulphuric acid produces a red color, changing to purple when heated, nitric acid a greenish, and hydrochloric acid a yellowish, color. C. A. Robbins (1876) obtained for it the empirical formula $C_{11}H_{19}NO_2$, and observed that ceroso-ceric oxide imparts to the sulphuric acid solution a rose-cherry-red color. E. Schwarz (1882) has studied its reactions, and considers the most characteristic one to be with sulphuric trihydrate in excess, followed by potassium chromate (or in place thereof manganese dioxide, ceric oxide, or lead dioxide), when a cherry-red color is produced, changing to dingy gray-brown, and finally to green. Fröhde's reagent colors roe-brown or red-brown, finally yellowish-green. *Brouardet-Boutmy's reagent* (potassium ferricyanide, followed by weak solution of ferric chloride; this produces Prussian blue with most of the *ptomaïnes* or cadaver alkaloids) gives an intense green color; *Schneider's reagent* (sugar and strong sulphuric acid) colors cherry-red; and *Selmi's reagent* (iodic acid suspended in sulphuric acid), rose-red.

Robbins regarded the *gelsemic acid* to be identical with *æsculin*, $C_{15}H_{16}O_9$, a principle present in the bark of the horse-chestnut (Æsculus hippocastanum, *Linné*), in quassia, red saunders, etc. It crystallizes in colorless prisms, is soluble in 400 parts of cold water, and nearly insoluble in chloroform and ether, possesses a bitterish taste, and yields with alkalies in extremely dilute solutions a characteristic fluorescence, being yellow in transmitted and blue in reflected light, and destroyed by acids. Æsculin is a glucoside, being split by dilute acids into glucose and *æsculetin*, $C_9H_6O_4$, which is colored yellow by alkalies and dark-green by ferric chloride. Dragendorff and Schwarz noticed the strong fluorescence of gelsemic acid, but did not examine into its alleged identity with æsculin. But Prof. Wormley (1882) has shown the former to be quite distinct; it crystallizes very readily, dissolves in 2912 parts of water, in 330 parts of ether, and, with a yellowish color, in cold or warm sulphuric acid, and is insoluble in hydrochloric acid; its solution is precipitated by silver nitrate, brownish-yellow, darkening to blue-black; by corrosive sublimate, yellowish, crystallizing in needles; by bromine, green, turning bluish and brownish; by copper sulphate, dirty brown, turning dull red and crystallizing; and by lead acetate, yellow, crystallizing. Wormley obtained on an average 0.2 per cent. of the alkaloid and 0.4 per cent. of the acid. The ash of air-dry root amounts to 4 per cent. (Kollock).

Off. Prep.—Extractum gelsemii fluidum, Tinctura gelsemii, *U. S.*

Physiological Action.—*On Animals:* Gelsemine induces paralysis both of sensation and motion, sometimes of the one first, and sometimes of the other, lowers the force and rate of the pulse and respiration, reduces the temperature, dilates the pupils, projects the eyeballs, and does not suspend the heart's action until after respiration has ceased. Death is apt to be preceded by intermittent tetanoid convulsions, which cannot be immediately reproduced like those excited by strychnine. Dr. Wormley found that $\frac{1}{8}$ grain given subcutaneously to a strong cat caused death in $1\frac{1}{2}$ hours, with symptoms of great debility; that $\frac{1}{6}$ grain given to a frog caused prostration, followed by tetanic convulsions and death in 4 hours; and when $\frac{1}{2}$ grain was injected into the peritoneum of a frog the animal opened its mouth convulsively, the jaws fell at intervals, and there was great muscular prostration. In 20 minutes the body was completely relaxed, and reflex irritability of the muscles was abolished, including that of the heart, which was arrested in diastole (*Am. Jour. of Phar.*, July, 1882, p. 343). According to Dr. C. G. Davis, the alkaloid hastens and intensifies the tetanizing action of strychnine (*Jour. Amer. Med. Assoc.*, ii. 128), doubtless by lowering the tone of the nervous system, just as it causes tetany when given alone. The results of Moritz's experiments may be summarized thus: Gelsemine produces in warm-blooded animals excitation, followed by depression, and even paralysis of the brain and spinal marrow. It first quickens, and afterward slows, the respiration and renders it shallower. On the heart it acts only through the respiration. Applied to one eye, it dilates the pupil and disturbs visual accommodation. The peculiar tremor caused by it in cold-blooded animals is of spinal origin, as are also its influence on the mode of respiration, as just described, and the slowing of the heart in the last stage of the lethal action of the poison (*Archiv f. Pathol. u. Physiol.*, xi. 299; compare Rouch, *Bull. de thérap.*, civ. 527).

On Man: Applied topically to the eye, gelsemine dilates the pupil. A physician subject to supraorbital neuralgia found that the tincture, gradually increased in dose, produced in him a very agreeable sense of languor and tranquillity; then slight dizziness, impairment of vision, and drooping of the eyelids, a feeling of numbness, beginning in the scalp and gradually extending to the upper and then to the lower extremities, followed by impaired motility, embarrassment of the respiration, and feebleness of the heart's action. A still larger dose aggravated all these effects, and produced marked vertigo, almost total blindness, and decided ptosis (Williams). The characteristic symptoms of excessive and poisonous doses of gelsemium are these: Great prostration and muscular relaxation and incoördination, affecting the entire system, and conspicuously paralysis of the upper eyelids and of the lower jaw (after recovery muscular debility continues for several days); the tongue is also affected; in more than one case there were signs of spasm of the pharynx and larynx, causing extreme distress and suggesting the phenomena of hydrophobia; paralysis of the voluntary muscles is usual; the pupils are dilated; vision is double or greatly impaired; the face is congested; the mind is usually clear, but in some fatal cases coma or unconsciousness exists; the skin is warm and dry until the approach of death, when it grows cool and moist; the general sensibility is blunted, according to some observers; the respiration is slow, irregular, shallow, and gasping, and the pulse is generally stated to be low, small, feeble, irregular, and intermittent, but other observers declare that it is little or not at all affected, or that it, as well as the respiration, is more frequent than natural. Death takes place through the gradual arrest of the respiration, and usually without convulsions. Dr. Wormley collected twenty-five cases of gelsemium-poisoning, of which thirteen proved fatal. In five fatal cases occurring in adults and collected by ourselves the doses of the fluid extract were respectively, f℥j, f℥ss, fʒiij, fʒiij, and fʒij; in four similar cases observed in children the fatal doses were respectively fʒij, fʒj, fʒj, and 21 drops. In two more recent cases a child of three years was killed by about 12 minims of the fluid extract, and an adult man who took four doses of 15 minims each of the fluid extract, repeated at short intervals, died in less than 4 hours after the last dose was taken (Wormley). After death the heart is distended with liquid and dark-colored blood, the stomach is congested, and the brain rather pale. Very small doses of this drug may cause alarming symptoms. A lady suffering from trifacial neuralgia was prescribed a dose of 3 drops of fluid extract of gelsemium three times a day. From the first each dose caused paralysis of the bladder with incontinence of urine, lasting for an hour or two. About the twelfth day she began to experience its sedative effects, and on the following morning she was unable to move; the pulse was small and feeble, the respiration sighing and jerky the pupils dilated, and the eyes suffused. Muscular paresis was most marked upon the right side of the body. The patient recovered, but the neuralgia was in no way modified.

Medical Uses.—Gelsemium appears to be one of the too-numerous remedies which have been used in a great variety of sthenic febrile diseases upon no better ground than their power of lowering the pulse and depressing the nervous system. Incalculable mischief has been caused by them, and still more is likely to be occasioned by gelsemium in febrile affections. Some of those persons who have most loudly eulogized it as an anti-pyretic have been at great pains to explain, in opposition to the popular doctrine, that heat is death and cold is life; that we have only to reduce the fever temperature to the normal standard or below it to cure febrile disease; and that, therefore, gelsemium will cure fever. Unfortunately for this mode of medical reasoning, gelsemium does not reduce the temperature, except in so far as it threatens to destroy life through its poisonous operation. But such is probably not the reduction that its advocates had in view. Among a host of incongruous diseases which are said to have been "cured" by this agent, the one in regard to which very positive testimony exists is acute or rheumatic *neuralgia*, especially of the first and second branches of the fifth nerve. The most usual testimony is, that the medicine is nearly inoperative when the pain affects the third branch of the fifth pair or the intercostal nerves. Yet there are cases in which, when the trigeminus alone is involved, it relieves the inferior dental even more than the other branches. Undoubtedly, acute attacks produced by cold are more promptly cured than others, as, indeed, they are by all remedies that cure neuralgia at all. Dr. Bulkley recommends the tincture of gelsemium for the relief of *itching* in chronic eczema, giving it in 10-drop doses every half hour or hour until the pruritus is relieved (*New York Med. Jour.*, Jan. 1881). Dr. Edson claims that the following lotion is of great service in *poisoning* by Rhus radicans: ℞. Acid. carbolic. ʒss; Ext. gelsemii fʒij; Glycerinæ ℥ss; Aquæ ad. ℥iv.—S. To be kept applied on cloths, while internally 2 minims of fluid extract of gelsemium are given every 3 hours (*Med. Record*, xxii. 121). From 3 to 10 minims (Gm. 0.20–60) of the fluid extract, or three times that quantity of the tincture, may be given every 2 hours. Like digitalis, aconite, veratrum, and antimony, it may, by reducing the pulse, prove useful in some attacks of *congestion of the brain*, *mania*, *and meningitis*. It has been claimed that gelsemium produces tolerance of quiniæ in certain cases intolerant of the anti-periodic alone; that it is efficient in convulsions produced by teething or by indigestion; that it exhibits peculiar virtues in rattlesnake-bites; that it expedites labor due to uterine rigidity, and relieves various forms of uterine congestion, etc. (Davis, *loc. cit.*). The evidence in favor of these claims does not appear to be sufficient. The proper *antidote* for poisoning by gelsemium is morphia hypodermically administered. General stimulation by mechanical means, rubefacients, and heat, and the administration of ammonia, coffee, and alcohol, the last hypodermically, should be employed, after the stomach has been evacuated by mustard and water, sulphate of zinc, tickling the fauces, etc.

GENISTA.—DYERS' BROOM.

Dyers' green-weed, *Woad-waxen*, E.; *Genêt des teinturiers*, Fr.; *Färberginster*, G.

The young branches of Genista tinctoria, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—Dyers' broom is a low shrub, 18 to 24 inches (45–60 Cm.) high, indigenous to Asia and Europe, and has been naturalized in the eastern part of the United States. The young erect branches are striately angled and have alternate sessile lanceolate entire bright-green leaves with a ciliate margin and 1 to 1½ inches (25–37 Mm.) in length. The bright-yellow flowers are in elongated racemes, and produce linear flat legumes, each containing from five to eight globular-obovate yellowish seeds. The recent plant, when bruised, has a rather refreshing odor and a mucilaginous afterward bitter and acrid taste.

Constituents.—Analyzed by Cadet de Gassicourt, the usual constituents of plants were found, but the principle giving the bitter and acrid taste was not isolated. The volatile oil is of a yellowish-green color, and the yellow coloring matter is stated to resemble that of the *weld* (Reseda luteola).

Medical Action and Uses.—The flowers and the seeds are both emeto-cathartic. In Russia dyers' broom was formerly vaunted as a remedy, or rather as a prophylactic, for *hydrophobia*. It is hardly necessary to add that the belief in it was groundless. Much better founded was its reputation in *dropsy*. In the early part of the present century the French government published a formula for the cure of dropsy, which consisted of the powdered seeds of this plant. It was given in the *dose* of a drachm in 6 ounces (Gm. 4 in Gm. 200) of white wine, followed in an hour by 2 ounces (Gm. 64) of olive oil to mitigate its operation. Its action and uses are very similar to those of scoparius.

GENTIANA, *U. S.*—GENTIAN.

Gentianæ radix, Br.; *Radix gentianæ*, P. G.; *Radix gentianæ rubræ (vel luteæ vel majoris)*.—*Gentian-root*, E.; *Racine de gentiane (de gentiane jaune)*, Fr.; *Enzianwurzel*, *Bitterwurzel*, *Rother (Gelber) Enzian*, G.

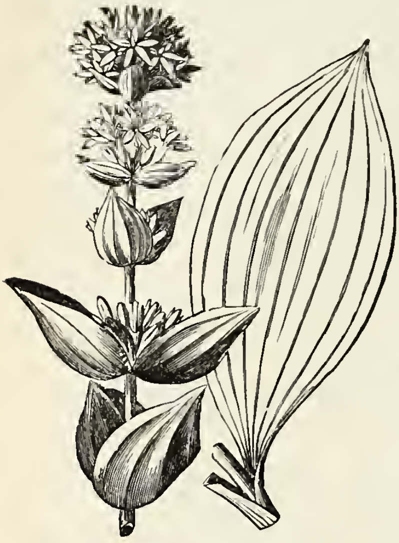
The root of Gentiana lutea, *Linné*. Steph. and Church, *Med. Bot.*, plate 132; Bentley and Trimen, *Med. Plants*, 182.

Nat. Ord.—Gentianaceæ.

Origin.—Gentian is indigenous to the mountainous regions of Southern and Central Europe as far north as Central Germany. It has a thick hollow stem 2 to 4 feet (0.6–1.2 M.) high, opposite, entire, five- to seven-nerved leaves, and axillary clusters of pedicellate flowers with a bright-yellow, five-lobed, spotted corolla, and producing a one-celled, ovate capsule containing numerous oval, compressed, and winged seeds.

Description.—The fleshy and branching one-headed to several-headed root attains a length of 2 to 3 feet (60–90 Cm.) and a diameter of about an inch (25 Mm.) or less, but appears in commerce always in shorter pieces, the thicker ones being longitudinally sliced before drying. Beneath the abrupt or concave somewhat conical heads they are closely annulated, the lower portion being deeply wrinkled longitudinally, with an overlapping bark in the longitudinally split pieces. The root is of a yellowish-brown color, the surface darker and grayish, the fracture short, of a slight waxy lustre, and with numerous minute brown dots. The transverse section shows a faint radiating arrangement only near the dark cambium-line, and a fleshy meditullium which is about six times thicker than the bark. Liber-fibres and wood-fibres are wanting, and are replaced by axially somewhat elongated parenchyma; the spiral and scalariform ducts are accompanied by sieve-tubes. The root is very hygroscopic, contains 14 to 18 per cent. of water, and is tough and flexible in moist weather. It has a faint but heavy characteristic odor, which is more prominent in a hot infusion; its taste is sweetish, then intensely bitter, but free from astringency or acridity. The importation of gentian into the United States during the seven years 1875–82 averaged 113.854 pounds annually.

Fig. 137.



Gentiana lutea.

The roots of other European species of Gentiana are occasionally collected with or in place of the one recognized by the Pharmacopœia; they closely resemble the latter, and have the same medicinal properties:

GENT. PURPUREA, *Linné*, with yellowish-purple flowers, is indigenous to the Pyrenees, Alps, Apennines, Norway, and Northern Asia, and has a many-headed (eight to ten) shorter and thinner root, which is darker brown internally. G. PANNONICA, *Scopoli*, with reddish- or blackish-purple flowers, indigenous to the mountains of Austria, has a scarcely-annulated, shorter, thinner, and darker root than the officinal. G. PUNCTATA, *Linné*, with straw-yellow, purplish punctate flowers, is found in the Alps and eastward to the Balkan Mountains; it is likewise many-headed and of a grayish yellow-brown color.

Constituents.—Kromayer (1862) was the first who isolated the pure bitter principle, which in many previous analyses had been obtained in an impure extract-like form. The crystalline *gentianin* of Henry and Caventou (1821) was in 1837 proven, by Trommsdorff and by Leconte, to be a yellow crystalline principle, subsequently named *gentisin*, *gentisic*, and *gentianic acid*, contaminated with some of the bitter matter. On washing the alcoholic extract of gentian with cold water to remove the bitter principle, afterward with some cold ether to remove fat, and crystallizing the residue from alcohol, *gentisic acid*, $C_{14}H_{10}O_5$, is obtained in bright-yellow, tasteless crystals requiring 5000 parts of water, 2000 parts of ether, and nearly 500 parts of cold alcohol for solution; it is soluble in alkalies and by ferric chloride colored brown (Leconte). Patch (1881) determined it to be soluble in 280 parts of cold and 120 parts of hot alcohol, and in 400 parts of ether, to become dark-green with nitric acid, and to dissolve unchanged in sulphuric acid; it melts above 100° C., and on cooling congeals crystalline. Hlasiwetz and Habermann (1875) obtained from it, by fusion with caustic potassa, *phloroglucin*, *acetic* and *oxysalicylic* (*gentisinic*) *acid*, the latter being $C_7H_6O_4$ and isomeric with protocatechuic acid. The infusion of gentian yields with gelatin a slight precipitate, which, after having been washed with water, is not colored dark by ferric chloride. J. Ville (1877) regarded gentisin as a kind of tannin, and proposed to call it *gentio-tannic acid*. But after the separation of pectin compounds the infusion yields no precipitate with gelatin, and fresh hide fails to remove any principle reacting with ferric salts. Prof. Patch (1881), however, has shown that the resinous matter is associated with a principle giving some reactions of tannin—namely, a greenish-black color with ferric chloride, and precipitates with cinchonidine sulphate, tartar emetic, and gelatin, after, respectively, 2, 6, and 24 hours; this principle has not been isolated.

Gentiopicrin, $C_{20}H_{30}O_{12}$, the bitter principle of gentian, is contained in the aqueous solution of the alcoholic extract, from which it is absorbed by animal charcoal; this is boiled with alcohol, the solution concentrated, treated with lead oxide to remove color, freed from lead by sulphuretted hydrogen, agitated with ether, and crystallized. It is very soluble in water and ordinary alcohol, insoluble in ether, dissolves with alteration in alkalies, and by dilute acids is split into glucose and *gentiogenin*, $C_{14}H_{16}O_5$, which is yellowish-brown, bitter, insoluble in water, and has the same composition as *physalin* (from Physalis Alkekengi). Kromayer states that crystallizable gentiopicrin is obtainable only from fresh, not from dried, gentian-root.

Gentian contains no starch, but a considerable amount of pectin and 12 to 15 per cent. of an uncrystallizable sugar, to which the hygroscopic nature of the root is due. A. Meyer (1882) obtained a slightly-sweet, fermentable crystalline sugar, *gentianose*, $C_{16}H_{66}O_{31}$, which does not reduce Fehling's solution. By fermentation a potable spirit is obtained from it in Switzerland and Southern Germany. The air-dry root yields 8.28 per cent. of ash, consisting mainly of calcium carbonate (Flückiger).

Off. Prep.—Extractum gentianæ, *U. S.*, *Br.;* Ext. gentianæ fluid., *U. S.;* Infusum gentianæ comp., Mistura gentianæ, *Br.;* Tinct. gentianæ comp., *U. S.*, *Br.*

American Gentians.—Several of the blue-flowering gentians of North America are botanically very similar, and some confusion has existed concerning their identity, which is best shown by placing the species and their synonyms together, as at present recognized by Gray. We thus have—

(1) G. puberula, *Michaux;* G. Saponaria, var. puberula (Gray's *Man.*, edit. 1); G. Catesbæi, *Elliott;* and G. Elliottii, *Chapman.*

(2) G. Saponaria, *Linné;* G. Catesbæi, *Walter.*

(3) G. Andrewsii, *Grisebach;* G. Saponaria, *Frœlich;* G. fimbriata, *Vahl.*

The first species is indigenous to the States south of North Carolina, and to most States from the Alleghanies to the Mississippi; the second is met with from the mountains of North Carolina to Southern Pennsylvania, and westward to Illinois; the third species is common in the Middle States and northward. We believe that the *blue gentian-root*, as found in commerce, is collected indiscriminately from the above three species. It is the Gentiana Catesbæi, *U. S.* 1870.

The subterraneous part of these plants consists of an indistinctly annulated head about ½ inch (13 Mm.) long and ⅛ inch (3 Mm.) thick, which, at its base, is usually divided into a number of fleshy nearly simple rootlets about 3 inches (37 Mm.) or more in length. When dry they are of a pale-brownish color, with a distinct yellow or orange hue, and short, deep longitudinal wrinkles, devoid of fibres, quite brittle, and breaking with a short or somewhat spongy fracture, which is pale-yellow. The bark is thick and the ligneous cord quite thin. The odor and taste are gentian-like. We have found it occasionally mixed with a root of unknown origin of similar dimensions and appearance, but having a gray hue, a tough fibrous bark, and a sweetish scarcely bitter taste.

From experiments made with the root we conclude that its constituents are probably identical with those of G. lutea.

Medical Action and Uses.—Gentian is a pure and simple bitter. In moderate doses it excites the appetite and strengthens the digestion and does not constipate. If used too long or too freely, it is apt to occasion headache and a full pulse and to render the sweat and urine bitter. It is a valuable remedy for *atonic dyspepsia*, such as accompanies general debility from any cause or that which is apt to occur in persons of a gouty habit. It was formerly used in the cure of mild intermittent fevers. The nominal *dose* of gentian in powder is from 10 to 30 grains (Gm. 0.60–2.00), but it is always prescribed in the form of extract, fluid extract, or compound tincture, all of which are officinal.

American gentian is employed to some extent in popular practice in the southern portion of the United States for the same diseases and in the same manner as European gentian.

GERANIUM, *U. S.*—GERANIUM.

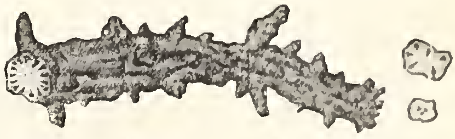
Cranesbill-root, E.; *Racine de geranium maculé*, *Bec-de-grue tacheté*, *Pied-de-corneille*, Fr.; *Fleckstorchschnabel-Wurzel*, G.

The rhizome of Geranium maculatum, *Linné.* Bigelow, *Med. Bot.*, i. t. 8; Bentley and Trimen, *Med. Plants*, 42.

Nat. Ord.—Geraniaceæ.

Origin.—This perennial herb is very common in rich woods in most parts of Canada and the United States, and it flowers from April to July. The stem is from 1 to 2 feet (30–60 Cm.) high; the hairy leaves, when old, become blotched with white, and are palmately five- or seven-lobed, with wedge-shaped divisions, which are coarsely toothed above; the light-purple flowers are in loose terminal umbels; the fruit is long-beaked, with five one-seeded carpels, which separate when ripe, curving upward together with the style, which separates from the beak. The horizontal rhizome should be collected late in summer or in autumn.

FIG. 138.



Geranium maculatum: rhizome and transverse section of rhizome and rootlets, natural size.

Description.—It is 2 to 3 inches (5–7 Cm.) long, ¼ to ½ inch (6–12 Mm.) in diameter when fresh, little branched, but tuberculated with the remnants of the stems, longitudinally wrinkled, with indistinct nodes, dark-brown externally, pale red-brown internally. It breaks with a nearly smooth fracture, showing a thin bark and the small, yellowish, broadly wedge-shaped wood-bundles arranged in a circle near the cambium, separated by broad medullary rays, and enclosing a large central pith. It has no odor; its taste is purely astringent. The rootlets are mostly on the lower side, and are much shrunken, fragile, and branched into hair-like fibres.

Constituents.—The analyses of Staples (1829) and Bigelow (1833) indicate, besides tannin, the presence of starch, pectin, sugar, mucilage, etc. Bowman (1869) found 13 to 17 per cent. of tannin, which has not been further investigated.

Off. Prep.—Extractum geranii fluidum, *U. S.*

Allied Plants.—Geranium Robertianum, *Linné.*—Herb Robert, *E.*; Herbe à Robert, *Fr.*; Ruprechtskraut, *G.*—It grows in shady thickets and woods in Europe, in the United States, and in Canada, has an erect branching stem, deeply three- or five-divided leaves, with the divisions twice pinnatifid and the lobes ovate and mucronately toothed, and rose- or purplish-colored flowers. It has a strong rather unpleasant odor and a bitterish, saline, and astringent taste. It contains tannin and a bitter principle.

Erodium (Geranium, *Linné*) cicutarium, *L'Héritier*—Storksbill—indigenous to the Levant and Southern Europe, is sparingly naturalized in the United States. It has a low spreading stem, pinnate leaves with the leaflets sessile and pinnatifid, and pale-reddish flowers. The odor of the bruised plant resembles that of carrot.

Erodium moschatum, *Aiton*, is found near the Mediterranean and in Southern Africa, and resembles the preceding, but has a rather strong musk-like odor.

Medical Action and Uses.—Geranium is a pure astringent, and may be profitably used in the treatment of subacute and chronic *diarrhœa*. A decoction of it in milk is employed in *cholera infantum*. A decoction, made with an ounce of the root in 1½ pints of water boiled to a pint, is sometimes used in *aphthæ* of the mouth and fauces, in relaxed conditions of the *throat*, *vagina*, and *rectum*, to restrain internal *hæmorrhages*, and to cure *leucorrhœa*, *gleet*, etc. The *dose* may be stated at from 20 to 40 grains (Gm. 1.30–2.60) of the powdered rhizome or from 1 to 2 fluidounces (Gm. 32–64) of the decoction.

Geranium Robertianum, like the officinal plant, has been much valued in Europe for its astringent and cleansing virtues, and employed in the treatment of *sore throat*, superficial inflammations and eruptions of the *skin*, in engorgement of *glands*, *ophthalmia*, etc. Internally, it was given as a diuretic for the relief of *gravel*, also for *hæmorrhages*, etc.

Erodium moschatum was used as a diaphoretic.

Erodium cicutarium attracted some attention in 1859 as a diuretic in *dropsy*, and in 1863 similar reports of its efficacy were published. A decoction was made with 2 ounces of the whole plant in 3 pints of water reduced to 2 pints, and it was prescribed in doses of 4 or 5 fluidounces three times a day.

GEUM.—Water-Avens.

Radix caryophyllatæ aquaticæ, *Radix benedictæ sylvestris.*—*Racine de bénoite aquatique* (*de bénoite des ruisseaux*), Fr.; *Sumpfnelkenwurzel*, *Wasser-Benedikten-Wurzel*, G.

The rhizome, with the rootlets, of Geum rivale, *Linné.*

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—This perennial plant grows in wet meadows and moist woods in hilly localities of North America from Pennsylvania northward, and is likewise indigenous to Central and Northern Europe and Northern Asia. It has a stem 1 to 2 feet (30–60 Cm.) high, with lyrate or interruptedly pinnate root-leaves and trifoliate or three-lobed stem-leaves, the leaflets or lobes being obovate or cuneate-oblong; the bell-shaped calyx is purplish-brown; the five petals are clawed, purplish-yellow, and veined.

Description.—The rhizome is nearly horizontal, 2 to 3 inches (5–7 Cm.) long, about ¼ inch (6 Mm.) thick, somewhat branched, tuberculate above from the bases of the stems, and there densely beset with red-brown hairy leaf-sheaths. It is externally blackish-brown, breaks with a rather short and waxy fracture, and has a thin purplish-brown bark, brown-gray pith, and small distant light-colored wood-wedges. It has a very faint somewhat clove-like odor and a bitterish-astringent taste.

Water-avens has not been analyzed; its constituents are probably similar to those of the yellow-flowered Geum urbanum, *Linné*, or *avens*, which grows in Europe in woods and shady places, and has an oblique or perpendicular rhizome 1 or 2 inches (25–50 Mm.) in length, abrupt below or passing into the main or tap-root; it is hard, dark-brown, tuberculate, and beset with dark-brown membranous scales; the numerous thin fibres are pale-brown and 3 to 4 inches (7–10 Cm.) long; the wood is in five or six broad and rounded wedges and encloses a large purplish pith. It has a distinct clove-like odor and a bitter astringent taste. It is known in Europe as *radix caryophyllatæ*. Geum japonicum, *Thunberg*, resembles it in appearance and properties, but has a brown horny centre.

Constituents.—Avens, according to Buchner (1844), contains a small quantity of a volatile oil possessing acid properties, about 3 per cent. of tannin, and a bitter principle which appears likewise to possess acid properties. The remaining constituents, sugar, fat, resin, etc., are not of medicinal importance.

Medical Action and Uses.—Water-avens is in its action very like avens, G. urbanum. Both are very astringent and more or less tonic. Like other agents with these qualities, it is apt to derange the digestion and cause vomiting if too freely given. It has been employed in all forms of disease of the mucous membranes depending upon relaxation and attended with excessive and altered secretions, including atonic *dyspepsia*, *diarrhœa*, *bronchorrhœa*, *leucorrhœa*, etc. It has also been used in chronic *rheumatism*, *scrofula*, slight *intermittent fever*, and in *menstrual derangements* depending on debility. The *dose* is represented by about 30 grains (Gm. 2) of the powdered root, but it is best administered in a decoction made by boiling an ounce (Gm. 32) of the root in a pint of water, which may be given in *doses* of 1 or 2 fluidounces.

GILLENIA.—Gillenia.

Indian physic, *Indian hippo*, *American ipecac*, *Bowman's root*, E.; *Racine de gillénie*, Fr.; *Gillenienwurzel*, G.

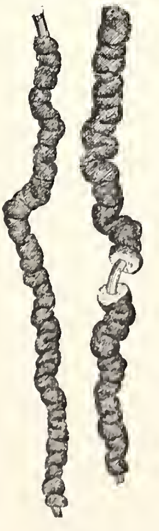
The rhizome, with the rootlets, of Gillenia (Spiræa, *Linné*) trifoliata, *Moench*, and of Gillenia stipulacea, *Nuttall* (Spir. stipulata, *Willdenow*).

Nat. Ord.—Rosaceæ, Spiræeæ.

Origin.—Both species are perennial herbs indigenous to the United States, the first being found almost exclusively east of the Alleghanies from New York south to Georgia; the other is found from New York westward and southward to Alabama. The plants are 2 to 3 feet (60 to 90 Cm.) high, branched, with nearly sessile, trifoliate, doubly serrate, or incised leaves, and loose corymbs of pale rose-colored or white flowers, the calyx of which is tubular and constricted at the throat, the five unequal petals being long linear-lanceolate. The two plants are readily distinguished by their stipules, which in G. trifoliata are awl-shaped and entire, and in G. stipulacea are large, leaf-like, ovate, and incised. The rhizome and rootlets are employed.

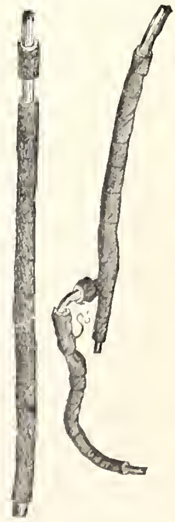
Description.—The rhizome of G. stipulacea, which is usually found in commerce, is nearly horizontal, about 1 inch (25 Mm.) thick, very knotty from the numerous branches and remnants of stems. The larger rootlets are $\frac{3}{8}$ inch (9 Mm.) thick near the base, tortuous, irregularly branched; the smaller rootlets are undulated, and have a knotty or annulated appearance from the semicircular constrictions and the transverse fissures of the bark on one side and the depressions on the opposite side. The rhizome and rootlets of G. trifoliata are smaller and less knotty, the rootlets often smooth or indistinctly annulated, and with few or no transverse fissures. Both have a reddish- or grayish-brown color externally, and are hard and very woody, breaking with some difficulty except through the brittle bark. The bark of the rhizome is thin, the wood, about eight times thicker, of a whitish color, with several annual rings enclosing a thin pith and traversed by fine medullary rays. The bark of the root is of uneven thickness, in its outer layer brownish-red, the inner layer reddish-white, with numerous minute red resinous dots. The odor is very slight; the taste of the bark is bitter, not unpleasant, exciting the flow of saliva; the wood is tasteless.

Fig. 139.



G. stipulacea.

Fig. 140.



G. trifoliata.

Rootlets, natural size.

Constituents.—The various analyses made of Gillenia have established the presence of starch, tannin, gum, albumen, fat, resin, etc. The bitter principle, *gillenin*, not quite pure yet, has been obtained by W. B. Stanhope (1856) in the form of a whitish powder having a slight odor and a very bitter taste, neutral to test-paper, soluble in water, alcohol, ether, and dilute acids, and colored blood-red by nitric acid. Its watery solution is stated to be precipitated by subacetate of lead, tartar emetic, and potassa, but not by tannin ; ½ grain caused much nausea. It was prepared by washing the alcoholic extract with water, treating the residue with very dilute sulphuric acid, adding magnesia, evaporating, and exhausting the dry mass with alcohol.

Medical Action and Uses.—The popular title of "American ipecacuanha" sufficiently indicates the prominent virtue of this medicine. It is a mild emetic. The *dose* is 20 to 30 grains (Gm. 1.30–2.00). The allied species, G. stipulacea, has identical qualities. Gillenin, when pure, will produce nausea and vomiting in *doses* of from ½ to 1 grain (Gm. 0.03–0.06). Injected into the femoral vein of a dog, it excited vomiting.

GLECHOMA.—GROUND-IVY.

Herba hederæ terrestris.—*Lierre terrestre*, Fr. ; *Gundermann, Gundelrebe*, G.

Glechoma hederacea, *Linné*, s. Nepeta Glechoma, *Bentham.*

Nat. Ord.—Labiatæ, Nepeteæ.

Description.—Ground-ivy is a creeping and trailing perennial which is common in Europe and naturalized in various parts of North America. The ascending branches are from 6 to 10 inches (15–25 Cm.) long, quadrangular, and have opposite petiolate leaves, which are 1 or 1½ inches (25–38 Mm.) long, round-reniform, deeply crenate, green, and underneath often purplish. The blue or purplish flowers are in small axillary clusters, from two to five in number. The plant has a slight balsamic odor and a bitter somewhat acrid taste.

Constituents.—Like other plants of the same natural order, ground-ivy contains volatile oil, resin, fat, gum, sugar, and tannin ; the bitter and acrid principle has not been investigated.

Medical Action and Uses.—Ground-ivy is said to act poisonously upon horses and sheep. It has been chiefly used in medicine in the treatment of *chronic bronchitis*, and its virtues in this affection are attested by medical evidence as well as by popular faith. It was at one time reputed to be a cure for consumption, by which was meant not the incurable disease which depends upon tuberculosis, but chronic bronchitis with mucopurulent sputa. It had also some reputation in catarrhal affections of the *urinary* organs and in atonic *dyspepsia*. Externally, the bruised herb has been applied in poultices or alone to indolent *ulcers*. An infusion may be made with an ounce (Gm. 32) of the herb to a pint of boiling water and given in wine-glassful doses.

GLYCERINUM, *U. S., Br., P. G.*—GLYCERIN.

Glycerina, U. S. 1870.—*Glycerine*, E. ; *Glycérine*, Fr. ; *Glycerin, Oelsüss*, G.

Formula $C_3H_5(HO)_3$. Molecular weight 92.

A liquid sweet principle obtained from fat and fixed oils, and containing not less than 95 per cent. of absolute glycerin.

Origin.—Glycerin, which is not found in the free state except in some rancid fats, exists in combination with the so-called fatty acids, forming compound ethers, which constitute most of the animal and vegetable solid and liquid fats. It is formed in small quantities during the fermentation of saccharine liquids. Scheele, who discovered it in 1779, called it *sweet principle of oils*. In the United States it was first manufactured in Philadelphia by Robert Shoemaker in 1846 ; at present it is extensively obtained by distillation in several cities, and in addition over 6,000,000 pounds are now annually imported, against about 2,000,000 pounds in 1878.

Preparation.—To obtain glycerin, fat must be decomposed into its proximate constituents, either by a caustic alkali, as in the manufacture of soap, or by oxide of lead, as in the preparation of lead plaster, or by the action of water at an elevated temperature under high pressure. The latter process, which was patented in 1854 by R. A. Tilghman, yields the acids of the fat and an aqueous solution of glycerin. Water which has been agitated with recently-prepared lead plaster is likewise such a solution, and the liquor from which soap has been separated contains glycerin, saline matters, and various organic impurities, which may be removed by treatment with the necessary precipitants and with charcoal, the solutions being finally evaporated and distilled with steam under pressure. By fractional condensation most of the glycerin is obtained in a nearly anhydrous state.

In subjecting soap-liquors to dialysis the glycerin passes quite freely with the salts through parchment-paper, but not through "gutta-percha paper," which has been recently (1882) recommended for the purification of such impure glycerin. The purification of glycerin by distillation was patented by Wilson and Payne in 1854.

Properties.—Glycerin is a syrupy liquid having the specific gravity 1.28 at 15° C. (59° F.) (Pelouze); W. Lenz (1880), in determining the carbon in the various dilutions of glycerin, arrived at the following results:

100 per ct.,	1.2691 sp. gr.	75 per ct.,	1.2016 sp. gr.	50 per ct.,	1.1320 sp. gr.	25 per. ct.,	1.0635 sp. gr.
95 "	1.2581 "	70 "	1.1889 "	45 "	1.1183 "	20 "	1.0498 "
90 "	1.2425 "	65 "	1.1733 "	40 "	1.1045 "	15 "	1.0374 "
85 "	1.2292 "	60 "	1.1582 "	35 "	1.0907 "	10 "	1.0245 "
80 "	1.2152 "	55 "	1.1455 "	30 "	1.0798 "	5 "	1.0123 "

The pharmacopœias require glycerin to have the density 1.250, *U. S.*, *Br.*, 1.225–1.235, *P. G.*, which, according to the above table, corresponds to 92½ and to 83½–87¼ per cent. of absolute glycerin. It is transparent, colorless, inodorous, very sweet and somewhat warm to the taste, owing to its affinity for water, oily to the touch, without action upon litmus, and soluble in all proportions in water and alcohol; also in spirit of ether, but not in ether, chloroform, benzol, fixed oils, or volatile oils. Its great affinity for water has been long known; W. Willmott (1879) ascertained that this continues in a moist atmosphere until about twice its bulk of water has been absorbed. Heintz, Berthelot (1854), and others observed that at about 100° C. (212° F.) glycerin volatilizes in appreciable quantity, more readily, it seems, with the vapors of water; in a current of superheated steam it distils readily between 170° and 200° C. (338° and 392° F.). In contact with the air it distils only partially unchanged, the greater portion being destroyed, with the production of very acrid *acrolein* among the empyreumatic liquids. Its boiling-point is 290° C. (554° F.). When anhydrous, it takes fire at 150° C. (302° F.) and burns quietly with a blue non-luminous flame, without giving off any disagreeable odor and without leaving any residue. It dissolves all deliquescent salts, is a solvent for many organic and inorganic compounds which are soluble in water or alcohol, and prevents the precipitation of some salts by alkalies and other reagents. By cooling glycerin to —40° C. (—40° F.) Berthelot could obtain it only as a nearly solid gummy mass. In 1867, Crookes saw it crystallized, after it had been exposed to cold weather while being transported, and Sarg obtained it in crystals by long-continued exposure to cold. The crystallization takes place slowly, but is greatly promoted even between 0° and 5° C. (32 and 41° F.) by the addition of a solid crystal to the cold glycerin. This behavior has been utilized for the purification of glycerin. The crystals are very deliquescent and melt at 22° C. (71.6° F.).

Chemically, glycerin is a triatomic alcohol; hence chemists often designate it *glycerol*, in analogy with other alcohols. It forms with acids three series of ethers, in which 1, 2, or 3 atoms of hydrogen are replaced by the corresponding number of univalent acidulous radicals. The so-called neutral fats are saturated ethers, like *tripalmitin*, $C_3H_5(C_{16}H_{31}O_2)_3$. A similar compound is *nitroglycerin* or *glonoin*, $C_3H_5(NO_2)_3O_3$, which is obtained on adding glycerin by drops to a mixture of concentrated nitric and sulphuric acids immersed in a freezing mixture, and afterward pouring into water. Nitroglycerin is a heavy colorless or yellowish oily liquid which is insoluble in water, readily soluble in alcohol and ether, very poisonous, and violently explosive. It forms the basis of *dynamite* and similar explosive mixtures.

When heated with an excess of phosphoric anhydride, $2H_2O$ are abstracted, and the glycerin is converted into *acrolein* or *allylaldehyd*, C_3H_4O, which is a light, very refractive, and volatile oily liquid, the vapors of which are extremely irritating to the eyes.

Glycerin dissolved in water and kept, with yeast, at a temperature of about 25° C. (77° F.), is converted into *propionic acid*, and with chalk and old cheese at 40° C. (104° F.) it yields *alcohol* and *butyric acid*. When slightly diluted with water and heated to just above 100° C. (212° F.) in the presence of oxalic acid, the latter will be decomposed into *carbonic* and *formic acids*. $C_2H_2O_4$ yields $CO_2 + CH_2O_2$; the formic acid may be afterward obtained by *repeatedly* diluting with water and distilling. Glycerin unites with the alkalies and alkaline earths to compounds soluble in water, the former also in alcohol; the latter are not precipitated by carbonic acid. It unites also with sulphuric and other acids. "If a fused bead of borax on a loop of platinum wire be moistened with glycerin previously made slightly alkaline with diluted solution of soda, and after a few minutes held in a colorless flame, the latter is tinted deep-green."—*U. S.* This behavior was observed by Iles (1877), and recommended as a test for borates or for glycerin; but Klein (1878) showed that the reaction with borax takes place not only with glycerin, but with other polyhydric alcohols; and the conditions for these reactions have been elaborately investigated by Dunstan (1883), proving that sodium pyroborate is decomposed, with the formation of sodium metaborate and a boric ether, or, if water be present, free boric acid, the alcohol being regenerated.

Tests.—Glycerin is now rarely adulterated, but much being prepared for uses in the arts, where purity is not necessary, impure glycerin may at all times be met with in the market. Water, mucilage, dextrin, glucose, and perhaps cane-sugar syrup, would be used as adulterants. The first is detected by the specific gravity of the sample, the others by the brown color produced on mixing the sample with twice its bulk of concentrated sulphuric acid. Since cane-sugar syrup which has been exposed to the light for some time contains appreciable quantities of glucose, glycerin adulterated with either kind of sugar will become brown on being heated with solution of potassa or soda, and will yield a red precipitate when heated to boiling with a drop of solution of copper sulphate and an excess of potassa. The impurities may consist of saline matters should the glycerin have not been distilled, or of odorous compounds if insufficiently purified by distillation. The odor becomes apparent on warming the glycerin or rubbing it well upon the hand. Most of these compounds reduce nitrate of silver, and produce a more or less deep color when glycerin is diluted with a little distilled water and after the addition of a few drops of nitrate of silver heated to boiling. The same reagent will detect chlorides by the white precipitate produced. Diluted glycerin should not be colored or rendered turbid on being tested with sulphuretted hydrogen or sulphydrate of ammonium (metallic salts), ammonium oxalate (calcium), or barium chloride (sulphuric or oxalic acid). The presence of butyric acid is readily determined by warming a mixture of glycerin with one-fourth its measure each of alcohol and sulphuric acid, when butyric ether, recognized by its odor of pineapple, will be given off. The most important tests for practical purposes are those with sulphuric acid and nitrate of silver. Goddefroy (1874) recommended the heating of glycerin in an open crucible to boiling, and then igniting it, when it should burn without diffusing the least smell or leaving the least residue. From these reactions the following tests have been formulated: "Glycerin should be neutral to litmus-paper. Upon warming a portion of 5 or 6 Gm. with half its weight of diluted sulphuric acid no butyric or other acidulous odor should be developed. A portion of 2 or 3 Gm., gently warmed with an equal volume of sulphuric acid in a test-tube, should not become dark colored (absence of cane-sugar). A portion of about 2 Gm., heated in a small open porcelain or platinum capsule upon a sand-bath until it boils, and then ignited, should burn and vaporize, so as to leave not more than a dark stain (absence of sugars and dextrin, which leave a porous coal). A portion heated to about 85° C. (185° F.) with test solution of potassio-cupric tartrate should not give a decided yellowish-brown precipitate, and the same result should be obtained if, before applying this test, another portion be boiled with a little diluted hydrochloric acid for half an hour (absence of sugars). After full combustion no residue should be left (metallic salts). Diluted with ten times its volume of distilled water, portions should give no precipitates or colors when treated with test solutions of nitrate of silver, chloride of barium, chloride of calcium, sulphide of ammonium, or oxalate of ammonium (acrylic, hydrochloric, sulphuric, or oxalic acids, iron, and calcium salts)."—*U. S.*

Pharmaceutical Uses.—Glycerin forms the base of the officinal *glycerita* (*glycerina*), and is a constituent of a number of officinal fluid extracts; also of Linimentum potassii iodidi cum sapone, *Br.*, and of Mucilago tragacanthæ, *U. S.* It is used for preserving pill-masses and certain extracts in a plastic condition, and for preventing fermentation and other changes in aqueous liquids containing organic matter in solution.

Medical Action and Uses.—The purest glycerin is irritating, on account of the avidity with which it abstracts moisture from the tissues, but commercial glycerin has sometimes a similar defect from containing nitric, sulphuric, or organic acids and other impurities. It is alleged that glycerin mixed with the food of animals tends to fatten them, while it diminishes the proportion of urea excreted. Catillon has shown that it sometimes augments and sometimes diminishes this excretion (*Bull. et Mém., etc.*, 1883, p. 133), but that, on the whole, the latter action prevails, and that during the use of the medicine the weight of the body increases. On the other hand, the careful experiments of Munk led him to the conclusion that glycerin is not in the least degree nutritious (*Virchow's Archiv*, lxxvi. 119). If given in larger doses than can be digested, it may be detected in the urine, but it cannot be recognized in the feces or the sweat. In excessive doses (such as f℥ss for every 2½ pounds of the animal's weight) its effects resemble those of alcoholic poisoning, including the gastric lesions found after death. Injected hypodermically, the same symptoms and lesions are produced. Similarly administered to frogs or injected into the veins of rabbits, it induces tetanic rigidity (*Archives of Medicine*, Oct. 1881).

Its richness in carbon suggested its use as a medicinal food, and especially as a substitute for cod-liver oil in *phthisis*, but, as in so many other instances, a little clinical experience showed the so-called scientific induction to be untrue. On theoretical grounds also it has been used in the treatment of *diabetes*, but without striking advantage, although when the amount of sugar excreted is very small the use of glycerin may cause it to disappear from the urine, at least in its usual form. It has been thought to retard emaciation in this disease. Prof. Semmola of Naples, inveighing against both the stimulant and the anti-pyretic treatment of *typhoid fever*, urgently advises in their stead the repeated administration of small doses of glycerin in water acidulated with citric or tartaric acid (*Bull. de thérap.*, civ. 481), apparently not perceiving that this method is essentially an expectant treatment. Glycerin is an eligible adjunct to castor-oil. It is said that a teaspoonful of each mixed together will act as a laxative. Its medicinal virtues depend almost entirely upon its having no tendency to evaporate and to its undergoing no change by exposure to the air. Hence it may be advantageously used in all cases in which oil has from time immemorial been employed, and, owing to its solubility in water, with more effect. Thus it has been applied with good results to the rectum in *dysentery*, to the pharynx, to the larynx, trachea, and bronchia (by atomization and inhalation) in various diseases of these parts exciting *cough* and spasm or causing their obstruction. In a woman suffering from *hæmorrhoids* it was observed that while she was taking glycerin for diabetes she obtained great relief from the hæmorrhoidal affection. In other cases a complete cure of the rectal disease was accomplished by the continued use of glycerin in the dose of 2 or 4 drachms (Gm. 8–12), taken morning and evening (Young). Several subsequent reports are equally favorable to the efficiency of this treatment, which is applicable to both blind and bleeding piles. Doubtless, the slight digestibility of the glycerin permits it to reach the rectum and act as an emollient and protective. Mixed with water or pure, according to circumstances, it forms the best solvent for hardened *cerumen* and concreted epithelial scales, and is much used for keeping the *tympanum* moist. It has been applied to the treatment of recent *wounds*, but with far less satisfactory results than are obtained by dry dressings that exclude the air. When these cannot be employed glycerin may be profitably substituted. Its affinity for moisture tends in certain cases to limit the secretion of pus by drying and constringing the secreting surface. This is strikingly the case in *leucorrhœa*. The addition of an astringent—tannic acid, for example—increases the efficiency of the glycerin, which should be applied upon a tampon of lint. A similar application may be used for *fissure of the anus* and for fissured *nipples*. For the latter, however, a mixture of compound tincture of benzoin and glycerin is preferable. *Fissured tongue* is curable by a solution of 40 grains of borax in about an ounce of glycerin and 4 ounces of water. Pure glycerin applied to *carbuncles*, *boils*, and *abscesses* is said to promote their cure, but it is unsuited for application over a large surface, owing to its affinity for the moisture of the air. It allays *itching* in most affections of the skin attended with this symptom, and hence is an appropriate ingredient of ointments and washes used in their treatment. To prevent the *laryngeal mirror* from becoming obscured by the condensation of vapor upon its surface, it has been recommended to pass lightly over it a cloth wet with glycerin. *Dryness of the mouth* from fever or any other cause may be lessened by a mixture of glycerin and water far better than by water alone.

The solvent powers of glycerin have suggested the glycerites as officinal forms of certain medicines, but many others are prescribed extemporaneously. A solution of iodide of potassium in 2 parts of glycerin, with the addition of 1 part of iodine, makes an almost caustic preparation. A solution of 1 part of iodine in 5 parts of glycerin is used as a resolvent of enlarged and indurated glands and as a revulsive over inflamed joints, abscesses, etc. 1 part of glycerin and 8 parts of sulphate of zinc form an energetic caustic. Vaccine lymph may be preserved from decomposition by mixing it with glycerin.

GLYCERITA, *U. S.*; GLYCERITES, GLYCERINA, *Br.* —GLYCERINES.

Glycerata, *Glycerolata*.—*Glycerines*, *Glycerols*, E.; *Glycérés*, *Glycérats*, *Glycérolés*, Fr.; *Glycerite*, *Glycerolate*, G.

This class of preparations consists mostly of solutions of 1 part of a chemical compound in 5 parts by weight of undiluted glycerin, which are readily made by trituration in the mortar. Two of the officinal glycerites require different manipulations, which will be noticed in the proper place. These preparations were suggested in 1854 by Cap and Garot, and soon after became favorably known and have become much used. Since the strength required in special cases is readily indicated by the physician, all glycerites except two have been dismissed from the U. S. Pharmacopœia. (For formulas of the Br. P. for the glycerins of alum, subacetate of lead, and tragacanth, see page 1657.)

GLYCERINUM ACIDI CARBOLICI, *Br.*—GLYCERINE OF CARBOLIC ACID.

Glyceritum acidi carbolici, U. S. 1870; *Glycerite of carbolic acid*, E.—*Glycérolé d'acide phénique*, *Glycérine phéniquée*, Fr.; *Phenol- (Phenyl-) Glycerit*, G.

Preparation.—Take of Carbolic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar until the acid is dissolved.—*Br.*

Medical Uses.—This is a convenient form for the application of carbolic acid in certain *eruptions of the skin*, such as scabies, prurigo, etc., in which the itching is tormenting.

GLYCERINUM ACIDI GALLICI, *Br.*—GLYCERINE OF GALLIC ACID.

Glyceritum acidi gallici, U. S. 1870.—*Glycerite of gallic acid*, E.; *Glycérolé d'acide gallique*, Fr.; *Gallussäure-Glycerit*, G.

Preparation.—Take of Gallic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish and apply a gentle heat until complete solution is effected.—*Br.*

Medical Uses.—This preparation, taken internally, has the advantage over gallic acid in substance of being more readily absorbable. The *dose* is from 20 to 60 minims (Gm. 1.30–4.0).

GLYCERINUM ACIDI TANNICI, *Br.*—GLYCERINE OF TANNIC ACID.

Glyceritum acidi tannici, U. S. 1870.—*Glycerite of tannic acid* (*of tannin*). E.; *Glycérolé de tannin*, *Glycérine tannique*, Fr.; *Tannin-Glycerol*, G.

Preparation.—Take of Tannic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish and apply a gentle heat until complete solution is effected.—*Br.*

Medical Uses.—This glycerite is not so often used internally as that of gallic acid, but as a local application to *suppurating surfaces* of limited extent it is more efficient—*e. g.* to the nostrils in chronic *coryza* and *ozæna*, to the *ear* in chronic catarrh, to the *throat* in chronic relaxation of its mucous membrane, etc. It is a useful dressing for certain chronic but irritable cutaneous eruptions, such as *eczema*, *impetigo*, *intertrigo*, etc. *Dose* 15 to 60 grains (Gm. 1–4).

GLYCERINUM BORACIS, *Br.*—GLYCERINE OF BORAX.

Glyceritum sodii boratis, U. S. 1870.—*Glycerite of borax*, E.; *Glycérolé de borax*, Fr.; *Borax-Glycerol*, G.

Preparation.—Rub together Borax, in powder, 1 oz., Glycerin 4 fl. oz., and Distilled Water 2 fl. oz., until the borax is dissolved; or heat gently until solution is effected.—*Br.*

From the investigations by W. R. Dunstan referred to in another place (see GLYCERINUM), it appears that this preparation will contain some free boric acid.

Medical Uses.—In this preparation the glycerin forms a convenient substitute for the honey usually employed along with borax in *aphthous* and other ulcerative affections of the *mouth*, *nipples*, *vulva*, etc., but is probably less efficient. It it more suitable for *pityriasis* of the scalp.

GLYCERITUM AMYLI, *U. S.*—GLYCERITE OF STARCH.

Glycerinum amyli, Br.; *Unguentum glycerini*, P. G.—*Glycerine of starch*, *Glycamyl*, *Plasma*, E.; *Glycéré d'amidon*, *Glycérat simple* (*d'amidon*), Fr.; *Stärke-Glycerit*, G.

Preparation.—Starch 10 parts (48 grains); Glycerin 90 parts (432 grains); to make 100 parts (480 grains). Rub them together in a mortar until they are intimately mixed. Then transfer the mixture to a porcelain capsule and apply a heat gradually raised to 140° C. (284° F.) and not exceeding 144° C. (291° F.), stirring constantly until the starch-granules are completely dissolved and a translucent jelly is formed. —*U. S.*

Starch 1 ounce; glycerin 5 fluidounces; distilled water 3 fluidounces. Stir and heat.—*Br.* Starch 1 part; glycerin 14 parts. Heat carefully.—*F. Cod.*

This preparation was introduced into British pharmacy by G. F. Schacht in 1858, and soon after became known in the United States. To obtain a uniform jelly-like mass, the starch should be first rubbed into a fine powder free from lumps, then intimately mixed with the glycerin, which may be done in the porcelain capsule, thus avoiding the unavoidable loss when done in a mortar; and finally the mixture is heated until all starch-granules are ruptured and the liquid is thickened to a translucent mass free from white spots. Prepared in this manner, the glycerite must be preserved in well-stopped bottles, for in contact with the air it attracts moisture and gradually becomes soft. This tendency is entirely removed, according to W. Willmott (1879), by substituting for one-third of the glycerin an equal measure of water.

For the same purpose T. B. Groves (1867) introduced a preparation under the name of *glycelæum*, which, besides glycerin, contains fixed oil; it is made by triturating ½ ounce of fine almond meal with 1 ounce of glycerin, and then incorporating with it 3 ounces of olive oil, gradually added. The oil may wholly or in part be replaced by volatile oil or oleoresins. The preparation is a soft semi-gelatinous paste, which admits of the further addition of powders, and when mixed gradually with water forms readily an emulsion.

Zulkowsky (1880) has shown that on heating starch to 130° C. (266° F.) the starch-granules are ruptured and the mixture becomes thick and translucent, and at a higher temperature again thinner; at 170° C. (339° F.) it is quite limpid, and at 190° C. (374° F.) the starch is converted into the soluble modification—quite readily if potato starch had been used, but more slowly with wheat or rice starch. If now cooled, the mixture becomes thicker, but not gelatinous; on being poured into water the insoluble starch will precipitate, and the soluble starch may afterward be thrown down on the addition of alcohol.

The corresponding preparation of the German Pharmacopœia contains tragacanth in place of starch, and is made by triturating powdered tragacanth 1 part with alcohol 5 parts, adding glycerin 50 parts, and heating in a steam-bath until a uniform, white, translucent mass is obtained.

GLYCÉRÉ D'EXTRAIT DE BELLADONE, *F. Cod.* Soften extract of belladonna 1 part with a little glycerin, and mix with glycerite of starch 9 parts. Other narcotic extracts are used in the same proportion.

Medical Uses.—This preparation forms a transparent, unchangeable, and unirritating compound. It has been much used in ophthalmic surgery, especially when medicinal agents were to be applied to the *conjunctiva*. Ordinary ointments are still to be preferred in affections of the eyelids. It answers the purpose of a light poultice in *burns*, *erythema*, *erysipelas*, *furuncle*, *intertrigo*, and various other local inflammations of the skin.

GLYCERITUM VITELLI, *U. S.*—GLYCERITE OF YELK OF EGG.

Glyconinum.—*Glyconin*, E., G.; *Glyconine*, Fr.

Preparation.—Fresh Yelk of Egg 45 parts (9 oz. av.); Glycerin 55 parts (11 oz. av.); to make 100 parts (20 oz. av.). Rub the yelk of egg with the glycerin, gradually added, until they are thoroughly mixed.—*U. S.*

This glycerite was introduced by E. Sichel (1866), who recommended 4 parts of yelk to 5 parts of glycerin. It has the consistence of honey, and keeps unaltered for a long time if kept in stoppered bottles to prevent absorption of moisture. G. C. Close (1874) recommended it as an excellent agent for emulsionizing cod-liver oil and other fats.

Medical Uses.—This preparation is a protective, and, although less emollient than glycerite of starch, may be used for many of the same purposes, and is useful in *burns*, *erythema*, *erysipelas*, *intertrigo*, and other local irritations.

GLYCYRRHIZA, *U. S.*—Glycyrrhiza.

Glycyrrhizæ radix, Br.; *Radix liquiritiæ*, P. G.; *Radix glycyrrhizæ hispanicæ.—Liquorice- or Licorice-root*, *Spanish liquorice-root*, E.; *Réglisse*, *Bois de réglisse*, *Bois doux*, *Racine douce*, Fr.; *Spanisches Süssholz*, *Spanische Süssholzwurzel*, G.

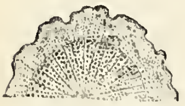
The root (and underground stem) of Glycyrrhiza glabra, *Linné*, s. Liquiritia officinalis, *Moench.* Woodville, *Med. Bot.*, t. 152; Bentley and Trimen, *Med. Plants*, 74.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This perennial in several well-marked varieties is indigenous to the countries on the northern and southern shores of the Mediterranean and farther east, through the Caucasus, Northern Persia, Afghanistan, and Southern Siberia, to China. The typical form, var. typica, *Regel et Herder*, grows wild as far east as Persia, and is cultivated in England, France, and Germany, and also to a limited extent in the United States. The stout roots penetrate deeply into the ground, while long horizontal rhizomes or runners are produced near the surface. The herbaceous overground stems are 4 to 6 feet (1.2–1.8 M.) high, and have imparipinnate leaves with oval-oblong mucronate leaflets, which are glutinous beneath, and racemes of white and purplish flowers producing brown legumes containing about four seeds. The variety glandulifera (Gl. glandulifera, *Waldstein et Kitaibel*, Gl. hirsuta, *Pallas*) has the leaves glandular-hairy beneath, and the legumes more or less glandular-prickly; it grows wild and is cultivated from Turkey and Hungary eastward to Turkestan. The roots and rhizomes are collected together and assorted before being brought into commerce. 11,072,095 pounds of liquorice-root were imported into the United States in 1877, and over 37,500,000 pounds in 1882.

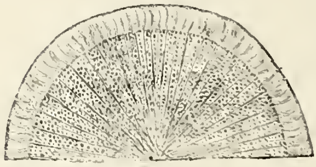
Description.—Liquorice-root consists of long cylindrical pieces varying in thickness from ¼ to 1 inch (6–25 Mm.). It is longitudinally wrinkled, covered with a grayish-brown warty cork, pliable, tough, and breaks with a coarsely fibrous fracture. The transverse section shows a bark about one-sixth the diameter of the root in thickness, underneath the cork of the dull or bright grayish-yellow color of the wood, and in its inner layer radiately striate from the long, narrow, and somewhat wavy bast-wedges. The woody meditullium consists of tough fibro-vascular tissue, appearing porous from the large vessels, and forming narrow wedges separated from one another by still narrower medullary rays. The rhizome has the same appearance and structure, and, in addition, a thin central pith. Liquorice-root has a peculiar odor and a strongly sweet somewhat acrid taste.

Fig. 141.



Spanish root (rhizome).

Fig. 142.



Russian root.

Glycyrrhiza glabra: transverse section of rhizome and main root.

Radix liquiritiæ mundata (*P. G.*), s. russica, Radix glycyrrhizæ echinatæ, *Russian liquorice-root*, has been stated to be obtained from Glycyrrhiza echinata, *Linné*, which is indigenous to South-eastern Europe and farther east to Central Asia, but the root as cultivated in Western Europe, though of about the same histological structure, differs very materially in the whitish color and the more bitter and slightly sweet taste from the commercial article. There can be no doubt now that at present Russian liquorice-root is mainly, if not entirely, derived from Gl. glandulifera, referred to above. It consists chiefly of the main root and its branches, with few rhizomes, and is about a foot (30 Cm.) long and 1 to 4 inches (2–10 Cm.) thick, often hollow above, usually deprived of the brown corky layer, and furnished with a light grayish-yellow, thin bark covering a more porous wood, which is often fissured in the direction of the medullary rays, is softer, and breaks with a more fibrous fracture, than the preceding. It has a very sweet and somewhat bitterish taste, and yields a lighter-colored powder than the former kind. Underneath the thin corky layer is the thin, small-celled primary bark; the cells of the medullary rays are larger and radially elongated; the long, tough, and somewhat wavy bast-fibres are surrounded by cells containing a crystal of calcium oxalate and accompanied by horn-like sieve-tubes; the ducts of the wood-tissue are usually in small groups, and are large, rather thick-walled, and dotted. The parenchyma of both the meditullium and bark contains much starch.

Constituents.—Robiquet (1809), Plisson (1828), and others obtained from liquorice-root starch, asparagin, albumen, a resinous oily matter, to which the slight acrid taste of the root is due, coloring matter, sugar, and *glycyrrhizin*. Roussin (1875) found the latter to be present in the root, in combination with ammonia, as *glycyrrhizate of ammo-*

nium, which he obtained pure from the cold infusion, after removing the albumen by heat, by precipitating with sulphuric acid, washing the precipitate well with water, dissolving it in strong alcohol, and adding ether, whereby a blackish mass is precipitated; the clear liquid is then carefully mixed with small quantities of alcoholic solution of ammonia. The precipitate is yellowish, very light, and its hot aqueous solution on cooling forms a jelly-like mass, and on evaporation leaves glycyrrhizin in brittle, translucent, shining scales. Prepared by the same process, with the exception of the final treatment with ammonia, it was found by Gorup-Besanez (1861) to have the composition $C_{24}H_{36}O_9$; to be soluble in alcohol, ether, and hot water, and on boiling with dilute acids; to be split into glucose and a bitter resinous substance named *glycyrretin*. Habermann (1880) gives to glycyrrhizin or *glycyrrhizic acid* the formula $C_{44}H_{63}NO_{18}$, and states that by heating with diluted sulphuric acid it is decomposed into glycyrretin, $C_{32}H_{47}NO_4$, and parasaccharic acid, $C_6H_{10}O_8$, the latter yielding amorphous salts, and the former being a white crystalline powder insoluble in water, alkalies, and ether, easily soluble in alcohol, glacial acetic acid, and strong sulphuric acid; fusible at 200° C., and not yielding any paraoxybenzoic acid with fusing potassa, as had been stated by Weselski and Benedict (1876). In purifying ammoniacal glycyrrhizin the amorphous bitter principle *glycyramarin*, $C_{36}H_{57}NO_{13}$, was obtained, soluble in ether-alcohol, and a resin soluble in glacial acetic acid and yielding paraoxybenzoic acid, $C_7H_6O_3$, on melting it together with potassa.

Allied Drugs.—Abrus precatorius, *Linné*, or *Indian liquorice* (see page 1).

Ononis spinosa, *Linné*, Radix ononidis, *P. G.*—Rest-harrow, *E.;* Bugrane, Bougrane, *Fr.;* Hauhechel, *G.*—This is a perennial herb common in sandy soil in Europe. The root, which is the part employed, is about 2 feet (30–60 Cm.) long, $\frac{2}{5}$ to $\frac{4}{5}$ inch (1–2 Cm.) thick, little branched, many headed, tough-woody, and mostly curved and of a flattened and twisted appearance. It has a deeply-wrinkled, dark gray-brown, thin bark and an irregular whitish, tough, fibrous meditullium with numerous medullary rays. It has a faint odor resembling that of liquorice-root, and a mucilaginous, sweetish afterward bitterish, and disagreeable taste. It was analyzed by Reinsch (1842) and Hlasiwetz (1855). *Ononin*, $C_{30}H_{34}O_{13}$, is a crystalline, colorless, and tasteless glucoside slightly soluble in boiling water, more so in alcohol. *Onocerin*, $C_{12}H_{20}O$, is crystalline, fusible, colorless, and tasteless. Reinsch's *ononid* is considered by Hlasiwetz to be altered glycyrrhizin; like the latter, it is precipitated by acids from its aqueous solutions.

Pharmaceutical Preparations.—Syrupus glycyrrhizæ, Syr. liquiritiæ, *P. G.* —Syrup of liquorice-root, *E.*—Macerate for 12 hours 20 parts of peeled liquorice-root with ammonia-water 10 parts and water 100 parts, express, heat to boiling, evaporate to 10 parts, and add alcohol 10 parts, filter after 12 hours, and add sufficient simple syrup to make 100 parts.—*P. G.* A syrup of the same strength will be obtained by mixing 2 parts of fluid extract of liquorice-root with 8 parts of simple syrup.

Pasta glycyrrhizæ (s. liquiritiæ). Macerate 1 part of cut liquorice-root in 20 parts of water for 12 hours, strain and filter; add 10 parts of water, 15 of gum-arabic, and 9 of sugar; dissolve, strain, and heat, removing the scum; then evaporate until on cooling it will form a translucent mass, which is cut into suitable pieces. The French Codex recognizes a *Pâte de réglisse noire* made with extract of liquorice and sugar each 5 parts, gum-arabic 10 parts, and water 33 parts; and a *Pâte de réglisse brune*, made with 100 parts of extract of liquorice, 1500 parts of gum-arabic, 1000 of sugar, 2500 of water, and 1 part extract of opium. The finished paste will weigh 3000 parts.

Off. Prep.—Confectio terebinthinæ, *Br.;* Decoct. sarsaparillæ (sarsæ) comp., Extract. glycyrrhizæ (purum), *U. S., Br.;* Extract. glycyrrh. fluid., Extract. sarsaparillæ comp. fluid., *U. S.;* Infusum lini comp., *Br.;* Massa (Pilula) hydrargyri, Pil. ferri iodidi, Pulv. glycyrrhizæ comp., *U. S., Br.;* Syrup. sarsaparillæ comp., Tinct. rhei dulcis, *U. S.*

Medical Action and Uses.—Liquorice-root is demulcent and laxative, and locally is slightly stimulant; it is supposed to promote the secretions of the congested mucous membrane of the air-passages. The infusion is a useful drink in *febrile catarrhal affections*, especially those attended with much thirst, and in febrile and irritative disorders of the *bowels* and *urinary organs*. In these cases it is usually prepared with flaxseed, rice, barley, or gum-water. It is said that an infusion of liquorice-root may be used by diabetic patients without aggravating their disease. Liquorice-root is an ingredient of the very excellent laxative which is now officinal as the compound powder of glycyrrhiza. It is also used to correct the acrid or bitter flavor of certain medicines, such as quinia, colocynth, aloes, quassia, senega, mezereon, guaiacum, and sal-ammoniac, but for this purpose the extracts are more convenient.

It is recorded that some children who chewed the roots of "glycine" in mistake for Spanish liquorice-root presented symptoms of gastric inflammation, general collapse, and somnolence (*Med. News and Abstract*, May, 1881, p. 308).

Abrus precatorius furnishes the seeds which are treated of elsewhere (page 1); its "root has been used in the place of liquorice, for which, in our opinion, it is a very bad substitute". (Flückiger and Hanbury). *Ononis spinosa* is credited with possessing diuretic properties, and is used in decoction, either alone or as a vehicle, in the treatment of *dropsy*. The same preparation is employed as a gargle for sore throat and as a wash for ulcers of the gums and other parts (Cazin).

GLYCYRRHIZINUM AMMONIATUM, *U. S.*—AMMONIATED GLYCYRRHIZIN.

Glycyrrhizinum ammoniacale, Glycyrrhizine ammoniacale, Fr.; *Ammoniak-Glycyrrhizin*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 100 parts (20 oz. av.); Water, Water of Ammonia, Sulphuric Acid, each a sufficient quantity. Mix 95 parts (19 oz. av. or 18¼ fluidounces) of water with 5 parts (1 oz. av. or 1 fluidounce) of water of ammonia, and, having moistened the powder with the mixture, macerate for 24 hours. Then pack it moderately in a cylindrical percolator, and gradually pour water upon it until 500 parts (100 oz. av. or 6 pints) of percolate are obtained. Add to the percolate, slowly and while stirring, a sufficient quantity of sulphuric acid as long as a precipitate is produced. Collect this on a strainer, wash it with cold water, redissolve it in water with the aid of water of ammonia, filter if necessary, and again add sulphuric acid as long as a precipitate is produced. Collect this, wash it, dissolve it in a sufficient quantity of water of ammonia previously diluted with an equal volume of water, and spread the clear solution upon plates of glass, so that on drying the product may be obtained in scales.—*U. S.*

This is Roussin's process (see GLYCYRRHIZA), as modified by Appenzeller (1876), who noticed that a considerably larger quantity, somewhat darker in color, is obtained by exhausting the root with ammonia-water, and that the scales have a more pleasant taste if liquorice-root deprived of the brown corky layer be used. Commercial extract of liquorice yields a still darker and less pleasant product. The cold percolate, if not too strongly alkaline, when heated to boiling deposits most of the albumen; this and other impurities are removed by again dissolving the precipitated glycyrrhizic acid in ammonia and reprecipitating it by an acid before its ammoniacal solution is finally evaporated and scaled. The yield is about 10 per cent.

Properties.—Ammoniated glycyrrhizin is in transparent "dark-brown or brownish-red scales, inodorous, of a very sweet taste, and soluble in water and in alcohol. The aqueous solution, when heated with potassa or soda, evolves vapor of ammonia. On supersaturating the aqueous solution with an acid a substance (glycyrrhizin) is precipitated which, when dissolved in hot water, forms a jelly on cooling. This substance, when washed with diluted alcohol and dried, appears as an amorphous yellow powder of a strong, bitter-sweet taste and an acid reaction."—*U. S.* The scales consist mainly of ammonium glycyrrhizate, $(NH_4)C_{44}H_{62}NO_{18}$, with a variable quantity of glycyramarin. They are insoluble in ether, sparingly soluble in strong alcohol, become darker colored at 100° C. (212° F.), and at a higher heat melt, being decomposed at the same time. Glycyrrhizic acid is tribasic; the taste of its alkali salts is very sweet, and in the pure state free from the characteristic after-taste of liquorice; their solutions in water foam strongly on agitation and produce voluminous precipitates with most salts of the heavy metals. On igniting ammoniated glycyrrhizin not more than a trace of ash should be left behind.

Medical Uses.—The superiority of this preparation over the fluid extract of liquorice is not apparent. Possibly it may be useful in the dry stage of inflammation of the respiratory mucous membrane.

GNAPHALIUM.—LIFE-EVERLASTING.

Pied de chat, Immortelle, Fr.; *Katzenpfötchen, Immerschön*, G.

The flowers and flowering herb of different species of Gnaphalium and allied genera.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—GNAPHALIUM POLYCEPHALUM, *Linné*, grows in fields and woods of North America. It is a woolly annual, with lanceolate nearly entire leaves, and with the numerous ovate and obovate flower-heads in dense corymbose clusters terminating the branches; the involucral scales are dry, scarious, and whitish, the tubular florets yellowish. The plant is quite fragrant, and has a bitterish and aromatic taste. On drying, the loss in weight of the flowering-tops amounts to about 65 per cent.

Gnaph. margaritaceum, *Linné*, s. Antennaria margaritaeea, *R. Brown*, grows in similar localities with the preceding, chiefly northward, and has larger, roundish-ovate heads, which are of a pearly whiteness and slight odor.

Gnaph. (Helichrysum, *De Candolle*) arenarium, *Linné*, grows in Europe and Asia. The heads are globular-oblong, $\frac{1}{6}$ inch (4 Mm.) long, of a lemon- or orange-yellow color and agreeable odor.

Gnaph. dioicum, *Linné*, s. Antennaria dioica, *Gaertner*, is indigenous to Europe. The barren flower-heads are hemispherical and whitish, the fertile ones more top-shaped and reddish or purplish. The species is very closely related to Antennaria plantaginifolia, *Hooker*, which is common in North America, where it is known as *mouse-ear*.

Constituents.—These plants appear to contain a little volatile oil and bitter principle.

Medical Action and Uses.—In Europe an infusion of the leaves and flowers of several species of Gnaphalium, which have, when chewed, an agreeable aromatic and slightly bitter and astringent taste, is used in chronic *bronchitis* and *diarrhœa* and in poultices to unhealthy *ulcers*. All the species are employed under similar circumstances. They may be given in an infusion made with half an ounce of the plant to a pint of water (Gm. 16 in Gm. 500).

GOSSYPII RADICIS CORTEX, *U. S.*—Cottonroot-Bark.

Écorce de la racine de cotonnier, Fr.; *Baumwoll-Wurzelrinde*, G.

The bark of the root of Gossypium herbaceum and of other species of Gossypium. Bentley and Trimen, *Med. Plants*, 37.

Nat. Ord.—Malvaceæ.

Origin.—The different species of Gossypium are indigenous to the tropical and subtropical countries of Asia and Africa, and have been cultivated from a very early period, whereby many characteristic varieties have been produced. They are herbaceous or shrubby plants or small trees, with three- to five-lobed leaves and showy axillary flowers, having a three-leaved involucre, a cup-shaped calyx, five petals, numerous stamens, and producing a three- to five-celled capsule, which opens by as many valves; the numerous seeds are densely covered with long woolly hairs. Bentley and Trimen refer the Sea Island cotton to Goss. barbadense, *Linné*, and to this the following as synonyms: G. vitifolium, *Lamarck*, G. peruvianum, *De Candolle*, G. punctatum, *Schumacher et Thonning*, G. acuminatum, *Roxburgh*, G. religiosum, *Parlatore*, non *Linné*. According to A. W. Chapman, the long-staple or Sea Island cotton cultivated in the United States is referred to Goss. nigrum, *Haworth*, and the short-staple or upland cotton to Goss. album, *Haw.* The seeds of Goss. religiosum, *Linné*, are invested with a yellow wool. Cottonroot is conical, nearly simple or little branched, hard and woody, and covered with a thin bark, which is officinal. Goss. arboreum, *Linné*, is cultivated in some tropical countries for cotton.

Description.—Cottonroot-bark is in bands or quilled pieces $\frac{1}{25}$ to $\frac{1}{12}$ inch (1–2 Mm.) thick, covered with a brownish-yellow, satiny, very thin cork, by the abrasion of which irregular dull brownish-orange patches appear. The cork forms slight longitudinal ridges, which are often confluent into elongated meshes and marked with black circular dots or short transverse lines. The inner surface is whitish or reddish-white, of a nearly silky lustre, and finely striate in a longitudinal direction by the thin medullary rays. The bast-fibres are long and tough, arranged in tangential rows, and are separated without difficulty in very thin layers. The bark breaks with difficulty in a transverse direction, but is readily torn longitudinally. It is without odor and without taste, with the exception of a very slight acridity and faint astringency. It bears a pretty close resemblance to mezereon-bark, except in color and taste.

Constituents.—The bark contains *starch*, and when fresh, according to W. A. Taylor (1876), a *chromogene* which dissolves in alcohol with a pale-yellow color, gradually changing to a bright brownish-red. The same change takes place on keeping the bark for some time, which then yields a red tincture with alcohol. This substance was examined by Prof. Wayne (1872) and W. C. Staehle (1875), who regard it as of a resinous nature. The latter obtained about 8 per cent. of this substance, which is soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, and 122 of benzol; also in alkalies, from which solutions it is again precipitated by acids. The potassa solution diluted with water is of a sage-green tint. *Glucose* was likewise observed, and the aqueous solution of the alcoholic extract contained a principle which gave a purplish-black precipitate with ferric chloride. C. C. Drueding (1877) obtained also a yellow resin soluble in petroleum benzin, fixed oil, little tannin, and 6 per cent. of ash.

Substitutions.—In 1875 a false cottonroot-bark, evidently obtained from the root of a tree, was found in the market; it was ⅛ to ¼ inch (3 to 6 Mm.) thick, pale-brown to rust-brown in color, covered with a soft fissured cork, inodorous, and of a slight astringent afterward bitterish and acrid taste, and yielded with alcohol a brown tincture. Its origin has not been ascertained.

Off. Prep.—Extractum gossypii radicis fluidum, *U. S.*

Medical Action and Uses.—The only virtue of cottonroot-bark consists in its action upon the uterine system. It is reputed to have long been used by the female negroes of the Southern States for producing abortion. There appears to be little doubt that it acts like ergot upon the uterus, and that it displays its virtues in *dysmenorrhœa* and scanty menstruation, and particularly in *suppression of the menses* produced by cold. It is generally used in a decoction, prepared by boiling 4 ounces (Gm. 128) of the bark in 2 pints of water, to the reduction of one-half. Of this a wine-glassful is given every 20 or 30 minutes as *an oxytocic.* The fluid extract, which is officinal, is a more convenient form of the medicine, and may be prescribed in the *dose* of from 30 to 60 minims (Gm. 2–4). A tea made from the fresh leaves of the cotton-plant is used in Jamaica as a *galactagogue* (*Med. Times and Gaz.*, Feb. 1880, p. 194). It is true that experiments performed on frogs and rabbits by Dr. Martin (*Amer. Jour. of Med. Sci.*, Jan. 1882, p. 82), so far from indicating any action that would explain the facts just mentioned, only denote a narcotic and paralyzing operation. It is sufficient to remark that the results of such physiological experiments by no means invalidate those of clinical experience. Cotton-seed tea is a mucilaginous liquid which forms an appropriate drink in *dysentery*. The seeds have also been recommended as galactagogue, but the evidence of their value in this respect is insufficient.

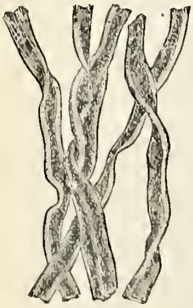
GOSSYPIUM, *U. S., Br.*—Cotton.

Bombyx, *Lana* (*Lanugo*, *s. Pili*) *gossypii.*—*Cotton-wool*, E.; *Coton*, Fr.; *Baumwolle*, G.

The hairs of the seed of various species of Gossypium (see above).

Gossypium, *Br.*, is carded cotton; Gossypium, *U. S.*, is cotton deprived of fat.

Fig. 143.



Cotton fibres.

Description.—Cotton consists of soft, narrow-filiform, thin-walled, simple cells, which are about ½ to 1½ inches (12 to 38 Mm.) long, and appear under the microscope as flattened hollow and twisted bands, which are slightly thickened at the edges, finely and spirally striate, and nearly cylindrical at the apex. Its specific gravity was by Schulmeister (1877) ascertained to be 1.707, while Kopp had previously determined it 1.27, and Grasi 1.979. It is without odor or taste, not readily moistened with water, insoluble in the ordinary solvents, but soluble in ammoniacal solution of oxide of copper, and is colored blue by solution of zinc chloride and iodine, but not by solution of iodine. It consists of nearly pure cellulose, and yields with nitric acid an explosive nitro-compound (see Pyroxylin) which is used in preparing collodion.

Gossypium depuratum, *P. G.*, Goss. purificatum.—Purified cotton, Absorbent cotton, *E.*; Coton absorbant, *Fr.*; Gereinigte Baumwolle, *G.*—The cotton-hairs are so thoroughly impregnated with fat that this cannot be removed by simple solvents. F. L. Slocum (1881) found the following process effectual: Boil carded cotton for half an hour with a 5 per cent. solution of caustic potassa or soda; wash thoroughly to remove all soap; express and immerse the cotton in a 5 per cent. solution of chlorinated lime for 15 or 20 minutes; again wash, first with water; then dip into water acidulated with hydrochloric acid, and thoroughly wash with water; express, and again boil for 15 or 20 minutes in a 5 per cent. solution of alkali, wash well with water, acidulated water, and water; express and dry quickly. By boiling once with alkali the cotton becomes somewhat absorbent, but the whole of the fat is not removed until it has been boiled a second time with alkali. The loss by this process is about 7 per cent., and represents mainly fat.

"Purified cotton should be perfectly free from all perceptible impurities, and on combustion should not leave more than 0.8 per cent. of ash. When thrown upon water it should immediately absorb the latter and sink, and the water should not acquire either an acid or an alkaline reaction."—*U. S.* By the absorption of water the hairs of the purified cotton distend and become more cylindrical, losing their band-like appearance. The untwisting of the flattened tubes of cotton filaments by caustic soda was noticed by Mr. Mercer (1867); dyed in this condition, the color becomes deeper and more durable and the fabric stronger; the process was called *Mercerizing.*

Pharmaceutical Preparations.—SALICYLIC (*Salicylated*) COTTON. According to Bruns (1878), cotton should be impregnated with 5 and with 10 per cent. of salicylic acid. 50 or 100 Gms. of salicylic acid and 10 or 20 Gms. each of castor oil and resin are dissolved in 4 liters of alcohol, and 1 Kgm. of clean absorbent cotton is immersed in the solution and dried.

BENZOIC COTTON is made by the same processes, substituting benzoic acid for salicylic acid; the addition of a small quantity of glycerin to the alcohol serves to fix these acids more permanently to the cotton.

IODOFORM COTTON is made in a similar manner, using an ethereal solution of iodoform.

HÆMOSTATIC COTTON is absorbent cotton impregnated with Monsel's solution or with a mixture of ferric chloride and alum.

CHLORINATED COTTON is made by Pavesi (1880) by suspending cotton slightly dampened with glycerin over a mixture of chlorinated lime, water, and sulphuric acid.

Surgical Uses.—Cotton has long been employed as a dressing for *burns, scalds, blisters, excoriations, erysipelas,* and similar inflammations. If the burn, scald, or blister is superficial, there is no better dressing for it. No other application more speedily and completely allays the pain of the injury. Even when the tissue of the skin is more deeply interested the dressing is unsurpassed. It should consist of very thin layers of carded cotton, successively applied and secured by a bandage, and should not be removed until the cure is complete. Cotton impregnated with carbolic, boracic, salicylic, and benzoic acids, iodine, iodoform, etc., has sometimes been employed. (For details see Woakes, *Practitioner*, xxv. 47.) The fibre has been used as a substitute for lint, and also for sponge, after being thoroughly freed from the unctuous matter which in its natural condition renders cotton inapt for absorbing the secretions. As a dressing for *surgical wounds* cotton is said to be one of the most perfect preventives of *purulent infection*, as well as of prolonged suppuration, if it is properly applied in the manner described above. Washed, or absorbent, cotton is especially applicable to this purpose, and is still more efficient if it has been washed in carbolic acid water. Vaginal pessaries have been made of carded cotton, chiefly for cases of *uterine displacement* in which instruments or harder materials cannot be tolerated. They are so shaped as to fill the upper part of the vagina, and usually are rendered somewhat firmer by holding in their centre a bent rod of gutta-percha. They require, of course, daily or frequent removal; to obviate which difficulty they have sometimes been dipped into a solution of caoutchouc, which gives them a thin, and for a time impermeable, coating. Absorbent cotton, medicated variously as above, is a convenient substance for introducing into the ears and nostrils.

GRANATUM, *U. S.*—POMEGRANATE.

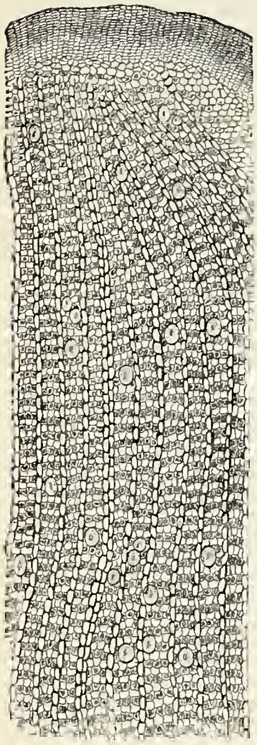
Granati radicis cortex, U. S. 1870, Br.; *Cortex granati*, P. G.—*Bark of pomegranate-root*, E.; *Ecorce de racine de grénadier* (*de balaustier*), Fr.; *Granatrinde*, *Granatwurzelrinde*, G.

The bark of the root of Punica Granatum, *Linné.* Steph. and Church, *Med. Bot.*, plate 57; Woodville, *Med. Bot.*, 190; Bentley and Trimen, *Med. Plants*, 113.

Nat. Ord.—Granataceæ (Myrtaceæ, Granateæ).

Origin.—The pomegranate is indigenous to South-western Asia from Northern India to Palestine; it has been cultivated from remote antiquity, and is now met with in all subtropical countries. It is a shrub or small tree about 20 feet (6 M.) high, with lanceolate or oblong, pointed, entire, and shining leaves, bearing one to three large crimson-colored flowers in the axils of the upper leaves, and producing a depressed globose fruit of the size of an orange, irregularly divided by a transverse dissepiment into two unequal parts, the lower and smaller of which is about three-celled and the upper five- to nine-celled. The numerous seeds are oblong, irregularly angular from pressure, each invested with a fleshy pink-colored translucent coating. The bark of the root (and trunk) is alone recognized by the pharmacopœias, but the flowers and the rind of the fruit and the sweet acidulous seed-coating are likewise used.

FIG. 144.



Punica Granatum: root-bark, transverse section, magnified 40 diameters.

Description.—The bark of pomegranate-root is met with in commerce in curved pieces or quills 2 to 4 inches (5–10 Cm.) long and ½ inch (1–2 Mm.) thick, which are externally of a brownish-gray color, marked with longitudinal or reticulate corky ridges, or irregular warts, and conchoidal depressions; the inner surface is smooth, finely striate, of a grayish- or reddish-yellow color, frequently with fragments of the whitish wood adhering. It breaks with a short, granular fracture, which is of a greenish-yellow hue and not perceptibly radiate in the inner layer; it has no odor and a purely astringent scarcely bitter taste. The trunk-bark, which is usually found in the commercial article, and is admitted by the German Pharmacopœia, is externally of a more yellowish-gray hue, is more regularly marked with corky ridges, has no conchoidal depressions upon the outer surface, and is frequently covered with blackish lichens, which are wanting on the root-bark. Both barks consist mainly of the bast-layer, and this is destitute of bast-fibres, but contains a number of scattered, thick-walled stone-cells, and consists of tangential rows of parenchyma-cells, which contain starch and tannin, and alternate with rows of crystal-cells containing calcium oxalate; the medullary rays are very numerous and delicate; the layer of primary bark is thin, and is covered with a thin layer of cork.

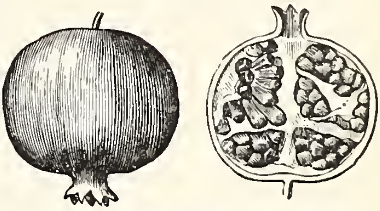
Constituents.—The principal constituent is tannin, of which Wackenroder (1824) found about 22 per cent., and which was recognized as peculiar by Stenhouse (1843). By fractional precipitation of the decoction with lead acetate, Ramdohr (1867) obtained some gallotannic acid, which could be converted into gallic acid, and *punico-tannic acid*, $C_{20}H_{16}O_{13}$, which is insoluble in alcohol and ether, reduces silver and alkaline copper solutions, and precipitates gelatin, tartar emetic, and ferric salts, the latter black. When boiled with dilute acids it is split into sugar and *ellagic acid*, $C_{14}H_6O_8$. Stenhouse did not succeed in obtaining indications of the presence of gallic acid. Boutron-Charlard and Guillemette (1835) isolated *mannit*, which Latour de Trie (1830) had named *granatin*, and Guiart (1831) *granato-mannit*. Cenedella (1835) obtained also sugar and mucilaginous and pectin compounds. Tanret (1878) announced the discovery in the root-bark and stem-bark of an alkaloid, which, in honor of Pelletier, he proposed to call *pelletierine;* it is obtained by mixing the bark with milk of lime, displacing with water, and exhausting the percolate with chloroform. Thus obtained, it is colorless, oily, aromatic, and very soluble in water, alcohol, ether, and chloroform; it precipitates the salts of most metals, and unites with acids to form crystallizable salts. 4 parts of the alkaloid were obtained from 1000 parts of the bark. Shortly afterward Tanret proved that it was a mixture of three liquid and one solid alkaloid, which may be separated by fractional treatment with sodium bicarbonate. Pelletierine, $C_8H_{15}NO$, has the spec. grav. .988 at 0° C. (32° F.), boils at 125° C. (257° F.), dissolves its own weight of water, is soluble in 20 parts of water, and shows a left rotation to polarized light. *Isopelletierine* has the same composition and properties, but is optically inactive, and its sulphate is deliquescent. *Methylpelletierine* requires 25 parts of water for solution, boils at 215° C. (419° F.), is dextrogyre, and its salts are very hygroscopic. *Pseudopelletierine*, $C_9H_{15}NO$, crystallizes from ether or chloroform in long prisms, melts at 46° C. (114°.8 F.), boils at 246° C. (475° F.), and is easily soluble.

Adulterations and Substitutions.—*The bark of boxwood* has an exfoliating corky layer, a yellowish-brown color, and a sweetish-bitter taste; its infusion is not affected by ferric salts. *Barberry-bark* is readily distinguished by the bright yellow color of its tissue. (See BERBERIS, p. 314.) Both these barks are free from tannin. The infusion of pomegranate-bark in 100 parts of cold water has a yellowish color, and yields with lime-water a red flocculent precipitate, and with ferric chloride a dark-blue or blue-black color.

Off. Prep.—Decoctum granati radicis, *Br.*

Allied Drug.—GRANATI FRUCTUS CORTEX U. S. 1870; Cortex granatorum (s. malicorii), Pericarpium granati.—Pomegranate-rind, Pomegranate-bark, *E.;* Écorce de grenade, Cuir de pomme de grenadier, *Fr.;* Granatenschalen, *G.*—Pomegranate-rind forms irregular curved fragments, which are about 1 line (2 Mm.) thick, externally somewhat tubercular and rough, of a brownish color with a yellowish or reddish tint, internally of a lighter color, marked with meshes indicating the depressions caused by the seeds. Some of the pieces are crowned by the thick, tubular, six- to nine-toothed persistent calyx, enclosing the remains of the style and numerous stamens. They break with a short granular fracture, are nearly devoid of odor, and possess a strongly astringent taste. Examined by Reuss, pomegranate-rind was found to contain about 28 per cent. tannin, 21 extractive, and 34 gummy matter. Bowman (1869) obtained 23.8 per cent. of tannin, which gives with ferric salts a blue-black precipitate. Flückiger obtained 5.9 per cent. of ash, calculated for the rind dried at 100° C. (212° F.), also some sugar.

Fig. 145.



Fruit of Punica Granatum, and longitudinal section.

Medical Action and Uses.—The bark of the root has long been celebrated as an efficient *tæniafuge* and *tæniacide.* Its specific operation upon the system is manifested by giddiness, dimness of vision, drowsiness, faintness, numbness of the limbs, and even convulsions. The bark is most efficient when fresh. It is best administered in a decoction prepared as follows: Take 2 ounces (Gm. 64) of the fresh bark, hashed, and let it soak over night in 1½ pints (Gm. 750) of water, and then by gently boiling reduce it to a pint. Strain off the liquor, expressing the grounds, and give it lukewarm in three doses, at intervals of an hour, before the patient has broken his fast. If the first dose is vomited, the others should still be administered, and will generally be retained. No purgative or other treatment need precede or follow; it is, however, more prudent to administer an ounce of castor oil as soon as the gurgling and colic provoked by the decoction begin to appear. Bettelheim used a strong decoction made with 10 ounces of the root-bark and 2 pints of water, of which from ½ pint to a pint was injected through an œsophageal tube into the patient's stomach. This method, which is claimed to be very prompt and efficient in its action, is certainly as barbarous as it is superfluous. The bark of the trunk and of the branches of medium size has recently been shown to equal the bark of the root in medicinal virtues. Indeed, according to some reports (Berenger-Féraud), it is more efficient than the bark of the root in expelling the unarmed tænia. It may be administered in the same manner as the latter.

It has been suggested that the superiority of fresh over dried pomegranate-bark is due to the evaporation from the latter of a portion of its pelletierine; but if such were the reason, it would be difficult to understand why the most efficient preparation of the bark is that which has been subjected to prolonged boiling. Recent observations (1879) seem, however, to render it probable that this alkaloid exists in combination with tannic acid.

The body termed pelletierine is said to be composed of several which differ in the degree, and even the nature, of their action. It exerts a paralyzing action upon leeches, frogs, and rabbits, and in the last-named animals the paralysis begins in the hinder limbs, and thence extends to the fore legs, the ears, the neck, the thorax, and the heart, in the order named. It also appears to cause dilatation of the capillaries, as may be seen by the ophthalmoscope in man when under its influence.

Medicinal doses of pelletierine have caused giddiness, with, according to some, slowing of the pulse, but, according to others, the heart is unaffected; there are mistiness before the eyes, cramps in the legs and arms, formication in the fingers and toes, and sometimes nausea and vomiting. It does not tend to purge, and thus, although a tæniacide, it is not a tæniafuge. Of the four alkaloids and their compounds said to exist in pomegranate-bark, the most active are pelletierine and isopelletierine in the form of tannates.

Pelletierine was first used, in the form of a sulphate, as a tæniacide in 1878, but soon afterward the tannate was employed in the dose of about 7 grains (Gm. 0.45). This quantity was given originally in divided doses, but later in a single dose, preceded and followed by a draught of water at short intervals, the patient remaining quiet and recumbent to repress nausea. At the end of about 2 hours a purgative was administered. Dujardin-Beaumetz prescribes a mixture of 5 grains of the sulphate in a solution containing 14 grains of tannin (Gm. 0.30 in Gm. 0.90). It is given on an empty stomach, and followed by an ounce of compound tincture of jalap (Gm. 32). After comparing the results given by the sulphate and the tannate of pelletierine, the superiority of the latter became manifest. As a purgative, castor oil at first was used in the dose of an ounce, but, owing to the slowness of its action, which allowed the tæniæ to recover if not killed, brisker cathartics were preferred, as the sulphates of sodium or magnesium or jalap, or the infusion of senna with the addition of the saline medicine or jalap. The "black draught," or compound infusion of senna, is very suitable for this purpose. It is desirable that the patient should diet very strictly for 1 day, taking only a moderate amount of milk in the evening, and on the following morning the medicine should be administered as above indicated. His stools should be received in a vessel filled with warm water, to facilitate the passage of the worm without breaking. Generally, it is discharged in the form of a knotted mass.

Pomegranate-rind is an astringent, and, although possessed of some anthelmintic virtues, is chiefly employed in a gargle for relaxed states of the *fauces* and in the treatment of chronic *diarrhœa*, *leucorrhœa*, passive *hæmorrhages*, and cancerous and other *ulcers* of the uterus and rectum. The *dose* in powder is from 20–30 grains (Gm. 1.30–2.00); a decoction prepared with an ounce of the rind and a pint of water (Gm. 32 to Gm. 500) may be given in the dose of a fluidounce.

GRATIOLA.—HEDGE-HYSSOP.

Herba gratiolæ.—Gratiole, Fr.; *Gnadenkraut*, *Gottesgnadenkraut*, G.

Gratiola officinalis, *Linné*.
Nat. Ord.—Scrophulariaceæ.

Description.—The stem grows from a creeping scaly rhizome to the height of 6 to 12 inches (15 to 30 Cm.), has opposite, sessile, lanceolate, finely serrate, three-nerved, smooth, pale-green leaves, and solitary axillary whitish or reddish two-lipped flowers, with yellow hairs in the tube. The plant is inodorous and has a very bitter somewhat acrid taste.

Constituents.—E. Marchand (1845) obtained the white crystalline bitter principle *gratiolin*, which is little soluble in water and ether. Walz afterward (1852, etc.) proved it to be a glucoside, splitting under the influence of acids into sugar, amorphous *gratiolaretin*, and scaly *gratioletin*. Walz also isolated the reddish amorphous bitter principle *gratiosolin*, which is soluble in water and alcohol, and is likewise a glucoside. *Gratioloic acid* crystallizes in white scales of a fatty odor.

Pharmaceutical Preparation.—Extractum gratiolæ is the inspissated juice of the plant freed from mucilaginous matter by mixing with alcohol.

Physiological Action.—Experiments upon animals and observations upon man show that gratiola is a powerful local irritant, and that when taken internally it causes retching, vomiting, colic, purging, even bloody stools, and inflammation of the stomach and bowels, especially of the rectum. Given by enema, it has occasioned so much pelvic irritation as to excite nymphomania, probably in predisposed persons. In one such case it is reported to have been fatal. In smaller (not purgative) doses it is said to be diuretic.

Medical Uses.—The chief, if not the only, use to which gratiola is applied in medicine is the treatment of *dropsy* by hydragogue purgation, as jalap, colocynth, and elaterium are employed. As it tends only to remove the dropsical effusion, and not its organic causes in the kidneys, heart, liver, etc., the main point to be regarded is that the effects of the medicine should not be so violent as to cause the patient's collapse. Like other drastics, gratiola has been employed in the treatment of insane *melancholy* and *mania*, and also to expel *intestinal worms*, remove *jaundice*, cure *amenorrhœa*, etc. To remove ascarides the infusion has been used as an enema, prepared with half a drachm of the root in half a pint of water (Gm. 2 in Gm. 250). As a drastic purgative the *dose* of the root may be stated at from 10 to 30 grains (Gm. 0.60–2.0).

GRINDELIA, *U. S.*—GRINDELIA.

Grindélia, Fr.; *Grindelienkraut*, G.

The leaves and flowering-tops of Grindelia robusta, *Nuttall*.
Nat. Ord.—Compositæ, Asteroideæ.

Description.—The genus Grindelia consists of herbaceous or suffruticose perennials which are indigenous to the western part of North America and to Mexico. They are characterized by their heads being many-flowered; the ray-florets yellow, ligulate, and pistillate; the disk-florets yellow, tubular, five-toothed, and perfect; the involucre hemispherical, with the scales imbricated in many rows, often with squarrose tips; the receptacle flat and alveolate; and the akenes smooth and crowned with a pappus consisting of a few rigid deciduous awns.

The officinal plant is a polymorphous species, very smooth, pale, usually stout; the leaves are 1 or 2 inches (25 or 50 Mm.) long, brittle when dry, vary from broadly spatulate or oblong to lanceolate, are sessile, the upper ones often clasping, with a heart-shaped base; obtuse at the apex, more or less sharply serrate on the margin, nearly smooth or bearing scattered glandular hairs of a pale-green color, finely dotted, and the upper surface sometimes covered with patches of a glossy resin. The involucre is about ½ inch (12 Mm.) broad, and near the tips of the scales beset with short, flattish, many-celled glands. The akenes are from one- to three-toothed at the apex, and have two or three, rarely five, awns for the pappus. The odor is balsamic, the taste pungently aromatic and bitter. The variety latifolia is the robust and broad-leaved form, the leaves being often 3 to 4 inches (7 to 10 Cm.) long. The variety angustifolia has rather fleshy and narrower leaves, the upper ones being nearly entire, and all narrowed at the base. The variety (?) rigida is more glutinous, the leaves rigid and coriaceous, some of them sharply serrate. All these plants have the tips of the involucral scales at length rigidly spreading. The plant is common along the Pacific coast and inland on the mountains.

Allied Species.—Gr. hirstula, *Hooker et Arnott*, is pubescent or tomentose, the stem often reddish or purplish, the leaves varying between spatulate, oblong, and lanceolate, the upper ones clasping. It is met with along the coast northward to Puget Sound.

Gr. glutinosa, *Dunal*, is said to be introduced in sandy ground near the coast of California. It is glabrous, has the leaves rounded at the apex, the involucral scales with short tips, and the pappus of five to eight rigid awns, with thin serrulate edges.

Gr. squarrosa, *Dunal*, which is not recognized as a distinct species in the flora of California, is found from Arctic America southward to California, Texas, and Nebraska, and is very common on the Plains. It is glabrous and viscidly resinous, the leaves rather rigid, glaucous, and punctate, varying between spatulate-lanceolate and oblong, the upper ones sessile, partly clasping, rather obtuse, and finely toothed, the involucral scales with very long, reflexed, squarrose, subulate points.

These plants resemble the former in odor and taste, and appear to be indiscriminately collected, more particularly the last one.

Constituents.—As far as may be judged from the sensible properties, these species contain volatile oil, a bitter principle, and resin, the latter not unfrequently coating the involucre and leaves, rendering them glutinous; hence the name *gum-plant* commonly applied to them. The principles mentioned seem to be deserving of a thorough investigation.

Off. Prep.—Extractum grindeliæ fluidum, *U. S.*

Medical Action and Uses.—Grindelia has a persistent acrid and bitter taste, and excites the secretion of saliva. It is said to reduce the respiration-rate, to stimulate the brain and the spinal cord, and subsequently to produce a tendency to repose or sleep, with impaired power of the legs. In experiments on frogs it appeared to arrest breathing and to cause engorgement of the heart. It increases the secretion of urine and irritates the kidneys. The herb of this plant is reported to be useful in *whooping cough* and *bronchitis*, and of singular efficacy in *asthma*. We have been informed of several cases occurring in aged persons in which half a teaspoonful of the fluid extract afforded almost instantaneous relief. It does not, however, prevent the return of the paroxysms, nor can it at all be depended upon for relieving them when they are actually present. It has been used with alleged advantage in *catarrh* of the *bladder* and of the *uterus*, as a dressing for *burns* and *blisters*, and to allay the pain of *herpes zoster*. The *dose* for a child two years old is stated to be 10 drops (Gm. 0.60) of the fluid extract every 2 hours. It is added that no unpleasant symptoms have been observed after large doses. It is alleged that the tincture or fluid extract of G. squarrosa has been used topically with advantage in cases of *poisoning* by Rhus toxicodendron.

GUAIACI LIGNUM, *U. S., Br.*—Guaiacum-Wood.

Lignum guajaci, P. G.; *Lignum sanctum (vel benedictum, vel vitæ)*.—*Lignum vitæ*, E.; *Bois de gayac (de gaïac)*, Fr.; *Guajakholz, Pockholz, Franzosenholz*, G.

The heart-wood of Guaiacum officinale, *Linné*, and of Guaiacum sanctum, *Linné*. Steph. and Church, *Med. Bot.*, plate 90; Bentley and Trimen, *Med. Plants*, 41.

Nat. Ord.—Zygophyllaceæ.

Origin.—These species are indigenous to the West Indian islands and to the northern coast of South America; the second extends also to Southern Florida. The former is about 40 feet (12 M.) high, has evergreen pinnate leaves, with two, rarely three, pairs of smooth oval and obtuse leaflets, blue flowers, and two-celled obcordate capsules, each cell containing one black seed. G. sanctum is smaller, has leaves with four or five pairs of oblong mucronulate leaflets, and a winged four- or five-celled fruit with red seeds. The wood of both species consists of heavy dark-colored heart-wood, surrounded by a yellowish zone of sap-wood, which is generally relatively broader in the second species. Guaiac-wood became known in Europe early in the sixteenth century.

Description.—The heart-wood is of a brown color, turning olive-green on exposure, and is composed of alternately darker and lighter zones, which form incomplete circles and resemble annual rings, the tissue being well filled with resin. The central pith is quite indistinct; the medullary rays are very fine, the vessels scattered. The wood is very heavy, of specific gravity 1.3, hard, tenacious, and splitting very irregularly, caused by the much-interwoven wood-bundles. In the shops it is usually seen in the form of raspings and shavings, which should be free or nearly so from the lighter sap-wood. Guaiacum-wood has a slight aromatic odor, which is more apparent on warming or rubbing it, and a somewhat acrid taste. The shavings acquire a dark blue-green color on being moistened with nitric acid or other oxidizing agents.

Constituents.—The wood contains from 20 to 25 per cent. of resin, which is the most important constituent, and yields about 3 to 4 per cent. of aqueous extract. Frémy and Urbain (1881) found in the wood, besides 21 per cent. of cellulose, also 36 per cent. of *vasculose*, which is not soluble in ammoniacal copper solution, even after treatment with sulphuric acid.

Allied Species.—Guaiacum angustifolium, *Englemann*, s. Porliera angustifolia, *Gray*, is a small tree of Southern Texas and Mexico, with a hard, heavy, and irregularly splitting wood of a yellowish-brown color, and used like the preceding.

Pharmaceutical Preparations.—Species lignorum, P. G.; Species ad decoctum lignorum.—Wood tea, *E.;* Espèces (Bois) sudorifiques, *Fr.;* Holzthee, *G.*—Guaiacum-wood 5 parts; rest-harrow-root (ononis), 3 parts; peeled liquorice-root, sassafras-root, each 1 part; cut and mix.—*P. G.* Guaiac-wood, sassafras-root, sarsaparilla, and china-root, of each equal parts.—*F. Cod.*

Off. Prep.—Decoct. sarsaparillæ (sarsæ) comp., *U. S., Br.;* Syrup. sarsaparillæ comp., *U. S.*

GUAIACI RESINA, *U. S., Br.*—Guaiac.

Resina guajaci, Guaiacum.—Guaiacum resin, E.; *Résine de gaïac,* Fr.; *Guajakharz, Guajak,* G.

The resin of the wood of Guaiacum officinale, *Linné.* (See Guaiaci Lignum.)

Origin.—The resin is obtained partly as a natural exudation or from incisions, partly by setting fire to a billet of the wood which has been grooved or pierced lengthwise on the side, the resin as it melts running from the opening.

Description.—The resin is in separate or agglutinated tears, varying in size from ¼ to 1 inch (6 to 25 Mm.) in diameter, or more generally in irregular masses, intermixed with fragments of wood and bark. It is of a greenish- or reddish-brown color, brittle, breaks with a somewhat conchoidal fracture having a glassy lustre, and is transparent in thin splinters. It yields a whitish powder which turns rapidly green on exposure to the air, has the specific gravity 1.2, fuses at about 85° C. (185° F.), emitting an agreeable odor, suggesting that of vanilla, and at a higher temperature gives off irritating vapors. Its taste is not strong, but distinctly acrid. The resin is soluble in caustic potassa and in nearly all the ordinary solvents for resins, except carbon bisulphide, benzol, and oil of turpentine; it is nearly insoluble in benzin and fats. The solutions, as well as the powder, are colored green or blue by nitric acid, chlorine, ferric chloride, and other oxidizing agents; the same color is produced by ozone and upon the inner surface of the paring of a raw potato. Guaiacum resin should be soluble in alcohol, leaving but a slight residue; sometimes it is very impure, containing as much as 16 per cent. of wood and bark. Its alcoholic solution has a slight acid reaction, and when dissolved in solution of potassa or soda it is reprecipitated on the addition of an acid.

Constituents.—On boiling guaiac resin with milk of lime *guaiacic acid* and *guaiac-yellow* are dissolved. If the residue is treated with hot alcohol, the tincture evaporated, and this residue dissolved in hot solution of caustic soda specific gravity 1.3, the sodium salt of *guaiaretic acid* will crystallize on cooling, and the mother-liquor contains *guaiaconic acid* and *beta resin*, which after the removal of the alkali are separated by ether, in which the former only is soluble.

Guaiacic acid, $C_{12}H_{16}O_6$, was discovered in guaiac-wood by Thierry (1841), and is present in very minute quantity; it crystallizes in white needles and is sublimable and soluble in water, alcohol, and ether. *Guaiaretic acid*, $C_{20}H_{26}O_4$, discovered by Hlasiwetz (1859), crystallizes in warts and scales, is of a faint vanilla odor, and is soluble in alcohol, ether, chloroform, benzol, etc., and sparingly soluble in cold water and ammonia. *Guaiaconic acid*, $C_{38}H_{40}O_{10}$, discovered by Hadelich (1862), is light-brown, amorphous, insoluble in water, benzol, and carbon bisulphide, easily soluble in alcohol, ether, chloroform, and acetic acid; it acquires a transient blue color with oxidizing agents. Hadelich's *guaiac-beta resin* is a red-brown powder; his *guaiac-yellow*, which was first noticed by Pelletier, has a bitter taste, forms pale-yellow octahedra, and dissolves in oil of vitriol with a handsome blue color and in alkaline liquids with a deep-yellow color. Hadelich obtained about 70 per cent. of guaiaconic acid, 10 per cent. each of guaiaretic acid and beta resin, and nearly 4 per cent. of gum, the remainder being the other constituents, including some impurities and 0.8 per cent. of ash.

On subjecting guaiaretic acid to dry distillation, a thick yellow oil is obtained, consisting of *guaiacol*, $C_7H_8O_2$, the methylic ether of pyrocatechin, which is a colorless oil of agreeable odor, and forms with alkalies crystallizable salts; *guaiacene*, C_5H_8O, which is thin, oily, of a bitter almond odor and hot aromatic taste; and *pyroguaiacin* (*pyroguaiacol*), $C_{19}H_{22}O_3$, which crystallizes in inodorous and tasteless scales. H. Wiesner (1880) gives to the last-named compound the formula $C_{18}H_{18}O_3$, and states that while it dissolves in sulphuric acid with a dark-blue color, its alcoholic solution gives no reaction with ferric chloride, contrary to the observation of Hlasiwetz, who found it to be colored green by ferric chloride, and regarded the similar reaction of the officinal resin to be probably due to this compound. By dry distillation guaiac resin yields *creosol*, $C_8H_{10}O_2$, in addition to the decomposition-product mentioned; it and the allied guaiacol are colored green by caustic alkalies and blue by alkaline earths; both have been observed in creasote. (See page 514.) On distilling pyroguaiacin with zinc-dust, Wiesner obtained *guaiene*, $C_{12}H_{12}$, in bluish fluorescing scales. Boetsch (1880) observed this to melt near 98° C. (208.4° F.), and to dissolve in sulphuric acid with a green color. He obtained this compound also from the resin by treatment with zinc-dust, and in addition thereto 50 per cent. of creosol and 30 per cent. of toluol, xylols, and pseudocumol. Hirschsohn (1877) found guaiacum resin to be free from cinnamic acid, umbelliferon, sulphur, and nitrogenated compounds.

Tests.—In addition to the properties mentioned above, Hirschsohn states that guaiacum resin should yield to petroleum benzin not more than 2 to 4 per cent. of its weight; colophony and damar dissolve to the extent of 77 to 90 per cent. The so-called *Peruvian guaiac resin*, of undetermined origin, has an odor resembling a mixture of rue and anise, and about 42 per cent of it is soluble in benzin. The alcoholic solution of guaiacum resin is precipitated by lead acetate (difference from carana resin), and with potassa solution gives a precipitate easily soluble in excess of the alkali (difference from colophony).

Off. Prep.—Mistura guaiaci, *Br.*; Pilul. antimon. comp. (hydrarg. subchlor. comp.), *U. S.*, *Br.*; Tinctura guaiaci, *U. S.*; Tinct. guaiaci ammoniata, *U. S.*, *Br.*

Physiological Action.—Guaiac was for a long time regarded as a diaphoretic, because the syphilitic patients to whom its decoction was largely administered, and who were placed in conditions favorable to diaphoresis, sweated abundantly. It appears to be a stimulant whose action may be artificially directed to the skin. In excessive and concentrated doses it excites a burning pain in the throat and stomach, vomiting, purging, palpitation, congestion of the head, confusion of mind. and giddiness. These effects are produced by the decoction of the wood, and cannot, therefore, be due to the resin, which is insoluble in water, but which from its strong taste and smell can hardly be without action upon the economy, and is probably, like its congeners, a vascular stimulant.

Medical Uses.—Guaiac is most renowned for the cure of constitutional *syphilis*, and the records of its use during nearly three hundred years were accepted as true until the scepticism of the nineteenth century condemned it. The vain and frivolous methods of employing it which prevailed among modern physicians fully account for its want of success in their hands. While it was in vogue the treatment by it was serious. The patient was obliged to observe a very strict regimen, to drink enormous quantities of a stronger and of a weaker decoction of the wood, to live upon a very sparing and simple diet, and in every manner to promote perspiration. The question of its efficiency has, however, possessed a very subordinate interest since the introduction of iodide of potassium. Like other vascular stimulants, guaiac resin has been found efficient in promoting menstruation in all atonic conditions of the uterine system, and hence in *dysmenorrhœa* as well as in *amenorrhœa* of that origin. For the same reason, doubtless, it is a valuable remedy for chronic muscular *rheumatism*. For these purposes the ammoniated tincture is to be preferred. In simple *tonsillitis* and in *diphtheria* it is alleged to be very efficacious, but the former disease gets well spontaneously, and the evidence of the value of guaiac in the latter is inconclusive.

Guaiacum-wood is prescribed only in decoction (*Pharm.* 1870), simple or compound, of which the latter is the more efficient. The resin may be given in doses of from 10 to 30 grains (Gm. 0.60–2.0). The guaiac mixture (*Br. P.*) is a convenient form for its administration.

When the red coloring matter of the blood is brought into contact first with tincture of guaiac, and then with peroxide of hydrogen, the guaiac is instantly turned blue. On testing suspected stains in this manner "it will be safe to say that if there is no bluing of the guaiac resin in the presence of the peroxide, the mark or stain is not owing to blood" (Taylor).

GUANO.—Guano.

Origin.—Guano consists of the partially-decomposed excrements of the penguin and other sea-birds, which congregate in large numbers on the barren and uninhabited islands on the western coast of South America, in Western Africa, and Australia. It is principally exported from the islands off the coast of Peru and Bolivia.

Description.—It is in the form of crystalline or amorphous masses, or more frequently of an irregular powder, having a grayish or pale-brown color and an offensive, usually ammoniacal, odor. Its spec. grav. is about 1.64; its reaction is mostly alkaline, though occasionally acid. It contains hygroscopic water varying between 6 and 20 per cent., which is expelled by the heat of a water-bath; when exposed to a higher temperature it blackens and burns, leaving a white ash varying in amount between 25 and 38 per cent.

Constituents.—Guano contains, besides the moisture, 25 to 52 per cent. of organic matter and ammonium salts, 19 to 42 per cent. of tricalcic phosphate, and 5 to 15 per cent. of alkaline salts; the nitrogen varies in amount from 7 to 15 per cent. The organic constituents of guano are chiefly *uric acid*, *ammonium urate*, and various oxalates. The chief inorganic constituents are phosphates of calcium, magnesium, and the alkalies, some sulphates, chlorides, and a very little sand; occasionally also ammonium carbonate. B. Unger (1845) discovered in guano the alkaloid *guanine*, $C_5H_5N_5O$, which has since been proved to exist also in the pancreatic juice of mammals; it forms a white crystalline powder which is insoluble in water, alcohol, ether, and ammonia, but soluble in acids and in potassa solution.

In estimating the value of guano as a manure the amount of the following constituents, besides moisture and ash, is determined: ready-formed ammonia (present as ammonium salts), latent ammonia (generated in the soil from nitrogenous compounds), uric acid, and phosphates.

Medical Action and Uses.—Under the singular delusion that the ammonia in guano possesses some special mode of action different from that of officinal ammonium compounds this substance was mixed with potter's clay and used as a dressing for several *diseases of the skin*, and afterward in baths and lotions. But it speedily exhibited the irritating effects proper to the salts of ammonia in common use, and is now quite abandoned. It will hardly be believed that this bird-dung should have been introduced into a syrup and administered internally.

GUARANA, *U. S.*—Guarana.

Pasta guarana.—*Guarana*, Fr., G.

A paste prepared from the crushed and ground seeds of Paullinia sorbilis, *Martius.* Bentley and Trimen, *Med. Plants*, 67.

Nat. Ord.—Sapindaceæ.

Origin.—Paullinia sorbilis is a climbing shrub with pinnate leaves composed of five oval-oblong toothed leaflets, small flowers in narrow spicate panicles, and pyriform beaked capsules containing one to three shiny blackish-brown subglobular seeds. It is indigenous to the northern and western provinces of Brazil.

Preparation.—The dry seeds are powdered, moistened by water or by exposure to the dew, and then kneaded into a kind of stiff paste, which is formed into globular or cylindrical masses; these are well dried near a fire or by exposure to the sun.

Description.—Guarana is met with in subglobular, cylindrical, or elliptic cakes which have an uneven surface, are hard, of a reddish-brown color, somewhat lighter internally, and breaking with an uneven, slightly glossy fracture, showing angular fragments of seeds with a brittle purplish-brown or blackish testa and with thick whitish cotyledons. It has a peculiar slight chocolate-like odor and an astringent and bitter taste.

Constituents.—Martius found guarana to contain starch, gum, a greenish fat, tannin which precipitates iron salts dark-green, and a crystalline substance, *guaranine*, which was afterward proved to be identical with *caffeine* (p. 342) by Martius and by Berthemot and Dechastelus (1840). The latter obtained 4 per cent., Stenhouse 5.07 per cent., and Feemster (1882) between 3.9 and 5 per cent., of caffeine. Saponin and volatile oil are likewise present in guarana. The alkaloid is best obtained, according to Dr. F. V. Greene (1877), by Prof. Wayne's process, by prolonged boiling with litharge; and Mr. Feemster found it of advantage to add near the end of the process a few drops of lead subacetate, which facilitates the settling of the insoluble matter. The tannin, *paullinitannic acid*, was shown by Dr. Greene to give precipitates with ferric salts (green, brown), gelatin, most alkaloidal salts, and barium salts, to give no precipitate with tartar emetic or copper sulphate, and to reduce salts of silver and gold.

Off. Prep.—Extractum guaranæ fluidum, *U. S.*

Allied Plant.—Paullinia Cupana, *Kunth*, which grows near the Orinoco River, has flattish, convex seeds; these are mixed with cassava and water and subjected to fermentation, yielding a saffron-yellow liquid which is used as a beverage.

Physiological Action.—Among the conclusions drawn from his experiments by Mantegazza are these: that guarana, by its tannin, tends to retard putrefaction; that, like caffeine, it first excites frogs, then impairs their power of co-ordination, and ultimately throws them into spasms; and that it also slows the action of their hearts. In various warm-blooded animals it produced similar effects, but it rendered the rabbit only somewhat dull and languid, and in dogs occasioned a sort of intoxication and eccentricity of movement. According to the same authority, in man it gives rise to gayety, restlessness, increased quickness of perception and mental activity, wakefulness, a slight fall in the pulse-rate, impaired appetite, and vesical irritation. Like others, he includes guarana in the same category with maté, coffee, and tea, giving it the first place as a promoter of cerebral action. In curious contrast to these definite and striking results are those of Dr. Macdowall of West Riding Insane Asylum, Eng. He experimented upon himself and two male attendants, and it soon became evident to him that even in very large doses its effect upon the body in a state of health is almost, if not quite, inappreciable. It does not even cause constipation. In large doses it appears to dispel drowsiness after a late dinner, just as tea and coffee do.

Medical Uses.—The curative powers of this agent when first introduced appeared to be not less wonderful than those of many other new remedies. It was a specific for diarrhœa and dysentery, gonorrhœa, leucorrhœa, and passive hæmorrhages, was lauded as a stomachic tonic, and was even put forward as remarkably efficacious in lumbago. Of all these virtues of the drug none survive, and the only affection in which it continues to be found useful is one which its congeners, tea (and especially green tea) and coffee, have never lost the reputation of relieving—*headache*. The particular forms of headache in which it is useful are the nervous sick headache which recurs frequently in the same person, and especially in females at the menstrual periods, and that which follows a debauch, when the head throbs and the eyes are bloodshot. Like the other more popular remedies, guarana gradually loses its power over these attacks, and even appears to render them more frequent and severe. It may be administered in substance in the *dose* of from 15 to 60 grains (Gm. 1–4) in powder, but in this form it is repulsive, and the doses mentioned are better given in infusion. The most efficient preparation is, however, the alcoholic extract, dissolved in alcohol to form a tincture in the proportion of 1 part to 30. From 2 to 5 grains (Gm. 0.10–0.30) of the extract may be given at a dose. A fluid extract, which is officinal, and a syrup, have been made, and are convenient forms for administration.

GUTTA-PERCHA, *U. S., Br.*—Gutta-Percha.

Gutta-percha depurata, Gutta-taban, Gummi plasticum.—Gutta-percha, Fr., G.

The concrete exudation, obtained by incisions, of Isonandra (Dichopsis, *Bentley*) Gutta, *Hooker.* Loudon's *Journal of Botany*, 1848; Bentley and Trimen, *Med. Plants*, 167.

Nat. Ord.—Sapotaceæ.

Origin and Preparation.—The taban is a stately tree, 40 to 60 feet (12–18 M.) high, with few branches, with evergreen oblong or obovate, entire, glossy, and underneath brownish-yellow scaly leaves, and small white flowers aggregated in little clusters near the top of the branches. It is common in jungles of the Malay peninsula and of the Malayan Archipelago; it is now extinct in Singapore, having been destroyed in the collection of the juice. To obtain the gutta-percha the tree is felled and circular incisions are made through the bark at distances of 6 to 12 inches (15–30 Cm.) along the whole trunk, from which the milky juice slowly exudes and hardens on exposure. The yield from one tree is stated to be from 6 to 10 pounds; others claim a yield of over 20 pounds. Several other sapotaceous trees of the genera Dichopsis, Payena, and Ceratophorus yield similar products.

Description.—Gutta-percha is grayish or yellowish, frequently with red-brown streaks from fragments of bark and other impurities. It is hard and rather leathery or horny, in thin pieces somewhat flexible, is readily cut with the knife, between 45° and 60° C. (113° to 140° F.) sufficiently soft to be rolled into sheets, quite plastic at 65° C. (149° F.), and very soft at the temperature of boiling water. Its specific gravity is about 0.98, but it is heavier than water after the removal of all air-cavities (Payen). It is insoluble in water, alcohol, acids, alkalies, and fixed oils, dissolves in boiling ether, chloroform, benzol, coal-tar oils, carbon bisulphide, and oil of turpentine; on evaporating these solutions it is left behind with its original properties. It is purified for dental and other purposes by agitating its solution with gypsum. If purified by treatment with water and hydrochloric acid, and then repeatedly dissolved in boiling ether and washed with cold ether and alcohol, a fine white powder is obtained of the composition $C_{20}H_{32}$, which is probably the composition of the recent juice (Baumhauer, 1859). It absorbs and combines with oxygen from the air, yielding white crystalline resin, Payen's *albane*, $C_{20}H_{32}O$, and yellow amorphous *fluavil*, $C_{20}H_{32}O_2$, which are contained in commercial gutta-percha sometimes to the amount of 20 per cent. Subjected to dry distillation, various gases, water, and volatile acids are obtained, and two oils, one yellow, the other red-brown, both of the composition $C_{10}H_{16}$.

Pure gutta-percha is inodorous and tasteless; ignited, it burns with a bright flame. Its mixture with caoutchouc is readily vulcanized, and after the incorporation of insoluble earthy or metallic compounds is largely used in the preparation of various instruments.

Percha lamellata, *P. G.*—*Gutta-percha paper*—is in thin, brown, translucent sheets, which are prepared by softening gutta-percha in hot water and pressing it between rollers.

Off. Prep.—Liquor gutta-perchæ, *U. S., Br.*

Allied Products.—Murton (1878) describes four additional guttas:

Gutta-soosoo of Perak is firmer than gutta-taban, and contains a little oil, but gutta-soosoo of Borneo is a caoutchouc.

Gutta-rambong of Perak is reddish-brown, closely resembles caoutchouc, and is probably obtained from the milk-juice of the roots of Ficus elastica.

Gutta-singgarip seems to be produced from a woody apocynaceous climber, and enters commerce as a soft, spongy, and wet mass.

Gutta-putih or Gutta-sundek comes from a species of Dichopsis, having shorter and broader leaves than the taban tree, and is whiter and more spongy than gutta-percha.

Other similar products from different species of Ficus and Isonandra are used in the Malayan islands for adulterating gutta-percha.

Balata—in Central America called *chicle, tuno gum*, and *leche de popa*—is the milky exudation of Sapota Muelleri, *Blume*, a tree called *bully tree*, growing on the banks of the Orinoco and Amazon Rivers. It resembles gutta-percha, becomes soft at 50° C. (122° F.), melts at 150° C. (302° F.), is soluble in benzol, carbon bisulphide, and hot oil of turpentine, and partly soluble in absolute alcohol and ether. It is not acted on by alkalies or hydrochloric acid, but is decomposed by strong nitric and sulphuric acids. It has been used as an addition to plasters.

Surgical Action and Uses.—The qualities which render this substance of value in the surgical and mechanical treatment of diseases are—its flexibility when warm, its firmness at ordinary temperatures, and its solubility in menstrua which do not alter its essential qualities. The facility with which it is bent and moulded when warm adapts it to making splints, whose size, shape, and weight can readily be changed. It has in a great degree supplanted the old and costly carved splint, to which, indeed, it is in all respects superior. Its lightness, firmness, smoothness, and unalterable character render it admirably adapted for the manufacture of syringes, specula, bougies, pessaries, stethoscopes, etc. Like collodion, the solution of gutta-percha in bisulphide of carbon or in chloroform may be used to retain the edges of incised *wounds* in apposition, and also as a protective of the *abraded skin* against mechanical injury or the *absorption of poisons.* In this manner it has been used as a coating for *sore nipples.* The solution in chloroform, which is officinal, is a very convenient agent for protecting portions of the skin from the air, while it exerts a slight degree of compression which is modified by the elasticity of the film formed by the dried solution. It has been used with more or less advantage in the treatment of *lepra* and *psoriasis*, to prevent pitting in *small-pox*, and to limit the efflorescence in *erysipelas;* but the results are not conclusive of its utility. Gutta-percha is also found to be a convenient vehicle with which to incorporate certain caustics, as potassa and chloride of zinc, for the purpose of limiting and mitigating their action.

GYNOCARDIA.—CHAULMUGRA.

The seed of Gynocardia (Chaulmoogra, *Roxburgh*, Hydnocarpus, *Lindley*) odorata, *R. Brown.* Bentley and Trimen, *Med. Plants*, 28.

Nat. Ord.—Bixaceæ.

Origin.—The chaulmugra is a large tree of the Malayan peninsula, growing northward to Assam and westward to Sikkim. It has alternate oblong and acuminate leaves and diœcious yellowish flowers, each petal having a dark-yellow spreading scale at the base. The fruit is globular, gray, one-celled, pulpy, and many-seeded.

Description.—The seeds are irregular ovoid, about an inch (25 Mm.) long, somewhat angular, dull-gray, have a brittle testa, and contain a large embryo with a thick radicle and a pair of leafy cordate cotyledons imbedded in a brown oily albumen. The kernel has a faint, peculiar, somewhat unpleasant odor and taste.

Constituents.—By subjecting the seeds to pressure or by boiling them in water *chaulmugra oil* is obtained, which, when pure, is of a pale or golden-sherry color, melts at about 40° C. (104° F.), and on keeping frequently deposits a granular fat; that obtained by boiling is said to remain clear, and, according to Dymock, does not form a green tenacious mass on stirring 20 minims of it with 1 minim of sulphuric acid. On the contrary, when the expressed oil is thus treated a reddish-brown resin-like mass is formed around the acid. John Moss (1879) ascertained that the acid reaction of the oil is due to palmitic and gynocardic acids, and that the oil consists of glycerides of palmitic and about 11.7 per cent. of gynocardic acid, with small proportions of hypogæic and cocinic acids. *Gynocardic acid* has a yellowish color, crystallizes readily in plates, melts at 29.5° C. (85° F.), has an acrid burning taste, is probably of the formula $C_{14}H_{24}O_2$, and gives a green color with sulphuric acid; a similar color is also produced by the same reagent with palm oil.

Allied Species.—HYDNOCARPUS VENENATA, *Gaertner*, a large tree of Western India, has a tomentose fruit containing longitudinally striate, and on the edges rugose, seeds.

HYDNOCARPUS WIGHTIANA, *Blume*, a large tree, a native of Ceylon, has a fruit of the size of a small apple and obtusely-angular seeds. The seeds of both species yield a fatty oil which is used like chaulmugra oil.

Medical Action and Uses.—Chaulmugra oil has from time immemorial been held in great esteem by the native races of India as a potent medicine in the treatment of *leprosy*, *scrofula*, *phthisis*, *syphilis*, *rheumatism*, *itch*, and various *diseases of the skin.* For the first named of these diseases it is held in the Mauritius to be a specific remedy. Of its mode of action nothing is known beyond the fact that when given in excessive doses it causes vomiting. Of its utility in leprosy we have the report of Dr. Young, who treated fifty-three cases, of which four belonged to the macular, twenty-three to the anæsthetic, fifteen to the tubercular, and eleven to mixed forms of the disease. He concluded that in the macular and in the early stage of the anæsthetic forms of leprosy chaulmugra appears to be of decided value. Several of the cases treated were complicated with bronchial affections, which were quite relieved during the treatment. The oil was given in gradually-increasing doses, beginning with 5 drops three times a day, but the good effects of the treatment were seen earlier in cases treated with the powdered seeds. A liberal milk diet seemed to be a valuable auxiliary. These results have, on the whole, been confirmed by the later experience of competent judges. Thus, Dr. Liveing draws attention to the fact that leprosy (E. græcorum), like many other fatal diseases, is liable to long periods of comparative rest or subsidence quite apart from any special treatment. After a study of twenty cases he concludes that neither gurjun oil nor chaulmugra oil can be regarded as a specific for the disease; some cases improved under its use, but he adds, "I have never met with one well-authenticated case of complete cure under its influence" (*Times and Gazette*, Aug. 1879, p. 205). Mr. C. T. Peters found this oil useful in relieving the dyspeptic symptoms of lepers and in promoting the absorption of the leprous tubercles (*Edinb. Med. Jour.*, xxviii. 214). It seems to form a convenient and useful local application, for its unctuous smoothness has been compared to that of goose-grease. It was employed in England (1879) in the treatment of pulmonary *phthisis*. The patients showed an unusual degree of objection to taking it on account of its nauseous odor and taste, and when mixed with cod-liver oil it became peculiarly repugnant to them. The result of the trial was altogether unfavorable (Yeo). These unfavorable results have been confirmed by subsequent observations of Murrell. "The oil has a deserved reputation in cases of *itch* and parasitic *pediculi*." In skin diseases, except, perhaps, in chronic *psoriasis* and *eczema*, this oil has proved irritating. Rheumatism and gout have been alleged (Cottle) to improve rapidly under the use of chaulmugra oil, but confirmatory evidence is wanting. It may be administered in the *dose* of 5 drops (Gm. 0.30) enclosed in gelatin capsules, or in an emulsion with milk, glycerin, or almond oil. The seeds, coarsely powdered, are given in pills in the dose of 5 or 6 grains (Gm. 0.30–0.40). The ointment (*Pharm. Ind.*) is used externally.

HÆMATOXYLON, *U. S.*—LOGWOOD.

Hæmatoxyli lignum, Br.; *Lignum Campechianum, Lignum cæruleum.—Bois de Campêche, Bois d'Inde, Bois de sang*, Fr.; *Blauholz, Bluthol*z, *Campecheholz*, G.

The heart-wood of Hæmatoxylon campechianum, *Linné.* Woodville, *Med. Bot.*, plate 17; Bentley and Trimen, *Med. Plants*, 86.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The logwood tree is indigenous to the shores of the Gulf of Campeachy and to other parts of Central America, and has been introduced into, and perfectly naturalized in, Jamaica, St. Domingo, and other West Indian islands. It is 30 to 40 feet (9–12 M.) high, has many spreading and crooked branches, alternate leaves with four pairs of obcordate leaflets, small yellow flowers in lax racemes, and two-seeded legumes. The tree is felled when about 10 years old; the bark and light-colored sap-wood are removed, the red heart-wood alone entering commerce.

Description.—Logwood is met with in logs about 3 feet long, which consist of the heart-wood, and, from exposure, are externally of a blackish-purple or red, internally of a brown-red, color. Irregular concentric circles of darker and lighter red color, resembling annual rings, are observed upon cross-section; the vessels are distinct to the naked eye, the medullary rays very fine. The wood is heavier than water, specific gravity about 1.06, splits irregularly, has a slight agreeable odor and a sweetish and astringent taste, and imparts a deep-pink color to the saliva. In the shops it is found in the form of chips and ground into a coarse powder, upon both of which a greenish lustre (*hæmatein*) is often observed. Under the microscope the cell-walls are seen to have a red color, and the ducts and wood-fibres to be filled with a red resin-like mass, occasionally forming in the ducts crystals of a green metallic lustre.

Constituents.—Analyzed by Chevreul (1812), it was found to contain a little volatile oil, brown extractive containing tannin, fatty or resinous and glutinous matter, and a crystalline substance which he named *hæmatin*, but which is now more properly called *hæmatoxylin*. According to Erdmann (1842), it is best obtained from powdered extract of logwood by mixing it with much sand and exhausting with ether; the ether is mostly recovered by distillation, and the residue mixed with some water and crystallized, a little sulphurous acid or solution of a sulphite being added to prevent oxidation; the yield is about 12 per cent. Impure hæmatoxylin is met with in French commerce as *hæmatine*, and is used for dyeing. When pure, hæmatoxylin is $C_{16}H_{14}O_6$, and crystallizes with 1 or $3H_2O$ in colorless or pale-yellow prisms which have a strongly sweet taste of liquorice, acquire a red color on exposure to the light, are freely soluble in hot water, in alcohol, and ether, and, fused with potassa, yield pyrogallol. The aqueous solution is slightly precipitated by solution of isinglass, and produces with baryta solution, lead acetate, and copper salts white or grayish precipitates which rapidly turn blue. Ammonia dissolves hæmatoxylin, the solution being rose-red, then purple, and finally blackish-red; the fixed alkalies produce similar solutions, and the color ultimately becomes yellowish-brown. The blackish ammonia solution contains *hæmatein-ammonia*, from which acetic acid separates *hæmatein*, $C_{16}H_{12}O_6$; this is soluble in alcohol and hot water, slightly so in ether, and forms a blackish-violet crystalline powder having a green metallic lustre. Hæmatein-ammonia causes, in a warm solution of a small amount of alum and with ferric chloride, deep-violet precipitates; with lead acetate, a brown one.

Off. Prep.—Decoctum hæmatoxyli, *Br.;* Extractum hæmatoxyli, *U. S.*, *Br.*

Medical Action and Uses.—Logwood is mildly astringent and has been reputed to possess tonic virtues. Its preparations darken the feces, and sometimes turn the urine blood-red and give it a sweetish taste. They constipate less than the pure astringents. They are used to check *diarrhœa*, *hæmorrhage*, and *sweat;* their mildness renders them appropriate for infantile diarrhœa. Externally, logwood is said to display antiseptic and healing qualities in the treatment of *gangrenous* and *ill-conditioned sores.*

HAMAMELIS, *U. S.*—HAMAMELIS.

Witch-hazel, E.; *Hamamélis*, Fr.; *Hamamelis*, *Zauberhasel*, G.

The leaves of Hamamelis virginica, *Linné*, collected in autumn.

Nat. Ord.—Hamamelaceæ.

Origin.—The witch-hazel is a shrub from 6 to 10 feet (1.8–3 M.) high, growing in damp woods and thickets in Canada and the United States. It has a rather crooked stem, with a close white wood and with flexuose branches, which are covered with a smooth brown bark, the older bark being brown-gray and somewhat fissured, and internally whitish and smooth. The flowers are in clusters of three or four with an involucre of three ovate leaflets, have a four-cleft calyx and four long linear, greenish-yellow petals, and appear in September and October, the nut-like two-celled and two-beaked capsule, containing two black oily edible seeds, not ripening until September of the next year. The bark, which has been medicinally employed, has a bitter, astringent, and somewhat pungent taste.

Description.—The leaves are alternate, short-petiolate, thickish, 4 to 6 inches (10–15 Cm.) long, oval or obovate, feather-veined, wavy-toothed on the margin, slightly heart-shaped and oblique at the base, stellate-pubescent when young and nearly smooth when old; they are inodorous, and have an astringent and bitter taste.

Constituents.—H. K. Bowman (1869) ascertained the bark to contain 8.10 per cent. of tannin, which was determined by means of gelatin. The leaves have not been analyzed; they contain tannin and a bitter principle.

Off. Prep.—Extractum hamamelidis fluidum, *U. S.*

Medical Action and Uses.—The accounts published of the remedial virtues of witch-hazel seem to be as hard to accept as the popular faith in it as an infallible divining-rod. Yet through the extravagant statements concerning it there runs a thread of truth, for all the conditions it is said to relieve are those of morbid excitement, such as *inflammations*, *congestions*, and *hæmorrhages*, and even the action of the gravid uterus in threatened *miscarriage.* To the tannin it contains, and to a peculiar bitter principle, some of its alleged sedative virtues may be attributed. It was used by the American aborigines in decoction as a wash, and also in a poultice, for various local swellings and inflammations, including *hæmorrhoids* and *ophthalmia;* and when the negro slaves endeavored to produce abortion by means of cotton-root, miscarriage is said to have been prevented by the use of hamamelis. Recent observations (1882) appear to justify the use of witch-hazel to check hæmorrhage, relieve irritable and painful piles, and promote the healing of unhealthy wounds and irritable and varicose ulcers. It may be used in a decoction made with an ounce of the bark to a pint of water (Gm. 32 to Gm. 500), and given in wine-glassful *doses* every 3 or 4 hours, or oftener, according to the urgency of the case. We have known a decoction or infusion to be applied as a lotion with apparent benefit in *crusta lactea.* The fluid extract is officinal, and an ointment may be made with this extract evaporated to dryness or with the fresh bruised bark boiled in lard. The last is used for *hæmorrhoids.*

HEDEOMA, *U. S.*—HEDEOMA.

American pennyroyal, E.; *Herbe de pouliot américain*, Fr.; *Amerikanischer Polei*, G.

The leaves and tops of Hedeoma (Melissa, *Linné*, Cunila, *Willdenow*, Ziziphora, *Des-*

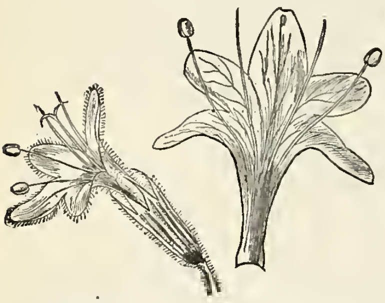
fontaines) pulegioides, *Persoon.* Barton, *Med. Bot.*, t. 41; Bentley and Trimen, *Med. Plants*, 200.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Pennyroyal is an annual herb indigenous to North America, from Canada south through the United States. It grows in barren and sandy fields, on hills, and along the open border of woods, always in dry places.

Description.—It has an erect, obscurely quadrangular, branched, and hairy stem about 6 to 12 inches (15–30 Cm.) high; opposite, shortly-petioled, oblong-ovate, and obscurely serrate leaves, which are about ½ inch (12 Mm.) long and glandular dotted on the lower side, and axillary cymules of about three flowers. The calyx is tubular-ovoid, hairy in the throat, and somewhat two-lipped, the upper lip divided into three lanceolate teeth, the two lower teeth subulate. The corolla is small, the tube scarcely exceeding the calyx, pale-blue with purplish spots, two-lipped, the upper lip erect and emarginate, the lower lip spreading and nearly equally three-lobed. It has two sterile and two fertile somewhat exserted stamens, a bifid style, and produces four small smooth akenes at the base of the persistent calyx. It has a strong aromatic mint-like odor and a warm and pungent taste.

Fig. 146.



Hedeoma pulegioides, *Persoon:* flower and corolla, cut open; magnified.

Constituents.—Its virtues depend upon the volatile oil. (See Oleum Hedeomæ.) Its other constituents are probably those generally found in plants of this natural order.

Allied Plants.—Mentha Pulegium, *Linné* (s. Pulegium vulgare, *Miller*), the European pennyroyal, is a perennial herb found in moist sandy localities in Central and Southern Europe. It has an ascending branching stem, oval-obtuse and crenately-serrate leaves, many-flowered axillary cymes forming globular whorls, and a purplish-colored four-lobed corolla. It resembles the former in odor, while the taste is somewhat bitter and acrid.

Hedeoma piperita, *Bentham*, Hed. Drummondii, *Bentham*, and some other species, are found near the Rocky Mountains, and may possess similar properties.

Medical Action and Uses.—Hedeoma is an aromatic stimulant. It may be prescribed, like other medicines of its class, to relieve flatulent *colic* or *painful digestion*, to correct the nauseating or griping operation of certain purgatives, etc. For these purposes it is less eligible than mint, anise, etc. In the form of hot infusion it is much used to dissipate the congestions tending to *diarrhœa* and to inflammations of the *throat* or *bronchia*, also in muscular *rheumatism*, etc., and, in conjunction with the hot hip- and foot-baths, to bring on retarded or suspended *menstruation*. An infusion made with half an ounce (Gm. 16) of the plant to a pint (Gm. 500) of water may be given in the *dose* of 2 fluidounces or more every hour. Mentha pulegium possesses similar virtues.

HELENIUM.—Sneezeweed.

Helenium autumnale, *Linné*. Meehan, *Native Flowers*, ii. 113.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—The sneezeweed or *sneezewort* is an herbaceous perennial which is common in damp places in the United States from Maine to Florida and Texas and westward to California and Oregon. It is of a grayish-green color, nearly smooth, 3 to 5 feet (.9 to 1.5 M.) high, has a branching quadrangular, winged stem, and lanceolate-serrate leaves which are pointed above and narrowed toward the base. The flower-heads are rather large, numerous, and have the involucral scales in two rows, the outer one foliaceous and reflexed; the ray-florets are ligulate, drooping, yellow, veined, and obtusely three-toothed at the apex. It flowers in August and September. The plant has scarcely any odor and possesses a very bitter taste.

Constituents.—It was analyzed by F. J. Koch (1874). Besides the principles common to herbs, it contains malic acid and traces of tannin; the bitter taste is due to a principle which was obtained in an amorphous condition, is soluble in ether, alcohol, and boiling water, and on being boiled with dilute sulphuric acid is resolved into sugar and an amorphous bitter substance having an acid reaction.

Allied Plants.—Hel. parviflorum, *Nuttall*, indigenous to Georgia, has lanceolate, nearly entire, scarcely decurrent leaves, and smaller flower-heads than the preceding.

Hel. tenuifolium, *Nuttall* (Meehan, *Nat. Flow.*, ii. 37), has numerous linear or filiform entire leaves and small flower-heads. It is found in the Southern United States from Georgia westward to Texas, Arkansas, and Southern Kansas. The properties of these two species appear to be similar to those of the first.

Medical Action and Uses.—Common sneezewort is so called on account of the acrid qualities of its flowers and leaves, which when dried and powdered have been used as an errhine for the purpose of dissipating incipient *coryza* and relieving *headache.* H. tenuifolium is said to be very poisonous to animals, producing in them muscular twitchings, passing into violent convulsions, and terminating in death. In four negroes it produced spasms, with more or less delirium and loss of consciousness (Galloway).

HELIANTHEMUM.—Frostwort.

Herbe de helianthème de Canada, Fr.; *Canadisches Sonnenröschen*, G.

The herb of Helianthemum canadense, *Michaux*, s. Cistus canadensis, *Linné.*
Nat. Ord.—Cistaceæ.

Frostwort or *rock-rose* is a perennial herb indigenous to dry and rocky hills and sandy or gravelly soil of Canada and of the United States south to Florida

Description.—The rigid slender stem is about 12 inches (30 Cm.) high, has alternate elliptic or linear lanceolate entire leaves, which are nearly an inch (25 Mm.) long and woolly beneath. The flowers are of two kinds: the earlier ones, appearing in June, are solitary, stalked, with five unequal hairy sepals, and the same number of large yellow petals, which unfold in sunshine only once. Somewhat later smaller apetalous and nearly sessile flowers make their appearance in axillary hoary clusters. The fruit is a three-valved, one-celled capsule, which is shorter than the calyx and contains few brown seeds. The herb, which varies much in habit, is inodorous and has a bitterish-astringent taste.

A closely-allied species, Hel. corymbosum, *Michaux*, is mainly distinguished by the petal-bearing and apetalous flowers being in crowded cymes near the top of the branches, the former being on elongated, filiform stalks. It grows from New Jersey southward near the coast, in similar localities with the former.

It has received the names of *frostwort* and *frostweed* from the crystals of ice which shoot from the cracked bark of the base of the stem during freezing weather in autumn.

Hel. vulgare, *Gaertner*, Cistus Helianthemum, *Linné*, indigenous to Europe, resembles the preceding and possesses similar properties.

Constituents.—Frostwort has not been analyzed. It seems to contain tannin and a bitter principle.

Medical Uses.—The bitter, astringent, and slightly aromatic taste of this plant may explain its alleged utility in *scrofula*, *diarrhœa*, and secondary *syphilis.* A strong decoction of it is apt to produce vomiting, but is employed as a gargle in *sore throat*, especially as it occurs in *scarlatina*, and also as a wash for *prurigo.* An extract is prepared which may be given in the *dose* of 2 grains (Gm. 0.12).

HELIANTHUS.—Sunflower.

Helianthe, *Grand soleil*, Fr.; *Sonnenblume*, G.

Helianthus annuus, *Linné.*
Nat. Ord.—Compositæ, Senecionideæ.

Description.—The sunflower is indigenous to tropical America and cultivated in most civilized countries, in many of which it has become naturalized or grows spontaneously. It has a straight stem from 10 to 15 feet (3–4.5 M.) high, which contains a large white pith. The leaves are alternate, petiolate, 10 inches (25 Cm.) long, broadly ovate or heart-shaped, three-ribbed, serrate, and rough. The flower-heads are from 8 to 12 inches (20–30 Cm.) in diameter, with bright-yellow ligulate ray-florets and a flat brownish disk. The akenes are obovate-oblong, somewhat quadrangular, flattened, vary in color between whitish and black, are at the base embraced by the chaff, and crowned with a very deciduous pappus of two chaffy scales. On being triturated with water the kernels yield a bland emulsion.

Constituents.—Wittstein (1876) obtained from the fresh plant, deprived of the fruit, 1.9 per cent. of ash, nearly two-thirds of which were carbonate of potassium, and from the fruit between 16 and 28 per cent. of fixed oil. *Sunflower oil* is pale-yellow, limpid, bland, has the sp. gr. 0.962, and dries slowly on exposure to air; under the influence of nitrous acid it forms a soft yellow mass; with strong sulphuric acid it turns red and brown, but is not altered by a weak acid. The kernels contain also, according to Ludwig and Kromayer, *helianthic acid*, $C_7H_9O_4$, which reacts dark-green with ferric salts, is soluble in water and alcohol, and not precipitated by gelatin or ferrocyanide of potassium. The dried pith, according to John, contains 9 per cent. of potassium nitrate.

Allied Plants.—The numerous species of this genus have yellow flowers, rough and frequently opposite leaves, and generally possess little odor. The next is occasionally cultivated for culinary purposes:

Helianthus tuberosus, *Linné.*—Jerusalem artichoke, *E.;* Topinambour, *Fr.;* Erdartischoeke, *G.*—Indigenous to Brazil. The tubers are thick, oblong, externally reddish, internally white, and resemble the artichoke in flavor, but are less pleasant. Examined by Braconnot, Payen, and others, they were found to contain 76 to 77 water, 14.7 sugar, mucilage, inulin, 1 to 3 per cent. albumen, etc.

Actinomeris squarrosa, *Nuttall*, is a coarse-looking herb 5 to 10 feet (1.5–3 M.) high, with a winged stem, and with alternate, or sometimes opposite, oblong-lanceolate, and tapering leaves. The involucre consists of two rows of spreading or reflexed scales; the receptacle is small, hemispherical; the ray-florets, about six, are short, yellow, and neutral; the flat, broadly-winged, and two-awned akenes are partly enclosed by chaff. The plant grows in moist ground in the Middle and Western United States.

Medical Uses.—Sunflower is scarcely a medicinal agent. Its oil may be used for many of the purposes of olive oil, the seeds for fattening poultry and, after expression of the oil, for cattle, the pith of the stalk for making moxas, and the growing plant for drying damp soils on account of its remarkable power of absorbing water. The preposterous assertion has been made that the dried stems infused in whiskey cure intermittent fever. Quite possibly the alcohol of the preparation may have some such effect.

Actinomeris helianthoides, or gravel-weed, is said to be diuretic and to have been used with advantage in cases of gravel, and also in dropsy (*Therapeutic Gaz.*, Sept. 1881). The evidence in its favor is not, however, very conclusive.

HELLEBORUS.—Black Hellebore.

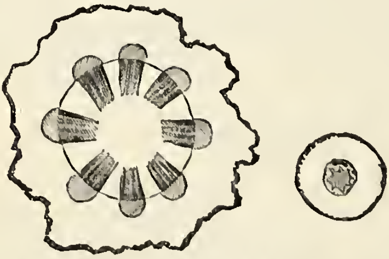
Radix hellebori nigri, *Radix melampodii.*—*Ellébore noir*, Fr.; *Schwarze Nieswurzel*, *Weihnachtswurzel*, *Winterrose*, G.

The rhizome, with the rootlets, of Helleborus niger, *Linné.* Woodville, *Med. Bot.*, 169; Bentley and Trimen, *Med. Plants*, 2.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

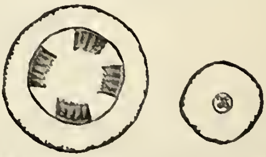
Origin.—Black hellebore, also called *Christmas rose*, is a native of Europe, and is met with in mountainous woods from Southern Germany and Central France southward to Italy and eastward to Greece. It flowers in winter, from December to March. The plant is acaulescent, and has coriaceous, smooth, pedately seven- to nine-lobed leaves, and pale-green petioles and flower-stalks mottled with red; the single flowers have five large white or pinkish sepals and ten or more small greenish petals. The fruit consists of five to nine follicles, having the black shining seeds in two rows.

Fig. 147.



Helleborus niger, *Linné:* transverse section of rhizome and root.

Fig. 148.



Helleborus viridis, *Linné:* transverse section of rhizome and root.

Description.—The rhizome, with branches, has an irregular knotty appearance, is 1 to 3 inches (25–75 Mm.) long, $\frac{1}{4}$ to $\frac{1}{2}$ inch (6–12 Mm.) thick; the branches are annulate from leaf-sheaths and terminate with a concave (or when more recent with a convex) scar. The numerous rootlets are long, but, being very brittle, are always more or less broken off in the commercial article, about $\frac{1}{10}$ inch (2.5 Mm.) thick, longitudinally wrinkled, and, like the rhizome, of a brown-black color. The transverse section of the rhizome shows a thick brownish-gray bark occupying about one-sixth of the diameter, a somewhat thicker whitish pith, and six to ten small wedge-shaped wood-bundles placed in a circle and separated by broad medullary rays. The rootlets have a thick bark and a central slightly pentagonal or hexagonal wood. In the dry state black hellebore has scarcely any odor; its taste is sweetish, then bitterish-acrid.

In several European countries the rhizome and roots of Helleborus viridis, *Linné*, are officinal and considered to be more efficacious. They are gathered, together with the radical leaves, in the autumn or in early spring, before flowering; the leaves serve merely for identification, and are to be removed when used. The plant, which is indigenous to Central and Southern Europe and grows wild on Long Island, produces its greenish flowers in March or April, and has pedately seven-lobed radical leaves with the lobes lanceolate-acute and serrate. The rhizome is smaller, about 2 inches (5 Cm.) long and ¼ inch (6 Mm.) thick, above knotty from the numerous stem-remnants, and annulate by the leaf-scars; the numerous nearly simple rootlets are 4 inches (10 Cm.) long, brittle, and usually broken off in the commercial article. In color, odor, and taste it resembles black hellebore. The transverse section of the rhizome shows a large pith with broad branches, and a woody ring consisting of four broad and short wedges, each composed of several smaller ones. The rootlets have a thick bark and a central obtusely four-branched ligneous cord. This drug is known in Europe, and prescribed as *Radix hellebori viridis*, or *green hellebore;* it should not be confounded with Veratrum viride, to which the same common name is sometimes given. It is considerably higher in price than black hellebore, and not often met with in the American market.

Constituents.—The two rhizomes appear to have the same constituents. Aside from those more generally met with, like resin, gum, etc., they contain *helleborin*, $C_{36}H_{42}O_6$, discovered by Bastick (1852), and *helleborein*, $C_{26}H_{44}O_{15}$, discovered by Husemann and Marmé (1865); the latter principle is more abundant in black, the former in green, hellebore. On exhausting the concentrated tincture with hot water and filtering from the resin and oil, helleborin will crystallize; it is very poisonous, scarcely soluble in cold water, little so in ether and fixed oil, and freely soluble in alcohol and chloroform; its alcoholic solution has a burning taste, and it yields grayish amorphous and tasteless *helleboresin*, $C_{30}H_{38}O_4$, on being boiled with solution of zinc chloride. *Helleborein* is obtained from the decoction by precipitating with basic lead acetate, then with sodium sulphate, and finally with tannin; the latter precipitate is decomposed by oxide of lead, the dry mass exhausted with alcohol, the tincture concentrated and mixed with ether. It forms colorless nodules of minute needles, is readily soluble in water, less so in alcohol, and insoluble in ether, and has a sweetish taste and a poisonous action. Boiling with dilute acids converts it into sugar and greenish amorphous and tasteless *helleboretin*, $C_{14}H_{20}O_3$.

Hellebore contains no tannin; an organic acid present is probably identical with aconitic acid.

Adulterations.—Black hellebore of commerce is often mixed with the rhizomes and roots of other, mainly ranunculaceous, plants, the most frequently occurring being Actæa spicata, *Linné*, which was formerly known as *Radix Christophorianæ, s. Aconiti racemosi;* the rhizome has a close resemblance to cimicifuga (see page 118), but merely the dimensions of black hellebore; its rootlets have the woody column arranged in four rays. The rhizome of Adonis vernalis, *Linné*, is subconical, almost simple, tufted above, not annulated, and has brittle rootlets with a cross-shaped wood; it probably contains potassium and calcium aconitates, of which salts Linderos found (1877) the leaves to contain about 10 per cent.; but the active principle appears to be a glucoside, *adonidin*, isolated in 1882 by Cervello as a colorless, amorphous, inodorous, and very bitter substance, which is soluble in alcohol, sparingly soluble in ether and water. and precipitated from the latter solution by tannin; in its effects it is said to resemble digitalin. At one time we observed a black, forked, monocotyledonous rhizome of unknown origin offered as black hellebore.

Pharmaceutical Uses.—EXTRACTUM HELLEBORI.—Extract of black hellebore, *E.;* Extrait d'ellébore noir, *Fr.;* Nieswurzextrakt, *G.*—The drug is exhausted with alcohol and diluted alcohol (*U. S. P.* 1870), or preferably with alcohol of 60–70 per cent.; the yield is about 14 per cent.

TINCTURA HELLEBORI.—Tincture of hellebore, *E.;* Teinture d'ellébore noir, *Fr.;* Nieswurztinktur, *G.*—Black hellebore 2 troyounces; displace with diluted alcohol sufficient for obtaining 1 pint.—*U. S. P.* 1870.

Physiological Action.—Experiments on animals show that, however introduced into the system, hellebore and helleborein are violent gastro-intestinal irritants, producing vomiting and purging, with copious bilious evacuations, and killing through exhaustion and convulsions. Helleborein acts chiefly on the nervous system as a powerful depressant. In man small and repeated doses of hellebore produce liquid alvine evacuations and increase the menstrual and hæmorrhoidal flows. In larger doses it causes vomiting, colic, spasm of the throat, thirst with heat in the abdomen, exhaustion, failing pulse, dilated pupils, cold sweats, and collapse with spasms. In the fatal cases reported nothing is said of its having purged.

Medical Uses.—The reputation of this medicine rests chiefly upon the cures attributed to it of *mania* and *melancholy*, for which it was in some sort held to be a specific. Possibly it may have been useful in cases of mental disorder connected with constipation and congestion of the liver and the abdominal organs generally. Yet the form of insanity which it seems most to have benefited in modern times is acute mania with febrile excitement. Like all drastic purgatives, black hellebore is sometimes curative of *amenorrhœa* either of the congestive or the atonic form, and is often a palliative of *ascites* by removing more or less of the dropsical fluid through the bowels. For this purpose it is inferior to jalap. The *dose* of the powdered root as a purgative is from 5 to 20 grains (Gm. 0.30–1.30). A decoction may be prepared by boiling 60 grains of the bruised root in a pint (Gm. 4 in Gm. 500) of water, of which a fluidounce may be given every 2 or 3 hours until it operates. The antidotes to poisoning by black hellebore are diffusible stimulants, given after the evacuation of the poison.

Adonis vernalis acts upon the frog's heart very much like digitalis, producing a tonic contraction of the organ and a diminished pulse-rate (Bubnow, 1880; Cervello, 1882). Clinical observation leads to a similar conclusion, for the medicine restores its rhythm to the arhythmical heart, rendering the pulse slower, fuller, and stronger. It augments the urinary secretion by increasing the proportion of water in it while diminishing its solid ingredients. In cardiac *dropsy* it therefore palliates all the symptoms depending upon obstruction of the heart—viz. those due to the heart itself and those occasioned by the dropsy—and measurably it has analogous effects in renal dropsy, unless the effusion is very large and the kidney lesion very general. The same is true of it in hepatic and splenic dropsy. Adonis is useless in functional disease of the heart. The infusion is made with from ½ drachm to 2 drachms (Gm. 2–8) in 6 fluidounces (Gm. 150) of water. *Dose*, a tablespoonful every one, two, or three hours (Botkin, *Centralblatt f. g. Ther.*, i. 361).

HEMIDESMI RADIX, *Br.*—Hemidesmus-Root.

Indian sarsaparilla, *Nunnari*, E.; *Racine de hemidesmus*, Fr.; *Hemidesmus-Wurzel*, G.

The root of Hemidesmus indicus, *R. Brown* (Periploca indica, *Willdenow;* P. emetica, *Retzius;* Asclepias pseudo-sarsa, *Roxburgh*). Wight, *Icon. Plant. Ind. Orient.*, ii. p. 594; Bentley and Trimen, *Med. Plants*, 174.

Nat. Ord.—Asclepiadaceæ.

Origin.—This slender climbing shrub is a native of the Indian peninsula, in all parts of which it grows in uncultivated places. It has opposite entire leaves, varying between linear-lanceolate and ovate, the broadest being on the upper branches, axillary clusters of small purple flowers, long linear follicles, and numerous seeds with tufts of slender hairs.

Description.—The root is met with in pieces about 6 inches (15 Cm.) long and ¼ to ⅗ inch (6–15 Mm.) thick, cylindrical, tortuous, longitudinally wrinkled, and transversely fissured, forming annulations. It is covered with a thin dark-brown corky layer, followed by a whitish mealy thin bark containing in its inner layer scattered laticiferous vessels. The cambium-line is dark, wavy, and the wood yellowish with narrow medullary rays, which are best observed in the thin roots. Hemidesmus-root has an agreeable odor, suggesting that of tonka, and a sweetish, slightly acrid, not unpleasant taste.

Constituents.—The root contains starch, and in the suberous layer some tannin. Scott (1843) obtained a stearopten by distillation with water. Its other constituents are unknown.

Off. Prep.—Syrupus hemidesmi, *Br.*

Medical Action and Uses.—In India, whence it was introduced into England, this medicine has some reputation for efficacy in the constitutional disorders supposed to be benefited by sarsaparilla. But its syrup, which is also officinal, is, like the syrup of sarsaparilla, chiefly used as a flavoring ingredient of mixtures.

HEPATICA.—LIVERWORT.

Herbe de hépatique, Fr.; *Edelleberkraut*, G.

The leaves of Hepatica triloba, *Chaix* (Hep. nobilis, *Moench;* Anemone Hepatica, *Linné*).

Nat. Ord.—Ranunculaceæ, Anemonideæ.

Origin.—A perennial acaulescent herb flowering in March and April, and indigenous to Europe and North America south to Georgia, growing in shady woods. The flowers are on villous scapes 4 to 6 inches (10–15 Cm.) long, and have a three-leaved involucre and six to nine petal-like blue or purplish, or sometimes white, sepals. The radical leaves are the portion used; the loss in drying amounts to from 70 to 75 per cent.

Description.—The leaves are subcoriaceous, smooth, dark-green, and shining above, paler beneath, broadly heart-shaped or somewhat kidney-shaped in outline, and divided into three lobes, which are obtuse or rounded (Hep. americana, *De Candolle*) or pointed (Hep. acutiloba, *De Candolle*). A similar distinction is also observed in the involucral leaves, the two forms being probably mere varieties of one species, the acute-lobed preferring a northern exposure. The leaves are inodorous and have an insipid, slightly astringent, and bitterish taste.

Constituents.—As far as may be judged from the sensible properties, liverwort does not appear to contain any important characteristic principle. Mucilage, sugar, and a small amount of tannin are present.

Medical Action and Uses.—Liverwort passes for being tonic and deobstruent. It once had a transient vogue in the treatment of chronic *bronchitis* and *phthisis.* But its medicinal value is very small, and hardly entitles it to a place in the materia medica. It may be given freely in infusion.

HERACLEUM.—COW-PARSNIP.

Heracleum lanatum, *Linné.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—The cow-parsnip, also called *masterwort*, is a woolly perennial herb growing from 5 to 10 feet (1.5–3 M.) high in most of the northern and middle parts of the United States westward to the Pacific. The root is many-headed, fleshy, nearly simple, or composed of many thinner branches, half an inch (12 Mm.) or less in diameter, brownish-yellow externally, white internally, with a rather thick bark containing resin-cells. The leaves are large, ternately dissected, on very broad and sheathing petioles, the segments often 10 inches (25 Cm.) long, the middle one usually three-lobed. The umbels are from 12 to 15 inches (30–38 Cm.) broad, with an involucre of oblong lanceolate leaves and involucels composed of five or eight lanceolate, slender, acuminate leaves. The flowers are white. The fruit is $\frac{1}{3}$ inch (8 Mm.) long, oval, flattened on the back, broadly winged on the margin, each mericarp with five slender ribs, the lateral ones being close to the margin, and in the upper half with six clavate oil-tubes, two of which are on the commissure. All parts of it have a rank odor and a pungently acrid taste. The root, leaves, and fruit have been employed.

HERACLEUM SPHONDYLIUM, *Linné*, the cow-parsnip of Europe and Northern Asia (Berce, Fausse acanthe, *Fr.;* Baerenklaue, *G.*), is a similar but smaller plant, and possesses similar properties.

Constituents.—These plants appear to contain volatile oil and resin; their acrid principles have not been investigated.

Medical Action and Uses.—In their fresh state the leaves applied to the skin may produce vesication and have been used as counter-irritants. Some of the European species are still more irritant, and contain a juice which has been applied to *warts* as an escharotic. The American plant has been used with alleged curative effect in *epilepsy* apparently depending upon gastro-intestinal irritation. It is given both in substance and in infusion, and is thought to correct *dyspeptic* disorder. A drachm (Gm. 4) of the root or its equivalent in infusion may be taken several times a day.

HEUCHERA.—ALUM-ROOT.

Racine d'heuchère d'Amérique, Fr.; *Amerikanische Sanikel-Wurzel*, G.

The root of Heuchera americana, *Linné.*

Nat. Ord.—Saxifragaceæ.

Origin.—This is a perennial herbaceous plant, with a tuft of orbicular-heart-shaped, slightly lobed, and crenately-toothed hairy leaves, and glandular hairy scapes about 2 feet (60 Cm.) high, bearing loose panicles of small flowers with short, white, narrow petals and exserted stamens and styles. It is common in rich woodlands of the United States from the New England States west to Wisconsin and the Mississippi and south to Georgia. It flowers in June, and the root is probably best collected in September.

Description.—The root is about 6 inches (15 Cm.) long and about ½ inch (12 Mm.) thick, with several short cylindrical heads terminating with a concave scar, tapering, and somewhat branched below, and beset with some thin radicles. In its fresh state it is fleshy; when dry, irregularly shrivelled, tuberculate, the brittle fibres usually broken off. It is externally of a purplish-brown color, has a thin bark and a thick, fleshy meditullium of a pale-reddish, sometimes brownish, tint, and breaks with a short somewhat spongy or granular, not fibrous, fracture, often showing internal cavities. It is inodorous, and has a strongly astringent, slightly bitterish taste. The rootlets agree with the main root in color and taste, but have a thick bark and thin. spongy centre.

Constituents.—The root has not been fully analyzed. H. K. Bowman (1869) found it to contain from 18 to 20 per cent. of tannin.

It is not unlikely that the root of Heuchera villosa, *Michaux*, and probably other species, may possess virtues similar to those of the officinal.

Medical Action and Uses.—Alum-root, as its name implies, is astringent. In decoction it is sometimes used in domestic medicine as a remedy for *diarrhœa* and *menorrhagia*, as a mouth-wash for *aphthæ*, and as an application to *ulcers, hæmorrhoids*, etc. It may be used in decoction.

HIERACIUM.—HAWKWEED.

Epervière, Fr.; *Habichtskraut*, G.

Nat. Ord.—Compositæ, Cichoraceæ.

Description.—The following species have been used:

Hieracium venosum, *Linné.*—Rattlesnake-weed.—It is a perennial herb, common in dry woods and plains of North America, with oblong-obovate, purple-veined, entire, and scarcely petiolate radical leaves about 2 inches (5 Cm.) long, and with a naked or one-leaved smooth scape about 18 inches (45 Cm.) long, bearing a loose paniculate corymb of yellow flower-heads, which have slender peduncles, a nearly cylindrical involucre, and linear akenes with a tawny, fragile, bristly pappus. The plant is inodorous, and has a somewhat bitter and acrid taste.

Hier. gronovii, *Linné*, likewise a North American species and growing in similar localities, has a wand-like simple stem which is leafy and hairy below. The leaves are petiolate, lance- or obovate-oblong, the peduncles slender, and. like the involucre, glandular-pilose. The akenes are tapering at the summit. This and the next species are sometimes used for toothache.

Hier. scabrum, *Linné.*—It is stouter than the preceding. rough-hairy. more branched, the involucre glandular-hirsute and the akenes not taper-pointed.

Hier. pilosella. *Linné.*—Piloselle, Oreille de souris, *Fr.;* Mäuseöhrchen, *G.*—A European plant, with white hairy leaves about an inch (25 Mm.) long, and a hairy, naked, or one-leaved scape. Its taste is bitter and astringent.

Hier. murorum, *Linné.*—Pulmonaire des Français, *Fr.;* Gelbes Lungenkraut, *G.*—It has ovate, pale-green, sometimes spotted radical leaves, and a hairy, few-leaved stem about 3 feet (90 Cm.) high, bearing several yellow flower-heads. Its taste is slightly bitter and astringent. It has been used as a vulnerary and in pectoral complaints.

Medical Uses.—Although hawkweed has been used in several diseases, such as scrofula and chronic catarrh, its chief claim to notice rests on its reputed power of curing the *bites of venomous snakes.* The late Dr. Griffith of Philadelphia. in his *Medical Botany*, relates the following: "Some years ago a person brought a collection of rattlesnakes to this city, and professed to be in possession of a certain cure for the symptoms arising from their bite, which he offered to divulge for a moderate compensation. This being paid him, he suffered himself to be bitten several times. and after the poisonous effects had displayed themselves was completely relieved by taking a few ounces of the decoction of a plant which was identified as Hieracium venosum. The same snake was suffered to bite a small puppy, which died from the poison in about 5 hours. These experiments were made in the presence of a number of distinguished medical and scientific persons."

HIPPOCASTANUM.—Horse-Chestnut Bark.

Cortex hippocastani, Cortex castaneæ equinæ.—Écorce de marronnier (chataignier) d'Inde, Fr.; *Rosskastanienrinde*, G.

From Æsculus Hippocastanum, *Linné*, s. Hippocastanum vulgare, *Gaertner*.

Nat. Ord.—Sapindaceæ, Hippocastaneæ.

Origin.—The horse-chestnut is a well-known stately tree which is a native of Persia and Northern India, became known in Europe in the latter half of the sixteenth century, and is at present cultivated as an ornamental tree and grows spontaneously in many countries of the temperate and subtropical zones. The bark of the smaller branches is the part employed. The seeds, which have a bitter and acrid taste, contain a large quantity of starch, which may be obtained pure by prolonged washing with water.

Description.—The bark is thin, externally of a gray color, has some small scattered warts, and shows opposite leaf-scars, which have the lower rounded margin marked with five or seven small warts. The inner surface is smooth and whitish, the internal color brownish. The inner bark is rather tough, breaks with a fibrous fracture, has a slight odor, and a bitter, astringent taste.

Constituents.—The tannin of horse-chestnut bark colors iron salts green. Besides some fat, chlorophyll, and other common compounds, the bark contains *æsculin*, $C_{15}H_{16}O_9$, and *fraxin* (*paviin*), $C_{32}H_{36}O_{20}$, both principles being inodorous, of a slightly bitter taste, and showing a blue fluorescence when dissolved in water, particularly in the presence of alkalies. Æsculin is obtained by precipitating the decoction with solution of alum and excess of ammonia, evaporating the filtrate to dryness, exhausting the residue with boiling strong alcohol, and recrystallizing. It forms small white needles containing $2H_2O$, which are insoluble in ether and have an acid reaction upon litmus. On boiling with dilute acids it is split into glucose and *æsculetin*. Baryta solution produces the same decomposition, and then yields *glucinic*, *apoglucinic*, and *æsculetinic acids*. Æsculetin, $C_9H_6O_4.H_2O$, crystallizes in colorless needles, is with difficulty soluble in cold water and alcohol, the solutions coloring ferric salts dark-green, dissolves in alkalies with a golden-yellow color, and on boiling with potassa is decomposed into oxalic, formic, and protocatechuic acids. Fraxin is obtained by precipitating the alcoholic tincture with an alcoholic solution of acetate of lead, diffusing the precipitate in water, decomposing by sulphuretted hydrogen, evaporating over sulphuric acid to dryness, and removing the tannin by washing with ice-cold water; it dissolves in alkalies with a yellow color, colors ferric chloride green, and then produces a lemon-yellow precipitate.

The integuments of the seeds contain some æsculin and *quercitrin*, which are likewise present in the flowers, but the leaves contain yellow *quercæscitrin*. The cotyledons contain, besides starch and gummy matter, some fixed oil, *oleum hippocastani*, which was obtained by Genevoix (1859) to the amount of $\frac{1}{10}$ per cent. by extracting with ether; it is of a greenish-brown or yellow color, has a turnip-like odor, a somewhat bitter taste, and the specific gravity .927, and congeals near the freezing-point of water. *Argyræscin* and *aphrodæscin* are two amorphous acrid bodies discovered by Rochleder (1862), which are insoluble in ether, soluble in alcohol, and yield with water solutions foaming like a soap solution; the latter is precipitated by baryta-water, and boiled with alkalies yields butyric and amorphous *æscinic acids*; the former is a glucoside.

Æsculus pavia, *Linné*.—Red buckeye.—B. C. Batchelor (1873) obtained from the testa tannin, 3 per cent. of resin, a tasteless crystalline principle, and coloring matter. The cotyledons were found to contain 5 per cent. of greenish-brown fixed oil, 2½ per cent. cane-sugar and syrup, and a brownish, bitter, and acrid glucoside different from argyræscin, and apparently poisonous.

Medical Uses.—It is asserted that the bark of the branches, and also the æsculin obtained from it, have cured *periodical fevers* in which even quinine failed. The same statement is made respecting numberless bitter vegetable products. It is also stated that æsculin will cure *neuralgia*. Oil of horse-chestnut has been used as an embrocation for joints affected with chronic *gout* or *rheumatism*, with the same effect, probably, as any other bland oil, and a decoction of the leaves has had some reputation as a remedy for *whooping cough*. These medicines are of little value—as little, probably, as the entire horse-chestnut, to which, if constantly worn in the pocket, a vulgar superstition ascribes the power of curing hæmorrhoids. This is evidently a survival of the doctrine of signatures. A decoction may be prepared with 1 or 2 ounces of the bark in a pint of water (Gm. 32–64 in Gm. 500), boiled for 10 minutes. *Dose*, a wine-glassful. Æsculin may be given in doses of 5 or more grains (Gm. 0.30).

HIRUDO, *Br.*—LEECH.

Hirudines, P. G.—*Sangsue*, Fr.; *Blutegel*, G.

Sanguisuga medicinalis, *Savigny*, and Sang. officinalis, *Savigny*.

Class Vermes; Ord. Annulata; Sub-ord. Apoda; Family Hirudineæ.

Description.—Leeches are invertebrate animals with an elongated, roundish, or somewhat flattened body, which has numerous transverse wrinkles, and is generally attenuate toward both ends; the posterior one always terminates by a broad and muscular disk, by means of which the animal fastens itself upon objects. The blood-sucking leeches have their anterior end or head likewise terminated by a narrower disk, in the centre of which is placed the mouth containing three jaws, which are provided with two rows of numerous-pointed teeth, and are mutually inclined at an acute angle, so as to make a triangular incision through the skin. Respiration is carried on through small apertures or *stigmata* arranged in two rows on the abdominal surface and found at every fifth ring. Leeches are hermaphrodites, but mutually impregnate each other. Several pairs of testicles are located in the fore and middle part of the body; the filiform penis is projected from an abdominal orifice about one-third distant from the head, and the female organs with two ovaries have their aperture or vagina five rings below the penis. The ova are deposited near the edge of the water, invested with a kind of a jelly or mucus, which contracts into a capsular or cocoon-like body having a spongy appearance and containing about ten or more eggs. Leeches are aquatic animals, and swim with a vertical undulating motion. For medicinal use their weight should be between 1 and 5 Gm. (15 and 75 grains).

SANG. MEDICINALIS, *Savigny* (HIRUDO MEDICINALIS, *Linné*), has the back of an olive-green color and marked with six longitudinal pale rust-colored stripes, which are mostly spotted with black. The belly is greenish-yellow, more or less spotted with black, occasionally to such an extent that the prevailing color is black. The animal is indigenous to Central and Northern Europe, and is known in commerce as the *Swedish* or *German leech*.

SANG. OFFICINALIS, *Savigny* (HIRUDO PROVINCIALIS, *Carena*). The back is green or blackish, marked with six longitudinal rusty-red stripes dotted with black. The belly is light olive-green, unspotted, but marked with a black stripe on each side. This leech is indigenous to the southern part of Europe, and is known in commerce as the *Hungarian leech*. There are several varieties of this species, differing from each other by modifications of the dorsal stripes.

Several other species of Sanguisuga are found in Southern Europe and occasionally employed, but are not an article of commerce. Leeches are generally kept in ponds by the wholesale dealer, and even cultivated in this manner. They are usually transported imbedded in moist turf.

The *American leech*, Hirudo decora, *Say*, which draws less blood, is sometimes employed. Its back is of a dark-green color and marked with one row of orange-brown and two lateral rows of black spots; the belly is of a light orange-brown color spotted with black.

Preservation.—Leeches require some attention to keep them healthy and in good condition. They are kept in clean river-water in a glass jar covered with a linen cloth and put in a shady place which is free from ammoniacal and other noxious vapors. The temperature is best kept between about 10° and 20° C. (50° and 68° F.), sudden changes being carefully prevented. As soon as the water begins to get turbid or colored the leeches should be placed in clean water of the same temperature and the jar well cleaned from the slimy deposit, which is caused by the transparent epidermis being thrown off every four or five days. To facilitate this removal some material is often put into the jar through which the leech may draw itself, and which, by retaining this slime, will tend to keep the water clean; charcoal, pebbles, clay free from lime, moss, and Irish moss have been recommended and found advantageous for the purpose, and apparatuses have been constructed in which leeches may be kept on a bed of material which permits of a frequent renewal of the water without handling the leeches. If they are kept in moist earth, turf, or clay, this should be examined from time to time and dead animals removed. The water should be changed at least once a week, and oftener in warm weather. It will be observed that the conditions for the preservation of leeches are pure air, pure water, and a pretty uniform temperature. Leeches are subject to several diseases which may become epidemic, and which are recognized by an excessive separation of mucus, ulcerations, tumors, or a flaccid appearance of the body; those thus attacked should be at once removed from the healthy ones, and placed in a separate vessel in clean water upon a layer of charcoal.

Medical History.—Leeches have been used from time immemorial in Asia, but particularly in Bengal, where they are considered the best means of local depletion. They are especially preferred for rayahs, for women and timid persons, and for the very young and very old (Wise). In Greek medicine they were not apparently known until a late date, the first mention of them being made by Themison, who lived in the century preceding the Christian era. They are scarcely alluded to by Pliny, who flourished a century later in Rome, but subsequently their uses were described by all the Latin and Arabian medical writers, as well as the mode of applying and preserving them and the accidents that may occur from their getting into the throat or stomach.

Medical Action and Uses.—Depletion by leeches is by no means identical with taking blood by venesection, even in its action upon the general system, for the rapidity of the loss in the one case and its slowness in the other produce quite different effects; in the former the impression is direct and sudden, in the other indirect and gradual. In their local action the difference is still more evident, for while in the one case the whole of the blood is despoiled to make a limited and local impression, in the other the object is attained by a very small loss of blood. It must be remembered that the circulatory apparatus is not a mere hydraulic machine, but that the blood-vessels, and especially the capillaries, are endowed with vital contractility which may be modified within a limited area and excited by a local irritation. All active congestions and inflammations are, in their origin, local diseases, and are therefore more or less amenable to local treatment, of which one of the most powerful forms is the abstraction of blood, the essential pabulum of inflammatory processes. Hence the utility of leeches in inflammations in whose immediate neighborhood these animals can be applied; it is not so intelligible when they operate upon the surface of the body immediately over inflamed organs which have no direct communication with the skin, as in pneumonia, metritis, gastritis, enteritis, meningitis, etc. The mere loss of so small a quantity of blood as they abstract from the general circulation does not appear to be a satisfactory explanation. The superiority of leeches over cups as a means of local depletion consists not only in the advantages referred to above, but also in their being applicable to various parts to which cups could not be applied, as the eye, the mouth, the anus, vagina, etc.

Large leeches should be used only when blood is to be freely abstracted and when the part is not very sensitive or exposed. The wounds they make are apt to become ecchymosed and leave visible scars. Small leeches are always preferable for application to the face and neck, for the reasons just given, and also because the bleeding from their wounds is more easily controlled. The number to be used will depend upon the size of the leeches, the quantity of blood to be abstracted, and the vascularity of the part. The part to which the leeches are to be applied should be thoroughly washed with warm water, and even with hot water, if it is not sufficiently vascular. Sometimes a hot-water fomentation is applied to stimulate the skin. In order to induce the animals to bite it is customary to moisten the part with sugared water or milk or to rub it with a piece of raw meat, or the leecher pricks the part with a fine needle and smears the blood over the skin, or he draws from his own finger a drop of blood for this purpose. A common method of applying leeches to a free surface is to put them in a small tumbler or wine-glass and invert it over the part. Others place the creatures in a cup and direct them, as they crawl over its edge, to the part where they should bite. For application to the nostril, throat, or vagina the leech may be enclosed in a tube open at both ends.

A healthy leech of medium size will draw from 1 to 2 fluidrachms of blood, and as much more will usually flow after the animal has fallen. When a strong and rapid impression is to be made by leeches the number applied at once should be considerable, but when a slow though continuous action is desired a succession of them may be used. This is often the case in traumatic and other inflammations within the cranium. It is an ancient custom, instead of applying many leeches, to apply one or two or a comparatively small number, and when they are nearly gorged to puncture their bodies near the tail with a needle or fine lancet, when they will often continue to draw blood indefinitely. In any case the punctures will not soon cease bleeding if they are kept sponged with warm water. Sometimes there is a difficulty in stopping the flow of blood, particularly if the wound is in the epigastrium, on the neck, or on some other part where firm pressure cannot readily be made. The various hæmostatics may here be applied, several of them being of common use in domestic medicine, such as scraped lint, burned rag, agaric, cobweb, powdered rosin, India-rubber softened by heat, vinegar and water, etc. If these fail or in their stead, a saturated solution of alum in hot water may be applied on lint while the liquid is hot, or lint saturated with a solution of perchloride of iron or of tannic acid, or the lunar-caustic pencil reduced to a fine point, may be inserted in the wound, or, finally, the point of a red-hot knitting-needle may be used in the same way. In all these cases the action of the hæmostatic should be aided by pressure with the hand, or with a small clamp or pincers made for the purpose, or by passing a needle through the skin, including the wound, and surrounding it with a ligature in the form of a figure-of-eight.

Small leeches are sometimes taken in drinking-water, and attach themselves to the fauces or pharynx, and have even penetrated into the larynx and fatally obstructed it. A strong gargle of salt and water usually suffices to make them quit their hold, and vinegar will have the same effect. These liquids have been used, and also wine, when leeches have been swallowed, but the creatures would probably be unable to live under the action of the gastric juice. In some cases, and especially when the leech has entered the larynx, its presence has been discovered by the laryngeal mirror; and in one case, at least, laryngotomy was performed for its removal.

When leeches have been gorged with blood they are not, if left to themselves, fit to be used again for several months. But by placing them in a weak solution of salt and water or of vinegar and water they may be made to disgorge the blood they have swallowed, and they soon regain their vigor if they are then placed in fresh water. They may also be emptied of their blood by stripping them. Such leeches are more subject to disease, and they should be kept separate from the fresh ones.

HORDEUM DECORTICATUM, *Br.*—PEARL BARLEY.

Hordeum, U. S. 1870; *Hordeum perlatum.*—*Orge perlé*, Fr.; *Perlgerste*, *Perlgraupen*, G.

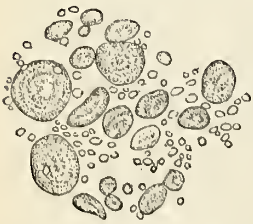
The husked seeds of Hordeum distichon, *Linné*. Bentley and Trimen, *Med. Plants*, 293.

Nat. Ord.—Graminaceæ.

Origin.—Barley is probably indigenous to Western Asia, and has been cultivated from a very early period. It is now raised in most parts of the temperate zones, and in Europe within the Arctic Circle. Besides the two-rowed or long-eared barley, Hord. vulgare, *Linné*, the four-rowed or spring barley and H. hexastichon, *Linné*, or six-rowed barley, are the principal species cultivated. The fruit of these species is used indiscriminately in the preparation of malt, and, when deprived in suitable mills of the integuments and rounded at the ends, constitutes the officinal pearl barley.

Description.—Pearl barley is nearly globular, of a white color and mealy appearance, with the exception of a groove in which fragments of the integuments are present. The larger pearls still contain externally a layer of gluten; the smaller ones consist altogether of the mealy albumen, and are formed of a cellular tissue filled with starch-granules, which resemble wheat starch and are made up of small and large grains with few intermediate ones. They are irregularly circular or elliptical in shape, with the nucleus or hilum rarely perceptible and the layers indistinct. Pearl barley is inodorous and has an insipid taste.

Fig. 149.



Barley starch-granules.

Constituents.—The average of the various analyses made by different chemists gives to barley 60 to 68 per cent. *starch*, 12 to 16 per cent. of *protein compounds* consisting of gluten and albumen, 2 to 3 per cent. of *oil*, the same of *ash*, 10 to 14 per cent. of *moisture*, and 8 to 12 per cent. of *cellulose*. Lermer (1863) found in exsiccated barley also 6.6 per cent. of *dextrin* and traces of tannin and bitter principle, and Lintner (1868) a little cholesterin. Proust's *hordein* was proven by Braconnot and Guibourt to be a mixture of cellular tissue, starch, and gluten. Beckmann's (1855) *hordeic acid* is evidently a fatty acid liberated by the oil of vitriol used in its preparation.

Pharmaceutical Preparations.—FARINA HORDEI PRÆPARATA, *P. G.* 1872.—Prepared barley flour, *E.*—Barley flour is pressed into a well-tinned or stoneware cylinder, so as to fill only two-thirds of the vessel, which is well closed and heated in a steam-bath for 30 hours. The upper layer of the flour is then removed, and the remaining portion pulverized and preserved in a dry and cool place. It is a yellowish or pale-reddish powder having a sweetish and mucilaginous taste, and contains dextrin and other derivatives of starch and of gluten.

Off. Prep.—Decoctum hordei, *Br.*

Medical Uses.—From the earliest times barley has been used not only as food, but to prepare drinks for the sick, especially in febrile diseases and in pulmonary and urinary disorders. It is now seldom employed externally, but continues to be given internally and for the same purposes as of old. The addition of honey makes barley-water more efficient in *bronchial affections* and *sore throat.* Formulæ for preparing it are given under Decoctum Hordei.

HUMULUS, *U. S.*—Hops.

Lupulus, Br.; *Strobili humuli, s. lupuli.*—*Hop*, E.; *Houblon*, Fr.; *Hopfen*, G.

The strobiles of Humulus Lupulus, *Linné.* Steph. and Church, *Med. Bot.*, plate 41; Bentley and Trimen, *Med. Plants*, 230.

Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—The hop is distributed over a great portion of the northern temperate zone, and has been introduced into Brazil and Australia. It grows in hedges and thickets, and is indigenous to North America, where it is particularly common in the northern and western regions, and is found in the Sierra Madre range of Colorado at an altitude of 10,000 feet; it is met with also in Middle and Southern Siberia and throughout the greater portion of Europe. In many countries it is extensively cultivated. It is a perennial, producing rough, long, and twining stems, which have the leaves mostly opposite, heart-shaped, and three- to five-lobed. The staminate flowers are in short racemes, and the pistillate flowers in densely-leafy, cone-like spikes upon different plants; the spikes or strobiles are the parts used.

Description.—The strobiles are ovate in shape, 1 to 1½ inches (25–38 Mm.) long, and consist of a grayish, hairy, zigzag-shaped, somewhat glandular axis, to the angles of which the enlarged leafy bracts and scales are attached; these are obliquely ovate, membranous, parallel-veined below, reticulately veined above, and at the base glandular and surrounding a subglobular akene, which is likewise covered with numerous yellow and shining glands (*lupulin*). Hops are of a yellowish-green color, of an agreeable aromatic odor, and of a bitter, aromatic, slightly astringent taste. When kept for some time hops acquire a brownish color, and an unpleasant odor from the formation of some valerianic acid; these changes are prevented, or at least retarded, by exposure to sulphurous acid gas, and the color of brown hops is to some extent restored by the same means.

(For an account of the culture of hops in the United States consult papers by W. H. Ramsey in *Amer. Jour. Phar.*, 1875, p. 241, and E. G. Bissell, 1877, p. 538.) In the fiscal year 1876–77, 20,177 pounds of hops were imported into the United States, and 874,559 pounds in 1882.

Constituents.—Besides the principles contained in the yellow glands (see Lupulinum), hops contain about 4 per cent. of *tannin*, which, according to R. Wagner, resembles moritannic acid. Bissell (1877), however, found its behavior to mineral acids entirely distinct, and noticed that only a small portion of it is precipitated by gelatin. Bowman (1869) obtained by means of this reagent 3.67 per cent. of tannin. Hops, entirely freed from lupulin, gave to Bissell, with water, a neutral distillate having an odor distinct from that of hops, and containing mere traces of organic matter; the extract was but slightly bitter. Hops contain 0.8 per cent. of volatile oil (R. Wagner, 1853), between 9 and 18 per cent. of resin (Siewert, 1870), some trimethylamine, and a volatile alkaloid, *lupuline* (Griessmayer, 1874); this alkaloid is liquid, has a strong coniine-like odor and an alkaline not bitter taste, and gives with phosphomolybdic acid a white or yellow precipitate which dissolves with a blue color in an excess of ammonia. Sacc (1876) asserted that hops contain a peculiar fermentative principle, which was disproven by Soxhlet and Pasteur (1876). C. G. Wheeler (1865) found hops to contain 1.7 per cent. of nitrogen, and to yield 7 to 10 per cent. of ash, in which potassa, lime, phosphoric acid, and silica predominate.

Off. Prep.—Extractum lupuli, Infusum lupuli, *Br.*; Tinctura humuli (lupuli), *U. S.*, *Br.*

Physiological Action.—Experiments on animals do not indicate the existence of a narcotic principle in hops, but clearly a sedative one, since under the use of hops the pulse-rate is diminished. Like other bitters, hops tend to invigorate digestion. Lupulin in moderate doses has the same effect, and in large ones causes abdominal pain and constipation. It certainly calms disordered nervous action, and in this manner favors sleep, but there is no evidence to show that hops, when given to persons in health or free from pain, have distinctly shown narcotic properties. The apparently direct influence of the hop-pillow in causing sleep is one which it shares with all odorous flowers, and is due to the essential oil which the strobiles contain.

Medical Uses.—The association in hops of a bitter tonic with a direct sedative of abnormal nervous action renders them peculiarly fitted to relieve those numerous cases of *dyspepsia* which are due to abuse of the stomach when it is both irritated and exhausted. Hence at one time they were celebrated in the treatment of atonic *gout*, a disease in which those conditions are prominent. These qualities also explain their reputation in the treatment of the forms of constitutional derangement which exist in *scrofula* and *rickets* when anæmia, glandular swellings, cutaneous eruptions, and dropsy, especially of the abdomen, are present. Hop-tea is one of the best remedies for *delirium tremens*, tending to restore its tone to the irritated and exhausted stomach, and directly to allay the characteristic nervous excitement of the attack. In various affections attended with genito-urinary irritation, as *priapism*, *seminal emissions*, *nocturnal incontinence of urine*, and *irritable bladder*, hops are often most salutary. As an external application to relieve the pain of *muscular rheumatism*, *abscesses*, *spasms*, *toothache*, *colic*, *bruises*, etc. hops form a most excellent application. They may be incorporated in a poultice, or the strobiles, enclosed in a bag, may be moistened with hot water, vinegar, or alcohol, and applied to the painful part. In this way hops are often associated with chamomile, thyme, lavender, mint, etc. The infusion of hops is the best preparation for internal use, although so much more bulky than the tincture or the fluid extract of lupulin. Its *dose* is from 1 to 2 fluidounces (Gm. 32–64). A pure and strongly hopped beer contains all the virtues of this agent, but ordinary malt liquors are too often fraudulently adulterated to deserve such praise.

HURA.—SAND BOXTREE.

Sablier, Fr.; *Sandbüchsenbaum*, G.

Nat. Ord.—Euphorbiaceæ.

Description.—The following species have attracted some attention:

HURA CREPITANS, *Linné*, indigenous to the West Indies and Central and some portions of South America, and known there as *ajuapar*. It is a straight tree, about 70 feet (21 M.) high, with long petiolate, cordate-ovate, and serrate smooth leaves, pendulous ovate staminate catkins, erect dark-red or purple pistillate flowers, and depressed globular twelve- to eighteen-celled capsules, which when ripe break with some violence, scattering the roundish flattened seeds, which have an agreeable sweetish taste. The tree contains a very acrid milk-juice. The leaves, steeped in oil, are used in rheumatic complaints.

HURA BRASILIENSIS, *Willdenow*, known in Brazil as *assacou* or *ussacu*, resembles the preceding in appearance and properties, but has oblong catkins. The thick, hard, grayish, inodorous, and slightly acrid bark, *casca de assacou*, is employed in South America.

Constituents.—Boussingault and Rivero (1825) ascertained that one of the acrid principles of the milk-juice is oily and volatile—the other, *hurin*, is crystallizable; the other constituents found were malates, nitrates, etc. Bonastre found in the integuments of the seeds much coloring matter, tannin, and gallic acid, and in the kernel 51 per cent. of fixed oil soluble in alcohol, solid fat, albumen, and salts. The oil is purgative.

Allied Plant.—HIPPOMANE MANCINELLA, *Linné*.—Manchineel, *E*.—A large West Indian tree, with ovate, acute, finely serrate leaves, which are about 2 inches (5 Cm.) long. The fruit resembles a small apple in size and color, is internally white and soft-fleshy, and contains from three to seven woody cells, each with a roundish-triangular silvery seed. All parts contain an acrid poisonous milk-juice; the poisonous principle appears to be volatile. Ricord-Madianna (1827) found, in addition to this *mancinellin*, volatile oil, fat, resin, caoutchouc, and gummy matter.

Medical Action and Uses.—Like several other Euphorbiaceæ, it is a powerful irritant, and taken internally in large doses occasions violent vomiting and purging. For these reasons, probably, it is used as an *anthelmintic*. Applied to the skin in decoction, it causes irritation and even vesication. In its native country, Brazil, it is much used in the treatment of *leprosy*, but there is no evidence of its having cured the disease. It is given in the form of a decoction, made by boiling half an ounce of the bark in a pint of water to half a pint (Gm. 16 in Gm. 250). Baths made with a saturated infusion of the bark are also employed. It is almost unnecessary to add that neither this medicine nor any other ever cured leprosy, and that the use of a drastic medicine like hura cannot fail to hasten the inevitable progress of the disease.

HYDRANGEA.—Hydrangea.

The root of Hydrangea arborescens, *Linné.*

Nat. Ord.—Saxifragaceæ, Hydrangeæ.

Origin and Description.—The wild hydrangea grows near the banks of rivers, preferring rocky places, from Pennsylvania westward to Illinois and southward. It has a pale-brown, internally whitish, woody, and much-branching root, which is of a sweetish and pungent taste. The stem is about 6 feet (1.8 M.) high, and has a grayish, or on the branches a light reddish-brown, bark, which is detached in thin concentric layers, from which circumstance the shrub is known as *seven barks.* The leaves are opposite, nearly smooth, ovate, pointed, rounded or slightly heart-shaped at the base and serrate on the margin. The flowers, which appear in July, are in flat cymes, whitish, the marginal ones often sterile and radiant, with four or five petals, and stamens twice that number. The fruit is a two-celled and two-beaked capsule, containing numerous seeds.

Constituents.—Nothing is known about the principles to which the medicinal properties of the root might be due. Laidley's analysis (1850) merely proved the presence of the common vegetable principles—gum, starch, resin, etc.

Medical Uses.—We are told that hydrangea-root was employed by the Cherokee Indians for the relief of calculous complaints, and that when duly administered to persons suffering from *urinary concretions* in the kidneys and bladder it provokes their discharge. We are also informed that in over-doses it occasions vertigo, oppression of the chest, etc. (*U. S. Dispensatory*, 12th ed.). If these qualities really belong to the medicine, it presents the singular case of being at once diuretic and narcotic. However this may be, there seems to be good reason to believe that hydrangea has been found useful in *gravel* and its associate disorders. In 1880 it was reported that the fluid extract had "a solvent effect on lithate of ammonia," and in the following year, that it put an end to attacks of renal colic which had beset a patient for years (Edson). A little later several aggravated cases of this affection were reported by N. F. Brown, in which the medicine seemed to be perfectly successful (*Med. Record*, xvii. 471; xx. 652; xxi. 39). The best form in which it can be administered is a fluid extract, which may be given in teaspoonful doses.

HYDRARGYRI CHLORIDUM CORROSIVUM, *U. S.*—Corrosive Chloride of Mercury.

Hydrargyri perchloridum, Br.; *Hydrargyrum bichloratum*, P. G.; *Hydrargyrum muriaticum corrosivum*, *Hydrargyrum corrosivum sublimatum*, *Hydrargyri bichloridum*, *Sublimatus corrosivus*, *Sublimatum corrosivum*, *Mercurius sublimatus corrosivus*, *Chloruretum* (*Chloretum*) *hydrargyricum.*—*Mercuric chloride*, *Perchloride of mercury*, *Corrosive sublimate*, *Bichloride of mercury*, E.; *Deutochlorure de mercure*, *Sublimé corrosif*, *Chlorure mercurique*, Fr.; *Ætzendes Quecksilberchlorid*, *Ætzender Quecksilbersublimat*, G.

Formula $HgCl_2$. Molecular weight 270.5.

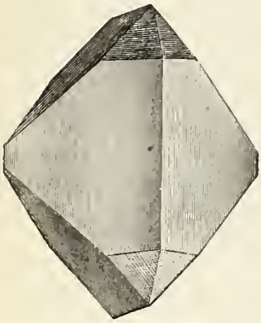
Preparation.—Take of Sulphate of Mercury 20 ounces; Chloride of Sodium, dried, 16 ounces; Black Oxide of Manganese, in fine powder, 1 ounce. Reduce the sulphate of mercury and the chloride of sodium each to fine powder, and, having mixed them and the oxide of manganese thoroughly by trituration in a mortar, put the mixture into an apparatus adapted for sublimation, and apply sufficient heat to cause vapors of perchloride of mercury to rise into the less heated part of the apparatus, which has been arranged for their condensation.—*Br.*

Mercuric chloride is formed by the mutual decomposition of mercuric sulphate and sodium chloride; $HgSO_4 + 2NaCl$ yields $HgCl_2 + Na_2SO_4$. By heat, mercuric sulphate is partly decomposed (see Hydrargyri Sulphas), and the product of the above process is thereby apt to become contaminated with mercurous chloride or calomel; to prevent such a result, the British Pharmacopœia directs the addition of a little binoxide of manganese, which, reacting with some of the sodium salt, generates chlorine sufficient to reconvert any mercurous into mercuric salt. On conducting the vapors into a large chamber they are condensed in the form of a heavy white crystalline powder.

Properties.—Corrosive sublimate forms colorless rhombic prismatic crystals, or, more generally, heavy white crystalline masses. It has the density 5.4, and when heated to about 265° C. (509° F.) fuses, and at a higher temperature sublimes without leaving any residue. It is permanent in the air, is inodorous, has a disagreeable acrid metallic taste, and dissolves in about 2 parts of boiling water and 16 parts of water at 15° C.

(59° F.) (Poggiale); also in 3 parts (2.3 parts, Simon) of alcohol, in 4 parts of ether, freely in volatile oils, and in 1.2 parts of boiling alcohol. In the presence of camphor the solubility is increased, so that 4 parts of ether and 16 parts of camphor will dissolve 8 parts of corrosive sublimate, and 4 parts of alcohol, with 25 parts of camphor, will dissolve 16.5 parts of corrosive sublimate (Karls, 1827; Simon, 1836). The aqueous solution has an acid reaction, becomes neutral on the addition of sodium chloride, and when exposed to the light is partly decomposed, with the precipitation of calomel and the liberation of hydrochloric acid; the decomposition is prevented by the presence of free hydrochloric acid or of ammonium chloride. The aqueous solution yields yellow precipitates of mercuric oxide with an excess of lime-water (see Lotio Hydrargyri Flava) or potassa solution, a white precipitate of ammoniated mercury with ammonia, and on the addition of nitrate of silver a white curdy one of silver chloride, insoluble in nitric acid, but soluble in ammonia. Phosphorous and sulphurous acids separate calomel from the solutions; hypophosphorous acid and stannous chloride produce the same change, but when in excess and heated liberate metallic mercury. The salt is soluble without decomposition in sulphuric, hydrochloric, or nitric acid, and crystallizes again on cooling. Solutions of albumen or of tannin, forming insoluble compounds, are used as antidotes to corrosive sublimate.

Fig. 150.



Crystal of Corrosive Sublimate.

Tests.—Corrosive sublimate should volatilize when heated without leaving any residue (absence of fixed impurities), and should be completely soluble in water or alcohol (absence of calomel). It often contains traces of arsenic, which are probably derived from the sulphuric acid with which the sulphate was prepared; this may be readily detected by mixing the solution with an excess of potassa solution, adding some zinc, and heating, the test-tube being covered with filtering-paper moistened with a drop of solution of silver nitrate; the appearance of a black spot indicates arsenic; or, "if 1 Gm. of the salt be dissolved in boiling water, then mixed with 5 Ccm. of strong solution of soda (sp. gr. about 1.260) in a long test-tube, and about 0.5 Gm. of fine aluminium wire, cut into small pieces, be added (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any tint to paper wet with test solution of nitrate of silver and kept over the mouth of the test-tube for half an hour (absence of arsenic)."—*U. S.* "The aqueous solution, when completely precipitated by hydrosulphuric acid, should yield a colorless filtrate, which on evaporation should leave no residue (absence of salts of alkalies, earths, and certain metals); and if the precipitated sulphide of mercury be agitated with diluted ammonia-water, the filtrate on being acidulated and tested with hydrosulphuric acid should not give a yellow precipitate (absence of arsenic)."—*P. G.* J. G. Smith (1877) found in some samples $\frac{1}{10}$ per cent. of arsenious acid.

Pharmaceutical Uses.—Corrosive sublimate is employed in making Hydrarg. oxidum flavum, Hydragyrum ammoniatum, *U. S.*, *Br.;* Hydrarg. iodidum rubrum, Liquor hydrarg. perchlor., and Lotio hydrarg. flava, *Br.*

Physiological Action.—*On Plants and Animals:* A solution of 1 part of this salt in 1000 of water prevents the germination of seeds and the communicability of the vaccine virus, and destroys the life of plants, leeches, and fish immersed in it. Marey's experiments led him to conclude that no other agents possess a germicide power equal to that of corrosive sublimate. "To-day," he remarks, "it clearly ranks first of all the known agents as a disinfectant" (*Jour. Am. Med. Assoc.*, i. 199). Introduced into the connective tissue, it is absorbed, and occasions the same symptoms and lesions of gastro-intestinal inflammation as if it had been given by the mouth. These symptoms include gastric pain, thirst, vomiting of mucus and blood, and death by convulsion or exhaustion. The lesions vary from slight redness to complete softening of the mucous membrane of the stomach; similar ones may be found in the intestine, and especially in the rectum.

On Man: Poisoning by corrosive sublimate may be produced by its external application as well as by its being taken internally. A solution of it applied to the unbroken skin has repeatedly caused symptoms of poisoning, such as an acrid taste in the mouth, irritation of the œsophagus, vomiting, epigastric pain, constriction of the chest, and a small and irregular pulse. When the skin is not whole the same and more aggravated effects arise, including those of severe local irritation, and the absorption of mercury is proved by the salivation that ensues, and sometimes by the deposit of mercury upon articles of gold worn next the skin. Poisonous doses of this salt cause constriction and severe burning pain in the fauces, œsophagus, and stomach, with retching and the vomiting of mucus, bile, and blood; the abdomen grows painful under pressure; there is tenesmus, and sometimes there are bloody stools. Intense thirst, a quick, frequent, and small pulse, labored breathing, a cold and clammy skin, and scanty or suppressed urine, are also observed. Death may occur within a few hours or may be delayed for several weeks. If recovery takes place the stomach and bowels remain irritable for a long time. After death from this poison the stomach is contracted and the mucous membrane of the œsophagus, stomach, and small intestine is occasionally injected and sometimes ulcerated. Excessive doses convert the gastric mucous membrane into a soft pulp. After death from 60 grains of this salt the kidneys are said to have been very large and heavy, not flattened, but almost cylindrical, and gorged with blood (*Boston Med. and Surg. Jour.*, Nov. 1879, p. 781). Smaller but not fatal doses present the above symptoms in a milder form and degree, and sometimes, although rarely, cause salivation. Indeed, of all mercurial compounds, this one is least apt to salivate when taken by the stomach. The presence of a large proportion of table-salt in the food is said to prevent in a great measure the absorption of the bichloride, while a moderate proportion of salt promotes its absorption. The latter may have been the cause of its toxical effects in the case of a man who took two pills which contained $\frac{1}{3}$ grain (Gm. 0.02) with $\frac{2}{3}$ grain (Gm. 0.04) of chloride of sodium. He was attacked with violent vomiting, colic, and purging, his pulse became thready, his extremities cold, and his features sunken. He, however, recovered (Kobryner). It is related that a woman after taking 3 drachm doses of "liquor hydrarg. perchlor." (*Br. P.*), each containing $\frac{1}{16}$ grain of corrosive sublimate, was attacked with persistent vomiting and had a temperature of 104° F. (*Practitioner*, xxix. 18).

Medical Uses.—Corrosive sublimate has never lost the pre-eminence which it shared with calomel of being one of the best internal remedies for *syphilis*. In general, it is found not to salivate unless given in doses of at least $\frac{1}{2}$ grain twice a day, but even in smaller doses it should be guarded by being associated with some syrup, bitter extract, or opium, and taken directly after meals. To prevent its decomposition in solution, it should be given along with muriate of ammonia, in the proportion of 1 grain of the bichloride to 5 grains of the latter salt. To this solution alcohol should be added in the proportion of 1 part to 10. It is preferable to prescribe as many daily doses of the medicine as the patient takes meals, in order to lessen the chances of gastro-intestinal irritation. In appropriate quantities this preparation is undoubtedly the best in infantile syphilis. About $\frac{1}{90}$ grain (Gm. 0.003) should be given in solution three times a day, and generally prescribed in a syrup or mixed with one when administered. If diarrhœa occurs, it should be corrected by diminishing the frequency or the size of the dose and by adding to it a minute proportion of laudanum. Baths of the bichloride have been used to cure syphilis, and with very great success; they are not apt to salivate, but the irritation of the skin they occasion renders them objectionable. The salt has also been employed hypodermically, but if it is more efficacious in this manner than when given internally, the inconvenience of repeating the operation and the severe local effects produced by it have caused the method to be abandoned by the greater number of syphilologists. According to Martineau, the latter objection is obviated by using an ammoniated peptonate of the bichloride of mercury, but his method has not been successful in the hands of others (*Bull. de thérap.*, ci. 91; ciii. 89). It must be added, however, that some, like Letnik, believe that the subcutaneous injection of mercury will supersede all other methods of treating syphilis, because it enables the physician to graduate the dose of the medicine—because, also, it dispenses with baths and frequent changes of linen, does not hinder the patient from pursuing his usual calling, and shortens the duration of the treatment. The salt preferred by him was "chloride of mercury with sodium chloride," but he did not make any experiments with mercury albuminate (*Edinb. Med. Jour.*, xxviii. 370). The peptonated bichloride was claimed by Terillon in 1880, and was still maintained by Martineau in 1882, to possess all the advantages hitherto attributed to it, including a rapid improvement in the general nutrition and the constitution of the blood; but it has been alleged, on the other hand, that its use hypodermically is very painful and irritating, and that its cures are not more radical than those obtained by innuction or by the internal administration of mercury (*Bull. de thérap.*, xcix. 150; *Med. Record*, xx. 684; *Bull. et Mémoires de la Soc. de thérap.*, Oct. 1882, p. 188). In 1881 the albuminate was introduced, and its efficacy was stated to have been equal, if not superior, to that of the peptonate, while it was free from the objections urged against that preparation (Gourgues, *Bull. de* *thérap.*, cii. 49). It has been claimed that a solution of $\frac{1}{4}$ gr. of the bichloride (Gm. 0.016) in an ounce (Gm. 32) of water is of great efficacy, both topically and internally, in the treatment of *diphtheria*. The dose used internally was $\frac{1}{32}$ gr. every one or two hours. An examination of the reports upon this subject suggests that the treatment, even if inoperative by itself, would be safer than the perturbative method for which it was in most instances substituted.

FORMAMIDATE OF MERCURY has been recommended for treating *syphilis* hypodermically by Liebreich (1882). In solution it causes neither local irritation nor salivation, according to this authority; but others have not found it so innocuous, and, indeed, object to it on account of the inflammation it excites. It has been used in a solution of 1 : 100, of which the amount injected daily varied from Gm. 0.5–1, equal to Gm. 0.005–0.010, or gr. $\frac{1}{12}$ to $\frac{1}{4}$, of the salt.

In various diseases of the *skin* solutions of corrosive sublimate are useful topical applications, but the strength of the preparation should be carefully regulated, and none should be employed if the skin is broken. *Psoriasis*, when inveterate, has been successfully treated by baths containing corrosive sublimate, the patients taking from 30 to 40 baths, kept at a lukewarm temperature, and remaining immersed from a half to three-quarters of an hour (Voss and Sperk, *Med. News and Abs.*, June, 1881, p. 356). A solution of 15 grains (Gm. 1) of the salt in a pint of water, or, still better, in 2 fluidounces of dilute alcohol and 14 fluidounces of water, forms a very efficacious lotion in many cases of *acne*, especially in the form which affects the noses of certain women at their menstrual periods; in *chloasma;* in lentigo and the discolorations of the skin which go under the general name of *freckles;* in *prurigo pudendi* as a palliative, and in *pityriasis* usually as a cure. A solution of 2 grains in an ounce of water is one of the best agents for destroying *pediculi pubis*, and is most efficiently applied with a fine-tooth comb. *Malignant pustule* is said to be treated more efficiently than by any other method with corrosive sublimate applied to the raw surface of a crucial incision made through the hardened tissues. *Ozæna*, especially of syphilitic origin, is benefited by the injection into the nostrils of weak solutions of the bichloride containing 1 or 2 grains (Gm. 0.06–0.12) to the ounce (Gm. 32) of water, or by a weaker solution applied with the nasal douche. In chronic vaginal *leucorrhœa* a similar application is sometimes useful. The nasal injection is objectionable, owing to the danger of the medicine being swallowed. Syphilitic *condylomata* have been successfully treated by washing them with a solution of common salt, and then sprinkling calomel powder over them. This method is said to be less painful than the direct application of corrosive sublimate (Nussbaum).

The inhalation of an atomized solution of Gm. 0.01 of the bichloride of mercury in Gm. 100 of distilled water (gr. $\frac{1}{6}$ in f℥iij) is stated to have cured *fetid bronchitis* (*Centralbl. f. d. ges. Ther.*, ii. 61).

In the subacute and chronic forms of muscular and also of articular *rheumatism* a very gentle but sustained mercurial action will sometimes put an end to the lingering stiffness of the joints. For this purpose minute doses of the bichloride in compound syrup of sarsaparilla will be found appropriate. In chronic rheumatic *arthritis* it is said that baths of the bichloride and compresses wet with solutions of the salt have sometimes produced cures of this intractable disease. It is recommended that a full bath should contain from 3 to 8 drachms (Gm. 12–32) of the salt. The many possible dangers from so large a quantity of a poisonous liquid should condemn its use for a disease in which its utility is so questionable.

HYDRARGYRI CHLORIDUM MITE, *U. S.*—MILD CHLORIDE OF MERCURY.

Hydrargyri subchloridum, Br.; *Hydrargyrum chloratum*, P. G.; *Hydrargyri chloridum, Hydrargyrum chloratum (muriaticum) dulce, Mercurius dulcis, Calomelas, Chloruretum (Chloretum) hydrargyrosum.—Calomel*, E., Fr., G.; *Mercurous chloride, Subchloride (Protochloride) of mercury*, E.; *Protochlorure (Sous-muriate) de mercure, Mercure doux*, Fr.; *Quecksilberchlorür*, G.

Formula Hg_2Cl_2 (or HgCl). Molecular weight 470.2 (or 235.1).

Preparation.—Take of Sulphate of Mercury 10 ounces; Mercury 7 ounces; Chloride of Sodium, dried, 5 ounces; Boiling Distilled Water a sufficiency. Moisten the sulphate of mercury with some of the water, and rub it and the mercury together until globules are no longer visible; add the chloride of sodium, and thoroughly mix the whole by continued trituration. Sublime by a suitable apparatus into a chamber of such size that the calomel, instead of adhering to its sides as a crystalline crust, shall fall as a fine powder on its floor. Wash this powder with boiling distilled water until the washings cease to be darkened by a drop of sulphide of ammonium. Finally, dry at a heat not exceeding 212° F., and preserve in a jar or bottle impervious to light.—*Br.*

Mercuric sulphate is first mixed with the requisite quantity of mercury to form mercurous sulphate, Hg_2SO_4, and afterward with chloride of sodium. On heating the mixture reaction takes place between the two salts, resulting in the production of mercurous chloride, which sublimes, and sodium sulphate, which remains behind; $Hg_2SO_4 + 2NaCl$ yields $Hg_2Cl_2 + Na_2SO_4$. If these vapors are cooled and condensed in a small space, white or yellowish-white crystalline masses are obtained, which should be finely powdered. To avoid this operation, the condensation is directed to be effected in a large chamber, whereby a fine crystalline powder is obtained; it is condensed in a similar form, but still finer and as a still softer powder, by injecting steam into the condensing-chamber while the sublimation is in progress. Calomel prepared in this way is designated in the German Pharmacopœia as *Hydrargyrum chloratum vapore paratum*, and is known in France as *Calomel à la vapeur.* Water being at the same time condensed, it will hold any corrosive sublimate in solution which may have sublimed with the vapors of calomel. It is for the purpose of removing the same impurity that the ordinarily-condensed calomel requires to be washed with water as long as mercuric chloride is dissolved, which is indicated by the filtrate producing a white turbidity with ammonia or a black one with sulphydrate of ammonium. A current of cold air injected into the condensing-chamber will precipitate the calomel vapors as a soft powder in a manner similar to that produced by steam.

Very finely-divided calomel, *Hydrargyri chloridum mite præcipitatione paratum*, known in France as *Précipité blanc* (which should not be confounded with ammoniated mercury), is obtained by gradually adding a not too concentrated solution of mercurous nitrate to a solution containing an excess of sodium chloride, digesting the mixture for a short time, and washing the precipitate thoroughly with water. Wöhler (1854) proposed the reduction of corrosive sublimate in solution by sulphurous acid and by warming the mixture. Good results and nearly the theoretical quantity of calomel are obtained, according to Sartorius (1855), if the corrosive sublimate has been dissolved in 80 parts, or, according to Stein (1857), in 45 parts, of water. Concentrated solutions yield only one-half the mercury as calomel.

Besides calomel manufactured in the United States, 2400 pounds were imported in 1875, and 8177 pounds in 1881.

Properties.—Calomel is a heavy, fine, smooth, and impalpable white powder, which under the microscope is observed to consist of minute needle-shaped crystals, but when prepared by levigating the crystallized mass it forms irregular fragments of crystals. These two varieties are usually met with in commerce. Calomel obtained by precipitation is in very minute particles, either crystalline or amorphous, but on account of its more energetic action is rarely used. The salt is without action on test-paper, is entirely inodorous and tasteless, and is not altered in the dark on exposure to the air; but if kept in the light it gradually acquires a gray or blackish color, indicating decomposition. Its density is about 7.0, but varies somewhat as prepared by different processes. When heated it sublimes completely without previous fusion. It is insoluble in water and other simple solvents, but boiled with water it is slowly decomposed into metallic mercury and mercuric chloride. Solutions of the fixed alkalies and alkaline earths decompose it, with the formation of soluble chlorides and black mercurous oxide Hg_2O (see LOTIO HYDRARGYRI NIGRA); ammonia-water also colors it black, but the resulting compound has the composition NH_2Hg_2Cl. When mixed with a dry caustic alkali, alkaline earth, or an alkali carbonate, and heated, decomposition takes place, metallic mercury being produced. Moist calomel is reduced to the metallic state by many metals either in the cold or on being warmed, soluble chlorides and metallic mercury being formed. Boiling nitric or sulphuric acid dissolves calomel, with disengagement of nitric oxide or sulphurous acid vapors and the production of mercuric chloride and nitrate or sulphate. Boiling concentrated hydrochloric acid dissolves mercuric chloride and leaves mercury; in the diluted state, and heated in contact with the air, mercuric chloride is slowly dissolved without separation of mercury. Calomel left in contact with solution of ammonium chloride is gradually converted into mercuric chloride, which dissolves; the decomposition occurs more rapidly with a concentrated solution and at a somewhat elevated temperature. Potassium and sodium chlorides have a similar effect, but react more slowly. According to Jolly's observations (1878), corrosive sublimate is also formed from calomel in the presence of hydrochloric acid, citric acid, alkalies, their carbonates, and alkaline earths, but not with calcium carbonate or with sugar which is absolutely free from lime. Chlorine-water converts calomel into corrosive sublimate. With potassium iodide a green powder is produced containing mercurous iodide. When triturated with impure sugar some corrosive sublimate is formed.

Tests.—Calomel should volatilize when heated, without leaving any residue (absence of fixed impurities). Heated with potassa solution, it should turn black, without evolving the odor of ammonia (absence of ammonium compounds). Agitated with warm distilled water or alcohol, the filtrate should not be colored by sulphuretted hydrogen, nor yield a white precipitate with silver nitrate (absence of mercuric chloride), nor should it on evaporation leave any residue (absence of fixed soluble impurities). "When moistened with water and placed upon a piece of bright iron, it should not produce a black spot within 1 minute (absence of corrosive sublimate)."—*P. G.* Agitated with diluted acetic acid, the filtrate should not be affected by sulphuretted hydrogen or silver nitrate (absence of ammoniated mercury).

Off. Prep.—Lotio hydrarg. nigra, *Br.;* Pilul. antimonii comp. (Hydrarg. subchlor. comp.), *U. S.*, *Br.;* Pilul. catharticæ comp., *U. S.;* Unguent. hydrarg. subchlor., *Br.*

Physiological Action.—The action of calomel does not materially differ from that of uncombined mercury (see HYDRARGYRUM); it is, however, rather more irritating, and in excessive doses may cause active vomiting and purging. Among the anomalous effects of calomel is a cutaneous erythema. In the case of an adult male three doses of about 3 grains each occasioned, besides the erythema, malaise, photophobia, hoarseness, fever, thirst, and insomnia (*Boston Med. and Surg. Jour.*, April, 1880, p. 420). It is a remarkable fact that dogs cannot endure, without experiencing hypercatharsis, a third of the doses of calomel which are administered to the youngest children (Bretonneau). No mercurial is so apt to occasion salivation. This and other effects are by no means constantly proportioned to the dose of the medicine; and since it is certain that it must first undergo solution before it can either act locally or be absorbed, the mode in which these results are brought about becomes of interest and has been variously stated and explained. The prevalent hypothesis regarding this point is, that the alkaline chlorides convert the calomel into corrosive sublimate, rendering it soluble and absorbable—an opinion which, considering the poisonous properties of that compound, seems irrational.

The cholagogue action ascribed to mercury, and especially to calomel, was an invention of the British physicians in India, who long accepted the doctrine that large doses of calomel diminish the vascularity of the gastro-duodenal mucous membrane, and dissolve the inspissated mucus investing it and obstructing the gall-ducts, and that small doses of the medicine are absorbed and through the blood promote the secretion of bile. But a careful repetition of their experiments proved that *large doses of calomel, as well as small doses, lessen the biliary secretion*, and that *among purgative medicines mercury in every form is the very one that tends least to augment the discharge of bile.* It seems to be agreed that all purgatives, whether they increase the biliary secretion and excretion or not, tend to hurry forward the bile through the intestinal canal, and thereby prevent its reabsorption after combination with the results of gastric digestion. In this manner mercury becomes a cholagogue, not by stimulating the liver to increased secretion, but by carrying off the bile already secreted, preventing its reabsorption, and thereby diminishing whatever evils may arise from an excessive amount of bile in the liver and in the system generally. It has long been believed that a proof of the cholagogue action of calomel is to be found in the darker color of the stools during its administration, which have hence been called "calomel stools;" and although one or two experimenters have recently reached the same conclusion, yet the more probable opinion is that the color in question is due to the presence of subsulphide of mercury in the dejections, and that even the natural brown color of the feces is produced, not by the bile, which is all reabsorbed in the small intestine, but by a special excretion of the colon. On the whole, the most probable conclusion upon this subject is expressed in these words: "Calomel is not a cholagogue, but diminishes the secretion of bile."

Medical Uses.—When the cure of *syphilis* was believed to depend upon profuse mercurial salivation, calomel was generally employed to produce that effect. But at the present day this action of calomel, along with its tendency to purge, has caused it to be less frequently used than formerly. If prescribed at all, it should be in very small and repeated doses, and the frequency of its administration determined by its effects upon the mouth, the bowels, and the course of the disease. These remarks apply to indurated chancres as well as to secondary symptoms.

Much has been written both for and against the use of calomel in *typhoid fever*, but a careful study of its history seems to show—1, that it is most useful when given in the forming stage of the disease and in purgative doses; and 2, that it is peculiarly mischievous in all cases which tend to assume an ataxic or an adynamic type. In other words, it is to be placed, in relation to typhoid fever, in the same category as other purgatives, among which the salines have been proved to be eminently useful in the first period of the disease. It is very probable that calomel, acting as a purgative, assists in removing the poisonous material from the bowel, and possibly tends to destroy it if it be a ferment, while, owing to its imperfect solubility, the medicine may serve as a protective to the mucous glands of the small intestine. It has been recommended to administer calomel in small and repeated doses, and so as slightly to affect the gums, about the height of the disease, when the tongue grows dry, the abdomen tympanitic, and the mind dull; but if we know anything about the nature of these symptoms, it is that they are signs of increased exhaustion of the nervous system and poisoning of the blood, and therefore the very last to be treated by a medicine which tends directly to aggravate such conditions. The period at which these phenomena appear, only to subside again in three or four days in the natural course of the disease when it tends to recovery, is the one in which the medicine is supposed to be indicated, and the reason assigned for its use probably results, therefore, from an error of observation.

At one time calomel was held to be a specific in *yellow fever*—according to some, if prescribed in large doses; according to others, if given in small doses intended to produce its constitutional effects. Experience has condemned both methods as not only useless, but injurious. The same may be said, but not so absolutely, in regard to *remittent fever;* the necessity of "unloading the portal circulation," which purgative doses of calomel were supposed to effect, does not now appear so imperative as it did to the theorists of thirty or forty years ago; but the gastro-duodenal inflammation and the engorged state of the liver are undoubtedly allayed by alvine evacuants, among which calomel is one of the best, because it is one of the least irritating, particularly if followed by copious saline draughts in divided portions. The constitutional action of calomel in this disease is no longer sought by judicious physicians.

During the last century, and indeed until within a few years, calomel was used by English and American physicians in all *inflammatory* diseases with complete faith in its efficacy. Borrowed originally from the treatment of acute hepatitis in hot climates, it was applied in England to a totally different order of diseases (plastic inflammations), and gradually came to be regarded as a specific in most of them. Subsequently, this empirical practice was supposed to find a rational justification when it appeared that mercury diminished the coagulability of the blood by lessening the proportion of its fibrin, and still later, when it appeared that the medicine directly diminished the proportion of red globules in the blood. The former effect was probably, indeed, only a consequence of the latter. But, although it seemed to be proved that mercury thus restricted inflammatory action and its consequences, it was not proved that their restriction by this means was necessary to cure the disease, and it was even rendered probable that the antiphlogistic use of calomel involved more danger than advantages. Extensive observation has now demonstrated that, with one or two possible exceptions, inflammatory affections may be cured quite as rapidly, and much more safely and agreeably, without mercury than with it, while the dangers involved in the antiphlogistic use of the medicine are so serious as to condemn it whenever a safer remedy can be substituted for it.

Of acute inflammations, for whose treatment calomel has been long supposed essential, may be mentioned *pericarditis*, *endocarditis*, *pleurisy*, *pneumonia*, *peritonitis*, *meningitis*, and *hepatitis*. It is now apparently determined that none of these diseases, as a rule, require calomel for their cure, and that most of them are aggravated by it. In regard to *peritonitis*, it may be added that as the disease is never idiopathic, at least in adults, and never primary unless traumatic, pathology confirms what clinical observation demonstrates—that mercury is unsuited to its cure. Acute *hepatitis* is not now, as formerly, indiscriminately treated by calomel in tropical climates, where alone the disease is frequently observed. The use of mercurial and of other purgatives appears to be beneficial in the early stage of the disease, but not through any specific operation. There are good grounds for suspecting that in hot climates the repeated administration of calomel in divided doses leads to the formation of abscess of the liver. *Meningitis*, like peritonitis, is always a secondary disease when not traumatic, depending upon a specific poison in epidemic cerebro-spinal meningitis, upon the rheumatic poison in another class of cases, upon tubercle in a third, etc. In no form of meningitis is calomel of any avail, unless it may be so in certain exceptional cases of the tubercular variety; and, although it must be confessed that diagnostic difficulties obscure the subject, still, in the present state of our knowledge, mercury stands next to iodine in the promise of doing good. In regard to pleurisy, pneumonia, pericarditis, and endocarditis the case is somewhat different. In their acute forms mercury is probably unnecessary, and, considering its liability to abuse, should not be employed; but when their acute stage has passed and the products of inflammation show no tendency to be absorbed, mercury sometimes hastens this consummation in a remarkable degree, even when all other medicines have failed to abate the hectic or asthenic symptoms or diminish the physical evidences of the causes that produce them. Especially is this the case when the local lesion is engrafted upon a syphilitic constitution. When under this dyscrasia alone the lung becomes solidified, simulating tubercular infiltration, a carefully-conducted course of mercury will often dissipate the local signs of disease and restore the general health. Calomel is worse than useless in acute articular *rheumatism;* it neither mitigates the disease nor prevents its complications. In certain cases of subacute and chronic rheumatism involving the ligaments of the joints and rendering the latter stiff and painful on motion, a course of very small doses of calomel will sometimes act beneficially; but more advantage may be derived from iodide of potassium. Several cases published by Dr. Ormsby illustrate the advantages of calomel in membranous *dysmenorrhœa* when given so as slightly to affect the gums (*Med. Record*, xx. 597). Simpson formerly attained the same end by means of pessaries medicated with mercurial ointment (*Clinical Lectures*, Amer. ed., 1863, p. 109). In *metritis*, both acute and chronic, calomel and opium are generally administered with supposed advantage. In diseases of the *kidney*, whether acute or chronic, mercury is a mischievous medicine. *Iritis*, although it may, in its simple form, recover without mercury, is more readily cured by calomel and opium internally, and mercurial ointment, with extract of belladonna or the instillation of atropia, topically. Syphilitic iritis should always be treated by the internal use of calomel, if not by mercurial inunctions.

In *jaundice* depending upon engorgement of the liver or upon obstruction of its ducts with thick bile saline purgatives are the appropriate remedies, but the English custom of first administering calomel or blue pill prevails in this country. It is very doubtful whether the mercurial renders the purgative treatment more efficient. It can do no harm as an occasional remedy, but is very mischievous if habitually taken.

Among mucous inflammations, *pseudo-membranous laryngitis*, or true croup (and not diphtheria, which we hold to be a totally different affection), is treated by calomel internally and by mercurial inunctions, in the belief that under its operation exudation-matter will form less densely and adhere less tenaciously, and hence be rejected by coughing or by vomiting more readily. The question of their efficacy is difficult to solve, for the cases of the disease differ widely among themselves in the thickness and tenacity of the membrane and in the extent of its deposit. But in a disease with such fatal tendencies even a doubtful remedy should not be rejected. In *syphilitic laryngitis*, which is generally ulcerative, calomel, or mercury in some form, is indispensable. In acute *bronchitis* which shows no tendency to decline at the usual period of subsidence small doses of calomel repeated until the mouth begins to feel its effects will often promote the cure; and in the chronic form of the same disease, with dyspnœa and bronchorrhœa depending upon thickening of the bronchial mucous membrane, the same method is often very efficient. In acute *dysentery* calomel has been used as a purgative and in small or so-called alterative doses. There appears to be no doubt that in the sthenic form of the disease purgative doses of calomel, if given in the forming stage, will modify the course of the disease, just as salines, rhubarb, and ipecacuanha will. There is no reason to attach any special importance to calomel as such. Its virtue resides chiefly in its mild evacuant and protective action. In this disease calomel in small or fractional doses is most useful when associated with ipecacuanha, and least so when combined with opium. The advantage of the latter combination consists mainly in its negative virtue of protecting the patient from perturbative measures. It is most suitable when the acute stage has begun to decline and after a judicious evacuant treatment has mitigated the severity of the attack. A similar remark is perhaps justifiable in regard to the calomel treatment of epidemic *cholera*. The huge doses of the drug which were originally used by the British East India surgeons have long ago been condemned, as well as the other elements of their crude therapeutics. If calomel has shown any special virtues in epidemic cholera, it has only been when it was administered in doses of 1 or 2 grains every 5 or 10 minutes, with 1 or 2 drops of laudanum in each of the first few doses. Knowing, as we do, the utter loss by the stomach of its absorbing function in this disease. the method in question really amounts to a negative treatment, and this, it is pretty well settled, is more efficient than any of the active methods which have prevailed. The hostile influence of mercury upon the lower forms of animal life explains the propriety of using calomel purges in some cases of *lumbricoid worms*. But the possibility of its poisonous action on the system renders it less eligible for this purpose than other direct vermicides.

It is perhaps even truer of calomel than of other mercurials, that it should be very cautiously exhibited to persons suffering under a scrofulous, tuberculous, or cancerous cachexia or to those who have begun to exhibit the infirmities of old age or who are known to be morbidly susceptible to its poisonous influence.

In an ointment—calomel ʒj, lard ℥j (Gm. 4 to Gm. 32)—calomel is sometimes applied locally in the treatment of limited *scaly eruptions*, and in powder it has been used to destroy *maggots* infesting wounds in hot weather. In the latter form also it has been applied to *ulcers of the cornea*, but is not strongly to be recommended for this purpose. Schlaefke warns against the application of calomel to the conjunctiva of patients taking iodide of potassium. This salt is then abundantly contained in the tears, and converts the calomel into iodate and iodide of mercury, which in solution exert a caustic action (*Med. News and Abst.*, April, 1880, p. 211).

Administration.—Calomel is most conveniently given mixed with a little syrup or enclosed in wafers. As a purgative *dose*, from 5 to 20 grains (Gm. 0.30–1.30) may be administered. Children require larger doses, in proportion to their age, than adults. To produce its constitutional action, of which the first sign is usually a metallic taste in the mouth or soreness of the gums, 1 or 2 grains (Gm. 0.05–0.10) may be given three times a day, with $\frac{1}{8}$ grain of opium; but still smaller doses, more frequently repeated, as $\frac{1}{10}$ or $\frac{1}{12}$ grain (Gm. 0.005–0.006) every hour, will affect the system more promptly.

HYDRARGYRI CYANIDUM, *U. S.*—CYANIDE OF MERCURY.

Hydrargyrum cyanatum, P. G.; *Hydrargyrum borussicum*, *Mercurius cyanatus s. borussicus*, *Cyanuretum hydrargyricum*.—*Mercuric cyanide*, *Cyanuret of mercury*, E.; *Cyanure* (*Bicyanure*, *Prussiate*) *de mercure*, Fr.; *Cyanquecksilber*, *Quecksilber-Cyanid*, G.

Formula $HgCy_2$ or $Hg(CN)_2$. Molecular weight 251.7.

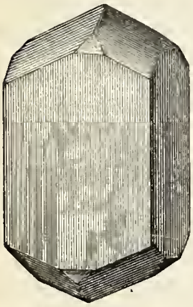
Cyanide of mercury should be kept in well-stopped bottles, protected from light.

Preparation.—The process recommended by the U. S. P. 1870 consists in dissolving oxide of mercury in hydrocyanic acid, the latter being prepared as the first step by acting upon potassium ferrocyanide with sulphuric acid. (See ACID. HYDROCYANICUM, page 66.) On agitating it with mercuric oxide a combination is effected, resulting in the production of mercuric cyanide and water; $2HCy + HgO$ yields $HgCy_2 + H_2O$. Should an excess of mercuric oxide be present, it will combine with the cyanide to mercuric oxycyanide, $HgO.HgCy_2$, which is converted into cyanide by the addition of a reserved portion of hydrocyanic acid; an excess of the latter does not change the nature of the product, and is volatilized on evaporating the liquid. When the clear liquid has been sufficiently concentrated it is set aside in a cool and dark place to crystallize, and the crystals are dried, protected from the light.

This is not the only process, but the most convenient one, by which mercuric cyanide may be obtained. On boiling pure ferrocyanide of iron with mercuric oxide, mercuric cyanide enters into solution; should the filtrate contain iron, it must be evaporated to dryness, the residue again taken up with water, and the solution evaporated to crystallization. On boiling potassium ferrocyanide with a proper quantity of mercuric sulphate, a complex reaction will take place, resulting finally in the production of metallic mercury and of a solution containing mercuric cyanide, potassium sulphate, and ferric sulphate, to be separated by crystallization from diluted alcohol. $7HgSO_4 + 2K_4FeCy_6 = Hg + 6HgCy_2 + 4K_2SO_4 + Fe_23SO_4$.

Properties.—Mercuric cyanide is in colorless or white quadrangular prisms, which are inodorous, have a bitter metallic taste, and are permanent in the air if the light be excluded. The salt is soluble at 15° C. (59° F.) in 12.8 parts of water (*U. S.*, *P. G.*) and in 14.5 (*P. G.*) or 15 (*U. S.*) parts of alcohol, also in 3 parts of boiling water and in 6 parts of boiling alcohol, but is quite sparingly soluble in absolute alcohol. The solutions have a neutral reaction to test-paper. The aqueous solution is not decomposed by nitric or dilute sulphuric acid, but hydrochloric acid liberates hydrocyanic acid, recognizable by its odor, and mercuric chloride remains in solution; it yields a black precipitate with sulphuretted hydrogen, but does not give the ordinary reactions for mercuric salt or cyanide when tested with alkalies, potassium iodide, or silver nitrate, double compounds, mostly crystalline, being formed, which are more or less freely soluble in water. The salt is blackened by exposure to the light, and when carefully dried and heated is decomposed into mercury and cyanogen, which is inflammable, burning with a purplish flame; but when rapidly and strongly heated the crystals decrepitate violently, and black paracyanogen is first produced before the whole is finally dissipated, and in the presence of moisture carbonic acid, ammonia, and hydrocyanic acid are evolved. When mixed with an equal weight of iodine and heated in a dry test-tube, two crystalline sublimates are obtained, the lower one consisting of mercuric iodide, being yellow and becoming red on cooling, while the upper one, consisting of cyanogen iodide, is white and has a penetrating acrid odor.

FIG. 151.



Crystal of Mercuric Cyanide.

Tests.—Mercuric cyanide dissolved in water should not impart a brown color to turmeric-paper (absence of mercuric oxycyanide). "A 5 per cent. aqueous solution of the salt, when mixed with a dilute aqueous solution of iodide of potassium, should not yield a red or reddish precipitate soluble in excess of either liquid (absence of mercuric chloride)."—*U. S.* In the presence of a little chloride this test is apt to fail unless the potassium iodide solution be very cautiously added. A much better test is the following: "The solution of the salt in 20 parts of water, slightly acidulated with nitric acid, should not produce a white precipitate on the addition of test solution of silver nitrate."—*P. G.* The absence of salts of other metals is shown by the complete volatility by heat.

Medical Action and Uses.—Cyanide of mercury is a violent irritant poison, producing also extreme prostration and local cyanosis, and death by exhaustion. In other words, its action includes that of hydrocyanic acid as well as that of the irritant mercurial salts. It has been used in the treatment of syphilis. A German physician claims that when all the usual remedies for *diphtheria* had failed he succeeded in curing nearly all his cases by administering every hour $\frac{1}{28}$ grain of cyanide of mercury (*Times and Gaz.*, Jan. 1881, p. 101). The share of the medicine in the alleged result is more than problematical. No sufficient reason appears for retaining so dangerous a preparation among officinal medicines. 20 grains (Gm. 1.30) of it caused death in 10 days, and 2 grains (Gm. 0.10) a severe illness which lasted for 3 weeks.

HYDRARGYRI IODIDUM RUBRUM, *U. S., Br.*—RED IODIDE OF MERCURY.

Hydrargrum biiodatum rubrum, P. G.; *Deutoioduretum* (*Biniodidum*) *hydrargyri*, *Mercurius iodatus ruber*, *Ioduretum hydrargyricum*.—*Biniodide of mercury*, *Mercuric iodide*, E.; *Deuto-iodure* (*Bi-iodure*) *de mercure*, *Iodure mercurique*, Fr.; *Rothes Jodquecksilber*, *Quecksilberjodid*, G.

Formula HgI_2. Molecular weight 452.9.

Preparation.—Corrosive Chloride of Mercury 9 parts (540 grains); Iodide of Potassium 11 parts (660 grains); Distilled Water a sufficient quantity. Dissolve the corrosive chloride of mercury in 150 parts (150 drachms or 20 fluidounces) of warm distilled water, and the iodide of potassium in 30 parts (30 drachms or 4 fluidounces) of distilled water, and filter the solutions separately. Add the solution of corrosive chloride of mercury, when cold, to the solution of iodide of potassium, constantly stirring. Collect the precipitate on a filter, wash it with distilled water until the washings cease to give a precipitate with test solution of nitrate of silver, and dry it between sheets of bibulous paper at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles.—*U. S.*

Take of perchloride of mercury 4 ounces; iodide of potassium 5 ounces; boiling distilled water 4 pints. Dissolve the perchloride of mercury in 3 pints, and the iodide of potassium in the remainder of the water, and mix the two solutions. When the temperature of the mixture has fallen to that of the atmosphere decant the supernatant liquor from the precipitate, and, having collected the latter on a filter, wash it twice with cold distilled water and dry it at a temperature not exceeding 212° F.—*Br.*

Mercuric chloride and potassium iodide, when mixed in the proportion of the weight of 1 molecule of the former to 2 of the latter salt, decompose each other into mercuric iodide, which precipitates, and potassium chloride, which remains in solution; $HgCl_2 + 2KI$ yields $HgI_2 + 2KCl$. The British and German Pharmacopœias use the two salts in the proportion of 4 to 5, which is a slight excess of the potassium salt over the theoretical quantity, but is generally necessary in practice, owing to the small percentage of impurities always present in commercial iodide of potassium. But even if both salts be absolutely pure, the proportions of the U. S. P. are wrong, and the resulting iodide is apt to be contaminated with chloride. By calculation it is found that 4 parts of mercuric chloride require for complete decomposition 4.898 parts of potassium iodide, or 9 parts of the former require 11.02 parts of the latter salt. When following the first process given above the precipitate should be permitted to settle, and solution of potassium iodide should be dropped into the supernatant liquid as long as a turbidity is produced. Adding the mercuric chloride to the potassium iodide prevents the formation of a sparingly-soluble compound until the former salt is used in excess. By mixing the two solutions cold the red iodide is separated in the form of powder, but when the hot solutions are mixed and slowly cooled beautiful crystals are obtained. In either case the yield should be about 60 per cent. over the weight of the corrosive sublimate used.

Properties.—Mercuric iodide is a scarlet-red crystalline powder or is in brilliant crystals. It is permanent in the air if kept in the dark or in diffused daylight, but acquires a brownish tint in the sunlight. It is inodorous and nearly tasteless, a metallic taste being slowly developed when kept upon the tongue. On being heated to above 150° C. (302° F.), it turns yellow, but on cooling readily resumes its red color under various influences. It fuses near 240° C. (464° F.) to an amber-colored liquid, and at a higher heat sublimes to bright-yellow tabular crystals, which, after cooling, are again converted into the prismatic or octahedral red crystals. The salt is very sparingly soluble in cold or hot water, little so in ether and diluted nitric acid, but more freely soluble in hydriodic or hydrochloric acid, in potassium iodide or chloride, in many ammonium salts, in solutions of mercuric salts, in chloroform, fixed oils, hot carbon disulphide, etc. It dissolves in 130 parts of cold and in 15 (*U. S.*) or 20 (*P. G.*) parts of hot alcohol, crystallizing on cooling; on pouring the alcoholic solution into cold water the salt separates as a fine yellow powder, remaining suspended in the liquid and gradually turning red. The solutions are colorless, and are partly decomposed by potassa solution, a portion of the mercury being deposited as mercuric oxide, the remainder forming a soluble iodide of potassium and mercury. On heating the salt with solution of soda and glucose or sugar of milk, metallic mercury will be precipitated, and on heating it with sulphuric acid and black oxide of manganese, vapors of iodine will be given off. When a hot solution of potassium iodide is saturated with mercuric iodide and then allowed to cool, one-third of the latter salt crystallizes on cooling; the remainder is obtained, on further concentration, as yellow prisms, which are soluble in alcohol and ether, but are partly decomposed by water. The crystals are *mercuric potassium iodide* $(2KI.HgI_2)3H_2O$, more generally known as *iodohydrargyrate of potassium*, and are likewise formed on adding mercuric chloride to an excess of potassium iodide.

Tests.—Impurities, if present, are readily detected by the residue left on subliming the salt (red oxide of lead and other non-volatile compounds) and on dissolving it in hot alcohol (vermilion, etc.). The cold alcoholic solution should be colorless and without acid reaction (mercuric chloride), and on the addition of ammonia should merely acquire a brown color, but not be precipitated (mercuric chloride). Distilled water, on being agitated with the salt and filtered, should not be affected by hydrosulphuric acid (metallic salts) nor by solution of silver nitrate (soluble chlorides, iodide, etc.).

Pharmaceutical Uses.—The observation of Nessler (1856) of the effect of ammonia upon solutions of mercuric iodide has resulted in the discovery of a very delicate reagent for minute quantities of ammonia or ammonia salts, known as the

Nessler Reagent.—It is made by dissolving 50 Gm. of potassium iodide in a little boiling distilled water, and adding to it, carefully, sufficient boiling hot concentrated solution of mercuric chloride until the red precipitate formed is no longer redissolved on agitation; the liquid is decanted and filtered, and the filtrate mixed with 200 Gm. of potassa dissolved in a small quantity of water; when cold the mixture is diluted to the measure of 1 liter by the addition of distilled water. The addition of 5 Ccm. of cold saturated solution of corrosive sublimate is recommended by some, but is not necessary. (See also AQUA AMMONIÆ, p. 235.) It will be observed that this is a solution of mercuric potassium iodide in caustic potassa. On the addition of ammonium salt this is decomposed by the potassa, ammonia is liberated, and reacts now with the double iodide and another portion of the potassa, resulting in the formation of brown insoluble dimercur-ammonium (NHg_2) iodide, potassium iodide, and water, as will be seen from the equation $NH_3 + 2(KI.HgI_2) + 3KHO = NHg_2I + 5KI + 3H_2O$. If the ammonia is present in minute quantity, the color is best observed by looking through the column of the liquid contained in a tall test-tube and placed on white paper.

Winckler (1830), Von Planta (1846), and Groves (1858) observed the behavior of solutions of the double iodide upon solutions of vegetable alkaloids, which led F. F. Mayer (1862) to the adoption of a tenth normal solution, now known as

Mayer's Solution.—It is prepared by dissolving 13.546 Gm. of mercuric chloride and 49.8 potassium iodide in sufficient distilled water to obtain 1 liter of liquid. The present test solution of iodide of mercury and potassium (see *List of Reagents*) is somewhat weaker, but otherwise almost identical with this. The test is applied in acidulated aqueous solutions, since ammonia would also be precipitated if an alkaline liquid was used. 1 Ccm. of this test liquid precipitates of

Aconitine,	0.0267 Gm.	Coniine,	0.00416 Gm.	Quinine,	0.0108 Gm.
Atropine,	0.0145 “	Morphine,	0.020 “	Quinidine,	0.0120 “
Brucine,	0.0233 “	Narcotine,	0.0213 “	Strychnine,	0.0167 “
Cinchonine,	0.0102 “	Nicotine,	0.00405 “	Veratrine,	0.0269 “

The end of the precipitation is determined by filtering a few drops of the liquid tested upon a watch-crystal, and by placing a small drop of the test solution alongside, allowing the two to run together. For colorless solutions which are free from chlorides, etc. an excess of the test liquid may be used, and the excess determined in the filtrate by a standard solution of silver nitrate.

Delffs' Reagent (1854) is a solution of potassium iodide saturated with mercuric iodide; its behavior to alkaloids appears to differ to a certain extent from the preceding.

Off. Prep.—Liq. arsen. et hydrarg. iodidi, *U. S.;* Unguent. hydrarg. iodidi rubri, *Br.*

Medical Action and Uses.—Biniodide of mercury is a powerful irritant poison; 2 grains (Gm. 0.12) of it taken with a drachm (Gm. 4) of iodide of potassium caused violent gastric pain, coma, stertor, opisthotonos, and convulsion. As an internal remedy it is superfluous, and dangerous unless very cautiously used. It may, however, be given in constitutional *syphilis* in a solution of iodide of potassium, and in the *dose* of $\frac{1}{16}$ grain (Gm. 0.004) cautiously increased. As a caustic it has been applied to the treatment of *lupus*, but is inferior to other preparations used for this purpose. It has also been employed in ointments in the proportion of 1 : 20, and from that to 1 : 5, as a stimulant or almost caustic application to *syphilitic diseases of the skin*, to chronic glandular indurations, fistulous *ulcers*, and chronic inflammation of the *joints;* in the proportion of 1 : 100 for granular eyelids, etc. This preparation has been administered subcutaneously. Yvon claims for the solution made according to the following formula that it does not irritate and that it is readily absorbed: Biniodide of mercury 1 Gm.; iodide of potassium 1 Gm.; neutral phosphate of soda 2 Gm.; distilled water 50 Ccm. (*Practitioner*, xxvii. 207).

HYDRARGYRI IODIDUM VIRIDE, *U. S.*—GREEN IODIDE OF MERCURY.

Hydrargyrum iodatum, P. G.; *Hydrargyrum iodatum flavum, Hydrargyri proto-ioduretum, Ioduretum hydrargyrosum.—Yellow iodide or Proto-iodide of mercury, Mercurous iodide*, E.; *Proto-iodure de mercure, Iodure mercureux*, Fr.; *Quecksilberjodür, Gelbes Jodquecksilber*, G.

Formula Hg_2I_2 (or HgI). Molecular weight 652.6 (or 326.3).

Preparation.—Mercury 8 parts (400 grains); Iodine 5 parts (250 grains); Alcohol a sufficient quantity. Pour about 3 parts (150 grains or 3 fluidrachms) of alcohol into a mortar containing the mercury, add the iodine in several successive portions, and triturate the mixture, adding sufficient alcohol from time to time to keep the mass constantly moist, and taking care that it shall neither become too hot nor be exposed to light during the various steps of the process. Continue the trituration until all globules of mercury have disappeared and the mixture has become nearly dry and has acquired a greenish-yellow color. Then add sufficient alcohol to reduce the whole to a thin paste; pour this into a bottle, let it stand for several days, and then wash the iodide twice with about 50 parts (2500 grains or 6¾ fluidounces) of alcohol each time, and decant the washings. Transfer the iodide to a filter, and continue washing with alcohol until the washings are no longer affected by hydrosulphuric acid. Lastly, dry the product in a dark place between bibulous paper at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles, protected from light.—*U. S.*

Take of mercury 1 ounce; iodine 278 grains; rectified spirit a sufficiency. Rub the iodine and mercury in a porcelain mortar, occasionally moistening the mixture with a few drops of the spirit, and continuing the trituration until metallic globules are no longer visible and the whole assumes a green color. The product thus obtained should be dried in a dark room on filtering-paper by simple exposure to the air, and preserved in an opaque bottle.—*Br.*, 1867.

Mercury and iodine are contained in mercurous iodide very nearly in the proportion 8 : 5, as directed by the United States and German Pharmacopœias; this gives a slight excess of mercury, amounting to less than 2.5 per cent. of the weight of the iodide. The French Codex directs the proportion 5 : 3, ensuring a still greater excess of mercury. The proportion used by the British Pharmacopœia is that of the atomic weights of the two elements. On bringing iodine and mercury together they unite, forming mercurous or mercuric iodide according to the proportions employed. It appears, however, that a portion of mercuric iodide is always formed, and, being poisonous, requires to be removed or reduced to mercurous iodide by long trituration. The former is the course adopted by the pharmacopœias, *Br.* 1867 excepted, the removal being accomplished by washing the product with alcohol. Washing the product with solution of sodium chloride in place of alcohol has been proposed; but, while mercuric iodide is thereby dissolved, the mercurous iodide is perceptibly decomposed, particularly at a somewhat elevated temperature. Le Canu (1877) states the washing to be unnecessary if the mercury is first finely divided by trituration with a little alcohol before the iodine is added in small portions. But even in this case we would prefer the subsequent employment of alcohol to ensure the absence of the red iodide.

It has been repeatedly proposed to prepare mercurous iodide by double decomposition of calomel or other mercurous salt with iodide of potassium; the results, however, are never satisfactory, since by the action of the potassium salt some red iodide is formed and metallic mercury liberated. (See a paper in *Amer. Jour. Phar.*, 1857, p. 11.)

Properties.—Mercurous iodide which has not been washed with alcohol is dark green, but having been freed from the red iodide by either hot or cold alcohol it is greenish-yellow, and becomes gradually of a brighter yellow color. It is inodorous, tasteless, not crystalline when viewed under the microscope, and has the specific gravity 7.64. On exposure to the light, red iodide is formed; it turns dark-green, and finally black, the decomposition being accelerated by moisture. When heated it turns red-brown, and finally sublimes, without leaving any residue, yielding mercury and red crystals of mercuroso-mercuric iodide, $Hg_2I_2.2HgI_2$, which become yellow on cooling. Mercurous iodide is almost insoluble in water and entirely insoluble in alcohol and ether; it dissolves in ammonia, leaving a gray residue; in potassium iodide, leaving mercury and yielding a solution of mercuric potassium iodide; in sodium hyposulphite, leaving mercury and yielding a colorless liquid which on heating deposits dark-red mercuric sulphide.

Tests.—After shaking 1 Gm. of the salt with 10 Ccm. of alcohol the filtrate should be scarcely colored by hydrosulphuric acid; on being dropped into water it should produce only a very faint cloudiness, and on evaporation should leave only a minute trace of red iodide. Fixed impurities, if present, remain behind if a portion is heated to redness in a porcelain crucible.

Medical Action and Uses.—Green iodide or protiodide of mercury is chiefly used in the treatment of constitutional *syphilis*, and is preferred above other preparations by several eminent syphilographers. It should be given in doses of from ¾ to 1 grain (Gm. 0.04–0.06) three times a day, and gradually increased until these doses are trebled or more, provided that neither salivation nor diarrhœa occurs. It is less apt than calomel to produce such effects. The following formula is much employed: ℞. Protiodide of mercury, extract of lettuce, each 45 grains (Gm. 3); extract of opium 15 grains (Gm. 1); confection of roses 90 grains (Gm. 6). Mix, and divide into sixty pills, one, two, or three to be taken daily.

HYDRARGYRI OXIDUM FLAVUM, *U. S., Br.*—Yellow Oxide of Mercury.

Hydrargyrum oxydatum via humida paratum, P. G.; *Hydrargyrum oxydatum præcipitatum (vel flavum).—Precipitated oxide of mercury, or Mercuric oxide*, E.; *Oxyde mercurique jaune (précipité), Deutoxyde jaune de mercure*, Fr.; *Präcipitirtes (Gelbes) Quecksilberoxyd*, G.

Formula HgO. Molecular weight 215.7.

Preparation.—Corrosive Chloride of Mercury 1 part (2 oz. av.); Solution of

Potassa 9 parts (18 oz. av. or 17 fluidounces); Distilled Water a sufficient quantity. Dissolve the corrosive chloride of mercury in 100 parts (200 oz. av. or 12 pints) of warm distilled water and filter the solution. Pour the filtrate into the solution of potassa, previously diluted with 100 parts (200 oz. av. or 12 pints) of distilled water, stirring constantly. Set the liquid containing the precipitate aside for 24 hours. Then decant the supernatant clear liquid from the precipitate, and wash the latter repeatedly by the affusion and decantation of distilled water, using about 100 parts (200 oz. av. or 12 pints) of water each time. Continue the washing on a strainer until the washings cease to be affected by test solution of nitrate of silver. Let the precipitate drain, and dry it between bibulous paper in a dark place at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles, protected from light.—*U. S.*

Take of perchloride of mercury 4 ounces; solution of soda 2 pints; distilled water a sufficiency. Dissolve the perchloride of mercury in 4 pints of distilled water, aiding the solution by the application of heat, and add this to the solution of soda. Stir them together; allow the yellow precipitate to subside; remove the supernatant liquor by decantation; thoroughly wash the precipitated oxide on a calico filter with distilled water, and finally dry it by the heat of a water-bath.—*Br.*

On mixing solutions of mercuric chloride and potassa of soda, sodium chloride, water, and mercuric oxide are formed, the latter being precipitated; $HgCl_2 + 2HKO$ yields $2KCl + H_2O + HgO$. The alkali must be in excess, lest some mercuric oxychloride be precipitated with the oxide, and it is advisable to pour the mercuric solution into the alkali. 9 parts of potassa solution of 5 per cent. contain .45 part of KHO, while theory requires .414 part for the mercuric chloride ordered, or an excess of a little over 8 per cent. This is ample, provided the potassa solution be free from carbonate or nearly so, otherwise brown mercuric carbonate would also be precipitated. The dilution of the liquids ordered by the U. S. P. is excessive; 1 part of mercuric chloride to 20 parts of water gives a sufficiently diluted solution, that of the German Pharmacopœia being 1 : 10. Of great importance for the appearance of the oxide is the temperature at which it is prepared; the lower it be kept the brighter will be the yellow color, while with an elevation of temperature the red tint will become more decided. The German Pharmacopœia allows 30° C. (86° F.) as the highest limit during all stages of the process. The yield is about 0.79 part (a little over 1½ oz. av.).

Properties and Tests.—Yellow mercuric oxide is a heavy, smooth, impalpable, amorphous, yellow or reddish-yellow powder, which is not altered in the air, but on exposure to light becomes dark, in consequence of partial reduction to mercurous oxide; when heated it assumes a red color, and at a sufficiently strong heat is decomposed and volatilized like red mercuric oxide. It has the specific gravity 11.0, is without odor or taste, and is insoluble in water and other simple solvents, but dissolves readily and completely without effervescence in diluted hydrochloric or nitric acid. When digested or agitated with a solution of oxalic acid it forms white mercuric oxalate (difference from red oxide). Heated with an alcoholic solution of mercuric chloride, it speedily turns black from the formation of an oxychloride; red mercuric oxide slowly undergoes a similar change (Roucher). It should be completely volatilized by heat, and its solution in diluted nitric acid should become merely opalescent on the addition of test solution of silver nitrate.

Off. Prep.—Oleatum hydrargyri, Unguent. hydrarg. oxidi flavi. *U. S.*

Medical Uses.—This preparation is used only as an external remedy to stimulate indolent *ulcers*, especially of venereal origin, and as an application in granular and ulcerated conditions of the *eyes*. It is applied chiefly in an ointment, which is officinal.

HYDRARGYRI OXIDUM RUBRUM, *U. S.*, *Br.*—RED OXIDE OF MERCURY.

Hydrargyrum oxydatum, P. G.; *Hydrargyri nitrico-oxidum*, *Mercurius corrosivus* (*præcipitatus*) *ruber*, *Oxydum hydrargyricum*.—*Peroxide of mercury*, *Red precipitate*, *Red mercuric oxide*, E.; *Deutoxide* (*Peroxyde*) *rouge de mercure*, *Oxyde mercurique*, *Précipité rouge*, *Poudre de Jean de Vigo*, Fr.; *Rothes Quecksilberoxyd*, *Rother Präcipitat* (*Quecksilber-Präcipitat*), G.

Formula HgO. Molecular weight 215.7.

Preparation.—Take of Mercury, by weight, 8 ounces; Nitric Acid 4½ fluidounces; Water 2 fluidounces. Dissolve half the mercury in the nitric acid diluted with the water, evaporate the solution to dryness, and with the dry salt thus obtained triturate the remainder of the mercury until the two are uniformly blended together. Heat the mixture in a porcelain dish, with repeated stirring, until acid vapors cease to be evolved, and when cold enclose the product in a bottle.—*Br.*

In this process nitrate of mercury is formed as the first step; this may be directly decomposed by heat, or, as directed above, it is previously mixed with an additional quantity of mercury, which, during the subsequent heating, is oxidized at the expense of the nitrate. In both cases the color changes to yellow and then to red, red fumes of nitric peroxide being given off. Occasionally a minute quantity of nitrate remains undecomposed. The decomposition is as follows: $2(Hg2NO_3) + Hg_2 = 4HgO + 2N_2O_4$. Should the nitric acid employed be contaminated with hydrochloric acid, a corresponding quantity of mercuric chloride, and finally oxychloride, would be formed, the latter remaining with the mercuric oxide as an impurity. The last traces of acid may be removed by boiling with diluted soda solution.

Properties.—When made on a small scale it is a finely granular powder of a yellowish-red color without lustre, but made in larger quantities it is obtained in the form of bright brownish-red shining crystalline scales, which on trituration yield a fine orange-red powder, the yellow tint increasing with the fineness of the powder. It is inodorous, and at first tasteless, but slowly develops a metallic taste. It is insoluble in water and other simple solvents, but completely soluble in diluted hydrochloric and nitric acids. It is permanent in the air if kept in the dark, but on exposure to light it becomes superficially black—however, much more slowly than the yellow oxide. When heated its color is changed to dark-red, brown, and near 400° C. (750° F.) to black, the original color reappearing on cooling; but at a red heat it is completely decomposed into metal and oxygen.

Tests.—When strongly heated, mercuric oxide should not give off red nitrous vapors (absence of nitrate), and when heated to full redness it should be decomposed and volatilized, without leaving any residue (absence of non-volatile impurities). On being agitated or digested with a solution of oxalic acid in 10 parts of water, the red color should not be changed (difference from yellow mercuric oxide). Treated with diluted nitric acid in excess, it should yield a colorless solution. A red-colored residue would indicate the presence of brick-dust or of vermilion, the latter being volatilizable by heat; a brown residue (of puce-colored oxide of lead) would prove an adulteration with red lead, and the nitric acid solution would contain lead, recognizable by the white precipitate appearing on the addition of a little sulphuric acid. The nitric acid solution should remain undisturbed or merely become faintly opalescent on the addition of test solution of silver nitrate (absence of chloride). If to 1 Gm. of red mercuric oxide 5 Ccm. of water be added, followed by 5 Ccm. of sulphuric acid, and after cooling 1 Ccm. of concentrated solution of ferrous sulphate be carefully poured upon the acid mixture, a brown color should not be produced between the two liquids (absence of nitrate).

The preparation formerly officinal in various pharmacopœias as *Mercurius præcipitatus per se* or *Mercurius calcinatus* was red oxide of mercury in the form of crystalline scales, which are obtained by keeping metallic mercury in a loosely-covered flask or retort at a temperature near its boiling-point. The process required several weeks for its completion.

Off. Prep.—Unguentum hydrarg. rubri, *U. S.*, *Br.*

Medical Action and Uses.—Red precipitate is a powerful irritant, and taken internally may act as a corrosive poison. Its application to ulcers, wounds, etc. has been frequently followed by its constitutional operation, including salivation. The last-named effect is said to be unusual when the medicine is administered internally, as it sometimes has been in the treatment of *syphilis*, in the *dose* of one-tenth of a grain (Gm. 0.006) twice a day and gradually increased. Externally, it is generally used in the form of an ointment, but sometimes it is also applied as a fine powder, mixed with sugar, to indolent *syphilitic ulcers*, *condylomata*, etc., and even to *granular eyelids*, *pannus*, *ulcers*, and *opacities of the cornea.* But for the latter purposes the officinal ointment of red precipitate is generally preferable. A mixture of 1 part of red oxide of mercury with 50 parts of finely-powdered white sugar was much used by Trousseau as a snuff in cases of *ozæna*, especially when of syphilitic origin. Before it is applied the nostrils should be cleansed by the nasal douche.

HYDRARGYRI SUBSULPHAS FLAVUS, *U. S.*—YELLOW SUBSULPHATE OF MERCURY.

Hydrargyri sulphas flava, U. S. 1870; *Hydrargyri subsulphas, Hydrargyrum sulphuricum flavum, Mercurius emeticus flavus, Sulphas hydrargyricus flavus, Turpethum minerale*.—*Basic mercuric sulphate, Oxymercuric sulphate, Subsulphate of mercury, Turpeth mineral*, E.; *Sulfate trimercurique, Sulfate jaune de mercure, Turbith minéral*, Fr.; *Basisches Quecksilberoxydsulfat, Mercurioxysulfat, Mineralischer Turpeth*, G.

Formula $2HgO.HgSO_4 = Hg(HgO)_2SO_4$. Molecular weight 727.1.

Preparation.—Mercury 10 parts (5 oz. av.); Sulphuric Acid 5 parts (2½ oz. av.); Nitric Acid 4 parts (2 oz. av.); Distilled Water a sufficient quantity. Upon the mercury, contained in a capacious flask, pour the sulphuric acid, then gradually add the nitric acid previously mixed with 3 parts (1½ ounces) of distilled water, and digest at a gentle heat until reddish fumes are no longer given off. Transfer the mixture to a porcelain capsule, and heat it on a sand-bath, frequently stirring, until a dry, white mass remains. Reduce this to a fine powder, and throw it, in small portions at a time and constantly stirring, into 200 parts (100 oz. av. or 6 pints) of boiling distilled water. When all has been added continue the boiling for 10 minutes, then allow the mixture to settle, decant the supernatant liquid, transfer the precipitate to a strainer, wash it with warm distilled water until the washings no longer have an acid reaction, and dry it in a moderately warm place.—*U. S.*

Mercuric sulphate is formed by the action of hot sulphuric acid upon metallic mercury, the combination being effected with decomposition of a portion of the sulphuric acid (see HYDRARGYRI SULPHAS), or, as in the above process, with decomposition of nitric acid; $Hg_2 + 2H_2SO_4 + 2HNO_3$ yields $2HgSO_4 + 3H_2O + N_2O_3$. On adding this normal sulphate to boiling water it is converted into basic sulphate, while an acid sulphate remains in solution. The result varies somewhat, depending upon the amount and the temperature of the water. Using boiling water in the above proportions, the yield will be about 75 per cent. of the weight of the dry mercuric sulphate used. The same compound is also formed by slowly pouring a solution of mercuric nitrate into an excess of a boiling solution of sodium sulphate.

Properties.—Yellow subsulphate of mercury is a heavy bright lemon-yellow powder which has the specific gravity 6.44, is permanent in the air, inodorous, has a slight metallic taste, on heating becomes red, and yellow again on cooling; at a red heat it is completely volatilized, being at the same time decomposed into metallic mercury, oxygen, and sulphurous acid. It is insoluble in alcohol and ether, requires 2000 parts of cold and 600 parts of boiling water for solution (Fourcroy), is decomposed by potassa solution, yellow mercuric oxide being formed, and dissolves completely in sulphuric, nitric, or hydrochloric acid, the latter solution, according to Mohr, containing corrosive sublimate and free sulphuric acid.

Tests.—"The salt should be soluble in 20 parts of hydrochloric acid without residue (absence of mercurous salt)."—*U. S.* Lead, if present, will likewise remain undissolved. The presence of nitrate is detected by sulphuric acid and ferrous sulphate in the same manner as stated for red mercuric oxide. Non-volatile impurities are left behind on heating to bright redness.

Medical Action and Uses.—Turpeth mineral is a powerful irritant, and in sufficient doses may act as a corrosive poison, causing active erosion of the fauces, œsophagus, and stomach, and even sloughing of the first-named parts, as well as salivation. Several fatal cases of its use are recorded (STILLÉ, *Therapeutics*, 4th ed. ii. 769). In a recent instance a healthy child five months old died poisoned by about 5 grains of this preparation 11 hours after taking it. The reporter of this case refers to another with a like fatal issue (McPhedran, *Med. News*, xliii. 682). Drs. Randolph and Roussel report the cases of five men, each of whom had at first 5 grains, and later 3 grains, of the medicine. All of the patients were poisoned, but at last recovered. One of them was badly salivated (*Med. News*, xliv. 275). In spite of its grave effects, turpeth mineral has been used as an emetic in "croup," by which was probably meant *spasmodic laryngitis*. The employment of so dangerous a remedy in a disease which involves no danger to life is inexcusable. The emetic action of this preparation is the first stage of its poisonous operation. The *dose* fitted to produce that effect is from 2 to 3 grains (Gm. 0.13–0.20) for a child. Owing to its tendency to salivate, it should not be employed as an errhine. It seems to be a superfluous article of the materia medica.

HYDRARGYRI SULPHAS, *Br.*—SULPHATE OF MERCURY.

Hydrargyrum sulphuricum, Mercurius vitriolatus, Sulfas mercuricus.—Persulphate of mercury, Mercuric sulphate, E.; *Deuto-sulfate (Persulfate) de mercure, Sulfate mercurique,* Fr.; *Schwefelsaures Quecksilberoxyd, Mercurisulfat,* G.

Formula $HgSO_4$. Molecular weight 295.7.

Preparation.—Take of mercury, by weight, 20 ounces; Sulphuric Acid 12 fluidounces. Heat the mercury with the sulphuric acid in a porcelain vessel, stirring constantly until the metal disappears, then continue the heat until a dry white salt remains. —*Br.*

Mercury does not dissolve in cold sulphuric acid, but on heating the mixture sulphurous acid and watery vapors are disengaged, any excess of sulphuric acid is driven off, and the residue consists of mercuric sulphate; $Hg_2+4H_2SO_4$ yields $2SO_2+4H_2O+2HgSO_4$. This is now named *Hydrargyri persulphas*, with the above title as synonym.

Properties and Tests.—Mercuric sulphate is a heavy white crystalline powder which, on being mixed with a small quantity of water, is at first colored yellow, but after some time is converted into colorless shining prisms or silvery scales of the hydrated salt, $HgSO_4.H_2O$. A larger quantity of water decomposes it permanently into yellow basic sulphate. When heated to redness it is decomposed into mercury, oxygen, sulphurous acid, and mercurous sulphate, and is finally completely volatilized.

Pharmaceutical Uses.—It is employed for the preparation of turpeth mineral, corrosive sublimate, and calomel.

It is not used in medicine.

HYDRARGYRI SULPHIDUM RUBRUM, *U. S.*—RED SULPHIDE OF MERCURY.

Hydrargyri sulphuretum rubrum, U. S. 1870; *Hydrargyrum sulfuratum rubrum; Cinnabaris, Sulfuretum hydrargyricum.—Red sulphuret of mercury, Cinnabar, Vermilion, Paris red,* E.; *Sulfure rouge de mercure, Cinnabre,* Fr.; *Rothes Schwefelquecksilber, Quecksilbersulfid, Zinnober,* G.

Formula HgS. Molecular weight 231.7.

Preparation.—Take of Mercury 40 troyounces; Sublimed Sulphur 8 troyounces. To the sulphur, previously melted, gradually add the mercury, with constant stirring, and continue the heat until the mass begins to swell. Then remove the vessel from the fire and cover it closely to prevent the contents from inflaming. When the mass is cold rub it into powder and sublime.—*U. S.* 1870.

The preparation of vermilion is carried on in large establishments, and will hardly ever be attempted by the pharmacist except as an experiment. It may be obtained in the dry or humid way. The above process belongs to the former class, but a large excess of sulphur is directed, 6½ troyounces being sufficient for the quantity of mercury; the excess is volatilized before the cinnabar is condensed. If the black mass obtained in the first part of this process is digested with solution of potassa and potassium sulphuret at a temperature of about 45° C. (113° F.), it will be gradually converted into vermilion. This is also produced by digesting white precipitate with a solution of sulphur in ammonium sulphide or of sodium hyposulphite.

Cinnabar, native as well as artificially prepared, has been known from a remote period. Although in the early part of the eighteenth century it was stated to consist solely of mercury and sulphur, this was not conclusively proven until the beginning of the present century. Fuchs afterward showed that it has the same composition as the amorphous black mercuric sulphide, differing from it in being crystalline.

Properties.—Sublimed mercuric sulphide forms brilliant dark-red crystalline masses having a fibrous fracture; after levigation it is seen in commerce in the form of a bright scarlet-red, fine, inodorous, and tasteless powder. It has the spec. grav. 8.12, acquires a darker color on exposure to the sunlight, but remains unaltered in the dark. When heated to above 250° C. (482° F.) it becomes brown, then black, and finally volatilizes, and assumes its red color again on cooling; heated in contact with the air, it burns with a blue flame, emitting the odor of sulphurous acid. It is insoluble in water, alcohol, ether, hydrochloric or nitric or diluted sulphuric acid, cold concentrated sulphuric acid, or diluted alkaline solutions. Nitro-muriatic acid dissolves it without heat, with the separation of sulphur and the production of sulphuric acid and mercuric chloride. It dissolves in boiling sulphuric acid, forming mercuric sulphate and separating sulphur;

also in alkali sulphides containing potassa or soda. Metallic mercury is separated by heating vermilion with soda to redness; by boiling with water and iron or zinc; by zinc and warm diluted sulphuric acid, etc.

Tests.—Its complete volatility by heat ensures the absence of red lead and basic lead chromate (American vermilion); and when it is treated with warm solution of potassa the colorless solution, on being acidulated, should not yield a yellow or orange precipitate (absence of arsenic or antimony), nor should it produce a colored precipitate with acetate of lead (absence of chromates, iodides, or other sulphides). If agitated with warm diluted nitric acid, it should not turn brown (absence of red lead), nor should the filtrate be colored or become dark-colored on the addition of hydrosulphuric acid (lead) or of ammonia and ammonium sulphide (iron).

HYDRARGYRI SULPHURETUM NIGRUM, *s. Æthiops mineralis.* This preparation has been very properly discarded by the United States and British Pharmacopœias, but is still employed on the continent of Europe. It is made by triturating equal weights of mercury and sulphur until all metallic globules have disappeared. It forms a fine black and heavy powder, which, when viewed with a lens, does not show any globules of uncombined mercury. When heated upon a plate it takes fire and burns with a blue flame, without leaving any residue; heated in a test-tube, it yields a red sublimate of vermilion. When digested with hydrochloric acid, the acid liquid does not yield a white precipitate on being diluted with water (absence of antimony). Ethiops mineral is a mixture of black amorphous sulphide of mercury, HgS, with a large excess of sulphur. Triturated with an equal weight of sulphide of antimony, *æthiops antimonialis* is obtained.

Medical Action and Uses.—The red, like other metallic sulphides, is less irritating than the sulphates of the same metal. Indeed, there is much reason for believing that in its natural state it has no action at all. It is seldom used, and then only by fumigation, powdered cinnabar being strewn upon hot coals; the sulphuret is decomposed, and the fumes contain metallic mercury and sulphurous acid. The irritating action of the latter renders the method objectionable. As occasionally employed, the patient is enclosed in a wooden box with an aperture through which his head passes, so that he is not obliged to inhale the irritating fumes. This method is said to be a very efficient one, although not without the risk of salivating, causing congestion of the brain, etc.

Black sulphuret of mercury is no longer officinal in the German Pharmacopœia, and its activity as a mercurial has been doubted. It was considered to be especially adapted to persons of delicate constitution or feeble health, and was given in (relatively) very large doses, such as from 5 to 20 grains several times a day.

HYDRARGYRUM TANNICUM OXYDULATUM, the tannate of the protoxide of mercury, has been proposed by Lustgarten as a substitute for other mercurials in the treatment of syphilis, etc. In the dose of from 3 to 5 gr. (Gm. 0.25–0.30) a day it appears as mercury in the urine after the lapse of 24 hours. It does not salivate or disturb the stomach or bowels. In ten cases of various forms of constitutional *syphilis* its effects were quite as favorable as those of mercurial ointment (*Centralblatt f. d. ges. Ther.*, ii. 93).

HYDRARGYRUM, *U. S., Br., P. G.*—MERCURY.

Hydrargyrum vivum, *Mercurius vivus*, *Argentum vivum.*—*Quicksilver*, E.; *Mercure*, *Vif-argent*, Fr.; *Quecksilber*, G.

Symbol Hg. Atomicity bivalent. Atomic weight 199.7.

Origin.—Mercury became known before the Christian era, but long after silver and gold had been in use. It is principally obtained from New Almaden in California, from Peru, China, Idria in Austria, and Almaden in Spain. It is found to some extent in the metallic state in the form of minute or large globules, also in combination with oxygen, chlorine, selenium, etc.; but the principal ore for extracting it is *cinnabar.* 38,250 pounds of mercury were imported into the United States in 1877, and 597,898 pounds in 1882.

Preparation.—Most of the mercury is obtained by roasting the ore in a kiln. It is placed upon an arch of brickwork containing several openings, through which the flames pass, whereby the sulphur of the ore is ignited and burns, air being admitted at the same time; the heat thus produced volatilizes the mercury, the vapors of which, mingled with the smoke and sulphurous acid gas, are passed through a series of condensing-chambers, where the metal is condensed, the incondensable gases finally escaping through the flue. This is essentially the process as carried on at Idria and New Almaden;

likewise at Almaden, except that the vapors are passed through the so-called *aludels*, consisting of cylinders adapted to each other, first in a descending and then in an ascending direction, where most of the mercury is condensed and collects in a gutter placed under the angle, the remainder being condensed in a large terminal chamber, from which the gases pass into the flue. In the Palatinate the cinnabar is mixed with lime, and in Bohemia with hammerslag, and then distilled, sulphide of calcium remaining behind in the former, and sulphide of iron in the latter, case.

Mercury appears in commerce in cylindrical iron flasks containing 75 pounds each. In this condition it still contains small quantities of other metals, principally lead, which, however, do not interfere with its uses in the silvering of looking-glasses, in the amalgamation process for the extraction of gold and silver, nor in the preparation of some chemicals. For barometers and thermometers, as well as for some pharmaceutical preparations, a purification of the metal is required or advisable, and may be effected by distillation or by the following process directed in several European pharmacopœias:

HYDRARGYRUM DEPURATUM, S. PURIFICATUM. Take of Mercury 100 parts; Nitric Acid, Distilled Water, each 5 parts. Digest in a suitable vessel for 3 days, shaking frequently. Having poured off the acid liquid, wash well the mercury with distilled water, and dry it completely.

The operation is best conducted in a broad glass or porcelain vessel, so as to expose a very large surface of the metal to the action of the dilute acid; or, as proposed by L. Meyer, by allowing the mercury to run slowly in a fine stream into a long glass tube containing the diluted acid. Lead, iron, and other metals, being far more easily oxidized and dissolved than the mercury, are thereby removed, though a little of the latter likewise passes into solution. After washing, most of the water may be removed by bibulous paper. These metals may also be removed by agitating the crude mercury with concentrated sulphuric acid or with solution of ferric chloride, the latter process being preferable for operations on a small scale.

Properties.—Mercury is solid at a temperature of —39.44° C. (—39° F.), and crystallizes in octahedrons and needles, which are ductile and may be cut with a knife. At the ordinary temperature it forms a bright silvery, lustrous, inodorous, and tasteless liquid, which is very cohering, and not adhering to glass or paper unless it be impure, when small globules will *tail* or leave a streak upon it. When triturated with sugar, fat, various salts, oil of turpentine, etc., it is converted into a gray powder consisting of minute globules separated by the foreign substances and running together again on their removal; this finely-divided state is called the *extinction* or *killing* of mercury, and is accomplished in making mercurial ointment and several other officinal preparations. Mercury has at 4° C. (39.2° F.) the specific gravity 13.59, and at 15° C. (59° F.) 13.57. It boils at about 357.2° C. (675° F.), giving a colorless vapor of 6.98 spec. grav., and leaving no residue; it volatilizes very slowly even at the ordinary temperature. It is permanent at the ordinary temperature, the whitish pellicle which forms upon the surface of commercial mercury being due to the presence of foreign metals (lead, zinc, etc.). It unites directly with chlorine, bromine, and iodine, and dissolves completely even in dilute nitric acid, with the evolution of nitric oxide. All simple solvents and boiling hydrochloric and dilute sulphuric acids are without action upon it, but hot concentrated sulphuric acid dissolves the metal, sulphurous acid being given off. When heated to near its boiling-point in contact with the atmosphere it combines with oxygen, forming scales of red oxide.

Tests.—The purity of mercury is ascertained from its behavior and properties as described above. When mercury is agitated for a few minutes with the officinal solution of ferric chloride, which is free from ferrous chloride, the liquid should afterward not yield a blue precipitate on the addition of potassium ferridcyanide, which would result through the solution of a foreign metal and the reduction of some ferric to ferrous chloride; nor should the liquid, if necessary, after being acidulated with hydrochloric acid yield more than a mere trace of a colored precipitate on the addition of hydrogen sulphide. Hager's test for distinguishing the purified from crude mercury has been adopted by the U. S. P., as follows: "On boiling 5 Gm. of distilled water with 5 Gm. of mercury, and 4.5 Gm. (1.5 Gm., Hager) of hyposulphite of sodium in a test-tube for about 1 minute, the mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade (absence of more than slight traces of foreign metals)."

Oxides and Salts.—Mercury unites with oxygen in two proportions, and forms two series of salts, the *mercurous* and *mercuric.* All soluble salts of mercury are poisonous, have a strongly metallic taste, and mostly an acid reaction upon test-paper. The normal salts are usually white, and the basic salts yellow; treated with stannous chloride, phosphorous or sulphurous acid, or other deoxidizing agents, they are blackened, and finally reduced to metal. Their solutions deposit a silvery coating of metallic mercury upon a bright piece of metallic copper, and yield black precipitates with sulphuretted hydrogen and white ones with sodium phosphate. *Mercurous* salts yield black precipitates with potassa, ammonia, and, on boiling, also with alkaline carbonates. Hydrochloric acid causes a white precipitate of calomel, and potassium iodide separates a greenish-yellow deposit. *Mercuric* salts yield with potassa or soda, if added in insufficient quantity, brown-red, and if added in excess yellow, precipitates—with ammonia and ammonium carbonate white, and with potassium or sodium carbonate red-brown, precipitates. Hydrochloric acid does not disturb the solutions; potassium iodide causes a scarlet-red precipitate, which is soluble in an excess of either solution. All compounds of mercury are either volatilized or decomposed by heat.

Pharmaceutical Uses.—The following chemical compounds of mercury are officinal: Hydrarg. chlorid. corros. (perchloridum), Hydrarg. chlorid. mite (subchloridum), *U. S.*, *Br.;* Hydrarg. cyanidum, *U. S.;* Hydrarg. iodidum rubrum, Hydrarg. iodidum viride, Hydrarg. oxidum flavum, Hydrarg. oxid. rubrum, *U. S.*, *Br.;* Hydrarg. sulphas, *Br.;* Hydrarg. subsulphas flavus, Hydrarg. sulphuretum rubrum, *U. S.;* Hydrargyrum ammoniatum, *U. S.*, *Br.;* also the solutions: Liquor arsenici et hydrarg. iodidi, *U. S.;* Liquor hydrarg. nitratis (nitrat. acidus), *U. S.*, *Br.;* Liquor hydrarg. perchloridi, *Br.*

The following pharmaceutical preparations contain mercury, chiefly uncombined: Emplast. ammoniaci cum hydrargyro, Empl. hydrargyri, Hydrargyrum cum creta, *U. S.*, *Br.;* Linim. hydrargyri, *Br.;* Massa (Pilula) hydrargyri, *U. S.*, *Br.;* Suppositoria hydrargyri, *Br.;* Unguentum hydrargyri, *U. S.*, *Br.;* Unguentum hydrarg. comp., *Br.*

The following pharmaceutical preparations contain combined mercury: Lotio hydrarg. flava, Lotio hydrarg. nigra, *Br.;* Pilul. antimonii comp. (hydrarg. subchloridi comp.), *U. S.*, *Br.;* Pilul. catharticæ comp., *U. S.;* Unguent. hydrarg. ammoniati, *U. S.*, *Br.;* Unguent. hydrarg. iodidi rubri, *Br.;* Unguent. hydrarg. nitrat., *U. S.*, *Br.;* Unguent. hydrarg. oxidi flavi, *U. S.;* Unguent. hydrarg. oxidi rubri, *U. S.*, *Br.;* Unguent. hydrarg. subchloridi, *Br.*

Metallic writing-pencils have been prepared by melting together bismuth 90 parts and lead 70 parts, then adding mercury 8 parts, and casting in suitable moulds. By increasing the proportion of lead and mercury softer pencils, producing darker marks, are obtained.

Physiological Action.—In the following account we shall consider the action and uses of metallic mercury, and the effects which are common to it and a certain number of the compounds of the metal, referring the reader to those compounds for a description of their special operations:

On Animals: It has always been well known that mercury in every form is destructive of life in plants, insects, and small animals, and that its vapors prevent the development of the embryo in seeds and eggs. In the neighborhood of furnaces for smelting mercurial ores animals become cachectic, cows abort, and fish in contaminated streams lose their natural color. It has also long been known that mercury rubbed into the skin of an animal may destroy its life after having deranged all the functions, and may be extracted from the secretions during life and from the blood and tissues after death. Injected into the veins, it accumulates in the lungs on the venous side of the pulmonary circulation, and occasions there the formation of small abscesses; a similar effect in remote portions of the body is produced by the injection of metallic mercury into the arteries. The experiments of Von Mering upon animals in 1881 plainly showed an identity of the effects of mercury in them and in the human race (*Archiv f. experiment. Pathol.*, *etc.*, xiii. 86). In *acute* poisoning gastro-intestinal phenomena were prominent, including profuse watery and bloody stools, with tormina and tenesmus, and sometimes vomiting. Salivation was usual, but not invariable. The respiration was irregular and jerking, the muscular power greatly reduced, and in several cases tremor and excitability existed. Death was caused mainly by exhaustion, but sometimes occurred suddenly. The primary phenomena of the *chronic* form of mercurial poisoning were those of stomatitis: the mucous membrane of the mouth and the gums became swollen, the tongue was indented by the teeth, and the breath was fetid. Soon the appetite failed and diarrhœa set in, which in a few days became mucous and bloody. On the inside of the cheeks and below the tongue phagedenic ulcers formed with a gray coating, and the teeth were attacked with caries. A high grade of anæmia followed, with emaciation, loss of appetite, and debility; the action of the heart grew feebler, and death took place in collapse. During the whole process the animals were very irritable and tremulous. No paralysis was observed, but in some instances albuminuria. After death by *acute* poisoning the gastro-intestinal mucous membrance was hyperæmic and presented hæmorrhagic erosions, especially in the lower part of the small and in the large intestine, which also contained a bloody liquid. In some cases hæmorrhage had taken place in the heart-muscle and in the diaphragm, and there was hyperæmia of the mucous membrane of the cheeks and ecchymoses in the bladder. The liver and kidneys were congested, the blood dark and for the most part thick. In *chronic* poisoning there existed a high grade of gastro-intestinal catarrh, and ofttimes ulceration of the mucous membrane, but more frequently of the large than of the small intestine—in the former it was covered with diphtheritic exudation. Uniformly, ulcers of the cheeks and edges of the tongue existed, which were, however, rather wide than deep; the teeth were discolored and showed a tendency to caries. The liver and kidneys were hyperæmic. The experiments and observations of N. Popow (*Virchow's Archiv,* xciii. 351) prove that mercury, like arsenic and lead, tends to accumulate in the nervous system, and especially in the spinal marrow, where it gives rise to changes in the white as well as the gray central substance.

On Man: Metallic mercury has frequently been swallowed in quantities varying from several ounces to 2 pounds, generally for the purpose of overcoming an intestinal obstruction. Occasionally, but very rarely, it has salivated, and sometimes also by its bulk and weight it has ruptured a diseased bowel. It has been found repeatedly in the metallic form in the tissues of persons who had taken mercury or breathed an atmosphere impregnated with its fumes; and it has also been demonstrated in the secretions of the skin, the kidneys, and the mucous membranes, in the blood, milk, saliva, bile, and pus. It may be detected in the urine 8 weeks after the discontinuance of a constitutional course of mercury, and upon the skin after the use of a sulphurous bath. The absorption of mercury by the skin when mercurial ointment is applied by friction is no more an open question than the absorption of food and medicines by the stomach: the mode by which it is effected is not so evident. The present view is that metallic mercury, as soon as it comes into contact with the blood in the tissues to which it is applied, is changed into a soluble compound, which then is taken up to circulate through the system (Fürbringer, *Virchow's Archiv,* lxxxii. 491). The permanence of mercury in the system of those who have used the metal is shown by its having frequently been revived by the administration of iodide of potassium. Vajda and Paschkis, who studied this question thoroughly, have shown conclusively that in a large proportion (42 per cent.) of cases mercury may be found in the secretions of those who have been treated with it, and in one case fourteen years after the suspension of the treatment (*Phila. Med. Times,* x. 437). These results have been corroborated by Oberländer and by Schuster (*Amer. Jour. of Med. Sci.,* Oct. 1882, p. 574); but the latter could find no trace of the mineral in the feces after the lapse of a year. He thinks that little of it is excreted with the urine, and attributes the finding of it by others in the excretion to an erroneous interpretation of their experiments (*Zeitschrift f. klin. Med.,* vii. 80). Its absorption is illustrated on a large scale by the cachexia of the miners of and workers in mercury, and by the salivation and other specific effects produced on numbers of persons in an atmosphere accidentally contaminated by the emanations even of metallic mercury, and especially upon the inhabitants of districts near smelting-furnaces, among whom the proportion of abortions, stillbirths, and cachectic children is vastly in excess of that existing under other circumstances. All persons employed in trades which expose them to mercurial emanations, such as miners of mercury, gilders, mirror-makers, etc., are apt to be affected with a trembling palsy and other and fatal disorders of the nervous system.

The action of medicinal doses of the milder preparations of mercury (as blue mass and calomel) is first seen in an increase of the secretions, especially of the intestinal canal; but if the action be maintained, nutrition becomes impaired, as is shown by the tendency of newly-formed callus and other cicatricial matter to be absorbed, while the muscles waste, the skin grows pale, and œdema readily forms where the venous circulation is interrupted. These symptoms appear to denote an impaired crasis or a liquefaction of the blood, which, indeed, is further exhibited by a tendency to ecchymoses and to hæmorrhage. It would seem that, provided the dose of mercury be small, although large enough to cure syphilitic disease, its primary effect is not to diminish, but actually to increase, the proportion of the red corpuscles of the blood, no doubt by counteracting the morbid poison in that liquid. This was the conclusion of Keyes (*Amer. Jour. of Med. Sci.,* Jan. 1876, p. 17), who also inferred from his observations that mercury in small doses is a tonic (for a time at least) to individuals in fair health and not syphilitic, and in them increases the number of the red corpuscles. These general conclusions have been confirmed by the experiments of Schlesinger (*Archiv f. exper. Pathol., etc.*, xiii. 317), who found that dogs and rabbits might continue for a year to take small doses of ammonio-chloride of mercury (*Quecksilber chloridchlornatrium*) not only without impoverishing the blood, but with a considerable increase of the red corpuscles. When at various periods the animals were sacrificed, no lesion whatever was found, but the deposit of fat was everywhere increased. Nevertheless, no evidence of a tonic influence of the mercury was perceptible, such as follows the use of iron, and especially no increase of the discharge of urea. Schlesinger is disposed to conclude, not that small doses of mercury improve nutrition, but that they limit waste—*i. e.* oxidation. On the whole, it would seem that mercury, like all active agents, medicinal or dietetic, exerts two opposite actions —the one when the dose is small, and the other when it is large and physiologically excessive. The power of mercury in the latter case to lessen the coagulability of the blood makes its use injudicious when there is already a hæmorrhagic tendency, and especially in females who suffer from repeated and profuse menorrhagia. (The existing state of knowledge respecting the action of mercury is set forth by Dr. E. B. Bronson in *Med. Record*, 1881, xx. 505.)

Along with the evidences of impaired nutrition just pointed out, another occurs which is peculiarly characteristic of the action of mercury. This is salivation. It is apt to be preceded and accompanied by feverishness and nervous susceptibility. The first local evidence of its occurrence is usually a metallic taste in the mouth, with soreness of the teeth when the jaws are struck together. The breath has a characteristic fetor. A red line may be observed first along the gingival attachments of the lower incisors, and then of the remaining teeth. The gums, lips, cheeks, tongue, and fauces are more or less tumefied, and the tongue has a sodden look, with an impression of the teeth upon its edges. The salivary glands are swollen and tender, and there flows from the mouth a transparent, viscid liquid of alkaline reaction and a penetrating smell. When salivation is excessive and prolonged, ulcers are apt to attack the gums, cheeks, and fauces, and in healing may cause the adhesion of contiguous parts; the breath becomes insufferably fetid, the teeth loosen and may fall out, and caries may attack the remaining teeth, and even the maxillary bones. Children and infants are seldom salivated, but when they are so the effects are apt to be very severe. Salivation is partly a reflex effect of the ulcerative processes in the mouth, and partly the sign of a direct action upon the salivary glands which they share with all the glands of the body.

Under the constitutional operation of mercury the appetite fails and the bowels readily become loose; it is probable that the pancreatic secretion is augmented, and very improbable that the secretion of bile is increased. The belief which was general and implicit that mercury had some mysterious control over the liver, through which it increased or diminished the secretion of that organ at the physician's will, has given place to a very general scepticism in regard to the matter; and, indeed, it is asserted that, compared with ipecacuanha, aloes, podophyllin, euonymin, ioidin, sanguinarin, rhubarb, colocynth, senna, colchicum, scammony, and certain sodium salts, mercury manifests the least degree of cholagogue operation. Upon the nervous system the action of mercury is depressing, occasioning a morbid susceptibility to cold and a state of mental uncertainty and restlessness, with feebleness of the intellectual powers. In some cases muscular spasm or paralysis, pain, or anæsthesia has been observed. It also appears to be injurious to the fœtus in utero and to favor miscarriage. Among its constitutional effects are cutaneous eruptions, generally in the form of eczema, sometimes in that of a febrile rubeoloid eruption, and more rarely as an eruption of bloody bullæ. Deep, foul, and intractable ulcers sometimes occur; they are most common within the cavity of the mouth and throat, and may prove fatal by hæmorrhage or by exhaustion, the ulcerative process sometimes destroying the cheeks and the soft parts of the throat. It appears probable that mercury may give rise to periosteal nodes which sometimes advance to the destruction of the bones. Finally, when administered too freely and for too long a period, mercury may produce a general cachexia, of which the chief phenomena are these: the muscles lose their firmness, and waste; the complexion turns pallid and earthy; the breath is fetid, and the urine readily becomes so; and usually there is diarrhœa. The gums grow spongy; the hair falls out; the bones and joints suffer dull pains; œdema of the ankles or general dropsy may supervene; hæmorrhage from the nose, bowels, kidneys, or reopened wounds takes place; and hectic fever, with tubercular consumption, may terminate life.

The effects of mercury upon the skin, which are referred to in the last paragraph, may well be illustrated by the following singular case: A healthy woman of nervous temperament after taking a mercurial pill was attacked with itching and burning of the skin, which grew red and hot, and after some days began to desquamate in large flakes over the whole body. Two years afterward a similar cause produced analogous effects. Subsequently, she held in the hollow of her hand for a few moments a solution of corrosive sublimate, and, although the liquid was immediately thrown away and the hand thoroughly washed, within a week it became inflamed, cracked, and bleeding. On another occasion, having taken a bath at a boarding-house, and suffered in consequence with inflammation of the skin of the whole body, it was discovered that a lodger suffering from pediculi had also used the bath-tub after anointing herself with mercurial ointment (Watson).

To remedy, as far as possible, the mischiefs arising during a mercurial treatment, its use should be suspended in season, and attempts made by means of iodide of potassium, purgative mineral waters, and diaphoretics to hasten the elimination of the poison. The regimen should consist of nutritious food, protection from cold and dampness, and the cautious administration of iron. The local ulcerative lesions should be treated with washes of muriatic acid, chlorate of potassium, or nitrate of silver. A neglect of the regimenal, dietetic, and topical treatment of constitutional syphilis is responsible for many failures to cure the disease.

The mode of action of mercury, which may be inferred from the preceding summary of its effects, is the following: Being essentially non-nutritive, yet penetrating every tissue, it probably acts in small and transient doses as a stimulant of all organic processes, but in a little greater proportion and by continued use it impairs nutrition, hindering the formation of tissue on the one hand, and on the other hastening its destruction and elimination. At the same time it augments more or less the glandular secretions. It diminishes the proportion of fibrin, and, by its toxical action, the proportion also of the red corpuscles in the blood. Thus, hindering nutrition at every step of the latter action, mercury causes the waste of all the tissues, and especially of those least organized, as cicatrices and callus, and favors the removal of all plastic exudations. These effects are essentially morbid and destructive, and only incidentally and within varying limits can they become salutary.

Medical Uses.—It is probable that as much injury has been inflicted by the use of mercury in primary *syphilis* as good has been accomplished by its administration in the constitutional forms of the disease. And when it is considered that every simple sore following a suspected coition was apt to be treated as syphilitic by mercurialization of the system, it may be a question whether, on the whole, the medicine has not been more mischievous than useful. In regard even to true chancres, although mercurials will sometimes hasten their cure by lessening their induration, and may thereby postpone constitutional infection, it does not in any case prevent that result, nor even the enlargement of the inguinal glands. Moreover, in certain states of the primary sore and of the patient's system mercury aggravates the disease. Such is the case when the skin around the sore is very red, swollen, tense, and painful, or shows a tendency to gangrene—when the patient is anæmic, scrofulous, tuberculous, or scorbutic, or has been an habitual drunkard. Opinions differ in regard to treating pregnant syphilitic women with mercury; the better opinion is in favor of this measure for the sake of the child as well as the mother. But this judgment refers to secondary, not to primary syphilis.

Until comparatively recent times the treatment of constitutional syphilis consisted in the administration of mercury for the purpose of exciting profuse salivation, which was maintained for 4 or 5 weeks at a time. The disastrous consequences of this method, which had no other reason for its use than the hypothesis that the syphilitic poison was to be eliminated with the saliva, and which thus illustrated the folly and dangers of *a-priori* therapeutics, caused it at last to be abandoned, and it is now certain that mercury cures syphilis without salivation better than by means of it. The dose of mercury should at first always be small, and gradually increased until its effects on the disease begin to appear or some soreness of the gums occurs; it should then be continued in a diminished quantity, or even temporarily suspended if the symptoms begin to decline, but it should never be abandoned as long as any trace of the disease remains. This often involves a course of 6 months', or even of several years', duration; but it is safe, while the method of treatment with large doses of mercury is always hazardous. (Compare Gouguenheim, *Bull. et Mém. de la Soc. de thérap.*, 1883, p. 97.)

The treatment by inunction with mercurial ointment may be referred to here. It is one of the oldest modes of employing mercury in this disease, and is still a favorite hospital method, but it is too filthy for private practice, and it necessarily betrays the nature of the patient's disease. It, moreover, ruins all the body- and bed-clothing that is used. The advantages attributed to it are that it is much less likely to disorder the bowels than mercury taken by the mouth; it cures, also, more quickly and with less risk of injuring the constitution. It is chiefly appropriate to the treatment of syphilitic affections of the skin, and, next to these, but far less efficiently, to ulcerated states of the mouth and throat, and still less to syphilitic disorders of the nervous system. Syphilis of the bones and their annexes is more successfully treated with iodide of potassium. Before commencing mercurial inunction the patient should live for some days on simple food, use laxative medicine, and cleanse the skin thoroughly by warm bathing. Immediately afterward, in bed or near a warm fire in winter, the ointment should be methodically rubbed into the skin with the hand protected by a caoutchouc glove or a piece of softened pig's bladder. The places selected for friction should be used alternately or in succession, as the thighs, the armpits, the legs, the arms, etc., and if the part is hairy it should be shaven and the frictions made in the direction of the hairs. About 2 drachms (Gm. 8) should be rubbed in daily for 5 or 6 days, at the end of which time the patient should have a warm bath with soap and be allowed to quit his bed, but warmly clothed. After an interval of a week the same discipline should be renewed, and this generally suffices for a cure. The result is supposed to be quickened by the use of sudorific diet-drinks, such as the compound decoction of sarsaparilla. Mercurial inunction of syphilitic infants is conveniently performed by enveloping the trunk of the patient with a flannel band that has been smeared with mercurial ointment. The use of other mercurial compounds in syphilis is treated of in connection with the several preparations of the medicine, and also the hypodermic use of mercurial salts, which possesses all the advantages, with none of the special disadvantages, belonging to the method by inunction (*Centralblatt f. Ther.*, i. 355). Mercurial soap has been used in place of mercurial ointment, and with alleged success. It has a great advantage over the ointment in cleanliness (Oberländer, *Centralbl. f. Ther.*, i. 150).

In the greater number of *febrile* and *inflammatory* affections calomel is the form of mercury usually selected by those who believe mercurials appropriate to these diseases, but sometimes its action is supplemented by the use of mercurial ointment, as in acute *meningitis*, *pericarditis*, *hepatitis*, etc. In these cases it is generally applied upon a blistered surface. In *acute dyspepsia*, often accompanied with jaundice and produced by excesses in eating and drinking and a constipated habit, a superstitious belief prevails among English physicians and their American copyists that the sovereign and specific remedy is blue pill, followed by a saline cathartic. Other nations, it is true, relieve such symptoms by the saline alone or by rhubarb and aloes along with it. Whenever congestion of the liver is associated with enlargement of the spleen, the administration of blue pill or other mercurial is extremely apt to be followed by profuse salivation, and even by gangrene of the mouth. An apparent exception to this rule is the cure of malarial enlargement of the *spleen* by the external use of biniodide of mercury. Metallic mercury has been used to overcome *intestinal obstructions* supposed to be formed by invagination, and also to expel intestinal worms. A case of the former sort in which the expedient was successful occurred in 1879 (*Med. Record*, xvii. 121). Bettelheim has reported seventy cases "of intestinal stenosis, of which fifty-seven were relieved" by this expedient alone, and in six it saved the lives of the patients (*Phila. Med. Times*, xiv. 174). Mercurial ointment is probably the best remedy for *ascarides of the rectum*. It is generally used as an application around the eye in the treatment of acute *iritis*, along with the internal use of calomel. It is a valuable auxiliary also in the treatment of true *croup* (pseudo-membranous laryngitis), when it should, from the commencement of the attack, but only in primary and sthenic cases, be rubbed into the axillæ and the groins. It is of all medicines the least to be advised in *diphtheria*, which is always an asthenic disease. And yet that it has been so is shown by the sharp and well-merited criticism of Jacobi, who says, "That it should be recommended as a panacea in all classes and forms of diphtheria shows that common sense and sound judgment do not always prevail in the treatment of a disease where individualizing is of the utmost importance" (*A Treatise on Diphtheria*, p. 188). The source of this deplorable error is in confounding epidemic diphtheria with true membranous croup. Mercurial ointment relieves the pain and is said to subdue the inflammation in *paronychia*; it has an analogous effect in *erysipelas*; and there is reason to believe that it checks the development of *small-pox* pustules, and thereby tends to prevent their pitting. Metallic mercury has been successfully used to amalgamate with a *gold ring* which had become too tight for the finger, and to render it so brittle that it readily broke under presssure. The ring in such cases should first be cleansed with alcohol or ether.

Metallic mercury is seldom given internally, except as above mentioned and in the modified form of blue pill. (See PIL. HYDRARGYRI.)

HYDRARGYRUM AMMONIATUM, *U. S., Br.*—AMMONIATED MERCURY.

Hydrargyrum præcipitatum album, P. G.; *Hydrargyrum amidato-bichloratum (ammoniato-muriaticum)*, *Hydrargyri ammonio-chloridum*, *Mercurius præcipitatus albus.*—*White precipitate*, *Mercur-ammonium chloride*, E.; *Chloramidure de mercure*, *Oxychlorure ammoniacal de mercure*, *Lait mercuriel*, *Mercure précipité blanc*, Fr.; *Weisser Quecksilberpräcipitat*, *Quecksilber-Chloridamidid*, G.

Formula NH_2HgCl. Molecular weight 251.1.

Preparation.—Corrosive Chloride of Mercury 10 parts (5 oz. av.); Water of Ammonia, Distilled Water, each a sufficient quantity. Dissolve the corrosive chloride of mercury in 200 parts (100 oz. av. or 6 pints) of warm distilled water; filter the solution, and allow it to cool. Pour the filtrate gradually, and constantly stirring, into 15 parts ($7\frac{1}{2}$ oz. av. or $7\frac{1}{2}$ fluidounces) of water of ammonia, taking care that the latter shall remain in slight excess. Collect the precipitate upon a filter, and when the liquid has drained from it as much as possible wash it twice with a mixture of 20 parts (10 oz. av. or $9\frac{5}{8}$ fluidounces) of distilled water and 1 part ($\frac{1}{2}$ oz. av. or $\frac{1}{2}$ fluidounce) of water of ammonia. Finally, dry the precipitate between sheets of bibulous paper in a dark place, at a temperature not exceeding 30° C. (86° F.).—*U. S.*

The process of the German Pharmacopœia is in all respects identical with the foregoing, except that the washing of the precipitate is accomplished with distilled water instead of diluted ammonia. The process of the British Pharmacopœia is like the last, but a somewhat smaller quantity of ammonia is directed, and the precipitate is dried at a temperature not exceeding 100° C. (212° F.). The French Codex no longer recognizes this preparation; it should, however, be remembered that the *précipité blanc* of French pharmacy is *calomel* prepared by precipitation (see page 775).

In following the above processes one-half of the ammonium has 2 atoms of the univalent hydrogen replaced by 1 atom of the bivalent mercury, producing the radical mercur-ammonium (NH_2Hg), which is a monad like ammonium, and combines with 1 atom of chlorine to form the white precipitate; the other half of the ammonium unites with the other atom of chlorine contained in the mercuric chloride to form ammonium chloride, which remains dissolved; water is likewise produced by the reaction, which is explained by the equation $HgCl_2 + 2NH_4HO = NH_2HgCl + NH_4Cl + 2H_2O$. The ammonium chloride requires to be washed out, for which purpose the Pharmacopœia very properly uses a very dilute ammonia to prevent decomposition. If water be used, it should be cold, and the washing should not be continued too long, to prevent the precipitate from acquiring a yellowish tint in consequence of the formation of oxidi-mercur-ammonium chloride, $NH_2(Hg_2O)Cl$. The above formula yields $9\frac{1}{4}$ parts ($4\frac{5}{8}$ oz.) of ammoniated mercury.

Properties.—Ammoniated mercury is a white, amorphous, inodorous powder or is often in friable masses, permanent in the air and having an earthy afterward metallic taste; the U. S. P. describes it as tasteless. It is insoluble in ether, alcohol, and ammonia-water, but is slowly decomposed by cold water, and yields with boiling water a lemon-yellow basic compound, $NH_2(Hg_2O)Cl$, ammonium chloride being dissolved. When rapidly heated it turns yellow, and above 360° C. (680° F.) is decomposed and completely volatilized without fusion, yielding nitrogen, ammonia, and calomel; when slowly heated intermediate compounds are first formed. It is completely soluble in a cold solution of hyposulphite of sodium, with evolution of ammonia; on digesting this solution for a short time it separates red mercuric sulphide, or vermilion, which on protracted boiling turns black. Ammoniated mercury is decomposed by potassa solution or lime-water, ammonia being evolved and a yellow compound separated. It is soluble in hot solutions of ammonium salts and in hydrochloric as well as in nitric and acetic acids; these solutions yield white precipitates with potassa (ammoniated mercury) and silver nitrate (silver chloride). When ammoniated mercury is triturated with iodine the mixture will after some time puff up, from the spontaneous decomposition of iodide of nitrogen or iodamine formed in it, but in the presence of alcohol the decomposition takes place suddenly and with violent explosion.

Tests.—Ammoniated mercury should dissolve in hydrochloric acid without effervescence (absence of carbonate), and without leaving any residue (absence of mercurous salt, calcium sulphate, starch, etc.). Its solution in acetic acid should not yield a precipitate with sulphuric acid (absence of lead), and, after treating it with an excess of hydrogen sulphide a colorless filtrate should be obtained, which, on being acidulated with hydrochloric acid, evaporated to dryness, and ignited, should not leave a fixed residue (absence of zinc, calcium, etc. salts).

Fusible white precipitate, which was formerly considered to be identical with the preceding, until Wöhler and Kane proved its difference, was prepared by dissolving ammonium and mercuric chlorides in water and precipitating with sodium carbonate. Thus obtained, it has the composition $(NH_3)_2HgCl_2$, or perhaps $NH_2Cl.NH_2HgCl$, and differs from the officinal ammoniated mercury in fusing, when heated, to a yellowish liquid, evolving nitrogen and ammonia and yielding a transparent and an opaque white sublimate.

Off. Prep.—Unguentum hydrargyri ammoniati, *U. S.*, *Br.*

Medical Action and Uses.—The insolubility of ammoniated mercury in water, and even in the normal acid contents of the stomach, renders it a less active irritant than some other mercurial salts. Sometimes its harsh operation seems to be attributable to defects in its manufacture or to its exposure to light, whereby a portion of it is converted into corrosive sublimate. Certainly in several cases it has occasioned all the symptoms of an active poison, with the specific effects of mercury, and a fatal result at last. The following case illustrates its action: A man aged forty took about 40 grains of white precipitate. He had suffered from vomiting and purging during some 12 hours, and when seen his mouth and throat were sore, his pulse feeble and frequent, and his skin cool and clammy. The lower lip was blistered at the corners, as were also the swollen tongue and the pharynx. The belly was tympanitic and tender upon pressure. In the vomit were found some shreds of mucous membrane, and the stools were bloody and mucous. Two days later general tremor existed, which continued until salivation was established. The latter lasted nearly a fortnight, and was accompanied by some sloughing of the lower lip and gums and loosening of the teeth. The patient recovered (*Times and Gaz.*, March, 1882, p. 302). This preparation is not used internally as a medicine, but its ointment, which is officinal, is employed in *ophthalmia* and *skin diseases*.

HYDRARGYRUM CUM CRETA, *U. S., Br.*—Mercury with Chalk.

Æthiops cretaceus.—*Mercure avec la craie*, *Poudre de mercure crayeux*, Fr.; *Quecksilber mit Kreide*, G.

Preparation.—Mercury 38 parts (380 grains); Sugar of Milk, in fine powder, 12 parts (120 grains); Prepared Chalk 50 parts (500 grains); Ether, Alcohol, each a sufficient quantity; to make 100 parts (1000 grains). Mix the mercury, sugar of milk, and 12 parts (120 grains) of the chalk in a suitable mortar; moisten the mass with a mixture of equal parts of ether and alcohol, and triturate it briskly. Gradually add the remainder of the chalk, dampen the powder occasionally with a mixture of ether and alcohol made in the same proportions as before, and continue the trituration until globules of mercury are no longer visible under a magnifying power of 10 diameters and the powder is of a uniform gray color, and dry.—*U. S.*

Take of mercury, by weight, 1 ounce; prepared chalk 2 ounces. Rub the mercury and chalk in a porcelain mortar until metallic globules cease to be visible to the naked eye and the mixture acquires a uniform gray color.—*Br.*

When certain substances are triturated with metallic mercury they acquire a gray tint, and the metallic lustre of the mercury gradually disappears in consequence of its fine division. (See Hydrargyrum.) To effect this with chalk alone is a tedious operation, to shorten which Dr. Stewart (1843) proposed to triturate first with resin, then with chalk, and finally to remove the resin by alcohol; Dr. Mettauer suggested the use of a mixture of starch and chalk, kept damp by a little water during the trituration; and W. Hewson (1850) proposed to shake the metal with a portion of the chalk in a bottle until extinguished, and then to add the remaining powder. This process is followed on a large scale, a barrel or other suitable vessel containing the mixture being turned on its axis, or it is combined with trituration, a ball being also introduced into a vessel having a somewhat eccentric motion. Dr. Squibb (1857) constructed an apparatus in which the mercury is shaken with honey or syrup, and when completely extinguished mixed with the chalk, most of the sugar being afterward washed out with cold water; this process yields a very pure product, but the globules are larger than in the products of the other processes, and the powder cannot be triturated with pressure without separating some metallic globules.

W. E. Bibby (1876) suggested a method which enables the pharmacist to prepare this medicament without the expenditure of much time by substituting sugar of milk for about one-fifth of the chalk, which greatly facilitates the fine division of the metal; this is the process adopted by the U. S. P., with the additional improvement to keep the material moist with alcohol and ether until the mercury has been finely divided.

Properties and Tests.—Mercury with chalk is a gray, uniform, non-gritty, inodorous, and nearly tasteless powder, from which the mercury may be volatilized by heat. When treated with an excess of diluted acetic acid the chalk dissolves with effervescence, metallic mercury being left behind; the solution thus obtained usually yields a faint turbidity on the addition of hydrochloric acid, calomel being formed with the *mercurous oxide* dissolved by the acid. The presence of this oxide is disregarded by the British Pharmacopœia, which requires the preparation to be partly dissolved by dilute hydrochloric acid; any mercurous oxide present would be converted into calomel and remain with the finely-divided, undissolved mercury; but it insists on the total absence of *mercuric oxide*, which is detected in the clear solution in hydrochloric acid by a white or gray precipitate with stannous chloride or by a black one with hydrogen sulphide. Arsenic may be detected in this solution in the same manner as in corrosive sublimate (see page 771). Dr. Squibb (1857) determined in a sample the presence of 1.2 per cent. of mercurous and 1.44 per cent. of mercuric oxide; Joseph P. Remington (1869) found even 14.3 and 25.7 per cent. of the latter in two samples taken from dispensing-bottles. These results fully explain the violent action which has been occasionally observed. The preparation should be examined from time to time to ensure its fitness for medicinal use, notwithstanding the U. S. P. has omitted to give tests for determining its quality.

Medical Action and Uses.—This preparation seems to be only metallic mercury maintained in a state of minute subdivision by chalk. The proportion of the latter ingredient is too small to be regarded as of any direct therapeutic value, for in 8 grains of the compound there are 3 of mercury and 5 of chalk; and in the dose of 2 or 3 grains, in which it is generally administered, any immediate action except that which belongs to an unirritating insoluble powder can scarcely be admitted. Mercury with chalk is chiefly used in the *bowel complaints* of children, especially when the discharges are colorless and sour, and is very generally believed to cause a secretion of bile, and thus restore the normal action of the alimentary canal. Of this action, as elsewhere stated (see HYDRARGYRUM), no proof exists. The chief good it does is very probably to take the place of larger doses of more perturbative medicines. *Dose*, from 3 to 10 grains (Gm. 0.15–0.50).

HYDRASTIS, *U. S.*—HYDRASTIS.

Golden seal, *Yellow-root*, *Yellow puccoon*, *Orange-root*, *Indian dye*, *Indian turmeric*, E.; *Racine d'hydrastis de Canada*, *Sceau d'or*, Fr.; *Canadische Gilbwurzel*, G.

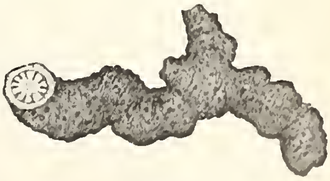
The rhizome, with the rootlets, of Hydrastis canadensis, *Linné*, s. Warnera canadensis, *Miller*. Bentley and Trimen, *Med. Plants*, 1.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—This perennial is indigenous to Canada and the United States east of the Mississippi; it grows in rich woodlands, and in the Southern States is confined to the mountainous districts. It has a low stem, and at the summit two round heart-shaped, palmately-lobed leaves and a single greenish-white flower, and produces a crimson fruit composed of twelve or more one- or two-seeded berries.

Description.—The rhizome is 1 to 2 inches (2 to 5 Cm.) long, about ¼ inch (6 Mm.) thick, oblique, with several short branches, terminated by a broad concave scar, somewhat flattened, annulate from the leaf-scars, longitudinally wrinkled, and below beset with many thin fragile rootlets 3 to 5 inches (75–125 Mm.) long, containing a thin triangular or quadrangular ligneous cord and a thick bright-yellow bark. The rhizome is externally brownish-gray with a yellow hue, hard, and breaks with a short waxy fracture of a bright reddish- or brownish-yellow color; the bark is about one-eighth the thickness of the rhizome; the central pith and medullary rays are broad, and the yellowish wood consists of eight to twelve narrow wedges, or, near the base of the branches, of a few linear and several larger irregular bundles. Golden seal has a slight odor, and a bitter taste free from any marked astringency.

FIG. 152.



Hydrastis.

Constituents.—Besides the common constituents, like starch, sugar, etc., A. B. Durand (1851) found in it a yellow coloring matter and a white alkaloid, *hydrastine.* The former was recognized by Mahla (1862) as *berberine,* the hydrochlorate of which has been used by eclectic practitioners under the incorrect name of *hydrastine.* Perrins (1862) obtained 4 per cent. of the crude hydrochlorate (see BERBERIS, p. 315) and 1.5 per cent. of hydrastine, which was analyzed by Mahla (1863). *Hydrastine,* $C_{22}NH_{23}O_6$, is contained in the mother-liquor from the preparation of berberine, and obtained by diluting the liquid with water, evaporating the alcohol, neutralizing carefully with ammonia, filtering from the precipitated resin, etc., and precipitating with ammonia; the fawn-colored deposit is purified by animal charcoal and recrystallization from hot alcohol. It is in white, shining quadrangular prisms which fuse at 135° C. (275° F.), are readily soluble in alcohol, ether, chloroform, and benzol, insoluble in water, colored red by nitric acid, brown-red by sulphuric acid and potassium chromate, and yield with acids soluble and very bitter salts. From the investigations of A. K. Hale (1873) and J. C. Burt (1875), it appears that the hydrastine of former investigators was not quite pure, but probably mixed with a third alkaloid, which Hale obtained of a dark-yellow color, and Burt crystallized as sulphate in colorless needles; warmed with nitric acid, it turns red, with sulphuric acid reddish-brown, and the solution of its hydrochlorate is colored dark-brown to black by ferric chloride; it is present in smaller quantity than hydrastine. Lerchen (1878), who proposed to call it *xanthopuccine,* found it insoluble in ether and chloroform, but soluble in alcohol and hot water, and the hot alcoholic solution, treated with iodine in potassium iodide, avoiding an excess of iodine, to yield light brown-colored spangles. In the preparation of the alkaloids Dr. L. Wolff (1881) has found it of considerable advantage to deprive the powdered hydrastis of the fixed oil by means of gasolin, and thus lessen the trouble of purification.

Off. Prep.—Extractum hydrastis fluidum. Tinctura hydrastis, *U. S.*

Medical Action and Uses.—The bitter taste of this root probably led to its employment as a stomachic tonic and in mild cases of intermittent fever. A variety of incongruous virtues have been attributed to it by the ignorant, such as being at once tonic, aperient, diuretic, and antiseptic. So far as its active principles have been tested, they display no peculiar virtues. Besides being used in constipation, hæmorrhoids, jaundice, and chronic diarrhœa, it has been vaunted as a remedy for all diseases of the urinary tract and in leucorrhœa, as well as for ophthalmia and cancer. According to Schatz, it induces contraction of the blood-vessels of mucous membranes and diminishes congestion of the genital organs (*Centralbl. f. d. g. Therapie,* ii. 82). From his experiments on the dog with the resinous extract known as "hydrastine," Rutherford concluded it to be an "hepatic stimulant of considerable power and a feeble intestinal stimulant." We are assured that hydrastis "is a stomachic tonic, one of the best remedies for the gastric catarrh of chronic alcoholism, and probably the best substitute for alcoholic stimulants when their use has to be abandoned. For habitual constipation depending on inaction of the liver it is undoubtedly a valuable remedy" (*Practitioner,* xxvi. 121). That a medicine should be alleged to be the best substitute for alcoholic drinks and also a remedy for habitual constipation, and all that it is said to be besides, implies marvellous virtues in it, or still more marvellous faith in those who make such an assertion. To this already long list of its virtues may be added the more recent statement of its efficacy in *uterine hæmorrhage,* especially when due to *myomata.* 20 or 30 drops of a tincture are given at short intervals until the bleeding is controlled, after which doses of from 2 to 5 drops are directed at longer intervals. It is also claimed to be serviceable in *dysmenorrhœa* depending upon chronic endometritis when taken in doses of from 7 to 10 drops of the tincture. Although it is expressly stated to be free from any marked astringency, it is especially recommended for the treatment of prolapse of the *rectum* in children, in fissure of the *anus,* and in ulceration of the rectal mucous membrane. In *gonorrhœa* a solution of 60 grains of hydrastine (the alkaloid) in 4 ounces of mucilage of acacia has been recommended as an injection, and also 2 drachms of the tincture to a pint of water. "In *fissure of the nipples* hydrastine has been strongly recommended, and it is said to be a good application in *stomatitis, otorrhœa, ozæna, conjunctivitis, leucorrhœa,* etc." To this list is added "cancer." In other words, it seems to have been found useful in affections for which are also employed baptisia, heuchera, salvia, ceanothus, etc. The statements thus briefly summarized render it probable that hydrastis is worthy of a serious and intelligent investigation. A decoction is made by boiling an ounce (Gm. 32) of the bruised rhizome in a pint of water for 15 minutes. Of this 1 or 2 fluidounces may be taken several times a day. The fluid extract is the most convenient form for administration.

HYDROCOTYLE.—Water-Pennywort.

Indian pennywort, E.; *Bevilacqua*, Fr.; *Wassernabel*, G.

Hydrocotyle asiatica, *Linné*. Bentley and Trimen, *Med. Plants*, 117.
Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—A low, creeping perennial which is indigenous to the tropical and subtropical regions of Asia, Africa, and America. The leaves are smooth, situated in tufts on the nodes of the stem, have petioles with a sheathing base, are roundish-reniform in outline with a somewhat crenate margin, about an inch (25 Mm.) broad, rather thick, radiately veined, and dark-green. The pink-colored flowers are in small umbellate clusters of about three, and produce small, laterally flattened, suborbicular fruits without oil-tubes. The plant is inodorous, but in bruising the fresh leaves a peculiar odor is developed; the taste is bitterish and pungent.

Constituents.—Lépine (1855) isolated *vellarin*, which he regarded as the active principle. It is an oily liquid having a bitter taste, a strong, peculiar odor, becoming viscous on exposure, insoluble in potassa solution, and soluble in ammonia, diluted alcohol, and ether. He obtained from the dried leaves 13 per cent. of ash.

Allied Plants.—Most other species of this genus appear to possess somewhat similar sensible properties. The North American species, H. ranunculoides, *Linné*, and H. americana, *Linné*, have likewise reniform leaves, those of the former being three- to seven-cleft; those of the latter, thin, crenate-lobed, the lobes of both being crenate.

Peltate leaves, with doubly crenate margins, are met with in the European H. vulgaris, *Linné*, which has five-flowered umbellate clusters, and in the American H. umbellata, *Linné*, which has the umbellate clusters about twenty-flowered.

Medical Uses.—About 1852 this medicine, which had long been employed in India in the treatment of febrile diseases and as a diuretic, was announced by a French physician in the Mauritius to have cured a case of *leprosy*. Other reports of a favorable character proceeded from different quarters, some of them containing specific details of the cure of this fatal affection in numerous instances, and then it fell into complete disfavor, as other medicines of like pretensions had done. Meanwhile, it was said to be an efficient remedy in scaly and pruriginous *diseases of the skin*, including those of a syphilitic origin, in chronic *eczema*, *lichen*, *prurigo*, in scrofulous and other *ulcers*, and in chronic *rheumatism*. The powdered root has been prescribed in doses of 3 grains (Gm. 0.20) several times a day, and an alcoholic extract in doses of ½ grain (Gm. 0.03).

HYDROGENII PEROXIDUM.—Peroxide of Hydrogen.

Hydrogen dioxide, E.; *Peroxide d'hydrogène*, Fr.; *Wasserstoffhyperoxyd*, G.
Formula H_2O_2. Molecular weight 34.

Origin.—Thénard (1818) discovered this compound, which has also been called *oxygenated water* and *oxygen hydrate*, by acting with dilute acids upon peroxide of barium. Meissner (1863) proved its presence in the rain-water collected during thunder-storms, and this observation has since been corroborated by Schönbein (1869), Struve, and others. Houzeau (1868) did not succeed in finding it.

Preparation.—The preparation of a solution of peroxide of hydrogen depends upon the decomposition of barium peroxide (see page 299) by hydrochloric acid in the presence of ice-cold water, and the precipitation of the newly-formed barium chloride by means of sulphate of silver. Instead of hydrochloric, carbonic or hydrofluoric acid may be employed, or peroxide of potassium may be acted upon by hydrofluosilicic acid. Such solutions usually contain about 3 to 5 per cent of the peroxide, and are concentrated by freezing, the last portions of water being evaporated *in vacuo* over sulphuric acid at a temperature not exceeding 20° C. (68° F.).

Properties.—Thus prepared, peroxide of hydrogen forms a colorless, transparent, syrupy liquid, which has the spec. grav. 1.452, does not congeal at — 30° C. (— 22° F.), and volatilizes *in vacuo*, slowly and without decomposition, at the ordinary temperature. But when exposed to the sunlight or when heated, or brought into contact with charcoal, silver, gold, the platinum metals, the oxides of manganese, alkalies, or various other compounds, the peroxide is decomposed, often with explosive violence, and in the presence of the oxides of the metals mentioned these are reduced to the metallic state. Some other bodies act less energetically or are oxidized. Litmus- and turmeric-paper are gradually bleached. Peroxide of hydrogen is without odor and has a harsh and bitter taste; applied to the skin, it colors it white and produces violent itching. It is soluble in water in all proportions, which solutions are decomposed by the same agents as the pure compound, but less violently, and are rendered somewhat more permanent by the addition of a small quantity of a mineral acid. Exposed to a low temperature, water freezes, and a stronger solution of peroxide is left.

Composition.—Peroxide of hydrogen is regarded by Traube as HO_2H, or a compound of an oxygen molecule with 2 atoms of hydrogen. Viewed as the *binoxide* or *dioxide of hydrogen*, its formula is H_2O_2, and viewed as a hydrate of oxygen. $O.H_2O$. The oxygen, which is given off under the conditions mentioned above, has been regarded by Schönbein and others as a peculiar modification which has been called *positive oxygen* or *antozone*, to distinguish it from *ozone*, or oxygen in the negative condition. The correctness of these distinctions, however, is denied by many investigators.

Solutions.—*Aqueous solution of hydrogen peroxide*, containing 3 per cent. of the latter, is now prepared on a large scale for the purpose of bleaching animal products, like feathers, hair, silk, bone, etc. The solution should be free from acids, and keeps well, provided the light be excluded and the temperature does not rise above 25° C. (77° F.). It is known as ten-volume peroxide of hydrogen, it yielding about 10 volumes of active oxygen, which may be estimated by adding a sufficient amount of sulphuric acid, and afterward a standardized solution of potassium permanganate, as long as the latter is decolorized, the reaction taking place according to the equation: $5H_2O_2 + 2KMnO_4 + 3H_2SO_4 = 8H_2O + 5O_2 + 2MnSO_4 + K_2SO_4$.

Ethereal solution of hydrogen peroxide has been prepared by Böttger by adding impure sodium peroxide (obtained by the burning of sodium) to a cold mixture of 1 part of sulphuric acid and 24 parts of water, with the precaution of avoiding an elevation of temperature; the mixture is then repeatedly agitated with ether. Such a solution was used by Dr. Richardson (1869) under the name of *ozonized ether*. He found that the addition of a little alcohol to the ether facilitates the absorption of the peroxide, and that the combination of the latter with the ether and some water, although very slight, is persistent, for the mixture was sent to Australia without deterioration.

Physiological Action.—Experiments made on animals by Guttmann and by Schwerin furnished the following results (*Virchow's Archiv*, lxxiii. 23, 37): 4 Ccm. of peroxide of hydrogen injected under a rabbit's skin immediately caused severe dyspnœa, clonic convulsions, and death in a few minutes from asphyxia. An examination showed the right auricle and ventricle filled with a frothy blood. Microscopic examination of the pulmonary circulation in curarized hogs injected with the peroxide showed that the bubbles of oxygen never penetrated the branches of the pulmonary artery. Guttmann found that if ¾ Ccm. of the peroxide solution is injected into one side of a rabbit's abdomen, and twice that quantity of a 20 per cent. solution of ferrous sulphate is simultaneously injected into the other side, the animal will not die, although ¾ Ccm. is the lowest fatal dose. Hence he concludes that at least a part of the oxygen liberated from the peroxide combines with the sulphate, and that the remainder is insufficient to obstruct the circulation and cause asphyxia. Peroxide of hydrogen is powerfully antiseptic, although, according to some authorities, it is less so than carbolic acid.

Medical Uses.—Upon theoretical grounds this compound was introduced as a cure for *diabetes*, but it signally failed after a sufficient trial by competent judges. It would seem to have had a favorable influence on some forms of atonic *dyspepsia*. It was also supposed to act as a palliative in various cases of *dyspnœa* due to an impeded circulation of blood through the heart and lungs. It is unnecessary to enumerate the other diseases in which it proved to be valueless as an internal remedy. Externally, it has been applied to *ulcers* of various kinds. It seems to promote their healing, both by stimulating them and coagulating their secretions, and in the case of *syphilitic sores* it is thought to disinfect their virus. It has been used in an ointment (1 part to 7 of lard) to anoint the skin of *scarlet-fever* patients, with the alleged result of diminishing the mortality and preventing the spread of the disease. There is no sufficient ground for this opinion. Peroxide of hydrogen may be given in tablespoonful doses of a solution of 1 part of the peroxide in 20 of water.

In 1878, Day claimed that the numerous hydrocarbons used in dressing wounds, etc. owed their utility to their faculty of absorbing oxygen and giving it up to the tissues, and hence that the aqueous solution of peroxide of hydrogen, or any of the above substances capable of generating it, must prove valuable as a surgical dressing (*Times and Gaz.*, Aug. 1878, p. 193). Goolden also, and others, testified to the powers of the gas to limit ulceration (*Practitioner*, xxiv. 47). And in 1882, Péan and Baldy drew the following conclusions from their clinical experience: Water containing from two to six times its volume of oxygen appears to be a fit substitute for alcohol and carbolic acid. It can be used as a dressing for every sort of wound and ulcer by injection and in vapor; in some cases, partly surgical, it may be given internally. It greatly hastens the cicatrization of fresh or of old wounds, even when covered with gangrene. It lessens traumatic fever; it neither offends by its smell nor acts poisonously, as carbolic acid does; and it occasions no pain. It seems adapted to ulcers of every description, deep abscesses, ozæna, and purulent cystitis. And, finally, it destroys microbes (*Bull. de thérap.*, ciii. 122).

HYOSCYAMINÆ SULPHAS, *U. S.*—SULPHATE OF HYOSCYAMINE.

Hyoscyaminum sulfuricum.—*Sulfate d'hyoscyamine*, Fr.; *Hyoscyaminsulfat*, G.
Formula $(C_{17}H_{23}NO_3)_2.H_2SO_4$. Molecular weight 676.

The neutral sulphate of an alkaloid prepared from hyoscyamus.

Preparation.—Hyoscyamine is dissolved in alcohol, and the solution carefully neutralized with diluted sulphuric acid and evaporated at a low temperature; or, the solution of the alkaloid in diluted sulphuric acid is concentrated under a bell-glass over sulphuric acid.

Properties.—Hyoscyamine sulphate is described by E. Rennard (1868) as forming bundles of microscopic crystals; by Thorey (1869), as crystallizing in long satiny prisms, united in bundles or sheaf-like groups; and by Höhn and Reichardt (1871), as radiating groups of white glossy needles, which lose at 70° C. (158° F.) 5.19 per cent. and at 110° C. (230° F.) 9.3 per cent., of water, the latter amount indicating $4H_2O$ (9.76 per cent.). But, according to Ladenburg (*Annalen*, vol. ccvi.), the salts of hyoscyamine are uncrystallizable, while those of hyoscine, or amorphous hyoscyamine, are crystallizable; most of the salts of both alkaloids are colorless or white if pure, but as ordinarily obtained are usually more or less colored (see HYOSCYAMUS); and no method is known for separating the two alkaloids except by the recrystallization of their gold double salts. It is evident, therefore, that the pharmacopœial description of hyoscyamine sulphate applies to a mixture with hyoscine sulphate more or less contaminated with coloring matter: "Small golden-yellow or yellowish-white scales or crystals, or a yellowish-white amorphous powder, deliquescent on exposure to air, odorless, having a bitter and acrid taste and a neutral reaction. Very soluble in water and in alcohol. When heated on platinum-foil the salt chars, and is finally completely dissipated. An aqueous solution of the salt is not precipitated by test solution of platinic chloride. With chloride of gold it yields a precipitate which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited on cooling (without rendering the liquid turbid) in brilliant, lustrous, golden-yellow scales (difference from atropine). The aqueous solution yields, with test solution of chloride of barium, a white precipitate insoluble in hydrochloric acid."—*U. S.*

Action and Uses.—These are detailed in the following article on HYOSCYAMUS. The dose of the sulphate is about the same as that of the alkaloid, hyoscyamine, $\frac{1}{65}$ grain (Gm. 0.001); but in urgent cases $\frac{1}{4}$ grain, and even a grain (Gm. 0.016–0.06), has been given by the mouth, and $\frac{1}{65}$ grain (Gm. 0.001) hypodermically.

HYOSCYAMUS, *U. S.*—HYOSCYAMUS.

Hyoscyami folia, Br.; *Herba hyoscyami*, P. G.—*Hyoscyamus-leaves*, *Henbane-leaves*, E.; *Feuilles de jusquiame noir*, Fr.; *Bilsenkraut*, G.

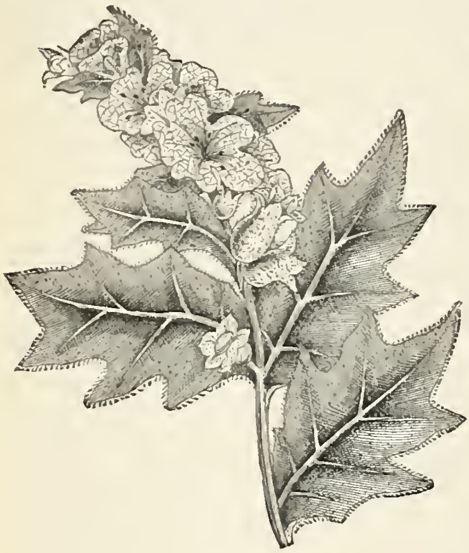
The leaves of Hyoscyamus niger, *Linné*, collected from plants of the second year's growth. Steph. and Church, *Med. Bot.*, plate 9; Bentley and Trimen, *Med. Plants*, 194.
Nat. Ord.—Solanaceæ.

Origin.—The typical form of henbane is biennial, grows in sandy soil and waste places throughout the greater portion of Europe and eastward and southward to Siberia, Northern India, and Egypt, and has been naturalized in North America from the New England States to Michigan. It is 2 to 3 feet (60–90 Cm.) high, covered with long, jointed, glandular hairs, and has the numerous nearly sessile flowers in a long, leafy, one-sided spike-like raceme. The funnel-shaped five-lobed corolla is about 1¼ inches (3 Cm.) long and wide, pale yellow, with purple veins and a similar colored base. The capsule (pyxis) is enclosed in the bell-shaped calyx, about ½ inch (12 Mm.) long, dehiscent near the top by a cap, two-celled, and contains numerous seeds. An annual variety, H. agrestis, *Kitiabel*, is not over a foot (30 Cm.) high, less villous, and has smaller leaves and fewer flowers; if the latter are veinless, the plant is H. pallidus, *Willdenow*.

H. albus, *Linné*, and H. aureus, *Linné*, of Southern Europe, are occasionally employed there, but are less active. H. physaloides, *Linné*, is used in Siberia.

Description.—Taken from different parts of the stem, the leaves vary from 2 to 10 inches (5–25 Cm.) in length and 1 to 4 inches (2–10 Cm.) in width, the lower leaves being stalked, the upper sessile and amplexicaul. They are ovate to ovate-oblong in shape, on each side with one (upper leaves) to five coarse, sinuate teeth or lobes, which are rather acute and oblong or triangular. In the dry state they are of a grayish-green color, glandular-hairy above, more densely so on the lower surface and upon the prominent broad midrib. Some of the characteristic flowers or capsules, or both, may usually be found with the drug, the heavy narcotic odor of which is diminished by drying, but becomes more prominent again when the leaves are moist. The taste is bitter and somewhat acrid. Being very hygroscopic, the leaves should be kept in a dry place. The German and British Pharmacopœias admit the leaves and flowering-tops.

FIG. 153.

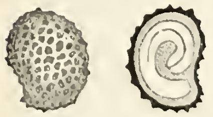


Hyoscyamus niger, *Linné*.

HYOSCYAMI SEMEN, *U. S.* 1870.—Hyoscyamus-seed, Henbane-seed, *E.*; Semences de jusquiame noir, *Fr.*; Bilsensamen, *G.*—The seeds are no longer recognized by the pharmacopœias, but are employed for preparing the alkaloid. They are about $\frac{1}{16}$ inch (1.5 Mm.) long, roundish-reniform, flattened; have a gray-brown, finely and densely rough-pitted testa, and contain a whitish oily albumen which encloses a curved embryo of the shape of the figure 9. The hilum is in the concave side of the seed. The seeds are without odor and have an oily, bitter, and acrid taste.

Belladonna-seeds are of about the same size and shape, but are of a red-brown color.

FIG. 154.



Hyoscyamus-seed and longitudinal section, magnified 7 diameters.

Constituents.—Brandes (1820) obtained from the seeds 25 per cent. of a bland, limpid, and colorless oil, of which about 20 parts were readily soluble in absolute alcohol. Their most important constituent, however, like that of the leaves, is the alkaloid *hyoscyamine*, which was observed by Brandes, and again obtained by Geiger and Hesse (1833) and by Kemper (1866) in a purer condition from both the leaves and seeds. More complete investigations were made by Höhn (1870 and 1871), and the exact composition of the alkaloid, its identity with duboisine, and its isomerism with atropine were determined by Ladenburg (1880). For preparing the alkaloid Höhn deprived the seeds of the oil by ether, and then exhausted them by alcohol slightly acidulated with sulphuric acid. The tincture was distilled and evaporated, filtered, almost neutralized with soda, and precipitated by tannin; the precipitate, still moist, was mixed with lime, exhausted with alcohol, the solution again acidulated, concentrated, shaken with ether to remove oil and color, decomposed by soda, and the alkaloid exhausted by ether. The filtrate from the tannin precipitate and the fixed oil retained some of the alkaloid, of which, altogether, 0.0453 per cent. was obtained. Thibault (1875) received it in silky crystals on the spontaneous evaporation of the chloroformic solution. Thorey obtains the alkaloid at once pure by removing the fat from the freshly-powdered seeds by means of petroleum benzin, exhausting with alcohol acidulated with hydrochloric acid, and distilling off the alcohol; the remaining liquid is filtered, deprived of color by benzin, supersaturated with ammonia, agitated with chloroform, and the chloroformic solution evaporated; the dried seeds yield from 0.08 to 0.16 per cent., the leaves 0.042 to 0.224 per cent., and the root 0.006 to 0.307 per cent., of this alkaloid.

Pure hyoscyamine, $C_{17}H_{23}NO_3$, crystallizes in colorless silky needles or is left as a white gelatinous mass; it is permanent in the air, melts at 108.5° C. (227.3° F.), is levogyre, and dissolves rather sparingly in cold water, but is freely soluble in alcohol, ether, and chloroform. Its chemical behavior is very similar to that of atropine (see page 283), but the double salt with chloride of gold forms lustrous golden-yellow scales which do not melt under boiling water, and in the dry state fuse at 160° C. (320° F.). Boiled with baryta-water, the alkaloid is decomposed into a volatile alkaloid and an acid, which, when discovered by Höhn, were named *hyoscine* and *hyoscinic acid*, but were proven by Ladenburg to be identical with tropine and tropic acid (see page 283). The same author did not succeed in obtaining the salts of hyoscyamine crystallized.

Commercial hyoscyamine is frequently impure, and is then deliquescent, and becomes brown on exposure. It contains a second alkaloid, which Ladenburg (1880) named *hyoscine*, and for which Buchheim (1876) proposed the name *sikeranine*. It is isomeric with hyoscyamine, and has a similar behavior to solvents and on the eye, but is semi-liquid and uncrystallizable; its salts are rather readily crystallizable, and its double salt with chloride of gold is less lustrous, less freely soluble, and melts at 198° C. (388.4° F.); heated with baryta-water, the alkaloid yields tropic acid and *pseudotropine*, $C_8H_{15}NO$, the latter being deliquescent and boiling at 241° C. (466° F.).

Höhn (1870) obtained from the seeds also a bitter glucoside, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, which has a bitter taste, is neutral, soluble in alcohol and water, and precipitated by tannin; by boiling with diluted hydrochloric acid it is decomposed into fermentable sugar and a yellowish-white resin which melts at 204° C. (399.2° F.), is soluble in alcohol and ether, and has a bitter and somewhat acrid taste. In addition to this, a yellow, amorphous, somewhat bitter and slightly acid resin containing nitrogen was found, and on distilling the mother-liquors with soda some volatile bases were obtained, among them, probably, methylamine and ammonia.

Thorey (1869) states that the leaves contain the largest proportion of hyoscyamine and of potassium nitrate before flowering.

Pharmaceutical Preparations.—OLEUM HYOSCYAMI INFUSUM.—Oil of hyoscyamus, *E.*—2 parts of hyoscyamus-leaves are left in contact with 1 part of alcohol until the latter is absorbed, when 20 parts of olive oil are added, and the whole digested until the alcohol has evaporated; the oil is expressed and filtered.—*P. G.* 1872.

BAUME TRANQUILLE of the French Codex is a similar preparation, made from the fresh leaves of hyoscyamus, belladonna, stramonium, black nightshade, tobacco, and poppy, of each 40 parts, and of 120 parts of dry aromatic herbs and flowers, comprising twelve kinds, with 1000 parts of olive oil.

Off. Prep.—Abstractum hyoscyami, *U. S.;* Extract. hyoscyami, *U. S.*, *Br.;* Extr. hyoscyami fluid., *U. S.;* Tinctura hyoscyami, *U. S.*, *Br.*

Physiological Action.—*On Animals:* It is implied in the etymology of "hyoscyamus" that the plant may be eaten without harm by hogs; it is also said not to injure sheep or cows, nor to have much effect upon rabbits, while barnyard fowls and fish are poisoned by it. Upon dogs hyoscyamus and its alkaloid act as they do upon man. In them, in cats, and in various other animals, they produce dilatation of the pupil, and in full doses acceleration of the heart's action and lowering of the temperature, dryness of the mouth, and a dull or lethargic condition, with loss of power in the hind legs. In moderate doses they slow both respiration and circulation, rendering the pulse fuller and stronger; in large doses they have the opposite effect. They increase the discharge of urine, from which the alkaloid can be recovered. These effects are so nearly like those occasioned by belladonna and atropine that some pharmacologists regard the latter alkaloid and hyoscyamine as identical.

On Man: The following effects are produced by henbane and by hyoscyamine: In full medicinal dose the former occasions headache, pasty mouth, hoarse voice, dry throat, a warm skin, and a slower and then an accelerated pulse, while the pupil becomes dilated and vision indistinct, and the limbs give way under the body. The sense of touch is blunted, and the voluntary muscles are apt to be cramped or to be affected alternately with spasm and paralysis. No direct narcotic effect is produced in the greater number of cases, but rather a loquacious sub-delirium, with hallucinations, which may merge into a restless and dreamy sleep. Only in large doses is it decidedly hypnotic. The power of henbane to produce a peculiar talkative and pugnacious delirium was fully described by ancient writers, and some modern observers have witnessed similar effects. It is curious that in certain cases, although the general sensibility is impaired, severe neuralgic pains may be felt in the limbs. Continued medicinal doses tend to produce a reddish efflorescence upon the skin, which is dry and itching. When poisonous doses, on the other hand, have been taken, the skin is sometimes cool and clammy, the face pale, and the lips bluish. Notwithstanding the threatening character of the symptoms, death from this substance is extremely rare. A maniacal patient to whom ¾ grain of amorphous hyoscyamine were given became comatose, the pupils were only slightly dilated, the capillaries were injected, the pulse 150, respiration was short and rapid, the jaw dropped, the eyelids were partly closed, and the eyeballs exposed and turned upward. In this condition he remained for 4 hours, but after that time, though he was drowsy and stupid, he could easily be aroused (Gill). The most striking example of its effects is furnished by Dr. H. A. Hutchinson of Pittsburg, who took ¼ grain of Merck's hyoscyamine (*Phila. Med. Times*, xiii. 139). Besides the dryness of the mouth and throat, there was intense congestion of the head and face and violent throbbing of the heart and carotids, numbness over the whole body and muscular incoördination, and an inability to walk without watching the steps. There was no mental excitement or sensory illusion, but an overpowering tendency to sleep, which came on and lasted for 11 hours. Various means were used by friends who were ignorant of the cause of the sopor to arouse the sleeper, but they availed nothing. During the sleep the muscular system was completely relaxed, and the pulse at first was full and hard, beating 138 a minute, the respirations 34 to 40, and the temperature 106° F. As the narcotism subsided these rates subsided rapidly toward the normal standards. On regaining consciousness the mind was unsteady and confused, and all objects looked tinged with yellow. During the sleep there was more or less nausea, and once vomiting. No recollection of anything after the commencement of sleep remained. For several days the pupils remained dilated, and there was double vision, while all the secretions, including the perspiration, were suspended. A patient of Empis affected with *paralysis agitans* took 5 Mgm. of hyoscyamine (gr. $\frac{1}{12}$), and, finding the tremor diminished, used a like quantity on the following day. The first dose caused a slight intoxication, and after the second there was a like confusion of the mind and senses, the face was flushed, the expression anxious, the whole interior of the mouth dry, the tongue stiff, and nausea was experienced. Hallucinations in which rats and serpents appeared and familiar persons were not recognized were accompanied and followed by furious delirium, tetanic spasms, and extreme dilatation of the pupils. Deglutition was impossible; the respiration was hurried and oppressed, the pulse at 96; and constant vesical tenesmus existed. The attack lasted for 3 hours, and gradually subsided, and on the morrow only some recollection of the hallucinations remained (*Bull. de thérap.*, xcix. 373). A phthisical patient accustomed to hypodermic injections of morphia was given $\frac{1}{40}$ grain of hyoscyamine. After vomiting he became delirious, lost all correct perception of the distance of objects, and constantly caught at insects, with which he said his bed-clothes were covered (*Practitioner*, xxii. 369). No death has been directly caused by hyoscyamine. In proportion to the dose the symptoms are less alarming in children than in adults, and especially in old persons. This peculiarity is doubtless due to the rapid elimination of the poison in the young. From an experimental point of view it must be concluded that, unless in very large doses, hyoscyamus is not so much a narcotic soporific as an anodyne or anæsthetic, that it excites the cerebral and depresses the spinal functions, and that it is a mydriatic.

According to Gnauck, *hyoscine* is tenfold stronger than hyoscyamine, even a very minute dose (gr. $\frac{1}{600}$) invariably producing its characteristic effects, and subcutaneously acting twice as powerfully as by the mouth. He thinks that it tends directly to slow the pulse (*Phila. Med. News*, xl. 323). Emmert has proposed "hydriodide of hyoscine" as superior to any other form of the active principle of hyoscyamus, and also to atropine and duboisine (*Med. Record*, xxi. 403). It should be noted that the hyoscyamine of commerce is rarely genuine. Regnauld and Valmont (*Archives gén. de Méd.*, Jan. 1881, p. 15) state that crystallized hyoscyamine is, sometimes at least, atropine mixed with some foreign substance, and that hyoscyamine has not really been procured in a crystalline form.

Medical Uses.—At one time hyoscyamus was believed to be a valuable remedy for *epilepsy*, but experience has shown that the doses formerly given were quite inert, and that even in really operative doses its utility is limited to cases of emotional origin. Dr. Lawson in England found hyoscyamine very useful in controlling violent outbreaks of *mania*, especially of the recurrent acute and subacute forms, the monomania of suspicion, and the excitement of senile dementia. He regarded it as essential to the success of the treatment that the medicine should be given in a dose not less than 1 grain. If a smaller dose is taken, it is said cerebral excitement, without complete motor paralysis, is produced, and remains through the whole period of the operation of the medicine. Mr. Gill, physician to the Lunatic Hospital, York (Eng.), on the other hand, recommended a dose varying from ⅛ to ⅜ grain; and that in exceptional cases ⅝ grain, or even a grain, might be given with safety. In some forms of *hypochondriasis* it seems to have been useful as a means of calming agitation. Prolonged experience has confirmed these statements. Thus we learn from Prideaux (*Practitioner*, xxiii. 446) that it produces sleep, sometimes of considerable duration, in excited conditions of the brain, as in *mania*, *delirium tremens*, *meningitis*, and where ordinary hypnotics, and especially opiates, are inadmissible. In such cases small doses ($\frac{1}{16}$ gr.) suffice, but in chronic mania large doses ($\frac{1}{2}$ grain, or even 1 grain) are necessary, and are very useful in cutting short exhibitions of temper and excitement of a violent and destructive character. It would appear to be particularly useful in delusional *insanity;* the illusions which it conjures up overlie and gradually obliterate those which belong to the disease. "In chronic *dementia*, associated with destructive tendencies, bad habits, and sleeplessness," the patients are much improved by a course of small doses of the drug. Dr. Gray, superintendent of the State Medical Asylum of New York, confirms these observations by his own experience, but recommends a combination of hyoscyamine and morphine where there is a failure of cerebral energy; and, on the other hand, when violence predominates he associates the hypodermic use of hyoscyamine with the internal exhibition of the bromides (*Practitioner*, xxvi. 299). These results are confirmed by those of Bacon (*Practitioner*, xxvii. 367), Seguin (*Med. Record*, xvii. 354), Gnauck (*Amer. Jour. of Med. Sci.*, Oct. 1883, p. 556), and many others. Seguin particularly corroborates the favorable action of the drug in delusional insanity with insomnia (*Med. Record*, xix. 712). In puerperal insanity the action of the medicine is most advantageous. In functional *palpitation* of the heart of a purely nervous nature it has been found beneficial, when used hypodermically, in the dose of about $\frac{1}{50}$ grain (Gm. 0.001). The same means relieve cardiac and pulmonary *asthma.* Hyoscyamine has been used in trembling *palsy* and mercurial *trembling*, *epilepsy*, *chorea*, *locomotor ataxia*, and *tetanus.* In the first it exerts a marked power in moderating the tremulousness, and in the second it is alleged to have effected cures. In the epileptic status in *epileptic mania* it diminishes the number, frequency, and severity of the attacks (Prideaux), and it is one of the most efficient means of procuring sleep in *delirium tremens* when the patient is at the same time properly fed. It seems to have cured a number of cases of chorea, of which several occurred in adults, but other preparations of hyoscyamus have but little influence on the disease; in locomotor ataxia it palliates the spasms and the neuralgic pains, and in tetanus moderates the severity of the paroxysms. In these affections, and notably in chorea, its therapeutical action may be explained by its paralyzing influence upon the spinal cord, which seems to be of the same nature as that produced by conium. The *vomiting* of pregnancy, a symptom of reflex origin, has been controlled by it. It was prescribed in a solution containing 5 Mgm. (gr. $\frac{1}{16}$) of the alkaloid in 125 Gm. (f℥iv) of liquid, of which a teaspoonful was given every hour.

There is no doubt that hyoscyamus is anodyne, and apparently by its operation upon the sensitive nerves and ganglia, and not upon the cerebral organs of perception. The crushed leaves of fresh henbane are popularly applied where the plant abounds for the relief of local pains, and internally its preparations are of common use to allay *neuralgic* and other pains that hinder sleep. It is also used to lessen the tendency to gripe of certain cathartics given in a pilular form, for it has the advantage of relaxing rather than confining the bowels. Like the other mydriatics, henbane (hyoscyamine) is used to dilate the *pupil.* *Poisoning* by henbane should be treated by evacuating the stomach, applying warmth to the extremities and cold to the head, and adminstering stimulants, particularly coffee, and morphia hypodermically in small and repeated doses. It is recommended not to give hyoscyamine to patients with degenerate arteries or chronic cardiac disease, or to very old people.

The *dose* of powdered henbane is stated at from 5 to 10 grains (Gm. 0.30–0.60), but this form of the medicine is rarely used. Hyoscyamine may be given in the dose of 1 Mgm. or $\frac{1}{65}$ gr., repeated at intervals of several hours, or, if not for a temporary purpose, this dose should be prescribed twice a day, and gradually increased until its characteristic effects are observed in the pupils and in the throat. But in cases of great functional excitement or disorder from $\frac{1}{4}$ grain to 1 grain (Gm. 0.016–0.06) may be given by the mouth. Hypodermically, its action is relatively far more powerful than when it is given by the stomach, but the dose of $\frac{1}{65}$ gr. can generally be administered in the cases here referred to.

In addition to the formula given above, the following is recommended (Gill): ℞. Hyoscyaminæ gr. x; spt. vin. rect. ℥j; ætheris sulph. f℥iv. The two latter are mixed, and this mixture will fully dissolve the hyoscyamine; then water is added to make the whole 20 ounces. This solution contains $\frac{1}{2}$ grain of hyoscyamine to the ounce.

HYPERICUM.—St. John's Wort.

Millepertuis, *Casse-diable*, Fr.; *Johanniskraut. Hartheu*, G.

Hypericum perforatum, *Linné*.
Nat. Ord.—Hypericaceæ.

Description.—This plant grows in fields and on roadsides throughout Europe, Northern Africa, and a considerable portion of Asia, and has been extensively naturalized in North America and in other countries. It has a perennial woody and branching dark-brown root and a somewhat two-edged stem about 2 feet (60 Cm.) high. The leaves are opposite, sessile, oblong or linear-oblong, nearly an inch (25 Mm.) long, obtuse, entire on the margin, and pellucid-punctate. The flowers are in open terminal cymes, deep-yellow, nearly an inch (25 Mm.) broad, and are furnished with numerous stamens clustered in three groups, and with a three-celled ovary. The petals, anthers, leaves, and stem are more or less marked with black dots. When bruised the herb has a slight balsamic odor; its taste is somewhat resinous, bitter, and slightly astringent. The flowering-tops, on drying, lose from 60 to 65 per cent. in weight.

Constituents.—Buchner (1830) found in the flowers a little tannin, producing a dark-green color with ferric salts, some pectin, and 8 per cent. of a red coloring principle, *hypericum red*, which is soluble in alcohol, ether, volatile oils, and warm olive oil, and dissolves with a green color in ammonia and other alkalies; calcium and lead salts produce yellow precipitates, ferric chloride a yellowish-green one. According to Clamor-Marquart, this coloring matter is a mixture of a red and a yellow principle, and is mainly contained in the black glands.

Pharmaceutical Uses.—The fresh flowering-tops, digested with olive oil sufficient to cover them, yield a yellowish-red liquid, *Oleum hyperici*, which is popularly known as *red oil*. Linseed oil is sometimes used in place of olive oil.

Allied Plants.—Several other European species of Hypericum possess similar properties, and some of our North American species may be equally effective.

Hypericum sarothra, *Michaux* (Sarothra gentianoides, *Linné*, s. Sar. hypericoides, *Nuttall*), has thin almost thread-like branches, opposite awl-shaped scaly leaves, and minute sessile yellow flowers. It is common in sandy fields in the United States, where it is known as *orange-grass* or *pine-weed*, and is sometimes used like the preceding.

Ascyrum crux-Andreæ, *Linné* (*St. Andrew's cross*), is a decumbent North American herb with narrow oblong-obovate leaves and solitary flowers, having the four linear-oblong yellow petals arranged in the form of a cross.

Medical Action and Uses.—The aromatic and terebinthinate odor of this plant when it is crushed in the hand, and its resinous and bitter taste, sufficiently account for the vogue which it enjoyed in certain diseases even from ancient times. It was celebrated by Celsus, Paulus Ægineta, Galen, and Dioscorides, and its vogue only declined when modern science substituted for it medicines whose remedial effects were conceived to be more intelligible. The titles it bore indicate its popular estimation; they were such as these: "St. John's Wort," "The Lord God's Wonder-Plant," "The Devil's Scourge," "The Witches' Herb," and many similar. The ancients attributed to it stimulating, drying, cleansing, and cicatrizing virtues, and held it to be diuretic and emmenagogue and a specific remedy for wounds, ulcers, and burns. In the Middle Ages analogous virtues were ascribed to it, as well as curative powers in calculous affections, intestinal worms, and mental disorders. In more recent times it was given for the relief of chronic *catarrhs* of the *lungs*, *bowels*, and *urinary passages*, and was especially esteemed in the last. It was also used in hot infusion to bring on retarded *menses*. Externally, it was applied in the fresh state, bruised, as a discutient for recent *contusions* and for the relief of local *pains*. Its flowers, immersed in olive oil in a bottle and hung in the sun for a month or two, give to the oil a dark-red color (red oil), forming one of the most popular applications made to *excoriations*, *wounds*, and *bruises* both in Europe and in this country. An infusion may be prepared with an ounce (Gm. 32) of the plant in a pint of hot water.

HYSSOPUS.—Hyssop.

Hysope, Fr.; *Isop*, *Ysop*, G.

Hyssopus officinalis, *Linné*.
Nat. Ord.—Labiatæ, Satureieæ.

Description.—Hyssop is an herbaceous perennial indigenous to Southern Europe, frequently cultivated and sparingly naturalized in the United States. It is about a foot (30 Cm.) high, with wand-like simple quadrangular branches and opposite, sessile, linear-lanceolate, entire, and nearly obtuse leaves, which are about an inch (25 Mm.) long, nearly smooth, and finely punctate on both sides. The purplish-blue flowers are in small clusters, and have a fifteen-ribbed calyx, a two-lipped corolla with a rather short and notched upper lip, and four exserted and divergent stamens. Hyssop has an aromatic somewhat camphoraceous odor and a pungent, aromatic, and bitterish taste.

Constituents.—Aside from tannin, resin, fat, sugar, mucilage, etc., the most important constituent is *oil of hyssop*, of which the fresh herb yields $\frac{1}{4}$ to $\frac{1}{2}$ per cent. It is pale-yellow or greenish, limpid, of about the specific gravity 0.94, and freely soluble in alcohol, it contains oxygen, and commences to boil at 142° C. (287.6° F.), the boiling-point rising to 180° C. (356° F.). It has the odor and taste of the herb. The *hyssopin* of Herberger (1829) was found by Trommsdorff to be impure sulphate of calcium.

Allied Plants.—Cunila mariana, *Linné* (*Dittany*), a North American plant, grows in dry soil, has a thin, purplish, much-branched stem, about 12 inches (30 Cm.) high, and nearly sessile, ovate, serrate, smooth leaves, which are rounded or subcordate at the base. The pale-purple flowers are in small pedunculate clusters and have two exserted stamens.

Satureja hortensis, *Linné*.—Summer savory, *E.;* Sarriette, *Fr.;* Saturei, Bohnenkraut, *G.*—This South European annual is cultivated as a culinary herb. The stem is about 10 inches (25 Cm.) high, much-branched, roughish-pubescent; the leaves are linear-lanceolate or oblong-linear, entire, acute, and tapering into a very short petiole; the cymules are about three-flowered, with the corolla pale-purplish, and with four diverging rather included stamens.

Satureja montana, *Linné* (Micromeria, *Reichenbach*).—Winter savory, *E.*—It is suffruticose, retrorsely hairy, and has hairy whitish or reddish flowers in small axillary clusters, and linear-lanceolate, mucronate, and pellucid punctate leaves about $\frac{3}{4}$ inch (18 Mm.) long and rough on the margin. Haller (1882) obtained from it .83 per cent. of volatile oil having an orange-yellow color, an odor resembling that of origanum, and the density .7394 at 17° C.; it is levogyre, and contains two hydrocarbons and two phenols, one of the latter being identical with *carvacrol*.

Pycnanthemum linifolium, *Pursh* (*Virginia thyme*), has rigid, narrowly linear sessile crowded leaves, which are entire and three-nerved; the flowers are in terminal hemispherical clusters, supported by imbricate, rigidly-pointed bracts. It has been popularly regarded as useful in hydrophobia, and has been employed in atonic dyspepsia.

Pycn. lanceolatum, *Pursh*, resembles the preceding, but has lanceolate or lance-linear leaves; both have a resinous and bitter taste.

Pycn. incanum, *Michaux*, has broader ovate-oblong, hoary, pubescent leaves and an aromatic mint-like taste. It is known as *mountain-mint*, *wild basil*, and in some places as *horse-mint*, and is used like Monarda.

Ch. Mohr (1876) isolated from Pycn. linifolium a tannin which is very similar to, if not identical with, caffeo-tannic acid; volatile oil, resin, bitter principle, etc. were likewise obtained.

Thymus vulgaris, *Linné* (Bentley and Trimen, *Med. Plants*, 205); Herba thymi, *P. G.*—Garden thyme, *E.;* Thym, *Fr.;* Thymian, Römischer Quendel, *G.*—A small South European suffruticose plant which is often cultivated for culinary purposes. The leaves are $\frac{1}{4}$ to $\frac{1}{3}$ inch (6–8 Mm.) long, ovate-oblong or linear, revolute on the margin, grayish-green, glandular, punctate on both sides and pubescent beneath, the upper ones bearing in their axils small clusters of whitish or reddish flowers with exserted stamens.

Thymus serpyllum, *Linné;* Herba serpylli, *P. G.*—Wild thyme, *E.;* Serpolet, *Fr.;* Quendel, Feldthymian, *G.*—It is a common prostrate suffruticose plant indigenous to Europe and Northern Asia and to some extent naturalized in North America. The leaves are $\frac{1}{5}$ or $\frac{2}{5}$ inch (5 or 10 Mm.) long, petiolate, flat, ovate or roundish-lanceolate, occasionally linear, entire, ciliate near the base, glandular on both sides, otherwise smooth. The purple or rose-colored flowers are aggregated in heads or dense spikes terminating the branches, and have the four stamens included or sometimes exserted. It is a variable plant, including several nominal species, among them Thymus citriodorus, *Schreber*, the *lemon-thyme*, which has an agreeable odor resembling that of melissa and of lemon. Both thymes have a strong aromatic odor due to volatile oil. (See Oleum Thymi.)

Micromeria Douglasii, *Bentham*, s. Mic. barbata, *Fischer et Meyer*. It is a perennial, creeping or trailing, sweet-scented herb of the Pacific coast from California to Washington Territory, and is known as *yerba buena*. The leaves are about an inch (25 Mm.) long, roundish-ovate, thin, sparingly toothed and short-petioled; the purplish flowers are mostly solitary in the axils on long and filiform peduncles.

Medical Action and Uses.—Anciently hyssop seems to have been used as a cathartic, for we read in Scripture, "I will purge thee with hyssop, and thou shalt be clean;" and, if this passage be thought to apply to external cleansing, Pliny says expressly that "mixed with figs it purges, and with honey vomits." He also refers to its external use in phthiriasis. Down to a quite recent period it was used to improve digestion, particularly in atonic and flatulent *dyspepsia*, and, like other plants which are so employed and contain an essential oil associated with a bitter and astringent principle, it is found useful in subacute and chronic *bronchitis*, especially in old persons, also in *amenorrhœa*, and externally as a stimulant application to *bruises* and in muscular *rheumatism.* Its infusion was also employed as a gargle in *sore throat* of the diphtheritic form. Hyssop may be given in an infusion made with a drachm (Gm. 4) of the herb to a pint of water. The essential oil was formerly given in doses of 1 or 2 drops (Gm. 0.06–0.12).

Summer savory has essentially the same medicinal virtues as the other plants in this group. It is also used as a vermifuge and as a cure for the itch. *Garden thyme* is used in domestic medicine for the purposes just mentioned, but especially to promote the digestion of certain fatty meats, such as pork and goose, or to give a flavor to insipid dishes. *Wild thyme* is held to be still more efficacious than garden thyme as a stimulant in all functional affections associated with exhaustion of the system, including, besides the above, whooping cough, headache from alcohol, passive hæmorrhages, etc. *Ditana digitifolia*, a native plant of Brazil, is reputed to be a galactagogue (*Med. Record*, xx. 420).

ICHTHYOCOLLA, *U. S.*—ISINGLASS.

Colla piscium.—Fish glue, E.; *Colle de poisson, Ichthyocolle*, F.; *Hausenblase, Fischleim*, G.

The swimming-bladder of Acipenser Huso, *Linné*, and of other species of Acipenser. Class Pisces. Ord. Sturiones.

Origin.—Isinglass is mentioned by the British Pharmacopœia among the articles employed in chemical testing. The kind preferred is that known in commerce as *Russian isinglass*, which is obtained from several sturgeons, species of Acipenser, which inhabit the Caspian and Black Seas and their tributary rivers, and the most important of which are Ac. Huso, *Linné*, or *belugo;* Ac. Güldenstädtii, *Ratzeburg*, or *osseter;* Ac. ruthenus, *Linné*, or *sterlet;* and Ac. stellatus, *Pallas*, or *sewruga.* It is prepared by cutting the air-bag or swimming-bladder open, washing and soaking it in water, and spreading it upon boards, the outer silvery membrane being turned upward and removed by rubbing. The bladder is then merely dried in sheets, and constitutes *leaf isinglass*, or several are put together and folded before they are completely dry, forming *book isinglass*, or each bladder is rolled up and folded around a few pegs in the form of a horseshoe, heart, or lyre, in which shape it is dried. The latter is the *staple isinglass*, which, according to its dimensions, is again divided into *long* and *short staple.* The kind now most commonly met with in our commerce is the leaf isinglass.

Description.—Russian isinglass is a somewhat horny and tough membranous tissue, which is semi-transparent, of a whitish or pale-yellowish color, pearly appearance, and iridescent; it is best torn in the direction of its fibres, is inodorous, and quite insipid in taste. Immersed in water or diluted alcohol, it swells, becomes opaque, and dissolves at a somewhat elevated temperature, leaving a flocculent residue not exceeding 2 per cent.; on cooling, its solution with 24 parts of water congeals to a transparent jelly. On incineration, it leaves 0.5 per cent. of ash. Isinglass which is discolored or less soluble in water is not adapted for medicinal purposes.

Off. Prep.—Emplastrum ichthyocollæ, *U. S.*

Constituents.—Besides membranous matter and some salts, isinglass consists of that variety of gelatin known to chemists as *glutin.* (See GELATINA, page 725.)

Adulterations.—In the place of Russian isinglass the swimming-bladder of other fishes is sometimes sold, and the intestines of various animals are said to be coated with gelatin and used for a like purpose. Such substitutions or adulterations are easily recognized by the larger amount of ash (3 to 10 per cent.) left on incineration or by the larger proportion of matter insoluble in hot water. Gelatin immersed in cold water swells, retains its transparency, and becomes soft and easily disintegrated.

Other Varieties of Isinglass.—The air-bags of most large fishes appear to be adapted for some of the purposes for which isinglass is used in the arts; when they are dried without being split open they are known as *purse* or *pipe isinglass.*

American isinglass, according to C. T. Carney (1857), is prepared from the sounds of Gadus merluccius, *Linné*, or *hake;* they are cleansed, soaked in water, passed through rollers, and dried in the form of ribbons or thin and transparent sheets. C. C. Meyer (1873) found the former to leave 30 per cent., and the latter only 18 per cent., of matter insoluble in water; the fresh bladder of a hake weighing 15 ounces left 1 ounce undissolved. Storer states that the swimming-bladder of Otolithus regalis, *Cuvier*, the *weakfish*, likewise furnishes some isinglass.

Brazilian isinglass comes from species of the genera Pimelodus and Silurus, the entire sounds being often dried so as to adhere together (*lump isinglass*), and the lumps are sometimes split open (*honeycomb isinglass*). A false isinglass from Para consisted, according to Pereira (1853), of the ovaries of a fish, probably Sudis gigas.

East Indian isinglass is produced from several large fishes, and is met with in the form of purses and of leaves.

Japanese or *Chinese isinglass* is a vegetable product. (See Chondrus.)

Medical Action and Uses.—Isinglass was anciently applied as a protective to the skin when it was *abraded* or affected with *eruptions*. It is emollient and nutritive, and forms a valuable addition to boiled milk or to farinacea prepared with milk in treating the chronic bowel complaints of children. In court-plaster it is used for its adhesive qualities.

IGNATIA, *U. S.*—IGNATIA.

Semen Ignatiæ, Faba Ignatii.—Bean of St. Ignatius, E.; *Fève de Saint-Ignace, Fève igasurique*, Fr.; *Ignazbohne*, G.

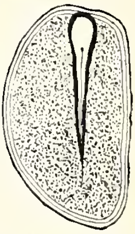
The seed of Strychnos Ignatia, *Lindley* (Str. Ignatii, *Bergius*, s. Str. philippensis, *Blanco*, s. Ignatiana philippinica, *Loureiro*, s. Ignatia amara, *Linné filius*). Bentley and Trimen, *Med. Plants*, 179.

Nat. Ord.—Loganiaceæ.

Origin.—This is a large climbing shrub indigenous to the Philippine Islands and naturalized in Cochin China, with opposite ovate leaves and an oblong or subglobular berry-like fruit having a brittle pericarp and containing about twenty-four seeds imbedded in a bitter pulp.

Description.—The seeds are from 1 to 1¼ inches (25–31 Mm.) long, ½ to ⅘ inch (12–20 Mm.) broad, oblong, ovate or roundish-ovate in shape, by mutual pressure irregularly angular; the hilum is on one of the edges in a small depression, and the surface of the seeds is of a dull reddish-gray or brownish, when old even blackish, color, and granular or partly covered by gray or light-brown silky hairs. Ignatia consists of a very hard, horny albumen, which is of the shape of the seeds and translucent at the edges, and surrounds an irregular cavity. The embryo projects into this cavity, and consists of a rather long radicle and oblong-ovate acute cotyledons. The seeds break under the hammer with a granular and irregular fracture, and soften after prolonged digestion. They are inodorous and have a very persistent bitter taste.

Fig. 155.



Ignatia: vertical section of seed.

Constituents.—Pelletier and Caventou (1819) found the seeds to contain the same constituents, though in different proportions, as nux vomica; they stated the yield of strychnine (still containing brucine) to be 1.4 per cent. Geiseler (1837) likewise found 1.5 per cent. of this alkaloid. F. F. Mayer (1863), on assaying ignatia with his solution, obtained from 2 troyounces of the seeds 4.5 grains of strychnine and 13.73 grains of brucine, which correspond to 0.52 per cent. of the former and 1.43 per cent. of the latter. The dried seeds yield 1.78 per cent. of nitrogen, indicating about 10 per cent. of albuminoids (*Pharmacographia*).

Off. Prep.—Abstractum ignatiæ, Tinctura ignatiæ, *U. S.*

Medical Action and Uses.—The action and uses of ignatia are identical with those of nux vomica. Its *dose* may be said to range from ½ grain to 2 grains (Gm. 0.03–0.10).

ILEX.—HOLLY.

Houx, Fr.; *Stechpalme, Christdorn*, G.

The leaves of different species of Ilex.

Nat. Ord.—Aquifoliaceæ.

Origin and Description.—Ilex opaca, *Aiton* (*American holly*). It is indigenous to the United States, and is either shrubby or a tree 30 or 40 feet (9 or 12 M.) high. The leaves are petiolate, coriaceous, and evergreen, about 2 inches (5 Cm.) long, oval in shape, and with a wavy-toothed margin, the teeth being furnished with rigid and sharp spines. They are without odor and have a mucilaginous, bitterish, and astringent taste.

Ilex aquifolium, *Linné* (*European holly*), is very nearly related to the preceding. The leaves differ in being rather ovate, dark-green and glossy on the upper surface.

Ilex cassine, *Linné* (known as *yaupon, youpon*, or *cassena*). It grows in the United States from Virginia southward. The leaves are shortly petiolate, about 1 inch (25 Mm.) long, coriaceous, varying in shape between lance-ovate, ovate, and oblong, crenate on the margin, smooth, dark-green, and glossy above, and paler beneath. They are inodorous, and have an astringent and bitterish taste.

The following two species are likewise known as *cassena* in the Southern States:

ILEX DAHOON, *Walter*, has leaves about 2 inches (5 Cm.) long, which are oblong or oblanceolate, with the margin revolute or entire or sharply serrate toward the apex.

ILEX MYRTIFOLIA, *Walter*. The leaves are linear-lanceolate or linear-oblong, 1 inch (25 Mm.) long, entire on the margin or furnished with a few sharp teeth.

The fruit of these species is a red drupe, usually containing four one-seeded ribbed or grooved nutlets.

ILEX PARAGUAYENSIS, *St. Hilaire*, is a small tree indigenous to Brazil and the Argentine Republic. The leaves are oblong or lanceolate, wedge-shaped at the base, rather obtuse at the apex, and with distant teeth on the margin. They furnish the *yerba mate* or *Paraguay tea*, also known as *Jesuits' tea* and *St. Bartholomew's tea*, which is extensively used in South America, the annual consumption in the Argentine Republic alone being estimated at 27,000,000 pounds, or about 13 pounds per head. It is prepared as follows: The small branches with the leaves are placed in the *tatacúa*, a plot of earth about 6 feet (1.8 M.) square, surrounded by fire, where they undergo their first roasting. They are thence taken to the *barbacúa*, which is a grating underneath which burns a fire, where they are somewhat torrefied to develope the aromatic principle. The leaves are subsequently reduced to powder in a sort of mortar formed of pits dug in the earth and well rammed. More recently, suitable furnaces have been erected for drying and torrefaction, and mills are used for powdering. According to Peckolt, the leaves possess most aroma when the fruit is nearly ripe, and are collected in different parts of South America from December or January till the following August or September.

Constituents.—The leaves of the European holly were examined by Lassaigne (1822), Déleschamps (1832), Lebourdais (1841), Moldenhauer (1857), and Bennemann (1858). The four first-named investigators obtained the bitter principle as a more or less colored amorphous mass; Bennemann, in the form of feathery crystals too small in quantity for further investigation. Déleschamps' *ilicin* was *not*, but Moldenhauer's and Bennemann's *was*, precipitated by subacetate of lead; Lebourdais's ilicin was absorbed from the decoction by animal charcoal and extracted from it by boiling alcohol. D. P. Pancoast's (1856) ilicin was obtained by Lebourdais's process from the fruit of the American holly, and is described as being in minute needles; the same process applied to the leaves yielded an amorphous green mass.

Moldenhauer isolated *ilixanthin*, $C_{17}H_{22}O_{11}$, the yellow coloring matter of the leaves, in the form of straw-yellow needles which are soluble in alcohol and boiling water, but insoluble in ether. *Ilicic acid* is syrupy; its barium salt is amorphous; the calcium salt crystallizes in scales.

The yaupon contains 0.122 per cent. of *caffeine*, 2.409 per cent. of tannin, 4 per cent. of ash, besides wax, resin, etc., according to the analysis of H. M. Smith (1872). Caffeine was also found in mate by Stenhouse (1843), who regards the tannin as differing somewhat from caffeo-tannic acid. Rochleder, on the contrary, considered the tannin from the two sources as identical, but, according to Arata (1877), *matetannic acid* gives with baryta-water a green, and with lead acetate a yellow-greenish, precipitate, and its precipitate with gelatin is insoluble in the tannin solution; like caffeo-tannin, it is not precipitated by tartar emetic, and on dry distillation yields pyrocatechin. Alonzo Robbins (1878) examined seven samples of maté, and found the caffeine to vary between 0.2 and 1.6 per cent. and the tannin between 10 and 16 per cent.; the samples containing the largest amount of caffeine yielded the least tannin, and *vice versâ*. Stenhouse had found 0.13 (in 1843) and 1.2 (in 1851) per cent. of caffeine. According to Peckolt, the average is 0.5 per cent., and the air-dried leaves vary to about the same extent as mate in the percentage of caffeine; 0.24 per cent. of crystallizable mateviridic acid is present in both, also a minute quantity of volatile oil and stearopten.

Medical Action and Uses.—According to Barbier, holly-leaves and their preparations produce a sense of heat and oppression in the stomach, with some nausea, followed by colic without diarrhœa. The berries vomit and purge, and at least one case is recorded of their proving fatal to a child. The leaves, being bitter, were naturally employed for the cure of *intermittent fever*, and a formal inquest upon their virtues having been held by the Institute of France, its chairman reported that their efficiency was real, although it was very slow in exhibiting itself. He was probably unacquainted with the fact that intermittent-fever patients removed to a hospital generally recover without medicinal treatment. Moreover, subsequent clinical observations by competent physicians proved that the curative power of the medicine in this disease is absolutely null. The leaves have been used in *rheumatism*, internally and topically, and the berries as carthartics in *dropsy*. An American species, I. opaca, is demulcent, and is used in decoction to palliate *cough* and promote expectoration. I. paraguayensis, or Paraguay tea, is employed in its native country very much as Chinese tea is used elsewhere, and for similar purposes and with like effects, or, more precisely, with effects like those of coca. According to Couty (1879), when its infusion was injected into an animal's stomach it excited efforts to urinate, with priapism and quickening of the pulse (*Archives gén. de Méd.*, 7 sér. iii. 239). In 1881, Couty and Arsonval declared that it "diminished the carbonic acid and the oxygen of the arterial blood to the extent of one-third or even one-half," and that thus it exerted a powerful influence upon the nutritive function (*Bull. de thérap.*, ci. 81). Its infusion is said to be sudorific or diuretic, and in large doses drastic.

ILLICIUM, *U. S.*—ILLICIUM.

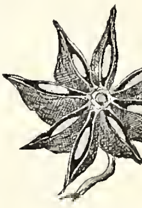
Anisi stellati fructus, Br.; *Semen badiani.—Star-anise, Chinese anise*, E.; *Badiane, Anise étoilé*, Fr.; *Sternanis*, G.

The fruit of Illicium anisatum, *Loureiro*. Bentley and Trimen, *Med. Plants*, 10. *Nat. Ord.*—Magnoliaceæ.

Origin.—This is a shrub or small tree 8 or 10 feet (2.4 or 3.0 M.) high, with evergreen lanceolate, entire, pellucid-punctate leaves and greenish-yellow polypetalous flowers. It is indigenous to the high mountains of Yunnan in South-western China and to the west of Canton. During the year 1866–67 there were imported into the United States 17,307 pounds of star-anise; more recent returns include the drug with anise.

Description.—Star-anise consists of about eight boat-shaped follicles, which are horizontally arranged in one circle around a pedunculate short axis. The follicles are about $\frac{1}{2}$ to $\frac{3}{5}$ inch (12–15 Mm.) long, have a shallow depression above near the apex, and a straight beak, which in the commercial article is usually partly broken off; they are rather woody, externally wrinkled and brown, internally smooth, red-brown, and glossy, and on the upper margin usually split open. Each carpel has a single seed, which is oval, flattened, oblique at the base, smooth, and of a polished brown-yellow color, and contains a large oily albumen enclosing the small embryo. Star-anise yields about 78 per cent. of capsular integuments, which have a very agreeable anise-like odor and a sweetish aromatic taste. The seeds weigh about 22 per cent., are but slightly aromatic, and have an oily taste. The poisonous fruit of Ill. religiosum, described below, has been occasionally mixed with star-anise.

FIG. 156.

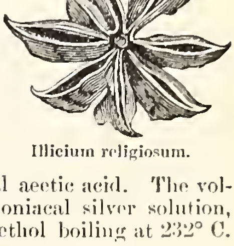


Star-anise.

Constituents.—The fruit and seeds were separately examined by Meissner (1818), who obtained from the former 5.3 per cent. of volatile oil, 2.8 of fat, 10.7 of resin, etc.; the fruit seems also to contain a little tannin, mucilage, and pectin. The seeds were found by Meissner to yield only 1.8 per cent. of volatile oil and 2.6 per cent. of resin, but about 20 per cent. of fixed oil. The volatile oil is chemically identical with that of Pimpinella Anisum. (See OLEUM ANISI.) According to Eykman (1880), the fruit contains an alkaloid, which has not been further examined.

Allied Plants.—ILLICIUM RELIGIOSUM, *Siebold*. This has usually been regarded as identical with the preceding, until attention was directed to the important distinctions by Geerts, Eykman, and Holmes in 1880. The plant is indigenous to Eastern Asia, and is often cultivated in Japan near the temples; it is a tree 25 to 30 feet (7.5–9 M.) high, with broader and more glaucous leaves and with an aromatic bark. The fruit, like the preceding, consists of eight follicles spreading horizontally, but only a portion of these are usually developed to maturity; each follicle is about $\frac{1}{8}$ or $\frac{2}{5}$ inch (3 or 10 Mm.) long, is woody, often shrivelled, has near the apex a short and rather deep depression, terminates with a short curved beak, and has a faint clove-like odor and an unpleasant taste. The plant is known in Japan as *sikimi* or *shikimi*. Eykman found in the fruit an alkaloid and a poisonous neutral principle, *sikimin*, which crystallizes in hard prisms or needles, is insoluble in petroleum benzin, slightly soluble in cold water, more freely soluble in hot water, ether, and chloroform, and easily soluble in alcohol and glacial acetic acid. The volatile oil is somewhat heavier than water, slightly levogyre, reduces ammoniacal silver solution, and consists of a terpene boiling near 175° C. (347° F.) and of liquid anethol boiling at 232° C. (450° F.).

FIG. 157.



Illicium religiosum.

ILL. PARVIFLORUM, *Michaux*, a native of Florida and Georgia, has yellow flowers and an eight-carpelled fruit, with a sassafras-like flavor; according to R. E. Griffith, the bark may be used as a substitute for cascarilla.

Ill. floridanum, *Ellis*, grows in Florida and westward to Louisiana, and has purple flowers. The fruit consists of thirteen carpels, has a rather unpleasant terebinthinate taste, and, like the leaves, is poisonous. The plant is known in Alabama as *poison-bay*, and in Louisiana as *stink-bush*.

Ill. Griffithii, *Hooker filius et Thomson*, a native of Eastern Bengal, has a thirteen-carpelled fruit of a bitter and somewhat acrid taste.

Ill. majus, *Hooker filius et Thomson*, grows in the Malayan Peninsula, and has a black-brown fruit consisting of eleven or thirteen carpels, and is of a mace-like taste.

Medical Action and Uses.—Star-anise has the same qualities as the officinal anise, and in the East its seeds and oil are used for similar purposes—viz. as carminative, anodyne, stimulant, and diuretic, and as condiments for vegetable food. Externally, they are applied to allay local pains, such as *colic*, *rheumatism*, *earache*, etc. In Germany they are employed in a similar manner internally, and for the relief of *bronchitis*. The native species, I. floridanum, is aromatic in its leaves, bark, and seeds; the bark has been suggested as a substitute for cascarilla, and the seeds for those of anise. The root of I. parviflorum is said to resemble that of sassafras in its properties. Illicium may be administered in the same manner as anise.

I. religiosum has attracted attention within several years on account of its poisonous properties and its close resemblance to star-anise. In 1880 cases of poisoning by the former occurred in Holland, owing to its having been mistaken for the latter (*Am. Jour. Phar.*, Aug. 1881, p. 407); and in the same year in Japan, of five children between two and five years old who had eaten of the fruit, three died, unconscious, in convulsions, and foaming at the mouth. Dr. Langgaard, who relates this case (*Virchow's Archiv*, lxxxvi. 222), states that the Japanese use the powder of the plant, every part of which is poisonous, to destroy rats, and also to kill fish, which are not rendered inedible by this mode of death. He refers also to another case in which of six persons who had partaken of illicium oil, instead of oil of sesame, one died. 10 Gm. of the oil were given to a large dog. In about 50 minutes the animal moved round in a circle, vomited, had spasmodic movements, with rejection of froth and bile, hard breathing, dilated pupils, diarrhœa, and all the symptoms of an irritant poison, but after about 6 hours recovered. The conclusions drawn by Dr. L. from a series of experiments are substantially the following: 1. The poison of I. religiosum resides in all parts of the plant, and by its action on certain centres in the medulla oblongata excites tonic, and also clonic, convulsions, analogous to those caused by picrotoxin, toxiresin, and cicutoxin. 2. In frogs, before the spasms set in, reflex excitability declines in consequence of the irritation of the reflex inhibitory brain-centres. At first the spinal cord is not involved, but the spasms in the last stage of the poisoning are due to its exalted excitability. 3. The respiration is quickened. 4. The pulse is slowed by small doses of the poison. 5. Small doses kill through suspension of respiration, larger doses by arrest of the heart. 6. True star-anise acts in the same manner, but much more feebly than illicium.

IMPERATORIA.—MASTERWORT.

Rhizoma (*Radix*) *imperatoriæ*, P. G.; *Impératoire*, Fr.; *Meisterwurz*, *Kaiserwurz*, G.

The root-stock of Imperatoria Ostruthium, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

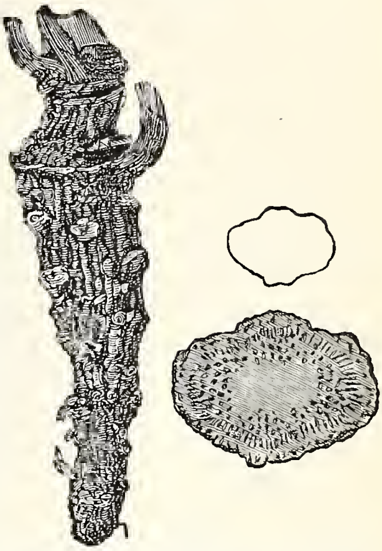
Origin.—Masterwort is indigenous to the mountainous regions of Southern and Central Europe, grows 2 or 3 feet (60 or 90 Cm.) high, and has large umbels of many white or reddish flowers. The root-stocks are produced at the termination of thin rhizomes which are about 6 inches (15 Cm.) long.

Description.—The horizontal root-stock is 2 to 4 inches (5–10 Cm.) long, of the thickness of a finger, somewhat conical, and slightly flattened. Externally, it is dark brownish-gray, wrinkled, with warty protuberances or scars, and finely annulate. Internally, it is brownish-white, and exhibits upon the transverse section a thin bark and a large central pith, both containing many brown-yellow resin-cells; the wood-bundles are small, yellowish, and form a loose circle. Masterwort has a strong balsamic odor and an aromatic, pungent, and bitter taste. It has been noticed by Holmes (1877) as an adulteration of aconite-root.

Constituents.—Masterwort contains about ¾ per cent. of volatile oil, which, according to Hirzel (1849), is a mixture of several hydrates of a hydrocarbon, $C_{10}H_{16}$. Wackenroder (1831) obtained colorless shining crystals of *imperatorin*, $C_{12}H_{12}O_3$, which, in alcoholic solution only, have a pungent taste. Schlatter (1833) obtained *peucedanin* from the root of Peucedanum officinale, *Linné*, which was afterward proved by R. Wagner to be identical with imperatorin. Both principles, when boiled with an alcoholic solution of potassa, are resolved into *angelic acid* and *orcoselin*, $C_{14}H_{12}O_4$. The latter body may also be obtained from *athamantin*, $C_{24}H_{30}O_7$, which was discovered by Winckler (1842) in the root of Athamanta (Peucedanum, *Mœnch*) Oreoselinum, *Linné*. Athamantin resembles imperatorin, unites with dry hydrochloric acid, and on boiling this compound with alcohol is split into *valerianic acid* and *oreoselon*, $C_{40}H_{10}O_3$, which crystallizes in needles, and on being boiled with water and an acid yields the crystalline oreoselin.

Medical Action and Uses.—The acrid and aromatic taste of this plant and its odor, resembling that of angelica, depend upon its essential oil, and to the stimulating operation of this oil nearly all the medicinal virtues of the medicine are due. It is but little used at the present day, but it was formerly prescribed in various conditions of local or general debility. Among these were the *typhoid state* of fevers and inflammations, *intermittent fever*, *delirium tremens*, and some forms of *dropsy*, atonic *dyspepsia*, *flatulent colic*, *hysteria*, and *asthma;* and locally it was used as a masticatory to relieve *toothache* and *paralysis* of the tongue or palate and as a stimulant of unhealthy *ulcers*. It may be administered in an infusion made with from 5 to 10 parts of the root and 100 parts of hot water.

FIG. 158.



Imperatoria Ostruthium, *Linné:* root-stock, natural size; and transverse section, natural size and magnified.

INDIGO.—INDIGO.

Indicum, *Pigmentum indicum.*—*Indigo*, Fr., G.

A blue dye-stuff extracted from different species of Indigofera. Bentley and Trimen, *Med. Plants*, 72.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus consists of herbaceous or suffruticose plants which are indigenous to and cultivated in tropical and subtropical countries. The most important species are Indigofera tinctoria, *Linné* (s. I. indica, *Lamarck*), I. Anil, *Linné*, and I. argentea, *Linné* (s. I. glauca, *Lamarck*, I. cœrulea, *Roxburgh*). The genus Baptisia appears to yield a similar coloring matter. Indigo is also obtained from Isatis tinctoria, *Linné* (Nat. Ord. Cruciferæ), the *woad*, indigenous to Europe, and from Polygonum tinctorium, *Linné* (Nat. Ord. Polygonaceæ), which is a native of China.

Preparation.—The plants are immersed in water until fermentation has set in, whereby the chromogene is dissolved. When the liquid has assumed a sherry color it is drawn off and briskly stirred, so as to bring it freely into contact with air. As the chromogene becomes oxidized the newly-formed coloring matter, which is insoluble in water, subsides. The supernatant liquid is then decanted, and the deposit heated to boiling to arrest fermentation, after which the precipitate is collected, pressed, and dried. Nearly 1,000,000 pounds of indigo were imported into the United States in 1876, and over 3,000,000 pounds in 1882.

Properties.—Indigo is met with in porous, hard, but brittle lumps or cubical cakes, which are inodorous, tasteless, and of a deep-blue color, assuming a coppery lustre when scratched or rubbed with a hard body; inferior qualities are of a dull hue, with a greenish or grayish tint, dense, firm, and not brittle. It is insoluble in the ordinary solvents, dissolves freely in concentrated sulphuric acid, and when rapidly heated sublimes partly in purple-colored vapors which condense into copper-colored needles. The color of indigo is altered by oxidizing and deoxidizing agents.

Constituents.—Indigo contains variable quantities of inorganic substances; when of good quality it yields about 7 per cent. of ash. It contains the proteid *indigo-gluten*, which is soluble in warm diluted acids, and the coloring principles *indigo-brown*, soluble in caustic alkalies, and *indigo-red* or *indigo-resin*, which is taken up by boiling alcohol after the indigo has been previously exhausted with dilute acids and alkalies. But the most important principle is *indigo-blue* or *indigotin*, of which good indigo contains between 50 and 60 or 70 per cent., and which is not contained in the plants, but is formed from a colorless syrupy bitterish compound called *indican*, $C_{26}H_{33}NO_{18}$. During the treatment described above indican is split into a saccharine body, *indiglucin*, $C_6H_{10}O_6$, and indigotin, $C_{16}H_{10}N_2O_2$. On mixing 2 or 3 parts of finely-powdered indigo, 6 parts of slaked lime, 4 parts of ferrous sulphate, and 450 parts of boiling water the blue color disappears, and the yellow solution contains *indigo-white*, $C_{16}H_{12}N_2O_2$, which may be obtained as a white crystalline powder on adding the clear solution to an excess of boiled dilute hydrochloric acid with the precaution to avoid all contact with the air; if access of air be permitted during the latter part of this process, indigotin is regenerated and deposited in the form of a deep-blue powder. By oxidation of indigotin with nitric acid, *isatin*, $C_{16}H_{10}N_2O_4$, is obtained, forming yellowish-red shining, bitter prisms which are soluble in alcohol, hot water, and alkalies, and on distillation with potassa yield *aniline*.

Soluble indigo, or *sulphate of indigo*, is prepared by gradually adding 1 part of powdered indigo to 5 parts of Nordhausen sulphuric acid or 8 parts of oil of vitriol, and preventing a rise of temperature by immersing the vessel in cold water. In the course of 2 or 3 days it becomes a dark-blue pasty mass, the solution of which in about 2 parts of water is *liquid blue*. The solution of indigo in sulphuric acid contains two compounds—*sulphopurpuric acid* or *indigo-purple*, $C_{16}H_9N_2O_2.HSO_3$, and *sulphindigotic* or *sulphocærulic acid*, $C_{16}H_8N_2O_2(HSO_3)_2$; the first one of these is insoluble in dilute acids, in which the second remains dissolved, and is obtained pure by transferring it from its dilute solution to wool and dissolving it from the latter by means of a weak alkali. Its salts are amorphous; those with potassium and sodium are sold in commerce as *indigo-carmine*, and are usually obtained by adding a potassium or sodium salt to a solution of sulphate of indigo, washing the precipitate with a solution of the same salt, and expressing; the product is soluble in pure water.

Artificial Indigo.—The synthetical preparation of indigo has been the subject of research for a series of years, and was finally accomplished by Prof. Adolf Baeyer (1878) by converting toluol, through a number of intermediate products, into isatin, and finally into indigotin. This elaborate process not promising commercial success, a more direct one, which is now in successful operation, was devised by the same chemist, starting with cinnamic acid prepared from coal-tar. It is converted by nitric acid into *nitro-cinnamic acid*, $C_6H_4(NO_2)C_2H_2COOH$; this with bromine yields *nitrodibrom-cinnamic acid*, $C_6H_4(NO_2)C_2H_2Br_2COOH$, which, by the action of caustic alkali, parts with bromine and hydrogen and leaves *orthonitrophenyl-propiolic acid*, $C_6H_4(NO_2)C_2COOH$. On heating this with an alkaline solution of grape-sugar, which acts as a reducing agent, oxygen and carbonic dioxide are eliminated, and indigotin $(C_6H_4NCHCO)_2$ is produced.

Valuation.—This is based upon determining approximately the amount of indigotin contained in indigo by the process given above, or by adding chlorine ($KClO_3$ and HCl) to finely-powdered indigo until the blue color has been destroyed. The richer it is in indigotin the larger will be the amount of chlorine necessary to effect decolorization.

Adulteration.—Indigo may be adulterated with water, which the better qualities readily absorb; when dried at 100° C. (212° F.) it should lose not over 6 per cent. in weight. The best qualities of indigo leave from 4 to 8 per cent. of ash when incinerated; a larger percentage indicates admixture of inorganic matter. Gum or starch, if present, forms with hot water a mucilaginous liquid or paste, and if treated with strong sulphuric acid is carbonized, coloring the indigo black. Adulteration with Prussian blue is detected with caustic potassa or soda, which does not alter indigo, but liberates from Prussian blue ferric hydrate, while potassium or sodium ferrocyanide remains in solution.

Pharmaceutical Uses.—Besides its uses in the arts for dyeing, a solution of indigo is employed as a test for determining the presence of nitric acid, chlorine, etc.

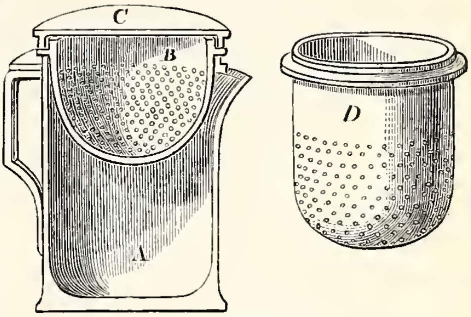
Medical Action and Uses.—During the experiments made many years ago with indigo in the treatment of *epilepsy*, it was given in very large doses, and, as a consequence, deranged the digestive organs, causing vomiting and purging, with debility and some nervous disorder. In some instances the urine and sweat acquired a bluish color. There is not the slightest ground for believing that it exhibits curative virtues in epilepsy or in any other disease. Its dose is usually stated to be from 5 to 15 grains and upward.

INFUSA, *U. S., Br., P. G.*

Infusions, E., Fr.; *Infusés,* Fr.; *Infusionen, Aufgüsse,* G.

Infusions are aqueous solutions of the soluble principles of vegetable or animal drugs obtained by maceration or digestion in hot or cold water, and differ from decoctions only in the lower degree of heat employed in their preparation. Substances containing volatile or other principles which would be dissipated or injured by boiling are particularly adapted for this purpose. Except in a few cases in which percolation is directed, the pharmacopœial infusions are prepared by pouring boiling or cold water upon the material and allowing them to remain in contact for a definite length of time, at the expiration of which the solution is poured upon a strainer, and the solid material expressed to recover the liquid absorbed by it. A convenient apparatus, well adapted for making these preparations, is Squire's infusion-pot: this consists of a jar A, with a projecting ledge near the top, which supports a strainer, B or D, containing the material to be exhausted; the jar is closed by a well-fitting cover, C. The advantages of this contrivance are—that the material is exhausted by circulatory displacement, the liquid, as it becomes charged with the soluble ingredients descending to the bottom, giving place to fresh portions of less saturated menstruum, and that no further straining is required should care have been taken not to use too fine a powder.

Fig. 159.



Squire's Infusion-Pot.

The drugs are best adapted for exhaustion with water if cut into thin slices by a suitable knife, so that they may be easily permeated by the liquid; when cutting is inadmissible they should be bruised to a coarse powder. Ligneous drugs, however, should be in a fine or moderately fine powder, which is also best adapted for most of those which may be made by percolation.

The time directed for the maceration with boiling water is, in the U. S. Pharmacopœia, usually 2 hours, and in the British Pharmacopœia 15 or 30 minutes, which is in most cases sufficient.

The strength of the infusions of the British Pharmacopœia is usually such that the virtues of 1 part of the drug are represented by 20 or 40 parts of the infusion; the simple infusions for which special directions are given in the U. S. Pharmacopœia are made in the proportion of 1½, 4, or 6 parts to 100 parts by weight. The French Codex classifies these preparations according to their strength, and designates such, 100 or 200 parts of which represent 1 part of the drug, as *tisanes, ptisanæ;* they are made either by maceration, infusion, or decoction, and are intended to be used freely. *Bouillons* are similar preparations made from lean meat, with or without the addition of aromatics and other substances. *Apozèmes* are infusions or decoctions differing from tisanes only in being more concentrated.

Infusions are not intended to be kept, except for a very limited period. Exposed to air, as they necessarily must be in the sick chamber through the vial containing them being opened from time to time, decomposition must ensue after a day or two, and may be retarded somewhat only by keeping the vessel in a cool place, or, better still, on ice. When desirable to have a larger quantity prepared the liquid may be preserved by *Appert's method:* it is put into convenient-sized vials, which are heated by a water-bath gradually to the boiling-point, and stopped at that temperature. However, considering that infusions are rarely made by the pharmacist, but are usually prepared by the attendants of the patient, and may be frequently made as required, there is little necessity for such a course or for any of the various contrivances that have been proposed for obviating fermentation and other changes in infusions. But for the physician it may be useful to know that most of the infusions may be prepared in a more concentrated form, or reduced in volume by evaporation at a moderate heat, and then be kept unaltered for a considerable time by the addition of one-third their volume of alcohol. Dissolving ½ grain of salicylic acid in each fluidounce of the infusion will have a similar preservative effect.

Nearly all the infusions will yield precipitates or become discolored with the salts of iron, lead, mercury, silver, and other heavy metals, and are therefore incompatible with them.

The U. S. Pharmacopœia has adopted the plan of the German Pharmacopœia in ordering all infusions, unless otherwise directed by the physician, and with the exception of five specially enumerated, to be made of 1 part of material to 10 parts of infusion, according to the following directions: "An ordinary infusion, the strength of which is not directed by the physician nor specified by the pharmacopœia, shall be prepared by the following formula: Take of the substance, coarsely comminuted, 10 parts; boiling water 100 parts; water a sufficient quantity; to make 100 parts. Put the substance into a suitable vessel provided with a cover, pour upon it the boiling water, cover the vessel tightly, and let it stand 2 hours. Then strain, and pass enough water through the strainer to make the infusion weigh 100 parts. *Caution.*—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician."

The Pharmacopœia omits to direct the expression of the drug after infusion, but it is evident that bulky herbs and flowers, which are best adapted to this process, would retain a considerable proportion of the liquid, which cannot be washed out simply by passing water through the strainer to make up the deficiency in weight. Allowing from 20 to 25 per cent. of the weight of the drug to be dissolved on an average by the boiling water, the 40 oz. av. of infusion obtained from 4 oz. of drug will measure 38 fluidounces; accordingly,

	¼	½	¾	1	1½	2	2½	3	3½	4 oz. av. of drug
will make	2⅜	4¾	7⅛	9½	14¼	19	23¾	28½	33¼	38 fluidounces

of infusion, or there will be required

for	1	2	3	4	5	6	8	10	12	16 fluidounces
	46	92	138	184	230	276	368	460	552	736 grains of drug.

The general directions for infusion given by the German Pharmacopœia are nearly identical with the above, from which they differ only in this, that the mixture of drug and boiling water is heated for 5 minutes in a vapor-bath of boiling water, occasionally stirred, allowed to cool, and strained. The *concentrated* and *highly-concentrated infusions*, made respectively with 1½ and 2 parts of drug to 10 parts of infusion, are no longer recognized.

INFUSUM ANTHEMIDIS, *Br.*—INFUSION OF CHAMOMILE.

Infusum chamomillæ romanæ.—*Tisane de chamomille romaine*, Fr.; *Römisch-Kamillenthee*, G.

Preparation.—Take of Chamomile-Flowers ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—*Br.*

A fluidounce of this infusion represents 15 grains *U. S.* 1870, 22 grains *Br.*, or 46 grains of chamomile, if made by the general formula above.

Medical Uses.—The *dose* of this infusion is about a wine-glassful (Gm. 64) before meals; it is more apt to agree with the stomach when made with cold water. The infusion, when warm, is an efficient and gentle emetic.

INFUSUM AURANTII, *Br.*—INFUSION OF ORANGE-PEEL.

Tisane d'écorce d'orange, Fr.; *Pomeranzenschalen-Aufguss*, G.

Preparation.—Take of Bitter Orange-Peel, cut small, ½ ounce; Boiling Distilled water 10 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—*Br.*

Medical Action and Uses.—This infusion may be prescribed to allay pain and flatulence in *colic* and as a vehicle for other medicines, particularly magnesia. *Dose*, 1 or 2 fluidounces (Gm. 32–64).

INFUSUM AURANTII COMPOSITUM. *Br.*—COMPOUND INFUSION OF ORANGE-PEEL.

Tisane d'écorce d'orange composée, Fr.; *Pomeranzen- und Citronenschalen-Aufguss*, G.

Preparation.—Take of Bitter Orange-Peel, cut small, ¼ ounce; Fresh Lemon-Peel, cut small, 56 grains; Cloves, bruised, 28 grains; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—*Br.*

Medical Action and Uses.—The compound infusion of orange-peel is a grateful carminative, appropriate in *flatulence* and also in slight *diarrhœa* caused by indigestion. *Dose*, 1 or 2 fluidounces (Gm. 32–64).

INFUSUM BRAYERÆ, *U. S.*—INFUSION OF BRAYERA.

Infusum cusso, Br.—*Infusion of kousso*, E.; *Apozème de cousso*, Fr.; *Kossotrank*, G.

Preparation.—Brayera, in No. 20 powder, 6 parts (½ oz. av.); Boiling Water 100 parts (8⅓ oz. av. or 8 fluidounces). Pour the boiling water upon the brayera, and let it macerate in a covered vessel until cool. This infusion should be dispensed without straining.—*U. S.*

Kousso, in coarse powder, ½ ounce; boiling distilled water 8 fluidounces. Infuse in a covered vessel for 15 minutes, without straining.—*Br.* Kousso 20 Gm.; boiling water 150 Gm.—*F. Cod.*

Medical Uses.—About 4 fluidounces (Gm. 130) form the appropriate *dose* used in the treatment of *tape-worm*.

INFUSUM BUCHU, *Br.*—INFUSION OF BUCHU.

Infusum diosmæ s. barosmæ.—*Tisane de bucco*, Fr.; *Buchuaufguss*, G.

Preparation.—Take of Buchu-Leaves, bruised, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

A fluidounce of this infusion represents 22 grains *Br.*, 30 grains *U. S.* 1870, or 46 grains of buchu if made by the general formula given above.

Medical Uses.—This preparation contains all the virtues of buchu, and is preferable to more concentrated forms of the medicine. *Dose*, 1 to 2 fluidounces (Gm. 32–64). It is usual to make an infusion with equal proportions of buchu and uva ursi.

INFUSUM CALUMBÆ, *Br.*—INFUSION OF CALUMBA.

Infusion of columbo, E.; *Tisane de colombo*, Fr.; *Kolombo-Infusion*, G.

Preparation.—Take of Calumba-Root, cut small, ½ ounce; Cold Distilled Water 10 fluidounces. Macerate in a covered vessel for 30 minutes, and strain.—*Br.*

The infusion made with hot water is much more mucilaginous and unsightly than if made with cold water, either by maceration or percolation. Each fluidounce represents 15 grains *U. S.* 1870, 22 grains *Br.*, or 46 grains if made by the above general formula.

Medical Uses.—This is probably the most useful preparation of columbo if made with due precautions. *Dose*, a wine-glassful (Gm. 64) before meals.

INFUSUM CARYOPHYLLI, *Br.*—INFUSION OF CLOVES.

Tisane de girofle, Fr.; *Gewürznelken-Infusion*, G.

Preparation.—Take of Cloves, bruised, ¼ ounce; Boiling Distilled Water 10 fluidounces. Macerate in a covered vessel for 30 minutes, and strain.—*Br.*

1 fluidounce of this infusion represents 7½ grains *U. S.* 1870, 11 grains *Br.*, and if made ready by the general formula, 46 grains.

Medical Uses.—Infusion of cloves is used to allay flatulent colic and nausea from exhaustion. *Dose*, a tablespoonful (Gm. 16).

INFUSUM CASCARILLÆ, *Br.*—INFUSION OF CASCARILLA.

Tisane de cascarille, Fr.; *Kaskarilla-Aufguss*, G.

Preparation.—Take of Cascarilla-Bark, in No. 20 powder, 1 ounce; Boiling Distilled Water 10 fluidounces (Imperial measure). Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

This is of precisely the strength as indicated by the general formula on page 816; made by the Pharmacopœia of 1870, it was two-thirds this strength.

Medical Uses.—Cascarilla is best administered in this form. It may be given in *doses* of 2 fluidounces (Gm. 64) two or three times a day.

INFUSUM CATECHU, *Br.*—INFUSION OF CATECHU.

Infusum catechu compositum, U. S. 1870.—*Compound infusion of catechu*, E.; *Tisane de cachou composée*, Fr.; *Catechuaufguss mit Zimmt*, G.

Preparation.—Take of Pale Catechu, in coarse powder, 160 grains; Cinnamon-Bark, bruised, 30 grains; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

This infusion, made by the U. S. P. 1870, was practically identical with the preceding. Made by the present general formula, it would be three times the above strength.

Medical Uses.—The addition of cinnamon to catechu in this preparation increases its astringency, and renders it stimulant and anodyne at the same time. It is a convenient remedy for diarrhœa with flatulent colic, provided the bowels are free from irritating ingesta. *Dose*, from 1 to 3 fluidounces (Gm. 32–96).

INFUSUM CHIRATÆ, *Br.*—INFUSION OF CHIRETTA.

Tisane de chirette, Fr.; *Chiretta-Thee*, G.

Preparation.—Take of Chiretta, cut small, ¼ ounce; Distilled Water, at 120° F., 10 ounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Medical Uses.—This infusion resembles that of quassia in its qualities, and may be used where simple bitters are needed, in the *dose* of 2 or 3 fluidounces (Gm. 64–96).

INFUSUM CINCHONÆ, *U. S.*—INFUSION OF CINCHONA.

Infusum cinchonæ acidum, Br.—*Acid infusion of cinchona*, E.; *Tisane acidulée de quinquina*, Fr.; *Saurer China-Aufguss*, G.

Preparation.—Cinchona, in No. 40 powder, 6 parts (1 oz. av.); Aromatic Sulphuric Acid 1 part (73 grains or 72 minims); Water a sufficient quantity; to make 100 parts. Mix the acid with 50 parts (8⅓ oz. av. or 8 fluidounces) of water, and moisten the powder with 3 parts (½ oz. av.) of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it first the remainder of the mixture, and afterward water until the infusion weighs 100 parts (16⅔ oz. av. or 1 pint). When no variety of cinchona is specified by the physician directing this infusion, use yellow cinchona.—*U. S.*

Red cinchona-bark, in No. 20 powder, ½ oz. (1 part); aromatic sulphuric acid 1 fl. drachm (¼ fl. part); boiling distilled water 10 fl. oz. (20 fl. parts). Infuse in a covered vessel for 1 hour and strain.—*Br.*

The first process, if well conducted, obtains all the alkaloids of the bark in a soluble condition, and is, in point of fact, simply a solution of the sulphates of these alkaloids slightly weaker than that made by the Pharmacopœia of 1870. The second process will yield a very similar preparation, the straining being effected when cold. The chief difference between the two preparations is that in the former any good variety of cinchona may be employed, while for the latter red bark from cultivated plants is used.

Infusum cinchonæ flavæ, Br. 1867, was made with boiling water, no acid having been used. Such infusions, if strained while hot, will become turbid; and if strained after cooling are clear, but retain merely those alkaloids which in the natural combination are soluble in cold water.

Medical Uses.—The infusion of cinchona is used only as a tonic, and not as an antiperiodic, and may be prescribed in the *dose* of 2 fluidounces (Gm. 64) three times a day.

INFUSUM CUSPARIÆ, *Br.*—INFUSION OF CUSPARIA.

Infusum angusturæ, U. S. 1870.—*Infusion of cusparia*, E.; *Tisane d'angusture*, Fr.; *Angustura-Infusion*, G.

Preparation.—Take of Cusparia-Bark, No. 40 powder, ½ ounce; Distilled Water, at 120° F., 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.*

1 fluidounce of this infusion contains the virtues of nearly 22 grains *Br.*, 46 grains *U. S.* 1880 (15 grains *U. S.* 1870), of angustura-bark.

Medical Uses.—Following the Abyssinian mode of administering this vermifuge, the coarsely-powdered flowers are taken along with the water in which they are infused. The 8 fluidounces should be divided into two portions, and used with an interval of an hour between them in the morning, fasting.

INFUSUM DIGITALIS, *U. S., Br.*—INFUSION OF DIGITALIS.

Tisane de digitale, Fr.; *Fingerhutaufguss*, G.

Preparation.—Digitalis, in No. 20 powder, 3 parts (60 grains); Cinnamon, in No. 20 powder, 3 parts (60 grains); Boiling Water, 185 parts (3700 grains or 8⅛ fluidounces); Alcohol 15 parts (300 grains or 6½ fluidrachms); Water a sufficient quantity; to make 200 parts. Pour the boiling water upon the mixed powders, and macerate for 2 hours in a covered vessel. Then strain, add the alcohol, and pass enough water through the strainer to make the infusion weigh 200 parts (4000 grains or 8¾ fluidounces).—*U. S.*

Take of digitalis-leaves, dried, 28 grains; boiling distilled water 10 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—*Br.*

The bitter taste of digitalis is masked in the first preparation by the cinnamon, and the small quantity of alcohol and oil of cinnamon will preserve the infusion for several days before a precipitate makes its appearance, which probably contains a portion of the digitalin in combination with the tannin of the cinnamon. D. E. Prall (1878), however, did not succeed in isolating digitalin from the precipitate. 1 fluidounce of the infusion represents 3 grains *Br.*, 7 grains *U. S. P.* 1880 (7½ grains, *U. S. P.* 1870), of digitalis.

Medical Uses.—The infusion is probably the most certain diuretic preparation of digitalis. In the treatment of *dropsy* it should be steadily continued until it begins to act either upon the kidneys, the stomach, the pulse, or the bowels. Then, however, it ought at once to be suspended or the dose greatly lessened. Its physiological effects, it should be remembered, continue for several days after the medicine is discontinued, and its diuretic action occurs most readily during a state of rest. *Dose*, from ½ fluidounce to a fluidounce (Gm. 16–32) two or three times a day. A compound vinous infusion is a more efficient diuretic than the simpler officinal preparation; thus: White wine 750 parts; juniper-berries, bruised, 50 parts; digitalis 10 parts; squill 5 parts. Macerate for 4 days, and add acetate of potassium 15 parts. *Dose*, a tablespoonful (Gm. 16) three times a day.

INFUSUM DULCAMARÆ.—INFUSION OF DULCAMARA.

Tisane de douce-amère, Fr.; *Bittersüssaufguss*, G.

Preparation.—Take of Dulcamara, bruised, 1 ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.* 1867.

Medical Uses.—The infusion is probably the most efficient preparation of dulcamara. Its very dilution increases its activity. *Dose*, from 1 to 2 fluidounces (Gm. 32–64).

INFUSUM ERGOTÆ, *Br.*—INFUSION OF ERGOT.

Tisane de seigle ergoté, Fr.; *Mutterkornaufguss*, G.

Preparation.—Take of Ergot, in coarse powder, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Medical Uses.—The *dose* of this preparation for a woman in *labor* is 1 to 2 fluidounces (Gm. 32–64). Each fluidounce (Gm. 32) contains about 10 grains (Gm. 0.60) of ergot.

INFUSUM GENTIANÆ COMPOSITUM, *Br.*—COMPOUND INFUSION OF GENTIAN.

Tisane de gentiane composée, Fr.; *Enzianaufguss*, G.

Preparation.—Take of Gentian-Root, sliced, Bitter Orange-Peel, cut small, each 55 grains; Fresh Lemon-Peel, cut small, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Take of gentian, in moderately coarse powder, ½ troyounce; bitter orange-peel, in moderately coarse powder, coriander, in moderately coarse powder, each 60 grains; alcohol 2 fluidounces; water a sufficient quantity. Mix the alcohol with 14 fluidounces of water, and, having moistened the mixed powders with 3 fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and then water, until the filtered liquid measures a pint.—*U. S.* 1870.

The first formula yields an agreeable preparation, which, however, does not keep as well as that made by the second formula, in which alcohol is present in sufficient quantity to preserve it unaltered for some days. As it is an elegant preparation, frequently prescribed in small quantities, J. T. Shinn (1862) proposed to exhaust four times the weight of material directed by percolation with diluted alcohol sufficient for obtaining 1 pint of tincture, 4 fluidounces of which, diluted with 12 fluidounces of water, will exactly represent 1 pint of the infusion, as directed by the U. S. P. 1870. The preparation was dropped from the recent Pharmacopœia, perhaps for insufficient reasons. (See also MISTURA GENTIANÆ.)

Medical Uses.—This is an agreeable and efficient stimulant stomachic tonic, and may be used in *doses* of a fluidounce (Gm. 32) two or three times a day.

INFUSUM KRAMERIÆ, *Br.*—INFUSION OF RHATANY.

Tisane de ratanhia, Fr.; *Ratanha-Aufguss*, G.

Preparation.—Take of Rhatany-Root, in No. 40 powder, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

A fluidounce of this infusion, made by the U. S. P. 1870, represented 30 grains; made by the present general formula, 46 grains.

Medical Uses.—In all cases of internal *hæmorrhage* to which astringents are applicable this infusion may be advantageously used, the more so the more passive the bleeding. It is also useful in *mucous profluvia* of the *bronchia* and the *gastro-intestinal* tube. A watery solution of extract of rhatany is, however, generally preferable. *Dose*, 2 fluidounces (Gm. 64).

INFUSUM LINI, *Br.*—INFUSION OF LINSEED.

Infusum lini compositum, U. S. 1870.—*Infusion of flaxseed*, E.; *Tisane de lin*, Fr.; *Leinsamenaufguss*, G.

Preparation.—Take of Linseed 150 grains; Fresh Liquorice-Root, sliced, 50 grains; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 2 hours, and strain.—*Br.*

Liquorice-root is added in this infusion with the view of improving its flavor. As the mucilage is contained in the covering of the seed, it should not be bruised, otherwise the oil will be emulsionized, and the swelling of the entire tissue will prevent the straining of the liquid.

Medical Uses.—The apparent intention of this preparation is to provide an appropriate remedy for acute mucous inflammations of the respiratory tract, an object which scarcely required a special formula, since in domestic practice it is customary to add extract of liquorice, sugar, or lemon-juice to flaxseed tea for these affections. The liquorice also renders the infusion less appropriate for bowel and urinary disorders, to which the simple flaxseed tea is generally well adapted. It may be drunk freely.

INFUSUM LUPULI, *Br.*—INFUSION OF HOP.

Infusum humuli, U. S. 1870.—*Tisane de houblon*, Fr.; *Hopfenaufguss*, G.

Preparation.—Take of Hop ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.*

If made by the present general formula, the infusion will be of three times the strength as compared with that of the U. S. P. 1870.

Medical Uses.—It is the most eligible form for the administration of hop when alcohol is contraindicated. *Dose*, from 2 to 4 fluidounces (Gm. 64–128) every two or three hours.

INFUSUM MATICÆ, *Br.*—INFUSION OF MATICO.

Tisane de matico, Fr.; *Matico-Aufguss*, G.

Preparation.—Take of Matico-Leaves, cut small, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Medical Uses.—This astringent but not very efficient preparation may be prescribed in *doses* of a fluidounce (Gm. 32) or more.

INFUSUM PRUNI VIRGINIANÆ, *U. S.*—INFUSION OF WILD CHERRY.

Tisane d'écorce de cerisier sauvage, Fr.; *Wildkirschen-Thee*, G.

Preparation.—Wild Cherry, in No. 40 powder, 4 parts (½ oz. av.); Water a sufficient quantity; to make 100 parts. Moisten the powder with 6 parts of water and macerate for 1 hour; then pack it firmly in a conical glass percolator, and gradually pour water upon it until the infusion weighs 100 parts (12½ oz. av. or 12 fluidounces).—*U. S.*

Made with cold water as directed by the Pharmacopœia, this infusion contains volatile oil and hydrocyanic acid, which are not generated by the use of hot water. Its strength has been somewhat increased over that of 1870.

Medical Uses.—This is the best form in which wild-cherry bark can be used, as a mild tonic and a sedative of the *irritable heart.* It is also applicable to the treatment of irritative *dyspepsia*, *nervous cough*, the cough of early pulmonary *phthisis*, and the hectic irritation of the decline of that disease. *Dose*, 2 or 3 fluidounces (Gm. 64–96) several times a day.

INFUSUM QUASSIÆ, *Br.*—INFUSION OF QUASSIA.

Tisane de quassie, Fr.; *Quassia-Aufguss*, G.

Preparation.—Take of Quassia-Wood, in chips, 55 grains; Cold Distilled Water 10 fluidounces. Maccrate in a covered vessel for 30 minutes, and strain.—*Br.*

We can perceive no objection to the use of warm water in making this infusion, whereby time might be materially economized without interfering with the appearance or efficiency of the preparation; maceration, as directed above, will yield a very bitter infusion, containing, however, only a portion of the quassia. If made by the general formula (see page 816), the infusion will be six times the strength of that directed by the U. S. P. 1870.

Medical Uses.—Infusion of quassia is the purest of bitter infusions, and is the best form for administering this useful stomachic tonic. The *dose* is 2 fluidounces (Gm. 64) three times a day.

INFUSUM RHEI, *Br.*—INFUSION OF RHUBARB.

Tisane de rhubarbe, Fr.; *Rhabarberaufguss*, G.

Preparation.—Take of Rhubarb-Root, in thin slices, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Rhubarb being easily permeated by water, it is preferable to employ it for this purpose cut into thin slices, instead of bruising it; in the latter case the finer powder should be sifted off. But in either case the preparation is unsightly, and becomes still more so by long-continued digestion. A handsomer though weaker infusion is obtained with the formula of the French Codex, by maceration for 4 hours with cold water. In Germany a preparation has long been in use under the name of *Infusum rhei kalinum* or *Tinctura rhei aquosa*, which is now prepared as follows: Rhubarb, sliced, 100 parts; borax and potassium carbonate, each 10 parts; boiling distilled water 900 parts. Infuse for 15 minutes, add alcohol 90 parts, and macerate for 1 hour; then express lightly, and to 850 parts of the liquid add cinnamon-water 150 parts. The finished preparation represents nearly 10 per cent. of rhubarb, is of a dark red-brown color, transparent in thin layers, mixes clear with aqueous liquids, and has not an alkaline reaction, but is incompatible with all preparations which are decomposed by alkalies. It may be preserved for several months if kept in small vials and in a cool place.

Medical Uses.—This infusion is seldom prescribed, either alone or as a vehicle for other purgatives. In the latter case it has been associated with salines, such as the tartrate of sodium or the bitartrate of potassium. The diluted form of this preparation is probably not without its advantages in maintaining a moderate and sustained operation on the bowels. *Dose*, 1 or 2 fluidounces (Gm. 32–64), repeated, if necessary, in three or four hours.

INFUSUM ROSÆ ACIDUM, *Br.*—ACID INFUSION OF ROSE.

Infusum rosæ compositum, U. S. 1870.—*Compound infusion of rose*, E.; *Tisane de rose composée*, Fr.; *Saurer Rosenaufguss*, G.

Preparation.—Take of Dried Red Rose Petals, broken up, ¼ ounce; Diluted Sulphuric Acid 1 fluidrachm; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

The Pharmacopœia of 1870 ordered red rose ½ troyounce; diluted sulphuric acid 3 fluidrachms; sugar 1½ troyounces; boiling water 2½ pints.

This infusion should not be made in a metallic vessel; it has a fine red color and agreeable flavor.

Medical Uses.—The compound infusion of rose is employed as a coloring and flavoring ingredient of mixtures, and as an excipient and solvent for sulphate of quinia and sulphate of magnesia, whose bitterness it partially covers. It forms an agreeable gargle for inflamed and ulcerated states of the *mouth* and *fauces*, and may be used to moderate profuse sweats. Its virtues are largely due to the sulphuric acid it contains. *Dose*, from 2 to 4 fluidounces (Gm. 64–128).

INFUSUM SENEGÆ, *Br.*—INFUSION OF SENEKA.

Tisane de polygale de Virginie, Fr.; *Senega-Aufguss*, G.

Preparation.—Take of Senega-Root, in No. 20 powder, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

Medical Uses.—This preparation is supposed to possess certain advantages over the decoction of seneka (*U. S. P.* 1870), which was originally prescribed, and continues to be preferred in this country; but as the senegin is not altered by the heat of boiling water, it is probable that the decoction extracts a larger proportion of it than infusion does. *Dose*, 1 to 2 fluidounces (Gm. 32–64).

INFUSUM SENNÆ COMPOSITUM, *U. S.*—COMPOUND INFUSION OF SENNA.

Infusum Sennæ, Br.—*Infusion of senna*, E.; *Tisane de séné composée*, Fr.; *Senna-Aufguss*, G.

Preparation.—Senna 6 parts (180 grains); Manna 12 parts (360 grains); Sulphate of Magnesium 12 parts (360 grains); Fennel, bruised. 2 parts (60 grains); Boiling Water 100 parts (3000 grains or 6⅝ fluidounces); Water a sufficient quantity; to make 100 parts. Pour the boiling water upon the solid ingredients, and macerate in a covered vessel until cool. Then strain, and add enough water through the strainer to make the infusion weigh 100 parts (3000 grains or 6 fluidounces).—*U. S.*

Take of senna 1 ounce; ginger, sliced, 28 grains; boiling distilled water 10 fluidounces. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

The first formula yields a preparation which is equivalent to the *black draught* of British pharmacy, and is recognized as such by the U. S. Pharmacopœia. The manipulation directed is very wasteful and faulty, since more than 20 per cent. of the active matter is left behind. The senna and fennel should be treated with 80 parts (2400 grains or 5¼ fluidounces) of boiling water, the infusion expressed, and the manna and magnesium sulphate dissolved in the liquid; the solution may then be strained and the proper weight obtained by passing water through the senna.

The second formula may be regarded as yielding a simple senna infusion, containing merely a corrective. Long-continued contact with hot water appears to increase the tendency of the senna to produce griping, particularly if digestion be resorted to. If the leaves have been cut or bruised, digestion for not over 10 minutes will yield an active infusion. The flavor being a matter of taste, the selection of aromatics had probably best be left to the physician.

MISTURA SENNÆ COMPOSITA, *Br.*; POTIO PURGANS ANGLORUM, s. POTIO NIGRA. By these titles *black draught* is sometimes prescribed, which in Great Britain is made by dissolving 4 ounces of magnesium sulphate in 15 fluidounces of infusion of senna, and adding 1 fluidounce of liquid extract of liquorice, 2½ fluidounces of tincture of senna, and 1½ fluidounces of compound tincture of cardamoms.

POTION PURGATIVE, MÉDECINE NOIR, *F. Cod.* Senna 10 Gm.; rhubarb 5 Gm.; boiling water, 120 Gm.; infuse for 30 minutes, express, and dissolve sodium sulphate 15 Gm. and manna 60 Gm.

TISANE ROYALE, *F. Cod.* Senna, sodium, sulphate, and fresh parsley-leaves, each 15 Gm.; anise and coriander, each 5 Gm.; 1 lemon, sliced; cold water 1000 Gm.; macerate for 24 hours.

INFUSUM SENNÆ COMPOSITUM, *P. G.*, also known as *Aqua* (*s. Potio*) *laxativa Viennensis*—Vienna draught, *E.*; Eau laxative de Vienne, *Fr.*; Wiener Trank, *G.*—is made by macerating 5 parts of cut senna with 30 parts of boiling water, and exposing it to the heat of a steam-bath for 5 minutes; when cold the liquid is expressed, and 5 parts of sodium and potassium tartrate and 10 parts of manna are dissolved in it; after straining it should weigh 40 parts.

Medical Uses.—The fennel-seed in this preparation lessens the tendency of the senna to gripe. If the infusion is allowed to macerate too long the tendency is increased. It is a very thorough purgative, and should be given in *doses* of from 2 to 4 fluidounces (Gm. 64–128) every hour, or at longer intervals, until it begins to operate.

INFUSUM SERPENTARIÆ, *Br.*—INFUSION OF SERPENTARY.

Tisane de serpentaire, Fr.; *Schlangenwurzel-Aufguss*, G.

Preparation.—Take of Serpentary-Rhizome, in No. 20 powder, bruised, ¼ oz.; Boiling Distilled Water 10 fl. oz. Infuse in a covered vessel for 30 minutes, and strain.—*Br.*

The infusion recognized under the same name by the U. S. P. 1870 was slightly stronger, and contained 15 grains of serpentaria to the fluidounce.

Medical Uses.—This preparation is preferable to the fluid extract and to the tincture of serpentaria. Its uses are fully detailed under SERPENTARIA. *Dose*, 1 or 2 fluidounces (Gm. 32–64) every two or three hours in typhoid conditions.

INFUSUM UVÆ URSI, *Br.*—INFUSION OF BEARBERRY.

Tisane d'uva ursi, Fr.; *Bärentraubenblätter-Aufguss*, G.

Preparation.—Take of Bearberry-Leaves, bruised, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.*

The medicinal principles of uva ursi are not volatile or decomposed by boiling water; a decoction may therefore be prepared.

Medical Uses.—This is a more convenient form than the decoction for extemporaneous use, and is perhaps sufficiently active, since it is certain that the amount of tannic and gallic acids which can be profitably absorbed from the stomach is not unlimited. *Dose*, 1 or 2 fluidounces (Gm. 32–64).

INFUSUM VALERIANÆ, *Br.*—INFUSION OF VALERIAN.

Tisane de valériane, Fr.; *Baldrian-Aufguss*, G.

Preparation.—Take of Valerian-Rhizome, bruised, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.*

Infusion of valerian, *U. S. P.* 1870, represented 15 grains of the root in the fluidounce, but made by the present general formula it contains 46 grains.

Medical Uses.—Although partially superseded by the more convenient fluid extract and tinctures, the infusion of valerian is, nevertheless, an efficient preparation, particularly where the medicine must be continuously given. *Dose*, 2 fluidounces (Gm. 64).

(For Hypodermic Injections of Apomorphine and of Ergotin, see pp. 1659, 1660.)

INJECTIO MORPHINÆ HYPODERMICA.—*Br.*

Hypodermic injection of morphia, E.; *Injection hypodermique de morphine*, Fr.; *Subcutane Morphineinspritzung*, G.

Preparation.—Take of Hydrochlorate of Morphia 92 grains; Solution of Ammonia, Acetic Acid, Distilled Water, of each a sufficiency. Dissolve the hydrochlorate of morphia in 2 ounces of distilled water, aiding the solution by a gentle heat; then add solution of ammonia, so as to precipitate the morphia and render the liquid slightly alkaline; allow it to cool; collect the precipitate on a filter, wash it with distilled water, and allow it to drain; then transfer the morphia to a small porcelain dish with about an ounce of distilled water, apply a gentle heat, and carefully add acetic acid until the morphia is dissolved and a very slightly acid solution is formed. Add now sufficient distilled water to make the solution measure exactly 2 fluidounces. Filter, and preserve the product in a stoppered bottle excluded from the light.—*Br.*

The object of the above process is the preparation of acetate of morphia in solution of definite strength, so that each fluidrachm shall contain 6 grains of that salt. On keeping, the solution decomposes, acquiring a brown color and slowly separating morphia, the crystals being very long if the solution remain undisturbed. To prevent this decomposition, Prof. C. Johnston (1873) recommended sulphurous acid, 5 drops of which were found by Jennings sufficient to protect a fluidounce. Squibb (1873) observed that $\frac{1}{6}$ per cent. of pure carbolic acid would preserve such solutions, and Limousin (1876) has obtained satisfactory results by using $\frac{1}{5}$ per cent. of salicylic acid.

Medical Uses.—The average hypodermic *dose* of this preparation is from 1 to 6 minims (Gm. 0.06–0.40), equal to from $\frac{1}{12}$ grain to $\frac{1}{2}$ grain (Gm. 0.005–0.03) of the salt.

INULA, *U. S.*—Elecampane.

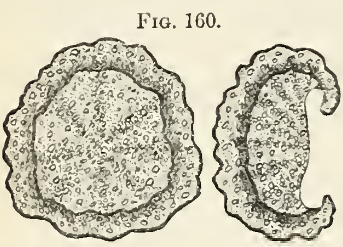
Radix Helenii, P. G.; *Radix inulæ, Radix enulæ.—Racine d'aunée, Aunée commune (officinale)*, Fr.; *Alantwurzel, Helenenwurzel*, G.

The root of Inula Helenium, *Linné* (Corvisartia Helenium, *Merat*). Woodville, *Med. Bot.*, t. 26; Bentley and Trimen, *Med. Plants*, 150.

Nat. Ord.—Compositæ, Asteroideæ.

Origin.—Elecampane is a native of Central Asia and Southern Siberia, and is found westward to Southern and Central Europe. It is not unfrequently cultivated, and has in many places escaped from gardens and become naturalized. In the United States it grows spontaneously along roadsides and in pastures from New England south to the mountains of North Carolina and westward to Illinois. It has a thick, solid stem 3 to 6 feet (0.9–1.8 M.) high, large radical leaves decurrent on the long petioles, and sessile clasping stem-leaves, all being acute, somewhat toothed, and grayish-hairy on the lower surface. The large flower-heads are terminal, and have a loosely-imbricated involucre, with an outer series of foliaceous ovate bracts; the numerous yellow pistillate ray-florets are ligulate, linear, and three-toothed, and the yellow disk-florets tubular and five-toothed. The akenes are smooth, pale-brown, four-sided, and crowned with a hairy pappus. The root is collected in the fall of the second or the spring of the third year.

Fig. 160.



Elecampane-root: transverse sections.

Description.—The root is about 6 inches (15 Cm.) long and 1 or 2 inches (25 or 50 Mm.) thick, divided below into branches 6 to 12 inches (15–30 Cm.) long and $\frac{1}{2}$ to 1 inch (12–25 Mm.) thick, very fleshy, in commerce always sliced either longitudinally or transversely. The longitudinal slices have the bark overlapping; the transverse slices are concave, somewhat radially striate; externally irregularly wrinkled and brownish, internally white when fresh, grayish after drying, of a peculiar aromatic odor and an aromatic, bitterish, and pungent taste. The root is hygroscopic and flexible in damp weather, but when dry breaks with a short fracture. The bark is $\frac{1}{8}$ inch (3 Mm.) and more thick, the inner portion radiate near the cambium-line; the meditullium has small fibro-vascular bundles and broad medullary rays, and all parts of the root are dotted with shining yellowish-brown resin-cells.

Constituents.—Elecampane contains a little *volatile oil*, some acrid *resin*, a *bitter principle* not known as yet in the isolated state, *waxy matter*, *inulin*, etc. On investigating the body formerly known as helenin and elecampane camphor, which crystallizes from the concentrated tincture mixed with water, Kallen (1873) isolated *helenin*, C_6H_8O, which is insipid, almost insoluble in water, crystallizes in needles, fuses at 110° C. (230° F.), and is by nitric acid converted into oxalic acid and a resinous body. On distilling the root with steam, Kallen (1876) obtained *inula camphor* or *alant camphor*, $C_{10}H_{16}O$, and *inulol* or *alantol*, $C_{15}H_{20}O_2$. The first of these forms colorless needles of a faint camphoraceous odor and taste, melts at 66° C. (150.8° F.), and is sublimable and very slightly soluble in water. Alantol is a yellowish liquid having the odor of peppermint and an aromatic taste, boiling near 200° C. (392° F.), and yielding crystallizable alantic or inulic acid, $C_{15}H_{22}O_3$. *Inulin*, $C_{12}H_{20}O_{10}$, is contained in the subterraneous parts of Compositæ, and is obtained by forcibly expressing the grated juicy roots, when a portion will deposit on standing, and the remainder may be precipitated by alcohol. Kiliani (1881) recommends boiling the roots with water containing sodium carbonate; the liquid is cooled by a freezing mixture, and the precipitate repeatedly dissolved in hot water and reprecipitated by cooling. The autumn roots contain the largest percentage (elecampane 44 per cent.) of inulin, which by the following spring is to a considerable extent changed into mucilage, sugar, and levulin, and in some cases to glucosides. Inulin is a fine white powder, tasteless and inodorous, insoluble in alcohol, slightly soluble in cold water, more so in hot water, and then partly altered, but mostly reprecipitated on cooling; on the slow evaporation of its aqueous solution it may be obtained in crystalline spheres, and by hydration it is converted into gum-like and horny modifications. It appears to be the anhydride of levulose, its formula being $(C_6H_{10}O_5)_6H_2O$, but it does not reduce Fehling's solution. Heated with water in sealed tubes, it yields levulose; with hot baryta-water lactic acid is formed; diluted nitric acid oxidizes it to formic, oxalic, racemic, glycollic, and probably glyoxylic acids. Inulin differs from starch by the absence of concentric layers, does not yield a jelly with water, and it is colored yellow (not blue) by iodine. (Two monographs on inulin were published in 1870—one by Prof. Dragendorff, the other by Dr. K. Prantl.)

Allied Drug.—Radix carlinæ.—Carline thistle, *E.;* Chardon doré, Carline, *Fr.;* Eberwurzel, *G.*—Carlina acaulis, *Linné* (Nat. Ord. Compositæ, Cynareæ), is a perennial plant, a native of Middle Europe. The root is long, fleshy, nearly an inch (25 Mm.) thick, and with few branches. It is usually cut lengthwise, is deeply wrinkled, and gray-brown externally, has a rather thin light-brown bark and a grayish fleshy meditullium, which, like the inner bark, is radiately marked by broad medullary rays. Rather large brown-red resin cells are found in all parts of the parenchyma. It has a penetrating, unpleasant odor and a sweetish, burning, and bitter taste; its principal constituents are a little resin and a volatile oil, to which the odor and taste are due.

Pharmaceutical Preparation.—Extractum helenii, *P. G.*—Extract of elecampane, *E.*—It is made by displacing the powdered root with cold distilled water (*F. Cod.*), or, preferably, by exhausting the ground root with a mixture of 2 parts of alcohol and 3 parts of water (*P. G.*).

Medical Action and Uses.—Inula was one of the most famous of ancient medicines, and continued in vogue until very recent times. It owed this reputation to its stimulant qualities. Even in the Hippocratic writings it is stated to be a stimulant of the brain, the stomach, the kidneys, and the uterus—qualities which continued to be ascribed to it—as well as to exert a rubefacient action upon the skin. It had a special reputation in all pulmonary affections and as a topical application in sciatica, gout, gravel, facial neuralgia, etc. One of its chief constituents, inulin, is probably quite negative, and whatever virtues the plant possesses must be due to the elecampane camphor, which it contains in small proportion, a very minute quantity of volatile oil, and the bitter extractive, which it holds in as large a proportion as of inulin. These elements are apparently too insignificant to justify the ancient repute of elecampane. It continues to be used as a domestic remedy, rather than by physicians, in the treatment of chronic *bronchitis*, *dyspepsia*, *vesical catarrh*, *amenorrhœa*, and other menstrual disorders, and internally in chronic eruptions of the skin. Korab claims for helenin a power of destroying bacilli, and especially those of tubercle (*Bull. de thérap.*, ciii. 271). The practical value of the alleged fact remains to be seen. It is also preserved as a candy, like calamus, and is used to flavor the alcoholic beverage *absinthe.* Its retention in the United States Pharmacopœia seems quite superfluous. Elecampane is generally administered in a decoction prepared by boiling half an ounce of the root in a pint of water (Gm. 16 in Gm. 500), and which may be given in the *dose* of 2 or more fluidounces (Gm. 64). Some German writers direct from 5 to 15 parts of elecampane to 100 parts of hot water.

Carlina acaulis had formerly a reputation not inferior to that of inula for very similar virtues. It was held to be powerfully diaphoretic or diuretic, according to the manner of its administration, and in large doses purgative. It was prescribed in *typhoid states* of acute diseases, in *amenorrhœa*, to overcome sexual *impotence*, and relieve local *paralysis*, especially of the tongue. It was administered in powder in *doses* of from 10 to 20 grains (Gm. 0.60–1.30), in decoction, etc.

IODI BROMIDUM.—Bromide of Iodine.

Bromure d'iode, Fr.; *Jodbromid*, G.
Formula IBr_5. Molecular weight 527.

Preparation.—20 parts of iodine are dissolved in 63 parts of bromine, and the solution heated for some time in a large flask to about 60° C. (140° F.), until it yields a clear solution with 6 or 8 parts of water.

Properties.—Pentabromide of iodine is a dark reddish-brown liquid, resembling bromine in appearance and sensible properties, but yielding a perfectly transparent brown-red solution with less than 6 parts of water. In the presence of a small quantity of water and at a low temperature the hydrate crystallizes in brown-yellow needles or prisms, melting again at 4° C. (39.2° F.), with separation of the water. A solution containing 15 per cent. of the bromide is found in commerce. When the compound is kept for some time at or above 63° C. (145.4° F.), the boiling-point of bromine, a portion of the latter distils off, and monobromide of iodine, IBr, is left as a dark-brown sublimable crystalline mass.

Terbromide of iodine is also prepared, and requires for 20 parts of iodine 37.8 parts of bromine.

Medical Uses.—A solution of 2 drops in a fluidounce of mucilage (Gm. 0.13 in Gm. 32) has been applied in *diphtheria*.

IODOFORMUM, *U. S., Br., F. Cod.*—IODOFORM.

Iodoformium, P. G.—*Iodoforme*, Fr.; *Jodoform*, G.
Formula CHI_3. Molecular weight 392.8.

Iodoform should be kept in well-stopped bottles in a cool place.

Origin.—Iodoform was discovered by Serullas in 1822, and its composition was determined by Dumas in 1834. It is formed by the action of iodine in the presence of fixed alkalies or alkali carbonates upon alcohol, acetic and other easily-saponifiable ethers, aldehyd, acetone, amylene, butyl, capryl, and propyl alcohols, kinic, meconic, and lactic acids, oil of turpentine, and some other compounds (Lieben, 1870). Millon (1846) ascertained that it is also produced, to a limited extent, by the action of the same agents, aided by heat, upon aqueous solutions of sugars, dextrin, and gum, and upon alkaline solutions of albumen, fibrin, casein, and other proteids. Pure ethyl ether, ethyl iodide, and allied compounds, methyl and amyl alcohol, chloral, chloroform, the fruit acids, lower fatty acids, various aromatic acids, glycerin, and other compounds, according to Lieben, do not yield iodoform under the conditions mentioned above.

Preparation.—Wilder (1875) recommends Bouchardat's process as an easy one, and Filhol's as one giving a large yield. By following the former, 100 parts iodine, 100 potassium bicarbonate, 1200 water, and 250 alcohol are mixed in a flask with a long neck and slowly heated to between 60° and 80° C. (140° and 176° F.) until the color has disappeared, when 25, 20, and 10 parts of iodine are to be added, waiting after each addition until the iodine color has disappeared, and adding at the close, if necessary, a little potassa; after setting aside for 24 hours the crystals are collected upon a filter. About one-third of the iodine is recovered as iodoform, the remainder appearing in the mother-liquor chiefly as iodide of potassium, and may be obtained by supersaturating with sulphuric, and then adding a a little nitric, acid.

In Filhol's process this iodine is utilized by liberating it by means of chlorine and converting it into iodoform. The proportions recommended are 2 parts of crystallized sodium carbonate, 10 of water, and 1 of alcohol, warmed as before; 1 part of iodine is added in small portions, and after cooling the crystals are collected. The filtrate is again warmed, 2 parts of sodium carbonate are added, and a rapid current of chlorine gas is passed through the liquid as long as iodoform is separated, which is again collected, while the filtrate may be made to yield a little more iodoform by repeating the treatment. As much as 72 per cent. of crystals may thus be obtained.

Rother (1873) recommended acidulating the mother-liquor with hydrochloric acid, adding some potassium bichromate to generate chlorine, then potassium carbonate to render the liquid alkaline, and some iodine and alcohol, and finally warming the mixture. The process will thus be continuous until the accumulation of the salts becomes too great. More recently (1882) he recommended bromine in place of chlorine.

The production of iodoform may be explained by the simultaneous formation of potassium iodide, water, and carbonic acid, as follows: $C_2H_6O + 4I_2 + 2KHCO_3$ yields $2CHI_3 + 2KI + 3H_2O + 2CO_2$. The reaction, however, is never so simple, formate of potassium being perhaps always one of the products, in which case the reaction, according to Liebig, is thus explained: $C_2H_6O + 4I_2 + 6KHCO_3$ yields $CHI_3 + 5KI + KCHO_2 + 5H_2O + 6CO_2$. At the same time other reactions take place—one resulting in the formation of acetic ether, another in the production of ethyl iodide and hydriodic acid; and from great variations of the yield observed it is evident that the result is greatly influenced by the relative proportion of the material and the temperature.

Properties.—Iodoform is in small, lemon-yellow, scale-like, hexagonal crystals, which have a pearly lustre, are somewhat fatty to the touch, and have a strong saffron-like odor and a peculiar sweetish and unpleasantly iodine-like taste. It is nearly insoluble in water, but by heating it with water for about 30 minutes to between 80° and 90° C. (176° and 194° F.) a permanent yellow solution is obtained, which, according to Schadewald (1882), contains between .5 and .7 per cent. of iodine. Iodoform dissolves in 80 parts (*U. S.*), 50 parts (*P. G.*), of alcohol at 15° C. (59° F.), in 12 parts (*U. S.*), about 10 parts (*P. G.*), of boiling alcohol, in 5.2 parts (*U. S.*, *P. G.*) of ether, and, according to Vulpius (1881), in 100 parts of petroleum benzin, in 67 parts of benzol, in 25 parts of oil of turpentine, in 14.3 parts of oil of lavender, in 12.5 parts of oil of cloves, in 11 parts of oil of fennel, lemon, or rosemary, in 7 parts of oil of cinnamon, and in 6 parts of oil of caraway; it is readily soluble in chloroform, carbon bisulphide, and fixed oils; the solutions have a neutral reaction to test-paper, but when exposed to sunlight liberate iodine. Iodoform has the spec. grav. 2.0, volatilizes slowly on exposure at ordinary temperatures, fuses at about 115° C. (239° F.) to a brown liquid, and sublimes partly unaltered, but at a higher heat is mostly decomposed into iodine and hydriodic acid, with a residue of glossy charcoal, which finally burns without leaving any residue. Heated with water, it volatilizes with the vapors without decomposition; but when boiled with potassa solution a portion of it is decomposed, yielding formate and iodide of potassium, and when distilled with alcoholic solution of potassa an oily liquid of an ethereal odor and containing iodine is obtained in the distillate; both the aqueous and alcoholic solutions thus obtained on the addition of nitric acid liberate iodine, recognizable by the blue color produced with starch-paste.

The odor of iodoform in mixtures and ointments is unpleasant, and may be disguised by the addition to 1 ounce of from 3 to 5 drops of oil of peppermint; Peru balsam, coumarin, the oils of fennel, anise, and others, have also been recommended. The odor adheres persistently to the vessels in which preparations of iodoform have been made, and may be removed by solution of potassa, aided by alcohol or boiling water.

Impurities are not likely to be present; the physical properties, and particularly its odor, behavior to solvents, neutral reaction, and complete volatility, determine the absence of impurities which might result from the process of manufacture. Fixed impurities would be left behind on heating a portion upon platinum-foil until the charcoal has been consumed. "Distilled water shaken with iodoform, and filtered, should give no precipitate with test solution of nitrate of silver (absence of iodide and iodate), *U. S.*, *P. G.*, or with nitrate of barium (absence of carbonate, iodate, and sulphate)."—*P. G.*

Off. Prep.—Unguentum iodoformi, *U. S.* (See page 1574.)

SUPPOSITORIA IODOFORMI, *Br.*, contain iodoform 3 grains, cacaobutter 12 grains.

COLLODIUM IODOFORMI.—Iodoform collodium.—Iodoform, balsam of Peru, powdered soap, of each 5 parts; collodion 85 parts; dissolve (James).

Physiological Action.—The experiments of Mikulicz (*Wiener Klinik.*, Jan. 1882) prove that, except when used in large proportion, iodoform has but a slight and transient power to prevent putrefactive fermentation, and that it is entirely wanting in a speedy and energetic disinfecting power, and especially can never be available for purifying the hands of the surgeon and the instruments, etc. used in operating. Given to animals, iodoform occasions a certain degree of hebetude or somnolency, muscular debility, staggering, and anæsthesia, and in large doses muscular rigidity and opisthotonos. 30 grains were fatal to a guinea-pig, 45 grains to a rabbit, and 60 grains to a dog of medium size. The experiments of Binz and of Högyes on such animals do not furnish any instance of convulsive attacks produced by this compound, but show that the reflex excitability is but feebly maintained throughout the deepest sleep, and is replaced by paralysis and a marked fall of temperature on the approach of death. On dissection fatty degeneration is found in the liver, kidneys, heart, and the muscles generally. In the lower lobes of the lungs hæmorrhagic infarcta exist. Applied in substance upon or under the skin, in the digestive canal, or on serous membranes, iodoform unites with the fat and is decomposed, with a liberation of iodine, which combines with the albumen, forming an albuminate that is absorbed, usually without leaving any lesion of tissue behind. Ultimately, the iodine is excreted, chiefly with the urine, in combinations which are soluble in water. After death no evidence of irritation is found in the stomach, whose lining membrane, on the contrary, is rather pale. But all the organs exhale the characteristic smell of the medicine (*Archiv. f. exper. Pathol.*, xiii. 113). Von Hoffer states that in animals, and also in syphilitic patients, the continued use of iodoform diminishes the red corpuscles of the blood and produces loss of weight.

In man doses of from 2 to 5 grains occasion no signs of a caustic operation, but 7 or 8 grains have caused a decline of the pulse-rate from 72 to 60. Applied to the sound skin and mucous membranes and to ulcers, it is not in the least irritating; on the contrary, it appears to allay all local painful sensations in them, and it even blunts common sensibility. Thus it may render the anus so insensible that the passage of the fecal mass will not be perceived. Sometimes the application of iodoform has excited a severe eczematous eruption (*Boston Med. and Surg. Jour.*, March, 1882, p. 250). It appears to be eliminated with the breath and all the secretions, and very speedily after its administration. Many cases of poisoning by this preparation have been recorded. A woman affected with syphilis had taken in the course of 4 months about 42 Gm. (℥j, ʒiij) of iodoform in pills containing each 1 Cgm. (gr. ⅙). She was suddenly attacked with faintness, vertigo, and double vision; within 2 days she sank into a deep sleep which lasted for 36 hours, and was followed by excitement, violent headache, and confused speech, succeeded by debility and a tottering gait, after which the vertigo, headache, and diplopia recurred. These effects lasted for a fortnight. In the case of another woman the toxical phenomena occurred at the end of the first week, and when no more than 5 Gm. (75 grains) of iodoform had been taken. She slept continuously for 5 days, after which debility and vertigo were experienced for several weeks (Oberländer).

In 1882, according to Deutu, there had already been published eleven cases of death following the use of iodoform as a surgical dressing, and many others had been reported in which dangerous or disagreeable phenomena were observed. The principal symptoms were lassitude, faintness, headache, irritability or depression of mind, rapid pulse, maniacal delirium, drowsiness or coma, rigid muscular flexion, local paralysis (including paralysis of the sphincters), aphonia, and inequality of the pupils, and in some cases a suicidal tendency. Very generally there was a rapid increase of the pulse-rate to 140, and even 180, and a corresponding rise of temperature to 102°–104° F., but this rise was followed by a rapid fall. A taste of iodoform in the mouth was complained of by many patients. The appetite failed; vomiting was usual, and was persistent and incoercible, the rejected liquid consisting of greenish mucus and water. The lesions found after death were fatty degeneration of the heart, kidneys, and liver. Iodoform intoxication is less apt to occur in children than in adults. Somnolence has been caused apparently by the inhalation of a drachm of powdered iodoform scattered on the patient's bed. Albert saw swelling of the parotids besides the delirium above mentioned. The plugging of a wound with the preparation has been followed by fatal collapse. According to Schede, "There is an idiosyncrasy against iodoform which makes it a dangerous poison for some persons, the more so that there are no indications to suggest special care, and that in many cases the poisonous action seems to be cumulative, so that its symptoms make their appearance suddenly and with great severity, and then even the instant withdrawal of the drug does not avert the fatal issue." (Compare *Phila. Med. Times*, xii. 560; *Amer. Jour. of Med. Sci.*, April, 1882, p. 545; *ib.*, Oct. 1882, pp. 577, 579, 629; Jan. 1883, p. 301; *Med. News*, xli. 240; *Med. Record*, xxi. 324; *Practitioner*, xxiii. 129; *Amer. Jour. of Phar.*, Feb. 1883, p. 104; *Centralblatt f. d. ges. Therapie*, i. 52; *Jour. Amer. Med. Assoc.*, i. 307; *Edinb. Med. Jour.*, xxix. 674.)

Medical Uses.—After having been used in 1846 by Bouchardat in cases of lymphatic glandular swelling, goitre, and amenorrhœa, it was employed ten years later by Maitre for similar affections, syphilis, diseases of the skin, and of the bladder, etc. This physician drew attention to its anodyne virtues, and administered it internally to the extent of 40 or 50 grains daily. Its value was more fully declared in 1862 by Righini, who demonstrated the presence of iodine in all the secretions after the administration of iodoform, and in the urine after even its external application. He stated, however, that, unlike iodine, it did not cause emaciation or stimulate the glands or act as a local irritant. He enlarged somewhat the sphere of its therapeutical uses. Its most important agency was first announced by Von Mosetig-Moorhof in 1879 to be that of a dressing for surgical wounds, and for this purpose it has been widely and successfully used, especially in Germany. Its anodyne quality was conspicuously displayed in the treatment of *cancer* of the uterus, breast, and other parts, for the progress of the local disease was rendered slower and the exhaustion of the patient's strength was retarded. Indeed, not a few tumors (cancroid), supposed to be cancers, were entirely cured under this treatment. Its special value as a dressing in cases of cancer consists in its relieving the pain and correcting the offensive smell of the discharges. But it also retards the progress of ulceration. Simple ulcers of the cervix uteri are most efficiently treated by its means, although some persons associate with it a carbolic acid lotion. No agent is more successful in promoting the removal of exudations in *metritis*, *parametritis*, and *perimetritis*, as well as in relieving the pain of these affections. It may be applied directly by means of a tampon or introduced into the rectum in a suppository. The absorption of the medicine in these cases is demonstrated by the taste in the mouth of which the patients complain. Moleschott praises highly a mixture of 1 part of iodoform and 15 parts of flexible collodion, applied night and morning with a brush, as a discutient of *swollen glands* in the neck and elsewhere, as well as of *effusions* in the *pleura*, *pericardium*, *peritoneum*, and even the *arachnoid*, and as a curative application to *chronically-inflamed joints*. He ascribes the cure of several cases of *tubercular meningitis* to the use of this compound, which was painted three or four times daily over the nape of the neck, the mastoid processes, the temples, and the forehead. Venereal and all other chronic *ulcers* are most favorably influenced by iodoform, the more so in proportion as they are irritable and painful. "Under its use healthy sores heal rapidly, creeping sores generally cease to spread, and sluggish ones take on healthy action" (Hill). Another declares its effects to be almost magical (*Practitioner*, xxii. 321). Mr. Miller says of his treatment of "chancroids," "I simply dust them with iodoform powder and keep them dry, and they invariably heal up in a few days" (*Edinb. Med. Jour.*, xxviii. 390). This surgeon especially lauds the virtues of the application to venereal sores of the female genitals; he also uses it for buboes after evacuation and for syphilitic ulcers of the mouth, nose, etc. In these encomiums almost all syphilographers unite. But, as a recent writer adds, iodoform "will not retard the growth of a large, indurated, infecting chancre, and will not arrest phagedena; it will not remove venereal warts nor materially affect an inflamed gland" (*Med. News*, xli. 98). It is alleged to exert a favorable influence upon the later constitutional symptoms of *syphilis* when given internally in doses of from ¼ to ½ grain several times a day, and has also been administered hypodermically, suspended in glycerin, for a similar purpose. A solution of 1 part of iodoform in 6 or 7 of ether is considered by some surgeons preferable to the former agent alone, since it acts in smaller quantity and also as a protective to the sore. Whitehead and others also prefer an ethereal solution of iodoform to the powdered drug, or a solution of 1 part of iodoform in 2 parts of ether and 7 parts of collodion. Carded cotton thoroughly impregnated with iodoform has also been found very useful for applying the medicine to the nostrils, vagina, and rectum. In the simple as well as in the syphilitic form of *ozæna* this treatment has been found successful, and an ointment of iodoform prepared with vaseline has been used with equally good results. The same statement is true regarding syphilitic ulcers of the *pharynx*, to which the ethereal solution or the powder has been applied, or which have been treated with gelatin lozenges, each containing 1 or 2 grains of iodoform and allowed to dissolve slowly in the mouth. When the liquid preparations have been used for the purposes under notice it has been recommended to administer at the same time pills, each containing 1½ grains of iodoform, three times a day in the beginning, the dose being gradually increased until 8 or 10 pills are taken in 24 hours. This combined local and general treatment is strongly recommended in cases of syphilitic fissured *ulcer of the tongue*. The application of iodoform as a dressing for open *buboes*, and especially for such as have indurated walls and sinuses, has been singularly efficacious, as it also has in the treatment of *chronic otorrhœa*. In all of the cases now named it deodorizes, while it tends to heal, the ulcerated surfaces. It is reputed to be an efficient application to *ringworm of the scalp*, and in the treatment of *purulent ophthalmia*, *granular* or *ulcerated eyelids*, *ciliary blepharitis*, *pannus*, and *phlyctenæ* and *ulcers* of the *cornea*. In these affections of the eyeball it is recommended to apply finely-powdered iodoform by means of a camel's-hair brush, and to use for the eyelids an ointment made with 1 part of iodoform to 4 parts, and for the eyeball 1 part to 10 or 15 parts, of vaseline. It allays the pain and promotes the healing of blistered surfaces and of ulcers left by *burns*. In some cases of ulcerated fissure of the *anus* it has proved a very useful palliative, as well as in certain *hæmorrhoidal* affections attended with pain in defecation. In both of these affections it acts by promoting a more healthy nutrition, while it prevents the irritation and pain which tend to perpetuate them. Iodoform suppositories used in these affections are apt to cause general toxical symptoms. Riehl has successfully treated *lupus vulgaris* with iodoform after removing the cuticle with caustic potassa. The latter agent occasions pain which the subsequent application of the iodoform neutralizes, while it causes a gradual shrivelling and disappearance of the morbid growth (*Boston Med. and Surg. Jour.*, May, 1882, p. 415). It appears to act in a similar manner upon various local inflammatory swellings of the *lymphatic glands* and the *testes* and to diminish the size of *goitrous* tumors. In *diseases of the skin* it seems to have been found more useful in dry and chronic affections than in others; thus, in *psoriasis* and *prurigo*, rather than in eczema. It has, however, been declared by Squire to be a very convenient and efficient remedy for *impetigo larvalis* (*British Med. Jour.*, May 14, 1881); and Frazer found it useful both in local *eczema* and impetigo and in *prurigo decalvans* (*Practitioner*, xxvii. 280); and it has been applied in an ointment or liniment to prevent pitting in *small-pox*. In chronic *nasal catarrh* powdered iodoform, diluted with a neutral powder, has been successful not only in deodorizing the discharge, but also in arresting it. A similar application, or one of iodoform dissolved in ether, has been found salutary in specific and other *ulcers* of the *throat*, *vagina*, etc.; and in chronic suppuration of the middle *ear*, but more especially of the internal *auditory canal*, iodoform excels all other applications in diminishing the discharge, correcting its fetor, and restoring the part to its normal condition. Some claims have been made for this medicine as a topical remedy in *diphtheria*, but they rest upon very inadequate grounds. The *gangrenous vulvitis* which is so common under certain conditions of constitution and recent sickness in hospital practice is more successfully controlled by powdered iodoform than by any other agent. According to Parrot (*Bull. de thér.*, c. 382), nothing so easily and promptly cures that aphthous form of *vulvitis* which attacks feeble and ill-fed children. In other forms of hospital *gangrene* it is efficacious. It is one of the best palliatives of *pruritus pudendi* when applied in an ointment containing about 20 grains to the ounce (Gm. 1.20 in Gm. 30). The anodyne virtues of iodoform displayed in these affections, as well as in various other painful disorders of the rectum, bladder, and uterus, the mouth and the nasal passages, are also exhibited in some internal disorders, and particularly in those of the stomach. *Gastralgia*, alone or associated with simple *gastric ulcer*, is relieved by it, and sometimes permanently cured. In cases of vaginal hyperæsthesia and *vaginismus* its action is favorably exhibited, especially when these conditions depend upon a lesion of the mucous membrane. In the absence of the latter belladonna may be usefully associated with iodoform. External *neuralgiæ* have, it is said, been cured by iodoform, but as in every case it was associated with iron, the cure was very probably due to the latter medicine. But there can be no doubt of its palliative anodyne action in these affections. According to Moleschott, it has often relieved the most intense pains and other symptoms of *gouty* inflammation within 24 hours after painting the affected part with the solution of iodoform in collodion. An ointment made with 1 part of iodoform and 4 parts of vaseline is said to have promptly reduced the pain and swelling in acute *orchitis* (*Med. Record*, xix. 463). Iodoform has also been recommended to relieve the pain of a *carious tooth*, but it was used along with carbolic acid, oil of peppermint, or other anæsthetic, to which, probably, the relief was mainly due. Owing to the use by German writers of the word "tubercle" in its generic sense, it has been supposed that iodoform was claimed to be a remedy for pulmonary tubercular phthisis; no reasonable physician has preferred so preposterous a claim. Some, however, allege that the medicine is a palliative of the cough, expectoration, fever, and sweating, in this disease, and attribute this favorable action to its elimination in part through the lungs.

The application of iodoform as a dressing for surgical and other *wounds*, which was introduced by Mosetig-Moorhof in 1879, became very general in 1880, and especially in Germany. It is claimed to be absolutely unirritating; wounds are said to be stimulated by it even less than by carbolic acid lotions, and the granulating process is thought by Mikulicz (*Wiener Klinik*, Jan. 1882) to be rather retarded than quickened by it. It has a remarkable anæsthetic action, and when kept applied to wounds is a disinfectant which has the advantage of being altogether unirritating. According to the surgeon just named, it is neither as prompt nor as energetic as some other antiseptics, and is quite unsuited for disinfecting the surgeon's hands, instruments, etc. Owing to its mild action, it is recommended as a permanent dressing for recent wounds, and especially for such as are attended with a loss of substance. It is said to be less eligible for granulating wounds. In penetrating wounds and deep cavities the whole interior surface should be coated with iodoform powder, but in recent wounds which are to be healed by the first intention it is, according to this authority, superfluous, if not injurious, to apply the powder to the raw surface, but the part should be dressed with iodoform gauze. In contused, complicated, and other analogous wounds due drainage precautions should be observed. An iodoform gauze dressing is also recommended in all operations involving the peritoneum, intestine, etc., and in those interesting the nasal cavities, the mouth, pharynx, rectum, vagina, etc. A great value is claimed for iodoform gauze in some of these cases—*e. g.* in excision of the tongue for cancer of that organ, as reported by Billroth (*Amer. Jour. of Med. Sci.*, April, 1882, p. 567). Its advantages are very conspicuous in the treatment of open cancer, *septic* and *gangrenous wounds*, and *ulcers*, in *panaritics* and *paronychia*, in *boils* and *carbuncles* after incision, and in the lesions connected with *scrofula*, *lupus*, and *syphilis*.

At the risk of some repetition, a brief summary may here be given of the conclusions of Mosetig-Moorhof, the most enthusiastic promoter of the surgical application of iodoform (1882): It is a specific against the formation of exuberant granulations, and represses them when they already exist, transforming them into a firm and healthy tissue. To effect this purpose it is necessary to scrape the indolent growth, so as to expose a raw surface. After this operation and the dressing the discharge ceases to be purulent. Iodoform is the most certain antiseptic of every description of wound, and in a moderate amount is not hurtful to the system, although it is absorbed and is found excreted with the urine. Its primary action is, indeed, anæsthetic, but secondarily it quickens granulation and absolutely prevents all septic processes in wounds. Under its use the healing process is apyretic, or, if at first the evening temperature is raised, it does not present the characters of septic fever. Introduced into a wound, it does not prevent union by the first intention. Still, with the iodoform dressing, as with all others, provision must be made for the escape of the secretions. Their discharge does not impair the antiseptic quality of the application, but the rise of temperature that attends their accumulation demands a renewal of the dressing, which also permits an inspection of the wound. If after a few days traumatic fever does not arise, a fresh dressing, although desirable for the sake of cleanliness, is not absolutely necessary. Under this method traumatic erysipelas is very rare. Iodoform as an antiseptic renders other antiseptics unnecessary. Besides it, only pure water is required. Perfect cleanliness of the hands and instruments that touch the wound is essential. Iodoform is the cheapest, surest, and most permanent of all antiseptic dressings. The materials are easy to manage. Iodoform powder and gauze may be preserved for years without the slightest loss of activity. They may be applied antiseptically to the buccal cavity and in or near the rectum and bladder.

The judgments now given are substantially the same as those of all the leading surgeons of Germany. (Compare *Centralblatt f. d. gesammte Therapie*, i. 49.) The results obtained by Prof. Boeckel of Strassburg are scarcely less remarkable than those now recorded (*Bull. de thérap.*, cii. 265, 321). In England most of the reports of the German surgeons have been confirmed (*Med. Record*, xxi. 400), and in this country, although the published accounts of iodoform in surgery are of the same character, they are less numerous than might have been expected (*ibid.*, xxi. 309). It is highly probable that the offensive smell of the preparation is the chief cause of its comparatively limited use outside of Germany. This is the more remarkable in view of the language of hyperbole which its German promoters adopt. Von Mosetig-Moorhof in his enthusiasm exclaims: "The hymn of praise that I have sung to iodoform is not pitched upon too high a key. The most eminent German surgeons join in the chorus that soon will echo around the world. Only let not impossibilities be expected from this agent; it cannot work miracles."

Administration.—The dose of iodoform is from 1 to 3 grains (Gm. 0.06–0.20) three times a day, in pill. It may be applied in a very fine powder, the part having been thoroughly dried, or in ointments, liniments, or suppositories, each application containing about 2 grains (Gm. 0.10) of iodoform. For some of these purposes it may be dissolved in alcohol, chloroform, ether, oil, glycerin, or vaseline. It may be used for insufflation or sprinkling, mixed with lycopodium, powdered sugar, or starch. As already described, it has been incorporated with gelatin to form pastilles. The following formulæ have been recommended: ℞. Iodoform ʒj–ʒiss; glycerin fʒxij; alcohol fʒiv.—M. ℞. Iodoform gr. xxx; alcohol q. s.; lard ℥j.—M. The following may be used for making suppositories: ℞. Iodoform Gm. 2.50 (gr. xxxviii); cocoa-butter Gm. 40 (℥j, ʒij); yellow wax Gm. 5 (gr. lxxv). Mix at a gentle heat, and make ten suppositories. Cylinders made with cocoa-butter, mucilage, and glycerin or gelatin are used in the treatment of sinuses and other deep and narrow cavities. A solution for topical application may be prepared by dissolving 1 Gm. (15 gr.) of crystallized iodoform in 4 Gm. (60 gr.) of sulphuric ether (60° Baumé).

A 20 per cent. solution of iodoform in ether has been used hypodermically. A 25 per cent. solution in olive oil and a 10 per cent. solution in glycerin have been injected into the *nasal* and other natural *cavities*, into cold *abscesses* after their evacuation, etc. Iodoform ointments generally contain from 5 to 10 per cent. of iodoform. Elastic collodion, containing from 6 to 10 per cent of iodoform, is a very useful application to inflammatory *swellings* of various kinds, enlarged lymphatic *glands*, the tender points in *neuralgia*, etc.

The smell of iodoform is intolerable to many and offensive to all, and the ingenuity of surgeons and pharmacists has been taxed to devise methods of neutralizing or concealing it. The latter object has been sought by the use of fragrant substances, such as musk and the oils of bergamot, peppermint, lavender, cinnamon, thyme, and eucalyptus. Oil of southernwood (Artemisia abrotanum) has been proposed for the same purpose. The following formula has been employed: Iodoform ʒij; oil of eucalyptus ♏xv; oils of verbena, mirbane, lavender, and lemon, of each ♏v (Arthur). When the powdered drug is kept in a jar with several Tonqua beans its odor is greatly diminished. An ointment recommended by Auspitz contains iodoform and carbolic acid, of each 2 parts; lard 7 or 8 parts. Lindemann claims that 2 parts of balsam of Peru to 1 of iodoform completely mask the smell of the latter. This mixture can be conveniently made up in an ointment with vaseline. Tannin is also stated to lessen the smell of iodoform.

IODUM, *U. S., Br., P. G.*—IODINE.

Iodinium, U. S. 1870.—*Iode*, Fr.; *Jod*, G.
Symbol I. Atomicity univalent. Atomic weight 126.6.

A non-metallic element, obtained principally from the ashes of sea-weeds and from the mother-liquor of Chilian sodium nitrate. Iodine should be preserved in glass-stoppered bottles in a cool place.

Origin.—Iodine was discovered in 1811 by Courtois in the ash of sea-weeds, and was soon afterward thoroughly investigated by Gay-Lussac; also by Davy, Soubeiran, and others. It is very widely distributed in nature, but is usually met with in small, and even quite minute, quantity, almost invariably in combination. It is found in some minerals combined with mercury, silver, lead, and other metals; in Chili saltpetre, principally as sodium iodate; in many mineral spring-waters, in sea-water, in coal, and in many plants and animals living in sea-water or near the sea-coast. It is often a constituent of the atmosphere in minute quantities, and occasionally of the ashes of some plants growing inland. During the fiscal year 1866–67 the United States imported 10,701 pounds of crude and 889 pounds of resublimed iodine; in 1878 the amount was 73,687 pounds, and in 1881 182,863 pounds, of the crude article.

Preparation.—*Kelp* is the ash left on the burning of sea-weeds. The weeds are first dried, and then charred or burned at as low a temperature as possible, to avoid loss of iodine. The ash is exhausted with hot water, and the solution concentrated and cooled to remove by crystallization potassium chloride and sodium carbonate and sulphate. More of the latter salt will crystallize after the addition of some sulphuric acid, whereby the sulphides and hyposulphites present are decomposed. To the mother-liquor, heated in lead retorts to a temperature a little over 60° C. (140° F.), binoxide of manganese is added in small quantities, when iodine will distil over, and is collected in glass receivers, several of which are connected with each other. The liberation of iodine from the sodium iodide of the liquor is explained by the following equation: $2NaI + 3H_2SO_4 + MnO_2 = I_2 + 2NaHSO_4 + MnSO_4 + 2H_2O$, acid sodium sulphate and manganium sulphate being formed at the same time. The mother-liquor obtained on the purification of Chili saltpetre contains sodium iodate and iodide; from the latter the iodine is separated by chlorine gas; from the former, by sulphurous, or preferably by nitrous, acid, in which case sodium sulphate or nitrate is produced.

Purification.—In the crude state iodine is chiefly contaminated with water, but it sometimes contains also cyanogen iodide, and occasionally iodine chloride, ICl. Purification is effected by drying the product as much as possible by mechanical means, and then subliming it carefully, so that the more volatile compounds named may first sublime; afterward the heat is raised and the receiver changed. The product is the *resublimed iodine* of commerce.

Properties.—Iodine is in flat, scale-like rhombic crystals of a grayish-black or bluish-black color and a bright metallic lustre, in thin splinters transparent with a red color. It is soft and friable, and has a peculiar odor, suggestive of chlorine, and a very caustic and acrid taste. The skin or paper is colored red-brown to dark-brown, the stain disappearing gradually. Iodine has neither an acid nor alkaline reaction, but slowly destroys all vegetable colors. It has the specific gravity 4.95, vaporizes slowly and without leaving any residue at ordinary temperatures, fuses near 115° C. (239° F.), congeals at 113.6° C. (236.5° F.), and boils above 175° C. (347° F.), according to Stas, when quite pure at 250° C. (482° F.); its vapor has the density 8.7, and a reddish or purple, or above the boiling-point a deep-blue, color. Iodine dissolves with a brown-yellow color in about 60 parts of glycerin, and in 7000 parts (Gay-Lussac) (65,000 parts, according to Dossios and Weith) of water, and forms with it gradually hydriodic acid, which dissolves more iodine; its solubility in water is also increased by tannin and by many salts, and particularly by iodides. It requires for solution about 11 parts of alcohol at 15° C. (59° F.), and dissolves freely in ether, both solutions having a brown color; it is easily soluble in chloroform, carbon disulphide, benzol, and other hydrocarbons with a purplish or violet color.

Iodine is readily recognized by the blue color which it imparts to starch-paste, by which test $\frac{1}{400000}$ part of free iodine is recognized. Water containing traces of free iodine will yield it to carbon bisulphide, etc., in which solution it is recognized by the purplish color and by the blue color produced with starch-paste. Iodine in combination must previously be liberated by chlorine gas, avoiding an excess of the latter, or, if present as iodate, sulphurous acid or other deoxidizing agent will set it free.

Impurities and Adulterations.—At present iodine is usually met with in commerce in a very pure condition, containing but minute quantities of impurities. An excessive proportion of water is indicated by the iodine adhering to the bottle, and may be removed by placing it under a bell-glass over oil of vitriol at a low temperature; moist iodine yields with benzol or chloroform a turbid solution, from which the water gradually separates, the solution becoming clear. Cyanogen iodide and iodine chloride are rather freely soluble in water, and their solutions dissolve iodine with a brown color; they may be separated by heating the iodine in a suitable apparatus for about 15 minutes to 100° C. (212° F.) and cooling the vapors well; the former impurity will sublime as white or yellowish needles, the latter as hyacinthine-red prisms or red-brown oil; both have a pungent odor. For their detection the following processes are given: "If the iodine be removed from this dilute aqueous solution by agitation with disulphide of carbon, and after the separation of the latter some dilute solution of ferrous sulphate with a trace of ferric chloride be added, finally solution of soda, and the whole supersaturated with hydrochloric acid, no blue precipitate should make its appearence (absence of cyanide of iodine)."—*U. S.* Instead of removing the iodine by carbon disulphide, the solution is directed to be decolorized by sodium sulphite (or hyposulphite), and further treated with ferrous and ferric salt and soda, as stated.—*P. G.* The aqueous solution of iodine, on being decolorized with an excess of ammonia and completely precipitated with silver nitrate, should yield a filtrate which, on being supersaturated with nitric acid, should merely give a turbidity, but no precipitate (chlorine and bromine).—*P. G.* The following is the same test somewhat modified: If iodine be dissolved in sulphurous acid, the solution strongly supersaturated with ammonia, and completely precipitated by nitrate of silver, the filtrate, on being supersaturated with nitric acid, should not at once become more than faintly cloudy (absence of more than traces of chlorine or bromine). The amount of iodine is estimated in solution with potassium iodide and water by decolorizing with volumetric solution of hyposulphite, as follows:

0.633 Gm. iodine,	1 Gm.	potassium iodide,	250 Ccm.	water	require	50 Ccm.	vol. solution,	*U. S.*
0.2 " "	0.5 "	" "	50 "	"	"	15.5–15.7 "	"	*P. G.*
12.7 gr. "	15 gr.	" "	1 oz.	"	"	1000 grain-measures,		*Br.*

By this test absolutely pure iodine is required by the U. S. and Br. P., while impurities not exceeding 1.5 per cent. are permitted by the P. G. Fixed impurities, such as graphite, charcoal, sawdust, metallic compounds, etc., are left behind on volatilizing a little iodine from a porcelain capsule.

Compounds.—Iodine combines in several proportions with oxygen, the most important compound being *iodic acid;* it unites with hydrogen to hydriodic acid, and combines with most of the other elements and with many organic compounds.

The iodides of metals are partly crystallizable, and are either white or not unfrequently of a bright color. With the exception of those of gold and allied metals, they are mostly not decomposed by heat, except in contact with air or with oxidizing agents. The alkali iodides are more volatile than the corresponding chlorides, and on being heated with calcium sulphate in the air evolve iodine, while alkali sulphate and calcium oxide remain behind. The iodides are decomposed by chlorine, bromine, nitric acid, and strong sulphuric acid, and on being heated with acid sulphates. Most of the iodides are soluble in water, and these solutions are precipitated dingy white by cuprous and cupric salts, the latter liberating a portion of the iodine; bright yellow by lead salts; brown by bismuth salts; green-yellow by mercurous salts; scarlet-red by mercuric salts; yellowish-white by silver salts; yellow or green with gold salts; black with palladium salts; and dark-brown by platinum salts, the solution acquiring at first a deep brown-purple color.

Pharmaceutical Uses.—PHENOLUM IODATUM. Iodized phenol, recommended by Dr. R. Battey (1876), is prepared by combining with a gentle heat 1 part of iodine with 2 parts of crystallized carbolic acid. It is solid in cool weather.

SYRUP OF IODOTANNIN. Debauque observed that a solution of tannin will dissolve a considerable amount of iodine without reacting with starch. Demolon has suggested a syrup containing this compound, which is made by dissolving 3 Gm. of iodine and 18 Gm. of tannin in 300 Gm. of water, evaporating the solution until 60 Gm. are left, which are mixed with 960 Gm. of simple syrup.

Iodine is contained in the following officinal chemical compounds: Amylum iodatum, Arsenici iodidum, *U. S.;* Cadmii iodidum, Ferri iodidum, *Br.;* Hydrargyri iodidum rubrum, Hydrarg. iodid. viride, *U. S., Br.;* Iodoformum, *U. S.;* Plumbi iodid., Sulphuris iodidum, *U. S., Br.*

The following pharmaceutical preparations likewise contain combined iodine: Linim. potass. iodidi cum sapone, *Br.;* Liquor arsen. et hydrarg. iodidi, *U. S.;* Pilulæ ferri iodidi, Syrup. ferri iodidi, *U. S., Br.;* Unguent. cadmii iodidi, Ferri iodidum saccharatum, *U. S.;* Ung. hydrarg. iodidi rubri, *Br.;* Ung. iodoformi, *U. S.;* Ung. plumbi iodidi, Ung. potass. iodidi, *U. S., Br.;* Ung. sulphur. iodidi, *Br.*

The following preparations contain free iodine; Linim. iodi, *Br.;* Liquor iodi comp.; Tinct. iodi, Ung. iodi, *U. S., Br.;* Vapor iodi, *Br.*

Medical Action.—*On Plants and Animals:* Iodine, being one of the most widely diffused of elementary bodies, may be presumed to be in harmony with life, and, in fact, it does promote the growth of vegetable organisms when its proportion is minute, but it hinders it and destroys their vitality when it is in excess. The proportion of it which may become hostile to animal life is exceedingly small, and it operates slowly and gradually by impairing nutrition, especially of glandular organs, while it occasions more or less irritation of the gastro-intestinal mucous membrane. The latter effect reaches ulceration when the dose is increased, and if a very large dose be given at once its effects are those of a corrosive poison.

On Man: Applied to the skin in ointment or in solution, iodine occasions a sense of warmth in the part, which, if the preparation be very strong, may amount to painful burning and cause redness and swelling of the surrounding integument. The tincture stains the skin a brownish-yellow; the color is more or less permanent, and may only disappear with exfoliation of the cuticle. It may be removed by solution of ammonia and by other articles mentioned below. It has generally been believed that iodine is absorbed by the skin, but carefully-conducted experiments appear to show that, at least in adults, when efficient means are taken to prevent the iodine vapors from reaching the mouth and nostrils, no trace of the substance can be found in the secretions. The rare cases of alleged poisoning by the application of iodine to the unbroken skin are contradicted by the experiments referred to. In children, however, the tincture of iodine applied to the unbroken scalp is said to have been absorbed, since its presence was detected in the urine, which, at the same time, became slightly albuminous.

The raw cutis, the mucous and the serous membranes, and the connective tissue give iodine ready access to the blood. It does not usually occasion severe inflammation when so applied, perhaps from the rapidity of its absorption. When the vapors of iodine are inhaled they irritate the mucous membranes and occasion headache, coryza, lachrymation, and cough. Their prolonged operation, as in certain manufactures, gives rise to dryness of the respiratory tract, dizziness, nervous disorder, etc. Absorbed iodine is readily detected, combined with sodium or potassium, in the blood, milk, tears, saliva, urine, serous effusions in closed cavities, etc. It is excreted chiefly by the kidneys as an alkaline iodide, even when it is taken into the stomach, and sometimes it occasions a temporary albuminuria. When given in full doses the tincture of iodine will sometimes occasion the coryza which is one of the usual effects of potassium iodide.

The direct effects of large doses of iodine (5–6 grains = Gm. 0.30), taken internally, are those of an irritant poison, such as heat and constriction of the throat, nausea, eructation, salivation, epigastric pain, vomiting, diarrhœa, and collapse. If reaction takes place the skin is apt to become intensely red. Notwithstanding the great severity of the symptoms, the death of a previously healthy person by the internal use of iodine is extremely rare—a circumstance due, doubtless, to its rapid absorption and elimination. On the other hand, medicinal doses have been known to occasion spasm of the larynx and severe gastric irritation, while very large doses have been taken at once, or excessive amounts in the course of a few weeks, without serious consequences. As an example of the former sort may be mentioned the case of a young man who swallowed a solution containing more than 2½ drachms of iodine without experiencing any remarkable effects; and as an instance of the latter, the case of a woman who in the course of 80 days took 953 grains of iodine, in the form of tincture, without injury.

The chronic effects of iodine are manifested by all the organs. In the nasal passages, throat, and alimentary canal there are signs of irritation, with coryza, dryness, burning pain, dyspepsia, and diarrhœa; there is a tendency to loss of flesh and to wasting of certain glandular organs, especially the mammæ and the testicles; the nervous system suffers from mental and sensory debility, impaired muscular power, and even general paralysis; the hair and the skin are apt to grow darker, and the latter is the seat of various eruptions. Usually on ceasing the use of the medicine recovery from these effects gradually takes place. In medicinal doses iodine appears to promote nutrition and to stimulate glandular secretion. It is thought to excite the genital organs and increase the menstrual flow. Finally, it tends to prevent or to limit putrefaction, and thereby to correct the fetor arising from this process.

Medical Uses.—In the following description of the internal uses of iodine its tinctures are intended unless it is otherwise stated. In *intermittent fever* iodine has been thought to display decidedly curative virtues both in the malarial regions of the tropics and in those of the temperate zones. The tincture was given in doses of from 5 to 15 minims (Gm. 0.30–1.00) three times a day, largely diluted. The compound tincture may be given in doses one-half larger. The reports published by Gibbons, Grinnell, Wadsworth, Atkinson, and Woods do not justify the favorable judgment entertained of iodine in this disease. The two last-named physicians, whose field of observation was Baltimore, concluded that in intermittent and remittent fevers iodine "is infinitely inferior to either cinchonidine or quinine" (*Amer. Jour. of Med. Sci.*, July, 1883, p. 77). *Typhoid fever* and other febrile affections have been treated by iodine, but without evident advantage. A physician has so far forgotten what is due to the authority of experience as to allege that "in simple, uncomplicated croupous *pneumonia*" half-drop doses of tincture of iodine given hourly "will arrest the further progress of the disease" (*London Med. Record*, May 15, 1881). *Mercurial salivation* may be diminished by its internal use. The iodide of potassium is less certain in its effects; if we might reason from its evident power of reviving mercury long quiescent in the system, its action should be mischievous when mercurial salivation already exists. *Constitutional syphilis* has sometimes been treated with iodine, but the potassic iodide has supplanted it in this respect. *Hypertrophy* of glandular organs is often reduced by iodine, especially of the mammæ, testes, liver, and spleen, and of the thyroid gland in *goitre*. Indeed, it is probable that all cases of true goitre in persons under middle age are curable by iodine. For this purpose the compound solution should be administered in doses of from 5 to 10 drops (Gm. 0.30–0.60) three times a day. Its action upon the other organs mentioned, unless perhaps the mammæ, is more equivocal. It has been used to reduce *polysarcia*. In all cases care should be taken to prevent the medicine from injuring the stomach by giving it largely diluted, while its internal is supplemented by its external use in proper cases. In *scrofula* iodine is most efficient in the glandular forms unconnected with a characteristic deposit; over the latter it has no direct influence. On the other hand, it is of great service in promoting the healing of scrofulous ulcers and curing caries of the same nature, especially in the chronic stages of that process. Anderson recommends iodide of starch (iodine gr. xxiv; starch ℥i), in doses of a heaped teaspoonful three times daily, as a remedy for *lupus erythematodes*, but not for lupus vulgaris. There is reason to believe that even *tabes mesenterica*, or scrofula of the mesenteric glands, may sometimes be cured, and often palliated, by this medicine, especially if it is given, as in other scrofulous affections, with cod-liver oil. In some cases of *ascites* depending upon obstruction of the spleen, liver, or mesenteric glands iodine has proved curative, but in such cases the iodide of potassium is preferable. *Chronic articular rheumatism*, and that peculiar disease known as *nodosity of the joints*, have been treated with iodine internally, the former more successfully than the latter. *Excessive lactation* has been controlled by this agent in small and repeated doses, which are also sometimes successful in arresting the *vomiting* of pregnancy. The dose in the latter case should not exceed 2 or 3 drops (Gm. 0.10–0.15) of the tincture, and should be largely diluted. Gaunt (*Amer. Jour. of Med. Sci.*, Apr. 1883, p. 413) used this method in almost every other form of vomiting, whether arising from indigestion, phthisis, hysteria, intoxication, nephritis, or cholera infantum, etc., and with uniform success. Uterine disorders indicating impaired activity of function sometimes appear to be benefited by the use of iodine.

As a *topical* application it is used both for its counter-irritant and its constitutional effects. *Erysipelas*, when superficial, has often been arrested by the use of the tinctures of iodine, and, as far as any local treatment can go, they would seem preferable to solutions of nitrate of silver and other more or less caustic lotions. In *small-pox* it appears to retard the maturation of the vesicles, or even to prevent it altogether, and in addition to avert pitting. But its operation is not too confidently to be relied on. Lieutenant Payer states that a mixture of iodine and collodion proved most efficacious against *frost-bite* during the Arctic voyage of the Tegethoff in 1872. In *burns* and *scalds* its stimulant, substitutive, and protective operations are often useful, and the same may be said of certain cutaneous diseases, as *psoriasis*, *herpes*, *acne*, *favus*, and *lupus*. Its substitutive action in the case of acne seems to be proven by the fact that when this eruption is caused by iodine the contents of the pustules have been found to give the iodic reaction with starch (*Bull. de thérap.*, xcvii. 335). In favus and lupus a saturated solution of iodine in alcohol must be employed. The stimulant operation of iodine, as well as its deodorizing influence, is useful in *ozæna;* it is a valuable agent for inhalation in chronic affections of the air-passages, and especially in *laryngitis* and *bronchitis*, both in their original form and in that which accompanies *phthisis*. Like other local irritants, it may cure *aphonia* depending upon relaxation of the vocal cords or upon nervous debility. Iodine has been used topically in *diphtheria*, and probably with more advantage in this way than nitrate of silver. It is a most valuable topical agent in *leucorrhœa*, vaginal or uterine, and in chronic engorgements of the *uterus*. The same may be said of its utility in *gleet*, chronic *vesical catarrh*, and chronic *dysentery*. A gargle made with half an ounce of compound tincture of iodine in half a pint of water is efficient in mercurial *ptyalism*, and a weak solution, as of 1 grain of iodine in an ounce of water, is one of the best means of retarding or curing *retraction of the gums*. A strong solution of iodine forms one of the best applications to chronic *ulcers of the tonsils*, *fauces*, and *uterus*, in *granular pharyngitis* and *conjunctivitis*, and in *blepharitis*.

In various chronic enlargements, especially of the superficial *glands*, iodine locally employed hastens the cure, and the same may be said of *mammary abscess* and of more chronic forms of inflammation, such as affect the *joints*. It sometimes promotes the removal of *pleural* effusions, and is adapted to relieve *muscular rheumatism* of the chest and *pleurodynia*, and probably to mitigate *chronic peritonitis*. Injected into the tunica vaginalis testis, the tincture of iodine, diluted with 2 parts of water, has long been used for the cure of *hydrocele*. In like manner, it has been employed to produce adhesion of the opposite sides of other serous cavities, such as *hernial sacs*, *synovial bursæ*, and even *large joints*, as in the case of white swelling or *hydrarthrosis; ascites* independent of organic mechanical causes has been cured in this manner, but, as such cases are extremely rare, the evidence in regard to the value of the operation is scanty. When paracentesis is practised in *chronic pleurisy* tincture of iodine is often injected, either to hasten the adhesion of the opposite pleural surfaces or to correct the fetor of the pleural secretion, or both at once. In recent cases the injection may consist of a watery solution of iodine in the proportion of from 2 to 5 grains in a pint (Gm. 0.10–0.30 in Gm. 500) of water; in more chronic ones a solution of 1 part of the compound tincture of iodine to 4 or 5 of water has sometimes been used. A similar method has been employed unsuccessfully in *hydrocephalus*. Numerous cases are recorded of the cure of *spina bifida* by means of iodic injections, and, among the more recent, those of McWhatt (*Edinb. Med. Jour.*, xxvi. 321), Gould and Clutton (*Trans. of Clinical Soc. of London*, xi. 75; xv. 191; xvi. 34), and Thiersch (*Boston Med. and Surg. Jour.*, May, 1881, p. 502). In England the following solution was employed: Iodine gr. x; iodide of potassium gr. xxx; glycerin ℥j. Of this about ½ drachm was injected at each operation, and gentle but firm pressure by means of collodion and bandages constantly maintained. Injection of the tinctures of iodine has been extensively used in the case of *cysts* containing either serum, pus, blood, hydatids, or meliceroús or atheromatous matter. In the case of *ovarian* serous cysts the operation has been remarkably successful when the tumor was unilocular. The puncture for evacuating the cyst and injecting the iodic liquid should be made above Poupart's ligament. *Fibrous tumors* of the uterus have been treated with iodine both topically and internally, and, although in some cases there has appeared to be an arrest or even a subsidence of the growth, the treatment cannot be depended upon to secure either. Indolent *abscesses* and *fistulæ* of all kinds are curable by injections of a solution of iodine, which appears to act by covering the diseased surface with a protecting film, by stimulating its curative processes, and by correcting the fetor of its secretions. In the first and last respects iodine is superior to nitrate of silver. The tincture of iodine has also been injected into *pulmonary cavities* by means of the needles usually attached to aspirators, and the result appears to be that the operation is less mischievous than might have been expected. Indeed, in some cases where a single superficial cavity existed the expectoration and general symptoms have for a time abated. In *malignant pustule* tincture of iodine has been administered internally, and also injected subcutaneously around the inflamed part, and apparently with excellent results (*Practitioner*, xxix. 290; *Archives générales*, Feb. 1882, p. 204). A case is reported in which severe inflammation produced by the fumes of *cashew-nut* (Anacardium occidentale) was treated without advantage with lotions of bicarbonate of sodium and of cold water, but at once subsided under the topical use of tincture of iodine. The application was very painful (*Am. Jour. Phar.*, June, 1881, p. 281). Iodine has been used in the treatment of *poisoned wounds*, and is probably the most trustworthy application to wounds made by *venomous serpents*. Brainard formerly testified to the efficacy of iodine as a local antidote to the rattlesnake's venom, but Dr. S. W. Mitchell's experiments led him to an opposite conclusion. Dr. G. H. Carpenter of West Virginia published several cases in which the use of iodine locally and internally seemed to counteract the poison of the copperhead snake (*Med. News*, xlii. 441). One physician refers to twenty-five cases of bites by *rabid animals* in which the wounds were treated by a strong solution of iodine until active suppuration took place. In not one of these cases did rabies occur (Mussey). Although the evidence so far is entirely negative, there is much reason to believe that iodine must be superior to the other caustics used in such cases with the hope of preventing *hydrophobia*. *Iodide of starch* has been recommended by Bellini as an antidote to *poisons* generally. It is free from any disagreeable taste, and, not being an irritant, can be administered in large doses (*Boston Med. and Surg. Jour.*, Aug. 1879, p. 267). Diluted compound tincture of iodine is said to have been used successfully to dissolve a splinter of iron imbedded in the cornea (*Practitioner*, xxviii. 377).

The best antidote for a poisonous dose of an iodic preparation is starch or wheaten flour mixed with tepid water. White of egg and also milk are efficient. A solution of carbonate or bicarbonate of sodium may be given as a chemical antidote. Free vomiting should be encouraged as long as the liquid rejected tinges blue a solution of starch. Opiates, counter-irritants, and repose of the stomach are indicated to allay gastric irritation.

Administration.—Its *dose* in various forms represents about $\frac{1}{4}$ grain of iodine (Gm. 0.016). It is seldom given, in substance, by the stomach. Its vapors are sometimes inhaled in laryngeal and pulmonary affections, and externally it is applied to the skin as iodized cotton or in bags or pads containing it in powder. To attenuate the local action of iodized cotton applied to the ear, vagina, etc. a wad of this material may be wrapped in simple cotton wadding and left *in situ*. These methods are more efficient than painting the part with solutions of iodine. The discoloration of the skin produced by it may be removed by ammonia, carbolic acid, soap liniment, or sulphite of sodium. For internal administration the simple or the compound tincture is to be preferred. As the simple tincture is precipitated by water, the compound tincture (*U. S. P.* 1870) is more suitable for this purpose. The remarkable solubility of iodine in oil of bitter almonds, and the permanency of the union, render the solution convenient for topical application and for addition to other preparations for internal administration, and especially to cod-liver oil. 20 grains (Gm. 1.30) of iodine will in the course of 2 months become perfectly dissolved in 60 grains (Gm. 4) of oil of bitter almonds. Of this solution about 15 grains (Gm. 1) may be added to cod-liver oil 1 pint (Gm. 500). A teaspoonful of this solution contains about $\frac{1}{32}$ gr. (Gm. 0.002) of iodine and $\frac{1}{10}$ gr. (Gm. 0.006) of oil of bitter almonds (Blackwell).

IPECACUANHA, *U. S., Br.*—Ipecacuanha.

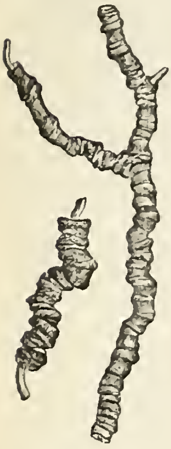
Radix ipecacuanhæ, P. G.—*Ipecac*, E.; *Ipécacuanha*, *Racine brésilienne*, Fr.; *Brechwurzel*, *Ruhrwurzel*, G.

The root of Cephaëlis Ipecacuanha, *A. Richard*, C. emetica, *Persoon*, Callicocca Ipecacuanha, *Brotero*. Steph. and Church, *Med. Bot.*, plate 62; Woodville, *Med. Bot.*, t. 274; Bentley and Trimen, *Med. Plants*, 145.

Nat. Ord.—Rubiaceæ, Coffeæ.

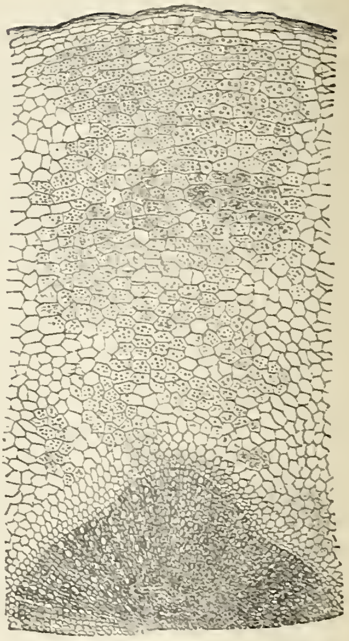
Origin.—The drug first became known in Europe in 1672, and a few years after was successfully employed by Helvetius, a Dutch physician living in Paris, from whom (in 1688) Louis XIV. purchased the secret for 1000 louisdors and made it public. Two varieties of the plant are known—one with a woody and the other with an herbaceous stem—both being indigenous to the damp forests of Brazil, New Granada, and the north-eastern portion of Bolivia between about 8° and 22° S. lat. The plant has a spreading root, a stem 12 to 18 inches (30 to 45 Cm.) high, opposite, nearly entire, and somewhat hairy leaves, and small white flowers in a dense head, followed by a cluster of dark purplish-blue berry-like fruits, each containing two plano-convex hard nuts. The plant has been introduced into India, and is cultivated to some extent in Sikkim with but moderate success. In Brazil the roots are collected at all seasons, but principally from January to March; they are dug up by means of a stick and pulling the stems, fragments of the roots remaining, which again produce plants from adventitious buds. The roots are dried in the sun, and finally packed in bales. The importation into the United States has increased from 15,000 pounds in 1876 and 1877 to 39,000 pounds in 1881 and 1882.

FIG. 161.



Ipecacuanha.

FIG. 162.



Ipecacuanha-root, transverse section, magnified 65 diam.

Description.—The young, thin, and thread-like roots are rejected; the older roots are in pieces of 2 to 6 inches (5–15 Cm.) in length and about $\frac{1}{6}$ inch (4 Mm.) thick; are mostly simple, bent, and contorted, and externally usually of a dull-gray color, but occasionally of a reddish or blackish tint. The root consists of a thin, toughish, white, and finely-porous ligneous cord, with no distinct medullary rays, and of a thick, brittle bark, which is finely wrinkled and closely annulated by projecting circles, the depressions between the rings being often fissured to the wood. The root breaks with a whitish granular and waxy fracture in the bark, which constitutes 75 to 80 per cent. of the weight and is easily separable from the wood. The bark consists, aside from the thin cork-layer, altogether of parenchyma, without any radiating arrangement, the cells being filled with small starch-granules and becoming smaller near the wood; the latter has a radiating arrangement, and is composed of more or less elongated and fusiform, rather thick-walled, and pitted wood-cells, containing starch and having upon transverse section a nearly quadrangular shape. A variety imported from Carthagena is usually thicker, about $\frac{1}{4}$ inch (6 Mm.) in diameter, less conspicuously annulated, and with more distinct medullary rays. Small portions of the thin non-annulated stem are not unfrequently found attached to some of the commercial roots. The odor of ipecacuanha is slight, but heavy and nauseous, and the taste bitterish, somewhat acrid, and nauseating. The root yields a light brown-gray powder.

Constituents.—The common constituents of the root are starch, gum, pectin, sugar, a little fat, and a trace of volatile oil; the important principle is the alkaloid *emetia* or *emetine*, which is combined with *ipecacuanhic acid.* Emetine was discovered in 1817 by Pelletier and Magendie, and is obtained by evaporating the alcoholic tincture of the root to a syrupy consistence, adding potassa in excess and in a well-filled bottle to prevent access of air, and agitating with chloroform; the chloroformic solution is evaporated, the residue treated with a weak acid, filtered from the resinous matter, and precipitated by ammonia. Lefort takes advantage of the insolubility of the nitrate, which is thrown down from a strong solution of the extract by a concentrated solution of potassium nitrate; it is dissolved in alcohol, decomposed by milk of lime, the alkaloid taken up by ether, and purified as above. It is a grayish or whitish inodorous powder having a bitter taste and an alkaline reaction to test-paper. It is sparingly soluble in cold water, freely so in alcohol and chloroform, less soluble in ether, benzol, benzin, and fixed oils. Nitric acid or nitrates yield with it a slightly soluble brown salt; other dilute acids dissolve it readily, and yield mostly non-crystallizable salts, the solutions of which are precipitated by the general reagents for alkaloids and by potassium nitrate at 70° C. (158° F.). Emetine fuses like wax, and at a higher heat burns without leaving a residue. Its formula, according to Lefort and Würtz (1877), is $C_{28}H_{40}N_2O_5$, and from a concentrated alcoholic solution it may be obtained in groups of fine needles; the yield is little over 1 per cent. By titration with Mayer's solution Zenoffsky (1872) found 3.75 per cent. of emetine; much larger yields have occasionally been reported, but are probably over-estimated. Power (1877) observed that emetine is colored bright-yellow or orange by chlorinated lime; a little acetic acid favors the reaction, which is still observable when dissolved in 6000 parts of water.

Ipecacuanhic acid, $C_{14}H_{18}O_7$, was by former investigators supposed to be identical with gallic acid. Willigk separated it from the precipitate obtained in the decoction by lead acetate, by dissolving in acetic acid and precipitating with subacetate of lead. It is amorphous, brown, very bitter, hygroscopic, soluble in alcohol, little so in ether, colors ferric salts green, and is a glucoside. It appears to be related to caffeo-tannic acid.

Podwyssotzki (1880) named the coloring principle of ipecacuanha *erythrocephalein*, because it acquires a deep purple-red color with alkalies. According to Reich, the bark contains about 30 per cent. and the wood over 7 per cent. of starch.

Tests.—Mix 10 grains of ipecac with 3 grains of lime and a few drops of water; dry in a water-bath, exhaust with 2 fluidrachms of chloroform containing a minute quantity of acetic acid, evaporate the chloroformic solution; add to the residue 2 drops of water, and add a saturated solution of potassium nitrate, which will give an amorphous precipitate to which Power's test may be applied; the wood treated in the same way gives no precipitate, but yields with tannin or potassio-mercuric iodide a slight turbidity (Flückiger). "Agitate the powdered root with 5 parts of warm water, filter after 1 hour, and add potassio-mercuric iodide, which should produce a copious white amorphous precipitate. If 0.2 Gm. of ipecac be agitated with 10 Gm. of hydrochloric acid, a portion of the filtrate should become blue on the addition of iodine-water, and another portion should become bright-red when a little chlorinated lime is sprinkled upon it."—*P. G.*

Adulterations.—Besides small portions of the stem, the commercial root is usually free from impurities, and the false ipecacuanhas described below are easily distinguished from the above. But powdered ipecacuanha is said to be sometimes adulterated with various farinaceous substances and with the powder of other roots, which may be detected by the microscope. Almond meal has also been mentioned; the large oblong cells of the scurfy testa and the hexagonal cells of the embryo which are free from starch, but contain oil-drops, readily characterize it under the microscope.

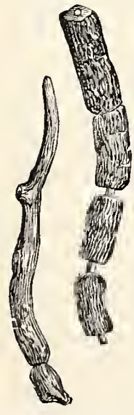
Pharmaceutical Uses.—EMETINUM COLORATUM, which is sometimes used, is made by exhausting ipecacuanha with alcohol, evaporating the tincture to a syrupy consistence, diluting with water, filtering, evaporating the filtrate to dryness, and powdering. The yield is about 3 per cent.

Off. Prep.—Extract. ipecacuanhæ fluid., *U. S.;* Pilula conii comp., Pilula ipecac. cum scilla, *Br.;* Pulvis ipec. et opii (ipecac. comp.), Trochisci ipecac., Troch. morphinæ et ipecac., *U. S.*, *Br.;* Vinum ipecac., *Br.* Syrup, compound tincture, and wine of ipecac, *U. S.*, are prepared from the fluid extract.

Allied Drugs.—Several emetic roots, known in South America as ipecacuanha or by the Brazilian designation *poaya*, have occasionally been sent to this country as substitutes; none, however, have any particular resemblance to the cephaëlis-root. The following, of which the plants yielding the first three belong to the natural order of Rubiaceæ, are the most important:

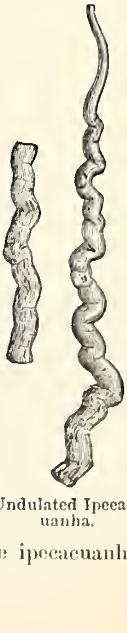
1. STRIATED IPECACUANHA, from Psychotria (Ronobea, *Richard*) emetica, *Mutis*, is $\frac{1}{4}$ to $\frac{1}{3}$ inch (6–8 Mm.) thick, blackish-gray, longitudinally striate; the bark has deep circular fissures at irregular distances; is thick, internally purplish-brown. The root is free from starch, contains much sugar, and has a sweet afterward bitter taste. The bark consists of parenchyma, which is not radiating, some of the cells containing acicular crystals: the wood resembles that of ipecacuanha, but the cells are larger and the cell-walls thinner. It is employed in New Granada and Peru.

FIG. 163.



Striated Ipecacuanha.

FIG. 164.



Undulated Ipecacuanha.

2. SMALL STRIATED IPECACUANHA, noticed by Planchon (1872), probably obtained from a species of Richardsonia, resembles the preceding, but is much smaller, and only $\frac{1}{12}$ to $\frac{1}{6}$ inch (2–4 Mm.) thick, gray-brown or blackish-brown, finely striate, has a thick bark, containing starch; a thin somewhat radiating bast-layer and a thick wood with thick-walled wood-fibres, large dotted ducts, and very fine medullary rays. Its taste is somewhat acrid, not sweet.

3. UNDULATED OR FARINACEOUS IPECACUANHA, from Richardsonia scabra, *Linné*, a native of Brazil, is, in the fresh state, white when dry, brownish externally, and white farinaceous internally; it is irregular undulate, fissured on alternate sides, and of a somewhat knotty appearance. The non-radiating bark-tissue consists of parenchyma containing starch; the wood is striate by medullary rays, and consists of thick-walled wood-fibres and large dotted ducts.

4. WHITE LIGNEOUS IPECACUANHA, from Ionidium Ipecacuanha, *Ventenat* (Nat. Ord. Violaceæ), indigenous to Brazil. The root is several inches long, about $\frac{1}{4}$ inch (6 Mm.) thick, several-headed, somewhat tortuous, not annulate, light-gray or yellowish, internally whitish, and with a yellowish, finely-porous wood, traversed by delicate medullary rays.

5. BASTARD IPECACUANHA, from Asclepias currasavica, *Linné* (Nat. Ord. Asclepiadaceæ), indigenous to the West Indies and South America. It has a very short root-stock, which is abruptly divided into numerous thin, pale yellowish-brown, and internally whitish rootlets. It is used in the West Indies like ipecacuanha.

6. Indian Ipecacuanha, from Tylophora (Asclepias, *Linné*) asthmatica, *Wight et Arnott* (Nat. Ord. Asclepiadaceæ), (Bentley and Trimen, *Med. Plants*, 177). The root-stock is short, knotty, about $\frac{1}{8}$ inch (3 Mm.) thick, emitting a considerable number of thin, wiry, brittle, and pale yellowish-brown rootlets. The outer portion of the bark contains large parenchyma-cells, filled with starch and with crystals of calcium oxalate. The drug has little odor; its taste is sweetish afterward acrid. It is free from tannin.

Batiator, a Senegambian root from an undetermined plant, is said to have properties similar to those of ipecac. It consists of a knotty and hairy root-stock with fascicles of thick rootlets, which are 10 or 12 inches (20–30 Cm.) long, somewhat flexuose, longitudinally wrinkled, more or less transversely fissured, yellowish- or grayish-brown, breaking with a smooth fracture, inodorous, slightly acrid, and nauseous.

Gardenia campanulata, *Roxburgh* (Rubiaceæ). The shrub is indigenous to India. The roundish-ovate, slightly five-furrowed yellow berries are said to be cathartic and anthelmintic.

Physiological Action.—Pure emetine is a powerful local irritant, occasioning inflammation, and even ulceration, of the tissues to which it is applied. Powdered ipecacuanha produces similar but less profound lesions. Friction of the skin with an ointment containing either substance excites, sooner or later, a pustular eruption like that produced by tartar emetic. 2 grains of pure emetine suffice to kill a dog. In less toxical doses it occasions vomiting, great depression of muscular power and of temperature, and diminished frequency and tension of the pulse. After death the mucous membrane of the stomach and bowels is, according to some, injected, and according to others pale. These varying results appear to occur whether the poison be given by the stomach, rectum, or veins, or even hypodermically. Moreover, if long continued by either mode of administration it occasions ulcers of the stomach and small intestine, which are limited to the mucous glands of these organs, and hence are attributed to the elimination of the poison through those glands. The balance of opinion is in favor of the view that nausea and vomiting from ipecacuanha are due to its action upon the nervous centres, and not to its influence upon the gastric terminations of the pneumogastric nerve. Other experiments appear to support the belief that ipecacuanha excites the bronchial secretion, and in poisonous doses causes pulmonary congestion (Podwyssotzki, *Archiv f. exper. Path.*, etc., xi. 231). Rutherford and Vignal found that 60 grains of powdered ipecacuanha, mixed with a small quantity of bile and placed in the duodenum of a dog, "powerfully stimulated the liver;" but owing to the admixture of bile with the drug this experiment appears to us inconclusive. Pécholier in 1862 showed that in animals poisoned by emetine the lungs were pale and almost bloodless, and pointed out that this effect was not due to ipecacuanha merely as a cardiac sedative, for tartar emetic, which is also a cardiac sedative, does not induce pulmonary anæmia (*Bull. de thérap.*, xvii. xlix).

The experiments of Dr. Foulkrod (*Inaugural Thesis*, Univ. of Penna., 1878) led him to conclude that emetine in contact with muscular fibres paralyzes them; that it reduces arterial pressure by debilitating the heart; that it produces sleep or coma by a direct action upon the brain; that it causes spinal convulsions; that it excites vomiting by a local action on the stomach; that it is eliminated unchanged by the kidneys, and also by the gastro-intestinal mucous membrane; that it occasions albuminuria; and that after poisoning by it glucose is found in the liver.

In man the effluvium or dust of ipecacuanha is apt to occasion coryza and congestion of the larynx and bronchia, causing dyspnœa, cough, and sometimes the rejection of fibrinous sputa. Some persons have a special susceptibility to these effects. In exceptional cases the conjunctival inflammation reaches a high grade and is accompanied by neuralgia of the face and scalp. Internally and in small and repeated doses ipecacuanha occasions malaise, depression, yawning, salivation, eructation, and nausea, with retching or vomiting. Its emetic operation is not protracted and distressing like that of tartar emetic, but it tends to relax the bowels if they were previously in a normal state, and to augment the purgative action of cathartics.

Like many other medicines, ipecacuanha in repeated doses sooner or later brings about toleration, and produces very different effects from the primary emetic phenomena. But the dose of ipecacuanha is not, at any time, a sure criterion of the effects to be expected from it. Often, 4 or 5 grains of it will vomit as much as 12 grains. While $\frac{1}{10}$ grain of emetine given to an adult occasioned vomiting, in another case 12 grains were administered within 24 hours without exciting either vomiting or diarrhœa. Allowance must be made for the varying degrees of activity of the preparations employed, as well as for the state of the patients who received them.

Medical Uses.—Although the experimental investigations above referred to indicate very little action of ipecacuanha upon the lungs, it is in affections of these organs that the medicine has been so generally employed that it has come to be classed among expectorants. The conditions to which it is appropriate are dryness of the respiratory mucous membrane on the one hand, and excessive secretion and obstruction upon the other. Its mode of action in the two cases is different: in the former, given in small doses and in the first stage of ordinary *bronchitis*, it promotes the bronchial and laryngeal secretions, and thereby renders the cough less painful and frequent and more productive; in the latter, administered in large doses, it acts as an emetic, producing an expulsion of the contents of the air-tubes, while it renders their secretions less tenacious. It is in the former of these ways that it is so efficient in the commencement of the attacks referred to, and in the latter when the bronchia become filled with mucus, serum, or fibrin, as in *whooping cough*, *suffocative catarrh*, *capillary* and *chronic bronchitis*, *bronchorrhœa*, etc. In addition, perhaps, to these two modes of action a third or anti-spasmodic action may be recognized in its cure of *spasmodic croup* (spasmodic laryngitis), but quite as probably the relaxation of spasm it occasions is secondary to its sedative and, therefore, so far as the local disorder is concerned, depletory action. Like other nauseants, it has been found efficient in expediting labor by relieving *rigidity of the os uteri*. A similar operation, no doubt, explains the reputation of the medicine in *spasmodic asthma*. In *membranous croup* it is not without utility in virtue of the same influences, which, however, are inadequate to the occasion. It is far more efficient in the several diseases mentioned when they occur in children than in adults. The utility of ipecacuanha in *pneumonia*, which has been affirmed, is probably limited to two occasions—the forming or congestive stage of the disease, before solidification has taken place, and the declining stage, when the bronchia are apt to become obstructed with softened exudation-matter and mucus. In both conditions the emetic action of the drug is appropriate—in the former by diminishing the quantity of blood in the lung and the force of its propulsion by the heart, and in the latter by a mechanically evacuant operation upon the obstructed bronchia. It is probable that the utility of ipecacuanha in *hæmoptysis*, which formerly was admitted by Stoll, Trousseau, and others, depends upon this mode of action. It is true that some reporters have not found it useful in this hæmorrhage (Verardini, *Phila. Med. Times*, xi. 430), but their results are contradicted by theory as well as experience—by theory based on experiment as above described, and by the clinical results of using large doses so as to induce speedy toleration; *e. g.* 90 grains infused in 4 fluidounces of boiling water and sweetened. A tablespoonful of this preparation may be given every hour or two (Pécholier).

The utility of ipecacuanha emetics in *hæmorrhage* from the stomach, uterus, etc. has long been known, but recently the use of repeated small doses of the medicine, without causing vomiting, has been very successful in such cases. Probably in hæmatemesis a full emetic dose should be first prescribed, after which smaller and only nauseating doses may be substituted. According to the modern views of the action of the medicine, it may be supposed to control hæmorrhage by contracting the capillaries, but the earlier explanation, that the heart was depressed and the blood no longer circulated so vigorously, should not be lost sight of.

Whether by direct stimulation or by indirectly promoting secretion, there is no doubt that this medicine has proved advantageous in *atonic dyspepsia;* that is to say, when digestion is laborious, painful, attended with flatulence, depression of spirits, cold extremities, etc. The *dose* should not exceed 1 grain, in pilular form, and may be taken in the morning fasting or else immediately after meals. The *vomiting of pregnancy* has sometimes been arrested by hourly doses of a single drop of wine of ipecacuanha. We have known it to arrest this symptom in a single day after it had continued for several weeks. There is some reason to believe, apart from the experiments above described, that ipecacuanha increases the secretion of bile, for large doses of it (20 grains), repeated daily, have relieved cases of catarrhal *jaundice* that had resisted other remedies (Cook, *Practitioner*, xxv. 104).

The title, *Radix antidysenterica*, originally applied to ipecacuanha, denotes the estimate then held of its dominant virtue. In Brazil it was the specific for dysentery, and its mode of administration was such as to produce vomiting first, and afterward tolerance of the medicine. The efficiency of such a method is intelligible in a country where dysentery is apt to assume a bilious type, and an analogy with it is found in a like treatment of the acute febrile diseases of hot climates which is everywhere adopted. In the present instance anti-bilious and anti-pyretic virtues are united in the same remedy. Other forms of acute dysentery than the bilious are not always as advantageously treated by ipecacuanha, and where in such forms the medicine has appeared to be most useful it has usually been combined with opium, whose share in the cure should not be overlooked.

Of whatever type the dysentery may be, the remedy is most efficient the nearer to the commencement of the attack it is administered. It ought to be given on an empty stomach, and no liquid should be taken for an hour or two after it is swallowed, the patient meanwhile keeping as still as possible. The original Brazilian method of administration was as follows: An infusion was made with 120 grains of the bruised root in 6 ounces of boiling water, and allowed to stand for 12 hours before the decanted liquid was used. A similar quantity of fresh water was then added to the dregs for the second day, and the same process was repeated on the third day. Each infusion was divided into two or more portions, one of which was given at intervals of two or three hours if the attack was mild, but the whole at one dose if the attack was severe. If vomiting occurred, the medicine was, after an interval, repeated. There can be no doubt that when it operates favorably the stools soon lose their dysenteric character and are voided without pain. In Peru it has been the custom to administer the powdered root mixed with a little syrup, and at the same time enemas made with an infusion of the root with the addition of laudanum. The enema has been found by many practioners in Europe and elsewhere to be sufficient by itself when prepared in the following manner: "Take of bruised ipecacuanha 150 grains, and boil it in 5 fluidounces of water for 10 minutes; strain off the liquid, and repeat the operation with a fresh portion of water a second and a third time; mix the three portions of liquid and evaporate them in a sand-bath to 4 ounces; divide this product into two equal parts, and administer one night and morning by enema, directing them to be retained as long as possible" (*Polichronie*). A simpler and, apparently, as efficient a formula is to boil 60 grains of bruised ipecacuanha for 10 minutes in 5 ounces of water; let it infuse for 1 or 2 hours, and strain off the decoction. It is only in chronic cases with decided ulceration that any nausea is excited by these enemas. In so important a matter it is desirable to know something of the treatment of dysentery by ipecacuanha in India, where the disease is endemic and often very fatal. No higher authority on the subject could be cited than Surgeon-General Fayrer. His directions, somewhat condensed, are these: "The treatment of an attack of ordinary acute dysentery is to be conducted on the following plan: The patient should remain in a recumbent posture. A dose of 20 or 30 grains of ipecacuanha powder should be given to an adult at once in water, and the patient should resist vomiting as long as possible. It is recommended by some to give a dose of 15 or 20 drops of laudanum before the ipecacuanha, and apply a sinapism to the epigastrium. He must abstain from all fluids except occasional mouthfuls of iced water or bits of ice. My own plan has generally been to repeat the dose of ipecacuanha in 4 or 6 hours a second or third time, according to the effects, and especially if the first dose has been rejected, as it often is. I have generally found that if this treatment be resorted to early in acute dysentery it is most effective, and nothing else is needed. The pain diminishes, the tormina and tenesmus are alleviated, the restlessness is abated, the sense of fulness and desire to go to stool passes away, the skin becomes moist and the motions feculent and assume a peculiar yellow appearance." "When the disease has advanced to ulceration, and when the chronic stage has been fully established, the ipecacuanha is no longer useful" (*Med. Times and Gaz.*, Feb. 1881, p. 143). The advantages claimed for the treatment of acute dysentery by ipecacuanha are—the simplicity, safety, and promptness of its operation, its efficiency in curing, and the rapidity of the cure. Even in *chronic dysentery* the same method of employing it has been very successful, although it is not recommended by Fayrer.

This medicine has long been used in the treatment of *chronic diarrhœa*, either alone or associated with calomel and opium. Of late it has been administered alone, or guarded with opium to prevent its rejection, in *infantile diarrhœa*, in *tuberculous diarrhœa*, and in chronic *dyspeptic diarrhœa*. Of these forms, the one most beneficially influenced by the medicine is the infantile. If the patient is not much exhausted the medicine may be given at first by the mouth, otherwise by enema and in the form of infusion. The diarrhœa of consumption, being due sometimes to intestinal ulcers and sometimes to debility, as well as in both cases to the swallowing of sputa, the results of any treatment must vary with the cause of the symptom. In this case the utility of the medicine is least when the cause is most permanent. If it is too long employed it may create an irritation as great as that which it is intended to relieve. Whether it acts by substitution or astringency, or as a stimulant of the vaso-motor nerves, it very certainly diminishes the secretions of the affected part, and apparently does so during its elimination after absorption. The same mode of operation is probable in the case of *hectic sweats*, which are sometimes completely suspended by enemas of ipecacuanha infusion when other remedies have proved ineffectual. The treatment of *cholera morbus* and of *epidemic cholera* by this medicine has been advocated by numerous physicians, who presented ingenious reasons for its use, but neither their opinion nor their practice has prevailed.

In bilious *remittent* and *intermittent fevers*, when gastro-hepatic congestion is indicated by the muddy eye and skin, and foul tongue, nausea, bitter taste, distended epigastrium and hypochondria, and perhaps bilious vomiting and diarrhœa, an emetic dose of ipecacuanha promptly palliates these symptoms and renders the action of quinine more immediate and certain. Ordinary *intermittent fever* is alleged to have been cured by doses of 1 or 2 grains every three or four hours. In all cases of *indigestion* due to the presence of food in the stomach, of *urticaria* produced by the same cause, and of *poisoning* where it is desired to expel the offending substance, ipecacuanha emetics may be advantageously employed.

As a local application to the eye in purulent *ophthalmia* when the active inflammatory symptoms have subsided, but chemosis remains, with a red and flabby state of the conjunctiva and cloudiness of the cornea, a decoction of ipecacuanha has been found efficient. It may be made by boiling 30 grains of bruised ipecacuanha for 10 minutes in 5 ounces (Gm. 2 in Gm. 160) of water. When cool the liquid should be strained off and instilled into the eye.

Administration.—As an emetic the *dose* of powdered ipecacuanha is 20 grains (Gm. 1.30), or 5 or 10 grains (Gm. 0.30–0.60) may be repeated every 10 minutes, the patient drinking freely of warm chamomile tea, or simply of warm water, as soon as the first signs of nausea appear. Or an *infusion*, prepared with 120 grains (Gm. 8) of the bruised root in 6 fluidounces (Gm. 190) of boiling water, may be given in doses of a fluidounce (Gm. 32) at intervals of 4 or 5 minutes. A *decoction* and its uses have been already described. As a *nauseant*, 1 or 2 grains (Gm. 0.06–0.12) of the powder may be repeated at short intervals; the same dose, at longer intervals, may be used as a diaphoretic and expectorant. For infants the syrup is preferable.

Batiator is used in its native country for the same purposes as ipecacuanha, as an emetic, and in the treatment of *dysentery*, in the same manner that ipecacuanha is employed in Brazil. The negroes are said to regard it as a sovereign remedy for *hæmorrhoids*.

Ixora (*I. bandhuca* and *I. coccinea*), an East Indian plant, is said to be very efficacious in *dysentery*, and has been compared with ipecacuanha, although it has no nauseating effect. The whole of the fresh root is used to prepare a tincture which has an agreeable aromatic taste and is given in doses of 10 drops (Gm. 0.75) three or four times a day (*Bull. de thérap.*, xcvii. 47).

IRIS, *U. S.*—Iris.

Blue flag, *Water flag*, E.; *Rhizome d'iris varié*, *Flambe variée*, *Glaïeul bleu*, Fr.; *Verschiedenfarbige Schwertlilie*, *Amerikanischer Schwertel*, G.

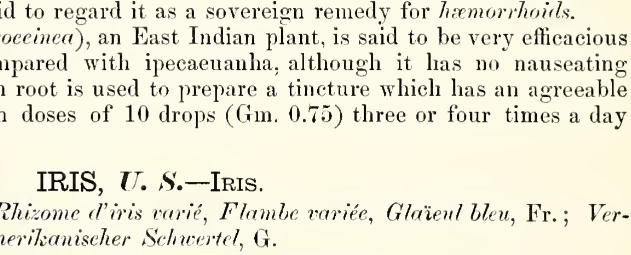
The rhizome of Iris versicolor, *Linné*. Meehan, *Native Flowers*, i. 141.

Nat. Ord.—Iridaceæ.

Origin.—The blue flag is common in wet and swampy meadows from Canada southward to Florida and westward to Minnesota and Arkansas, and flowers in the latter part of spring. The sword-shaped leaves are about as long as the stout stem, which bears a few showy blue flowers, having the three outer lobes of the corolla with a yellow blue-veined base, and the inner lobes paler.

Description.—The rhizome is horizontal, and grows in annual shoots or joints, bearing a flowering stem at their end and producing two, or often four, lateral branches. The joints are 2 to 4 inches (5–10 Cm.) long, cylindrical at the base, the upper portion vertically flattened and ¾ to 1 inch (18–25 Mm.) broad; they have an annulated appearance from the projecting leaf-scars, and at the lower side are beset with simple rootlets, 4 to 6 inches (10–15 Cm.) long, and crowded near the broader end of the joint. The color of the fresh rhizome is yellowish-brown, when dry gray-brown, and internally gray or brownish. A distinct nucleus-sheath separates the cortical

Fig. 165.



Iris versicolor, *Linné*: joint of rhizome and section of branches.

layer from the central portion, in which nearly all the scattered wood-bundles are contained; the parenchyma contains mainly starch and some crystals. The dry rhizome has no marked odor; its taste is acrid and nauseous.

Constituents.—The rhizome contains starch, gum, tannin, fat, and acrid resinous matter; the latter may probably represent its medicinal virtues. D. W. Cressler's experiments (1881) render it probable that blue flag contains a browish viscid alkaloid which is soluble in amyl alcohol and in dilute acetic acid, and may be obtained from the alcoholic extract by treatment with acetic acid. The resin, amounting to about 25 per cent., is soluble in ether, chloroform, and hot alkalies, and from the latter solution reprecipitated by acids.

Off. Prep.—Extract iridis, Extract iridis fluid., *U. S.*

Allied Plants.—Iris virginica, *Linné* (Meehan, *Native Flowers*, i. 189), the slender blue flag or *Boston iris*, and Iris verna, *Linné*, the *dwarf iris*, have much smaller rhizomes than the pharmacopœial species, but they are otherwise of the same appearance and possess similar properties. The Boston iris grows near the coast southward to South Carolina; the dwarf iris is found on hillsides from Virginia and Kentucky southward.

Medical Action and Uses.—The fresh root has an acrid taste, and its expressed juice is emetic and cathartic, producing great prostration. Diuretic and cholagogue virtues are also ascribed to it. It was a medicine highly esteemed by the aborigines of this country. Its activity appears to depend upon its oleoresin ("iridin"), which may be used as a purgative in the dose of 1 or 2 grains (Gm. 0.05–0.10.) According to the experiments of Rutherford and Vignal, 5 grains of iridin, when mixed with a little bile and water and placed in the duodenum of a dog, very powerfully stimulated the liver. It is also a decided stimulant of the intestinal glands. It appears to be less irritant than podophyllin and a less active cholagogue, but its purgative effects are greater than those of euonymin. It may be used as a cathartic in constipation associated with evidences of imperfect hepatic action. The *dose* of the dried root is stated to be from 10 to 20 grains (Gm. 0.60–1.30).

IRIS FLORENTINA.—Florentine Orris.

Rhizoma iridis, P. G.; *Radix iridis Florentinæ*, *Radix ireos.*—*Orris-root*, E.; *Iris de Florence*, Fr.; *Veilchenwurzel*, G.

The rhizome of Iris germanica, *Linné*, I. pallida, *Lamarck*, and I. florentina, *Linné*. Stephenson and Church, *Med. Bot.*, i. t. 27; Bentley and Trimen, *Med. Plants*, 273.

Nat. Ord.—Iridaceæ.

Origin.—Florentine orris, or *white flag*, is found in dry localities from the southern shores of the Black Sea westward along the north shore of the Mediterranean; though wild near Florence and Luca, Hanbury does not regard it as indigenous to those places. It has large sweet-scented white flowers, the sepals with a yellow beard and brownish veins. It is cultivated together with Iris pallida, which is likewise indigenous to Southern and South-eastern Europe, has a rather tall stem, and pale-blue or purplish flowers, and with Iris germanica, which is indigenous to Southern Europe, and is met with in Northern Africa and Northern India; this has a lower stem, bears deep-blue or purplish-blue flowers, and is known in England as *blue flag*, in France as *flambe*, and in Germany as *Blauer Schwertel* or *Schwertlilie*. The rhizomes of the three species are collected, and, as it appears, those of the last two much more frequently than of the first. They resemble each other very closely, and, though the branches of the second species are usually broad and stout, there are no permanent characters by which they may be distinguished. The rhizomes are collected in the latter part of summer, peeled, and dried in the sun. 28,000 pounds of orris-root reached the United States in 1877, and 223,870 pounds in 1882.

Description.—The horizontal rhizome is composed of joints, which are 2 to 4 or 6 inches (5 to 10 or 15 Cm.) long, the broadest part near the apex, about 1 to 1½ inches (25–40 Mm.) wide, tapering below, and abruptly narrowed above to the circular stem-scar, from two sides of which similar joints are produced. The rhizome is vertically compressed, and when peeled of a white or whitish color externally and internally. The leaf-scars on the upper side are indicated by transverse lines of fibro-vascular bundles, and the rootlets on the lower surface by circular brownish scars, which are more crowded near the upper end. The texture is firm, the rhizome breaks irregularly, and shows upon the transverse fracture, near the surface and parallel with it, a distinct nucleus-sheath enclosing a number of scattered wood-bundles. The parenchyma-cells enclose mainly small oblong or elliptic starch-granules and few crystals. Orris-root has an agreeable violet-like odor, which is slowly developed on drying, and a mealy afterward bitterish and somewhat acrid taste. The powder has a whitish color.

Constituents.—Orris-root contains a minute quantity of volatile oil, which is solid, crystalline, and of a pearly lustre, as described by Dumas (1835). By distillation with steam about .8 per cent. of a solid crystallizable substance is obtained, which Flückiger found to consist mainly of *myristic acid* impregnated with a little volatile oil; this acid, however, does not pre-exist in the rhizome. This constitutes the commercial *oil of orris-root*, but a *liquid oil of orris* has appeared in the market, which is said to be made by adding oil of cedar-wood to the crushed rhizome and distilling the mixture with water. Orris-root contains also a large quantity of starch, some soft brownish resin of an acrid taste, and a little tannin which colors ferric salts green.

Adulterations.—The rhizomes of other species of Iris in most cases resemble the officinal one in shape, but are destitute of its agreeable odor; those of Iris pseudacorus, *Linné*, and I. fœtidissima, *Linné*, which are indigenous to Europe, have a dark color and a more astringent and acrid taste, and cannot be mistaken for Florentine orris. The adulteration of powdered orris is best detected by the microscope from the different shape of the starch-granules contained in the material employed for the purpose.

Medical Action and Uses.—The fresh root is said to possess irritant properties, and, taken internally, to cause colic, vomiting, and purging, while the dry root acts as a moderate digestive stimulant. When powdered and applied to the nostrils it excites sneezing and increased secretion, and in the mouth a flow of saliva. It is asserted that when freely sprinkled in the hair it has caused alarming nervous symptoms. It was formerly used along with more active medicines in the treatment of *chronic diarrhœa* and *bronchitis*, and also as a diuretic and sternutatory. A piece of the root was, and occasionally is still, employed for children to bite upon while teething; it probably excites salivation and mitigates the pain of the process. Iris is also used to make issue "peas," is often added to dentifrices on account of its aromatic flavor and its favorable action on the gums, and is an ingredient in *pastilles* used for the same purpose or to conceal fetor of the breath. Its liability to be attacked by insects renders care in its use as an issue "pea" desirable. The dose of the powdered rhizome may be stated at from 5 to 15 grains (Gm. 0.30–1).

JALAPA, *U. S.*, *Br.*—JALAP.

Tubera jalapæ, P. G.; *Radix jalapæ.*—*Jalap*, Fr.; *Jalape*, *Jalapenknollen*, G.

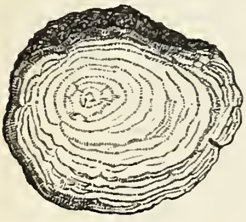
The tuberous root (tubercles) of Exogonium Purga, *Bentham* (*Bot. Mag.*, vol. lxxiii. plate 4280; Bentley and Trimen, *Med. Plants*, 186), Ipomœa Purga, *Hayne*, Convolvulus Purga, *Wenderoth*, C. Jalapa, *Schiede*, Ipomœa Schiedeana, *Zuccarini*, Ipom. Jalapa, *Nuttall.*

Nat. Ord.—Convolvulaceæ.

Origin and Collection.—This twining herbaceous perennial is indigenous to the damp and shady woods on the eastern slope of the Mexican Andes, at an altitude of from 5000 to 8000 feet (1520–2440 M.) It has been introduced into India, and flourishes well in the Nilgherry Mountains. Its cultivation has also been carried on to some extent in Jamaica. The plant has alternate cordate leaves, acute at the apex and the basal lobes, and axillary cymes of three to five dark pink-colored flowers, with a long tube, spreading border, and protruding stamens. The tubers (hypertrophied roots, *Bentley*) are collected during the whole year, but principally in the spring. Owing to the wet climate, the drying cannot be effected by exposure to the sun, but is accomplished by suspending the tubers in a net over a wood-fire; the smaller pieces are dried entire, the larger ones are incised to facilitate the drying. The supply of jalap is very variable; in 1876 there were 4595 pounds of it imported into the United States, while in 1882 the importation reached 93,628 pounds.

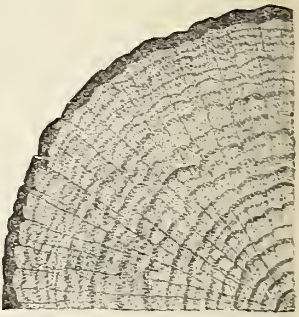
Description.—Jalap, when fully developed, is napiform or depressed globose in shape, above marked by the scar of the overground stem, below suddenly contracted into a thin root. The tubers are often pyriform, ovate, oblong, or nearly cylindrical in shape, and vary in size from that of a walnut to 3 or 4 inches (37–50 Mm.) in diameter. They are externally of a dark-brown color, and usually of a smoky appearance, more or less longitudinally wrinkled, and beset with brown, broad, corky warts, becoming transversely confluent. Jalap is hard and compact, and breaks irregularly; the transverse fracture is not fibrous, and shows a distinct concentric arrangement. The bark is quite thin, gray-brown, with a large number of resin-cells forming a dense zone near the cambium-line. The central portion of jalap has the resin-cells arranged in concentric circles, which vary in width, a zone of two or four rows of resin-cells usually alternating with one of a single row. The parenchyma consists of smaller cells containing subglobular starch-granules, which, particularly in the outer layers, are more or less transformed into a pasty mass; crystals of calcium oxalate are sparingly met with. The vascular tissue exists in small circularly-arranged groups of spiral vessels. Jalap has a very faint radiate appearance, the fibro-vascular bundles being small and not very numerous. It has a slight smoky and sweetish odor and a sweetish afterward acrid taste. Good jalap should not be deeply wrinkled or sticky internally, but should be plump, heavy, and hard, and when fractured should present a resinous appearance.

Fig. 166.



Transverse section of Jalap.

Fig. 167.



Jalap: transverse section, nat. size.

Impurities and Substitutions.—Jalap appears to be sometimes collected in an immature state or at an improper season; at least many of the tubers frequently contain little resin, but otherwise present all the characteristics of genuine jalap. Occasionally jalap has been met with which has been previously deprived of the resin, and is then sticky upon the surface and of a dark color internally. Hager (1882) states that good jalap will sink in a solution of sodium chloride of spec. grav. 1.140, while if exhausted by alcohol it will float in this liquid. A *mealy jalap* has been observed which resembles true jalap externally, but has few scattered resin-cells and a mealy fracture. The so-called *jalap-stalks, male, fusiform,* or *woody jalap,* consist of the tuberous root of Ipomœa orizabensis, *Ledanois* (Convolvulus, *Pelletan*), often cut into transverse slices 2 to 3 inches (50–75 Mm.) broad, light-brown, compact, often horny, distinctly radiate and more fibrous in texture; it is spindle-shaped, 2 feet (60 Cm.) long, and contains resin which is entirely soluble in ether. *Tampico jalap,* from Ipomœa simulans, *Hanbury,* forms globular or elongated tuberous pieces which are often smaller, but occasionally larger, than true jalap, deeply wrinkled, destitute of transverse scars, and of a more woody fracture; the resin contained in it is completely soluble in ether.

The tuberous root of Mirabilis Jalapa, *Linné,* or *Four-o'clock,* resembles jalap somewhat in shape, but is darker externally and contains a large number of acicular crystals. *Radix mechoacannæ,* probably obtained from a Convolvulacea, is found always in sections, of whitish or gray color, destitute of resinous circles; it cannot be mistaken for jalap.

Valuation.—"On exhausting 100 parts of jalap by alcohol, concentrating the tincture, and pouring it into water, a precipitate of resin should be obtained which, after washing with water and drying, should weigh not less than 12 parts (10 p. Br. *P. G.*), and of which not over 10 per cent. should be soluble in ether."—*U. S.*

Constituents.—Jalap contains starch, gum, uncrystallizable sugar, and extractive matter; its medicinally important constituent, however, is *resin,* of which selected pieces may contain 22 per cent., but which varies in good commercial jalap between 12 and 18 per cent. Jalap grown in Jamaica yielded to Thos. Greenish (1881) only 8.27 to 8.68 per cent. of resin. About one-twelfth or one-tenth (occasionally one-eighth) of the resin is soluble in ether, of a brown color, acid reaction, and acrid taste; it is soluble in alkalies, and reprecipitated from these by acids. It is contained in the pharmacopœial resin of jalap, the main constituent of which is the resin insoluble in ether; this, investigated by Kayser (1844), was named *rhodeoretin,* and by W. Mayer (1852) *convolvulin.* Pure convolvulin is colorless, transparent in thin layers, inodorous, and tasteless, but in alcoholic solution it has an acrid taste. It is insoluble, or nearly so, in carbon disulphide, chloroform, petroleum, benzin, and volatile oils, but dissolves in acetic and cold nitric acid; when dry it melts at 150° C. (302° F.), but at a much lower temperature if mixed with water. It consists of $C_{62}H_{100}O_{32}$, dissolves readily in caustic alkalies, and is not reprecipitated by acids, but converted into *convolvulic acid,* $C_{62}H_{106}O_{35}$, of which convolvulin is the anhydride. Both are glucosides, and when boiled with dilute acids yield sugar and *convolvulinol,* $C_{26}H_{50}O_7$, which crystallizes in needles, is bitter and acrid, and when treated with alkalies loses water and is converted into *convolvulinolic acid,* $C_{26}H_{48}O_6$. Convolvulin and its derivatives, on being oxidized with nitric acid, are finally converted into oxalic and *ipomic acids*, the latter being $C_{10}H_{18}O_4$, and, according to Neison and Bayne (1874), identical with *sebacic acid*, one of the products of the destructive distillation of olein.

W. Mayer (1855) has very improperly given the name of *jalapin* to the resin obtained from orizaba-root, which, with all its derivatives, is homologous to the preceding. *Jalapin*, $C_{63}H_{112}O_{32}$, closely resembles convolvulin, but is soluble in ether and chloroform, also in acetone, benzol, and phenol. Dissolved in alkalies, it is converted into *jalapic acid*, $C_{68}H_{118}O_{35}$, which is soluble in water; when treated with dilute acids, into sugar and *jalapinol*, $C_{32}H_{62}O_7$, which is acrid; and with alkalies yields *jalapinolic acid*, $C_{32}H_{60}O_6$. Nitric acid oxidizes these compounds to oxalic and sebacic acids. Spirgatis (1860) considers jalapin chemically identical with *scammonin*.

The resin of tampico-root is likewise homologous. Spirgatis (1870) calls it *tampicin*, $C_{68}H_{108}O_{28}$, which yields with alkalies *tampicic acid*, $C_{68}H_{120}O_{34}$, and with diluted acids sugar and *tampicolic acid*, $C_{32}H_{64}O_6$.

Off. Prep.—Abstract jalapæ, *U. S.;* Pulv. jalapæ comp., *U. S., Br.;* Pulv. scammonii comp., *Br.;* Resina jalapæ, *U. S., Br.;* Tinctura jalapæ, *Br.*

Allied Plants.—Of the numerous species of Ipomœa which have been used like jalap, we mention the following in addition to those named above:

Ipomœa pandurata, *Meyer*, s. Convolvulus panduratus, *Linné*, grows on sandy banks in the United States, and is known by its pointed, heart-shaped leaves, which are sometimes contracted near the middle and fiddle-shaped. The root is elongated, cylindrical, 2 or 3 feet (60–90 Cm.) long, 1 to several inches (25 Mm. and more) thick, abruptly contracted above to the thickness of a finger. It is pale-brownish externally, grayish-white internally, and emits when wounded a resinous milk-juice. The resin-cells form a dense zone in the inner portion of the thin bark, and are irregularly scattered in the medullary rays. It is known as *man-root, man of the earth, wild jalap*, and *wild potato*, and is feebly cathartic. Analyzed by C. Manz (1881), sugar, gum, starch, a tannin-like body, and 1.5 per cent. of resin were obtained. The latter is purgative, completely soluble in alcohol, ether, chloroform, and potassa, and from the latter solution again precipitated by acids; it consists of an acid resin soluble in methyl alcohol and precipitated by lead salt, and of a non-acid resin, which, like the former, is a glucoside.

Five or six Brazilian Convolvulaceæ have tuberous roots containing purgative resins; though employed in their native country like jalap, they are not articles of general commerce. They are popularly known as *purga, batata purgante, jalapinha, jeticucú*, and *emburerembo*, and are obtained from plants of the genera Convolvulus, Ipomœa, and Piptostegia.

Ipomœa turpethum, *R. Brown, turpeth-root*, is indigenous to India and the East Indian Islands. The root is met with in commerce in pieces of various length, $\frac{1}{2}$ to 1 inch (12–25 Mm.) thick, frequently with pieces of the woody stem attached, reddish-brown externally, internally grayish or brownish. The bark is thick, mealy, and contains numerous small brown resin-cells in concentric rows, and several, or in older roots numerous, woody groups. The central wood is pale-brown, porous, and divided by narrow medullary rays into four or six parts. The resin amounts to about 4 per cent., a portion of which is soluble in ether; the insoluble portion, *turpethin*, $C_{34}H_{56}O_{16}$, resembles jalap resin in its behavior to alkalies and dilute acids.

Ipomœa Nil, *Roth*, s. Convolvulus (Pharbitis, *Choisy*) Nil, *Linné* (Bentley and Trimen, *Med. Plants*, 185), is indigenous to the tropics, and grows spontaneously in the Southern United States. The seeds are about $\frac{1}{4}$ inch (6 Mm.) long, black, somewhat triangular, rounded on the back, of a rather heavy odor while fresh, and of a sweetish afterward acrid taste. The seeds are known in India as *kaladana*, and roasted or in powder are used as a purgative, like, but somewhat weaker than, jalap; they contain a fixed oil and 8 per cent. of *pharbitisin*, which appears to be identical with convolvulin (*Pharmacographia*).

Medical Action and Uses.—Jalap and its resinous principle, convolvulin, act as local irritants, and, taken into the stomach, excite irritation of that organ, with nausea, vomiting, colic, and mucous, watery, and even bloody dejections, according to the dose. When given to dogs in excessive doses it has occasioned death, after which the gastro-intestinal mucous membrane was found inflamed. Although it is said to produce analogous effects in these animals when rubbed into the skin, it is, on the other hand, denied that this effect takes place in man, and affirmed that the milk of nursing women is not rendered purgative by its use. So, too, convolvulin, which purges if taken into the stomach, has no such effect when it is injected into a vein or hypodermically. The experiments of Rutherford and Vignal led them to conclude that jalap is an hepatic stimulant of considerable power, rendering the bile more watery, but at the same time increasing the secretion of biliary matter. Its effect on the liver is, however, far less notable than its effects on the intestinal glands. Its medicinal virtues depend upon its being a hydragogue cathartic whose operation is not rendered less decided by the repetition of the medicine. Hence it is profitably employed for the removal of *dropsical effusions* from whatever cause they arise, the duration of its usefulness depending upon the nature of the cause of the dropsy. It is usually associated with bitartrate of potassium for this purpose, and with calomel in congested states of the liver or spleen. It is to be commended in states of *constipation* attended with habitual dryness of the intestine, when it should be given in a dose of 2 or 3 grains (Gm. 0.10–0.20) in the morning, fasting, and followed within an hour by a draught of cool water. A grain or two of aloes given the night before renders its operation more certain, and is apt to promote the biliary secretion. It is not an anthelmintic, but a *vermifuge*, and is associated habitually with proper anthelmintic medicines.

Administration.—The purgative *dose* of jalap is from 15 to 20 grains (Gm. 1–1.30). Its powder should be thoroughly triturated with sugar and flavored with an aromatic oil. The resin is estimated to be from two to four times as strong as jalap. The syrup of rhubarb is said to completely dissolve it and to increase its efficiency.

JEFFERSONIA.—TWINLEAF.

Jeffersonia diphylla, *Barton*.

Nat. Ord.—Berberidaceæ.

Origin.—The twinleaf is an herbaceous, acaulescent perennial growing in woods in the Middle, Southern, and Western United States. The leaves are on long petioles composed of two obliquely ovate leaflets; the scape is about 10 inches (25 Cm.) high, bearing a white flower an inch broad, which has four fugacious sepals, eight spreading petals, and eight stamens, and produces an obovate capsule with many seeds. It flowers in April and May.

Description.—The rhizome is horizontal, knotty, beset with long, fibrous, and matted roots of a yellowish or dark-brown color, somewhat corrugated and transversely fissured; the bark is brown, of a resinous appearance, and has a bitter and acrid taste. The pale-yellowish wood is destitute of taste.

Constituents.—The rhizome was analyzed by E. S. Wayne (1855), and contains, besides the ordinary vegetable principles, tannin, precipitating ferric salts dark-green, a bitter principle and an acrid acid analogous to polygalic acid. F. F. Mayer (1863) states that the rhizome contains a small quantity of *berberine*, a larger proportion of a *white alkaloid*, and a considerable amount of *saponin*.

Medical Action and Uses.—No recent observations seem to have been made of the virtues of this plant. It is said to be diuretic, tonic, and expectorant in small, and emetic in large, doses. It has been compared to seneka.

JUGLANS, *U. S.*—BUTTERNUT-BARK.

Ecorce de noyer gris, Fr.; *Graue Wallnussrinde*, G.

The inner bark of the root of Juglans cinerea, *Linné* (J. cathartica, *Michaux*, J. oblonga, *Miller*). Bentley and Trimen, *Med. Plants*, 247.

Nat. Ord.—Juglandaceæ.

Origin.—A handsome tree, 30 to 40 feet (9–12 M.) high, growing in forests and bottom-lands in Canada and the greater portion of the United States westward to Missouri and Arkansas. It has a brown, soft, but durable and easily-worked wood; the leaves are composed of about fifteen sessile, oblong-lanceolate, serrate, and underneath pubescent leaflets; the staminate flowers are in aments about 4 inches (10 Cm.) long; the pistillate flowers, to the number of about five, form a spike; the fruit is ovoid-oblong and viscid pubescent. The tree flowers in April and May, and ripens its fruit in September and October. The bark is collected in May and June, or, according to the Pharmacopœia, in autumn, and is deprived of its corky layer.

Description.—The liber, of which the medicinal article exclusively consists, is white when fresh, but rapidly turns yellow and deep-brown on drying. It is met with in commerce in flat or in curved pieces, about ⅛ or ¼ inch (3 or 6 Mm.) thick, and varying in length, both ends being usually cut off obliquely. The outer surface has often thin patches of cork adhering; the inner surface is smooth and striate. The tangential arrangement of the brownish bast-fibres, alternating with white parenchyma and crossed by the numerous fine white medullary rays, gives the cross-section a delicately checkered appearance. The bark breaks readily with a short fracture both transversely and longitudinally. It has a feeble odor and a bitter somewhat acrid taste. If collected in April it has a sweetish, insipid taste, and is said to be less active.

Constituents.—The bark has been examined by Thiebaud (1872) and by Dawson

(1874). The latter found a little tannin, trace of volatile oil, a little resin, and 14 per cent. of fixed oil; also a volatile acid, called by Thiebaud *juglandic acid*, but which is doubtless identical with the *nucin* of Reischauer and Vogel (1856), discovered by them in the pericarp and leaves of Juglans regia, *Linné*. Nucin, or *juglone*, which seems to have the composition $C_{36}H_{12}O_{10}$, has an acrid taste, an acid reaction to test-paper, and is sparingly soluble in water, more so in alcohol, and readily so in ether, chloroform, and carbon bisulphide; it crystallizes as orange-yellow needles, and acquires, with alkalies and with the alkaline borates and phosphates, a handsome purple color. If the properties of the bark depend wholly or in part on this principle, it is easily explained why continued boiling should render it less efficacious. Tanret and Villiers (1877) obtained from the leaves of the European walnut a crystallizable non-fermentable sugar, *nucit*, $C_6H_{12}O_6.2H_2O$, and Tanret (1876) reported having isolated a crystallizable alkaloid. According to Sestini, the root of the European walnut contains *glycyrrhizin*.

Allied Plants.—Juglans regia, *Linné*, *English walnut.* The green pericarp (Cortex fructus juglandis) and the leaves (Folia juglandis, *P. G.*) have a peculiar odor and a somewhat astringent and bitter taste. The young fruit of both species is used for pickles, and when ripe the kernels yield a bland and drying fixed oil known as *nut oil;* it is greenish or pale-yellow, congeals like lard at about −18° C. (0° F.), and acquires a red color with nitric acid and a dark-brown one with a mixture of nitric and sulphuric acids. Similar oils are contained in the butternut and in the seeds of Juglans nigra, *Linné*, Carya olivæformis, *Nuttall* (*pecan-nut*), and other species of Carya, the various *hickory-nuts.*

Off. Prep.—Extractum juglandis, *U. S.*

Medical Uses.—Butternut is employed medicinally in the form of the officinal extract alone, which, according to Rutherford's experiments, is a "moderately powerful hepatic and a mild intestinal stimulant."

Juglans regia, or English walnut, was once reputed to be a remedy for *scrofula*, and in France about 1840 it was actively advertised for this purpose by Négrier and others, but its credit was not sustained. The leaves are a popular cure for *leucorrhœa* when used in decoction as an injection, and in other mucous profluvia internally. An extract of the leaves has been claimed by Luton to be curative of tubercular *meningitis* (*Études de thérapeutique*, 1882); and his reports are more or less sustained by those of Tanret, Meslier, and Guénot (*Bull. de thérap.*, tom. xc. xci.), but they have not been confirmed by ulterior observation. Juglans nigra, or black walnut, says Griffith, has a styptic and acrid bark, seldom used except in dyeing. The rind of the unripe fruit is said to remove *ringworm* and *tetter*, and a decoction has been given as a *vermifuge*. In France the leaves, the rind of the fruit, and the inner bark of J. regia have long been in popular and medical use for repressing the *mammary secretion*, for curing *ulcers* of all parts, including the uterus, for treating *diarrhœa*, *leucorrhœa*, *ulcerated sore mouth*, affections of the *tonsils*, *uterine hæmorrhage*, etc. In 1853, Pomeyrol treated with singular success *carbuncle* and *malignant pustule* by the simple application of the fresh leaves of black walnut frequently renewed (Cazin, *Plantes médicinales*, p. 640). A decoction of black-walnut leaves was also advantageously substituted for a complex and perturbative treatment of *diphtheria* by Dr. Curtis (*Boston Med. and Surg. Jour.*, March, 1881, p. 226).

In England a preparation known as "spirit of walnut" is made by distilling alcohol from fresh walnuts, and is stated to be very efficient in "hysterical *vomiting*, the vomiting of pregnancy, and even for cerebral vomiting" (Mackey, *Practitioner*, xxi. 401).

JUJUBA.—Jujube-Berries.

Jujube, Fr.; *Brustbeeren*, *Judendornbeeren*, G.

The fruit of Zizyphus vulgaris, *Linné*, and Z. Lotus, *Lamarck*.

Nat. Ord.—Rhamnaceæ.

Origin.—The jujube-shrubs are indigenous, the former to Asia Minor and Syria, the latter to Northern Africa, and are cultivated in Southern Europe. They are shrubby or sometimes tree-like, and have alternate ovate and serrate three-nerved leaves, at the base with two prickly afterward spiny stipules. The fruit is a two-celled and two-seeded, or by abortion one-celled and one-seeded, drupe.

Description.—Jujubes are roundish oblong and nearly an inch (25 Mm.) long, but obtained from the second species are subglobular and about $\frac{3}{5}$ inch (15 Mm.) long; they are bright-red, or after drying brownish-red, wrinkled, with a thin leathery pericarp, a soft mucilaginous and sweet sarcocarp, and an ovate, acute, wrinkled, and usually one-seeded endocarp.

The fruits of Ziz. Jujuba, *Lamarck*, a slender East Indian tree, and of several other species, possess similar properties.

Constituents.—Jujubes contain mucilage and sugar. The bark contains tannin.

Pharmaceutical Uses.—Massa de jujubis—Jujube paste, *E.;* Pâte de jujubes, *Fr.*—is prepared by extracting 5 parts of jujubes with sufficient water to obtain 35 parts of infusion, in which are dissolved gum-arabic 30 parts and sugar 20 parts; the solution is evaporated, 2 parts of orange-flower water added, kept slowly boiling for 12 hours, and then poured into moulds.—*F. Cod.* In the jujube paste, as sold in the United States, the jujubes are usually omitted.

Medical Action and Uses.—In the native countries of the jujube its fruit is ranked with figs and raisins and other more or less saccharine and acidulous fruits which are used in tisanes for acute irritations of the *throat* and *air-passages*, much as in this country we employ the syrup and jelly of currants, blackberries, etc. The so-called jujube paste seldom contains any of the fruit, but is made of gum-arabic and sugar, with some flavoring ingredient and a variable proportion of opium.

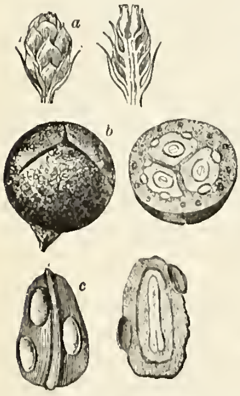
JUNIPERUS, *U. S.*—Juniper.

Fructus juniperi, P. G.; *Baccæ, s. Galbuli juniperi.—Juniper-berries*, E.; *Genièvre, Fruits du genévrier, Baies de genièvre*, Fr.; *Wachholderbeeren, Kaddigbeeren*, G.

The fruit of Juniperus communis, *Linné*. Woodville, *Med. Bot.*, t. 6; Bentley and Trimen, *Med. Plants*, 255.

Nat. Ord.—Coniferæ, Cupresseæ.

Fig. 168.



Juniperus communis, *Linné: a*, fertile catkin and longitudinal section; *b*, galbulus and transverse section; *c*, seed and longitudinal section, magnified.

Origin.—Juniper is indigenous to the northern hemisphere, and is found in North America from the Southern United States to Canada and Greenland, and westward to the Pacific, throughout Asia from the Himalayas northward, in Northern Africa, and throughout Europe. It is commonly a shrub 4 to 6 feet (1.2–1.8 M.) high, sometimes arborescent, or in the variety alpina (Jun. nana, *Willdenow*), prostrate and spreading, the latter being met with in Arctic and mountainous localities. The numerous leaves are persistent, spreading, in whorls of three, linear and sharp-pointed; the staminate flowers are arranged in short ovate catkins; the pistillate form a short cone consisting of about five imbricate whorls, each of three scales. Three naked ovules are situated at the base of the upper whorl, and, after fructification, these scales enlarge, coalesce, become fleshy, and ultimately enclose the seeds, forming the officinal berry-like galbulus, which ripens during the second year. The trade is mostly supplied from Southern and Central Europe; in 1882 the United States imported about 170,000 pounds (1187 packages).

Description.—Juniper-berries are nearly globular, about ⅓ inch (8 Mm.) in diameter, dark-purplish, and covered with a bluish-gray bloom; the short stalk at the base contains one or two whorls of the small scales, and the apex is marked by three radiating furrows, which are surrounded by ridges enclosing a triangular space. The three, or by abortion one or two, bony seeds are ovate in shape, triangular above, have six to ten large oil-sacs on their surface, and are imbedded in a brownish pulp which likewise contains oil-cells. Juniper-berries have an aromatic somewhat balsamic odor and a sweet, terebinthinate, bitterish, and slightly acrid taste.

Constituents.—Juniper-berries were analyzed by Trommsdorff (1822), Nicolet (1831), Steer (1856), and Donath (1873). They contain from ½ to 2½ per cent. of volatile oil (see Oleum Juniperi), about 30 per cent. of sugar, resins amounting to 10 per cent., 4 of protein compounds, fat, wax, formic and acetic acids, malates, and *juniperin*, which is light-yellow, slightly soluble in water, freely so in alcohol and ether, and with a golden-yellow color in ammonia. Ritthausen (1877) obtained from juniper-berries, containing 10.77 per cent. of water, only 14.36 per cent. of sugar, 3.77 of ash, and 31.60 of cellulose.

Pharmaceutical Uses.—Infusum juniperi.—Infusion of juniper-berries, *E.;* Tisane de genièvre, *Fr.;* Wachholderbeeren-Aufguss, *G.*—Bruised juniper-berries a troyounce, boiling water a pint; macerate for an hour in a covered vessel, and strain.—*U. S. P.* 1870.

Other Products of Juniper.—Lignum juniperi, *Juniper-wood*, is used in Europe as an alterative and diaphoretic in diseases of the skin and rheumatic affections. Resina juniperi, the resinous exudation found in the bark, is sometimes called *German sandarac.*

Succus juniperi inspissatus, *P. G.*, s. Roob juniperi.—Extract of juniper-berries, *E.; Rob de genièvre*, *Fr.;* Wachholdermus, *G.*—An infusion is made of bruised juniper-berries by macerating with water (hot water, *P. G.*), filtering, and evaporating to the consistence of a soft extract. Fresh juniper-berries yield about 32 per cent. of this extract, which is of a dark-brown color and of a sweet and aromatic taste.

Off. Prep.—Oleum juniperi, *U. S.*

Medical Action and Uses.—Juniper is stimulant, stomachic, carminative, diuretic, and emmenagogue. It communicates a special odor to the urine. It is much used in the treatment of *dropsies*, and especially of scarlatinous and other forms of dropsy due to tubular obstruction of the kidneys. (Juniperi contus., Potassii bitart. āā ℥ss; Aquæ fervent. Oj. Make an infusion, to be used in divided doses during 24 hours. Acetate of potassium may be substituted for the bitartrate in this formula, but in half the quantity. The diuretic virtues of the infusion may be increased by the addition of parsley, buchu, horse-radish, etc.) In chronic catarrhal affections of the *urinary passages* juniper is useful, and also when sabulous matter is habitually voided. As an anodyne for painful *swellings*, and generally for *local pains*, bruised juniper-berries are sometimes used, and fumigations made by throwing the berries upon hot coals may be employed to relieve *rheumatic pains.*

JUNIPERUS VIRGINIANA.—Red Cedar.

Cèdre de Virginie, Fr.; *Virginische Ceder, Rothe Ceder*, G.

The tops of Juniperus virginiana, *Linné.*

Nat. Ord.—Coniferæ, Cupresseæ.

Origin.—Red cedar is shrubby, or is more frequently a tree 50 or sometimes 90 feet (15–27 M.) high, growing in sterile or rocky soil in Canada and the United States, south to the Mexican Gulf and westward to Eastern Texas, Nevada, and British Columbia. It has a compact, close-grained, very durable, reddish, and odorous wood, and horizontal branches, the older leaves spreading and awl-shaped, the young leaves appressed and imbricate, and a small non-pendulous fruit. The young branches, on which the leaves are still appressed, are collected for medicinal purposes.

Description.—The branchlets resemble savine, are about 1 inch (25 Mm.) long, and of a quadrangular appearance from their four rows of scale-like leaves, which are ovate-lanceolate, obtuse, or rather acute, appressed, and imbricated. They have a longitudinal furrow on the back, which gradually deepens toward the base, where there is contained a circular or oblong gland. They have a not unpleasantly terebinthinate odor and an aromatic, bitterish, and somewhat acrid taste.

Constituents.—Red cedar was analyzed by W. J. Jenks (1842), who found it to contain volatile oil, resin, fat, tannin, and other common constituents of plants. *Oil of red cedar*, distilled from the wood, was examined by Walter (1842). On exposing it to cold, expressing the coagulated mass, and recrystallizing the solid portion from alcohol, *cedren camphor*, $C_{15}H_{26}O$ (Gerhardt), was obtained, which has an aromatic odor and a slight taste. The liquid portion, after rectification and distillation over potassium, is *cedren*, $C_{15}H_{24}$ (Gerhardt), which is colorless, of specific gravity 0.98, boils at 237° C. (458.6° F.), and has an aromatic odor differing from that of the camphor, and an aromatic afterward pepper-like taste.

Medical Action and Uses.—The leaves of red cedar are said to possess in some degree the qualities of savine, but definite information upon the subject is wanting so far as their internal operation is concerned. An ointment prepared with them is employed as a dressing to maintain the discharge of *suppurating surfaces.* The fumes given off by the burning shavings of the dried wood are reputed to be useful in muscular *rheumatism.* An infusion of the berries is reported to be diuretic when cold and diaphoretic when hot, and the small gall-like excrescences found on the branches are eaten as an *anthelmintic* medicine.

KAIRINA.—Kairine.

Kairine, Fr.; *Kairin*, G.

The hydrochlorate of an artificial alkaloid prepared from chinoline. Formula $C_{10}H_{13}NO.HCl.H_2O$; molecular weight 217.4.

Preparation.—Chinoline (page 472) is treated with fuming sulphuric acid; the resulting *methylsulphonic acid* is fused with caustic soda, when *oxychinoline* is obtained, the potassium compound of which, on being treated with methyl iodide, yields *oxymethyl-chinoline*, and this, with tin and hydrochloric acid, yields *oxyhydromethyl-chinoline;* by precipitating this from its ethereal solution with hydrochloric acid gas, *kairine* is yielded. The order of treatment may vary (*Ber. Chem. Ges.*, 1883, 712). The salt was prepared by O. Fischer and C. Bedall (1881).

Properties.—The pure alkaloid is sparingly soluble in water and readily soluble in alkalies, benzol, hot alcohol, and methyl alcohol; it crystallizes from ether in tabular and from alcohol in prismatic, rhombic colorless crystals. Its alcoholic solution yields with ferric chloride a dark-brown or black-brown color and precipitate; with ferrous sulphate a transient dark-red color, and in concentrated solutions a dingy-colored precipitate; and with potassium ferrocyanide in acid solutions a nearly colorless voluminous precipitate, which crystallizes from boiling water in bluish-green needles.

The hydrochlorate (*kairine*) is readily soluble in water, and on evaporating this solution over sulphuric acid yields colorless glossy monoclinic tabular crystals, which at 110° C. (230° F.) lose 8.27 per cent. of water. The commercial salt is a grayish or yellowish crystalline powder, of a slight phenol-like odor, and of a saline, bitter, and somewhat aromatic taste. Klie (1883) found it nearly insoluble in ether, insoluble in chloroform, carbon disulphide, and oil of turpentine, but soluble in 7.5 parts of cold and 1.5 parts of boiling water, in 19 parts of alcohol, and in 15 parts of glycerin. The solution is colored dark-purple by potassium bichromate, and is precipitated by the group reagents for alkaloids. The platinum double salt crystallizes in prisms, and on boiling with water turns red. Kairine burns upon platinum-foil with a smoky flame.

Allied Compounds.—KAIRINE A, $C_{11}H_{15}NO.HCl$, is oxyhydroethyl-chinoline hydrochlorate, crystallizes in white prisms, and resembles in its properties the preceding salt.

KAIROLINE is the sulphate of tetrahydromethyl-chinoline, $C_{10}H_{13}N$.

KAIROCOLL, $C_{11}H_{11}NO_2$, dissolves sparingly in water, but readily so in alcohol and ether.

Medical Action and Uses.—In 1882, Prof. Filehne of Erlangen announced that the newly-discovered muriate of kairine reduced the temperature of fever to the normal degree without occasioning any of the unpleasant effects of other anti-pyretics. Taken by healthy adults in doses of from 15 to 20 grains (Gm. 1–1.60), it was said not to produce any appreciable change in the temperature nor to cause headache, buzzing in the ears, vomiting, etc. Sick or feeble persons who took 15 grains (Gm. 1) every 2 hours were apt to present a cyanotic discoloration. The action of the last-named doses did not last more than 3 hours, and of 8 grains more than 2½ hours; and as their effects passed off the patients experienced a chill that sometimes continued until the return of the normal temperature. Single doses of from 5 to 15 grains (Gm. 0.30–1) reduced the temperature from ½ to 2° C., or even more; and when a dose was repeated before the action of the previous one had passed off, the temperature might be depressed to 37° or 36.5° C. (98.6 or 97° F.). These observations were confirmed by Hallopeau (*Bull. de thérap.*, civ. 241). The primary action of an efficient dose began about 25 minutes after it had been taken. The fall of temperature was generally accompanied by copious perspiration until the lowest point was reached. According to Filehne, during this process the fevered patient is extremely comfortable—in pneumonia, for example, he ceases to suffer from pain or oppression—but as the action of the medicine subsides the fever returns, and with it the local symptoms. While the patient is taking the medicine the urine acquires a green color, but contains neither albumen nor sugar. An objection early made to the medicine was the necessity of continuing to administer it at regular intervals of about 2½ hours, day and night, for unless this is done the fever soon returns to its former height (*Centralblatt f. Therapie*, i. 31, 273).

Other observers have more or less confirmed or modified these statements. In Vienna, Drasche, in treating *pneumonia* according to Filehne's method, found that the larger doses given in rapid succession sometimes induced collapse, with cardiac failure and bilious vomiting—symptoms that remind one of poisoning by digitalis. Such effects were also observed in *phthisis*. In *erysipelas* of the face its virtues were not evident, and in *typhoid fever* it did not aggravate the diarrhœa, while it seemed to suppress the brain symptoms and keep the tongue moist (*ibid.*, i. 277). Freimuth and Poelchen used the medicine in *relapsing fever*, and decline to recommend it for that disease, and in view of its disturbing the stomach suggested that it be administered by enema or hypodermically (*ibid.*, i. 279). Seifert states that his experience with the medicine in *pneumonia* did not confirm Filehne's reports, and points out that a fall in the pulse-rate and temperature is by no means a constant effect of the medicine (a statement also made by Hoffer); that the alleged solace of the pain in the side, of the dyspnœa, etc., did not occur, but that vomiting did, and that profuse sweating and a state of alarming collapse were induced by the medicine. He concludes that he will not again prescribe kairine in pneumonia (*ibid.*, p. 280). Reigel arrived substantially at the same conclusions (*ibid.*, p. 416); and Hoffer adds that not only is the action of the medicine transient, but that tolerance is very soon established (*ibid.*, p. 421). Pribram states that in certain healthy persons even small doses of it have occasioned a thready pulse, nausea, and a cyanotic complexion, and that it has no influence upon either the duration or the issue of pneumonia (*ibid.*, p. 417). On the other hand, Purjesz agrees pretty nearly with Filehne (*ibid.*, p. 419); Guttmann gives to kairine the preference over all other anti-pyretics in certainty and promptness of action; and Riess is of the same opinion (*ibid.*, p. 419, 420). Elsewhere than in Germany the reports concerning this medicine agree, more or less, with the above in essential particulars (compare Shattuck, *Boston Med. and Surg. Jour.*, Nov. 1883, p. 415; Draper, *ibid.*, p. 417; Crook, *Med. News*, xliv. 326), and especially that the medicine is an efficient anti-pyretic; but none of them prove it to bear the marks of a true remedy, curing disease "*cito, tuto, et jucunde.*"

Two inferences may be drawn from the statements of these observers: 1, That there is no agreement as to the clinical effects of the medicine; and 2, that no proof is given that it either shortens the duration or lessens the mortality of any disease in which it has been used. In this respect, then, it stands in the same line with various other preparations that lower the temperature and the pulse-rate. Like them, it may be considered as a physiological agent rather than a medicine, at least in febrile affections—*i. e.* an agent that illustrates the relation of certain functions, but not as a remedy for the diseases in which it has thus far been used.

Filehne recommends that the primary dose of kairine should not exceed 4 or 5 grains (Gm. 0.25); that it should be repeated and increased at intervals of 2 or 3 hours, according to its influence on the temperature, to 8 or even 15 grains (Gm. 0.50–1); and that when the desired subsidence is obtained the dose should be gradually reduced. Guttmann prescribes 15 grains (Gm. 1) hourly for 2 hours, and after that 7 or 8 grains (Gm. 0.50) every hour until the desired reduction of temperature is secured; after which 3 or 4 grains (Gm. 0.25) should be given at like intervals to prevent reaction. If a chill threatens, an additional dose like the last should be administered. Riess went so far as to give hourly doses of from 20 to 50 grains (Gm. 1.50–3.50); but as the latter dose caused grave symptoms, it was only once administered (*Edinb. Med. Jour.*, xxix. 850). It is most conveniently administered in wafers or capsules, to avoid its bitter saline taste and its acrid impression on the fauces.

KALMIA.—MOUNTAIN LAUREL.

Calico-bush, *Spoon-wood*, E.; *Kalmie*, Fr., G.

The leaves of Kalmia latifolia, *Linné*.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—This shrub is found in Canada, and in the United States south to Florida and Alabama and west to Wisconsin, Kentucky, and Arkansas. It is abundant in many places, preferring woods on rocky hills and damp soil, and is usually about 6 feet (1.8 M.) high, but sometimes tree-like and 30 or 40 feet (9–12 M.) high. The wood is yellowish, close-grained, very hard and strong; the elegant but inodorous flowers appear in May and June, are in dense racemose corymbs, and have a rose-red or whitish subcampanulate corolla, which, in the lower part, is furnished with ten cavities holding the ten anthers until they begin to shed their pollen. The Indians are said to have made spoons from the wood.

Description.—The leaves are alternate, 2 or 3 inches (5–8 Cm.) long, petiolate, coriaceous, oval-lanceolate, or elliptic, entire, acute at both ends, smooth and green on both sides. They are without odor and have an astringent and bitterish taste.

Constituents.—Charles Bullock (1848) proved the leaves to contain tannin, a principle resembling mannit, an acrid principle, resin, gum, and other common constituents of plants. Kennedy (1875) isolated *arbutin*, which appears to be present in smaller proportions than in uva ursi.

Allied Plants.—KALMIA ANGUSTIFOLIA, *Linné*, known as *sheep-laurel*, *sheep-poison*, and *lamb-kill*, has opposite or ternate linear-elliptic leaves, which are 1 or 2 inches (2 to 5 Cm.) long, and whitish or brownish beneath. The small flowers are of a deep-crimson color (Meehan, *Nat. Flowers* [2], ii. 181).

Kalmia glauca, *Aiton*, *Swamp-laurel*, has pale-purple flowers and subsessile lanceolate leaves, which are glaucous beneath, about an inch (25 Mm.) long, and opposite on the two-edged branches.

Andromeda mariana, *Linné*, or *stagger-bush* (Meehan, *Native Flowers*, ii. 185), is likewise reported to be poisonous to lambs and calves. It is a shrub 2 or 3 feet (60 or 90 Cm.) high, produces clusters of white, nodding, ovate-cylindrical flowers, and has thick but deciduous, smooth, oval or oblong, entire leaves, about 2 inches (5 Cm.) long. It grows in the seaboard States from New England to Florida and westward to Tennessee and Arkansas.

Oxydendrum arboreum, *De Candolle*, s. Andromeda arborea, *Linné*, *sorrel tree* or *sour-wood*, is about 40 feet (12 M.) high. The leaves are deciduous, oblong-lanceolate, pointed, serrulate on the margin, and nearly smooth. They resemble peach-leaves in shape and have a refreshing acidulous taste. The tree grows in the Alleghanies and westward to Arkansas.

All the species named above belong to North America.

Medical Action and Uses.—The leaves and berries of the mountain-laurel have long been known to be poisonous, but their action has chiefly been learned through the effects produced in man by eating the flesh of partridges (Tetrao umbellus) that have fed upon the berries. From a number of cases observed or collected by Dr. Jacob Bigelow he prepared (1857) the following summary of the symptoms of this poisoning: The flesh of the bird "acts as a direct sedative poison, impairing the functions of the brain, and, in connection, those of the digestive and circulatory systems. The cerebral symptoms, in a majority of the cases, have been vertigo, loss of sight, tinnitus aurium, and in bad cases general loss of the power of sensation and voluntary motion. Respiration has been slow, sometimes to a great degree. In the circulatory system there has been syncope, feeble and sometimes irregular action of the heart, weak, slow, and sometimes imperceptible pulse, cold surface, and pale or livid complexion. In the digestive system there are oppression, nausea with a tendency to vomit, and in many cases pain in the abdomen, extending through to the back. In more rare cases pain has been felt in the head and limbs. . . . . The poison of the partridge has never, to my knowledge, proved fatal." One of the most recent cases was published by Dr. Homans in 1871, and answers, trait for trait, to the summary given above. The connection of these symptoms with laurel-poisoning has been questioned, and they have been attributed to the partial putrefaction of the bird's meat when it was eaten. But as they are identical with the effects observed by Stabler (*Am. Jour. of Phar.*, x. 241) in himself after taking a strong decoction of laurel-leaves, there need be no doubt of their having been referred to their true source. The medicinal value of this plant is almost entirely conjectural. The bruised leaves, and also a decoction, are said to have been applied to certain *cutaneous eruptions*, and it is added that alarming symptoms have sometimes resulted, probably because the skin was not whole. It might be profitable to test their efficacy in neuralgic and other local pains by applying them in the same manner.

Oxydendron arboreum is said to be diuretic and laxative. A semi-solid extract, in doses of from 3 to 12 grains three times a day, is alleged to have removed dropsical effusions (Clendennin, *Med. Record*, xxiii. 707).

KAMALA, *U. S., Br., P. G.*—Kamala.

Rottlera, U. S. 1870; *Glandulæ rottleræ.*—*Kameela*, *Kamala*, Fr., G.

The glands and hairs obtained from the capsules of Mallotus (Echinus, *Baillon*) philippinensis, *Müller Arg.*, s. Croton philippense, *Lamarck*, s. Rottlera tinctoria, *Roxburgh*. Bentley and Trimen, *Med. Plants*, 236.

Nat. Ord.—Euphorbiaceæ.

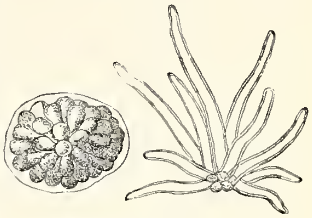
Origin.—The kamala grows wild in Australia, Eastern China, India, Southern Arabia, and Abyssinia, and in most of the islands lying between these countries from the Philippines westward. It is a large shrub or small tree, with petiolate, ovate, acute, and entire leaves, and produces globular tricoccous three-seeded capsules, from which the glands are obtained by rubbing and sifting in baskets.

Description.—Kamala is a fine granular, mobile powder of a brick-red color, somewhat resinous appearance, inodorous, and nearly tasteless. It is with difficulty mixed with water, imparts to boiling water only a yellow tinge, but a deep-red color to alkaline solutions, alcohol, ether, chloroform, and benzol. When thrown into a flame it burns similar to, but less rapidly than, lycopodium, and when heated in a crucible it leaves a small amount of ash, which weighs from pure kamala 1.37 per cent. (*Pharmacographia*).

Examined under the microscope, the glands are seen to be depressed-globular, and to consist of a thin transparent membrane enclosing a yellowish mass in which are imbedded many club-shaped vesicles radiating from a common centre, and containing a red substance; this structure becomes more apparent after treating the glands with potassa and pressing them between glass. The glands are always mixed with colorless stellately-arranged simple hairs, but fragments of leaves and stems should not be present. When heated in a crucible to redness, kamala should leave not more than 8 per cent. (*U. S.;* 6 per cent. *P. G.;* at most 10 per cent. *Br.*) of ash, having a gray, not a red, color.

Constituents.—Pure kamala contains only between .5 and 3.5 per cent. of moisture, and yields to ether, alcohol, amyl alcohol, glacial acetic acid, or carbon disulphide about 80 per cent. of resin, which is also soluble in alkalies, but not in benzin, and whose alcoholic solution is colored dingy-green by ferric chloride (Flückiger). Leube (1860) analyzed a sample of kamala which yielded nearly 29 per cent. of ash, 47.6 of resin, and 19.7 of other soluble matters, consisting of citric, oxalic, and tannic acids, gums, etc. Cold alcohol dissolved a resin, $C_{15}H_{18}O_4$, fusible at 80° C. (176° F.), and left a more sparingly soluble resin, $C_8H_{12}O_5$, melting at 191° C. (376° F.). Both resins are brittle, red-yellow, soluble in alkalies with a red color, not altered by dilute acids, and when treated with nitric acid yield oxalic acid. Leube could not obtain Anderson's *rottlerin*, $C_{22}H_{20}O_6$ (1855), which crystallized from the concentrated ethereal tincture in yellow silky needles. Groves (1872) ascertained that it is easily modified by exposure to air, and is consequently obtained only from the recent drug. Flückiger subsequently observed that on being fused with potassa rottlerin yields *paraoxybenzoic acid*. Anderson's *resinous coloring matter* has the composition $C_{30}H_{30}O_7$, melts at 100° C. (212° F.), is easily soluble in alcohol and ether, and yields with lead acetate an orange-colored precipitate. By treating kamala with boiling alcohol, and cooling, amorphous floccules of the composition $C_{20}H_{34}O_4$ are obtained, which are sparingly soluble in cold alcohol and ether, and are not precipitated by lead or silver salts.

Fig. 169.



Kamala, magnified 190 diameters.

Allied Drug.—Wars, Warras, or Wurrus. This name, which is the Arabian for saffron, has occasionally been given to kamala, but in Eastern Africa is given to a distinct drug of unknown origin, but used for dyeing, and medicinally like kamala. It forms a rather coarse powder of a deep-purple color and slight odor, becomes black at the temperature of a water-bath, yields from 6 to 12 per cent. of ash, and under the microscope is seen to consist of cylindrical or subconical glands enclosing oblong vesicles arranged in three or four tiers; the glands are mixed with rather long, simple hairs.

Medical Action and Uses.—Kamala has long been employed in Hindostan as a remedy for *tænia*. It does not occasion much nausea, colic, or purging. British soldiers in India, it is said, often apply for a dose of the medicine, "after which they invariably part with the worm in the course of a few hours, and then go on with their military duty as if nothing had happened." In general, the parasite seems to have been discharged dead. The medicine appears to be equally efficient in removing *lumbricoid worms* and rectal *ascarides*.

The *dose* of powdered kamala is 1 or 2 drachms (Gm. 4–8). To prevent its griping, hyoscyamus may be associated with it. A saturated tincture has been found efficient in doses of from 1 to 3 fluidrachms (Gm. 4–12), diluted with cinnamon-water, or the extract produced by evaporating the tincture may be employed. The dose of either preparation should be repeated several times at intervals of about 3 hours.

KINO, *U. S., Br.*—Kino.

Gummi (s. Resina) Kino.—*Kino*, Fr., G.

The inspissated juice, obtained from incisions made in the trunk, of Pterocarpus Marsupium, *Roxburgh. Corom.*, plate 116; Bentley and Trimen, *Med. Plants*, 81.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The kino tree, called *bija* in Bengal, is 60 to 80 feet (18–24 M.) high, has numerous spreading branches, a red inner bark, unequally pinnate deciduous leaves, yellowish flowers in loose racemes, and nearly orbicular and winged pods, which contain a single kidney-shaped seed. It is indigenous to India and Ceylon, and on incisions being made through the bark yields a red juice, which is dried by exposure to the air and sun. Pter. indicus, *Willdenow*, a native of Southern India and of the Philippine Islands, yields kino of a fetid odor. 7783 pounds of kino were imported into the United States in 1881.

Description.—East India or Malabar kino is met with in small, angular, dark-red or brownish-red, glistening, and brittle pieces, which in thin layers are transparent and of a ruby-red color, and tinge the saliva deep-red; it softens between the teeth, is inodorous, and has a very astringent and sweetish taste. It is partly soluble in cold water, leaving a flocculent residue, and is entirely soluble in alcohol and nearly insoluble in ether. The solutions have an acid reaction; the aqueous solution is precipitated green-black by ferric salts, gray-purplish by lead acetate, light-brown by tartar emetic, and reddish by mercuric chloride. The solution in diluted alcohol is apt to gelatinize.

Constituents.—By treating kino with ether Eissfeldt (1854) obtained a minute quantity of *pyrocatechin*. The products of the dry distillation of kino contain a larger quantity of the same substance, which may be obtained pure by subliming in a benzoic acid apparatus. Kino contains no *catechuic acid*, but its tannin, *kino-tannic acid*, seems to be chemically related to catechu tannin, since it yields similar decomposition-products; but it has not yet been obtained in a pure condition, being accompanied by red coloring matter, and, according to Hennig (1853), by a pectin compound from which it cannot easily be freed. The aqueous solution of the acid gives with pure ferrous salts when carefully neutralized a violet color, and with ferric salts a blackish-green one. Mineral acids and many metallic salts produce precipitates; hot nitric acid converts it into oxalic acid. In solution it is darkened by alkalies, and when treated with fusing potassa it is decomposed into *protocatechuic acid* and *phloroglucin*. On exposure to air the aqueous solution yields a red precipitate, slowly at the ordinary, more rapidly at the boiling, temperature; this is *kino-red*, an amorphous, tasteless mass, the alcoholic solution of which has a slight acid reaction. Kino-red, $C_{28}H_{22}O_{11}$, is also produced by heating *kinoin* to 130° C. (266° F.). This compound was obtained by Etti (1879) by boiling kino with diluted hydrochloric acid and agitating the clear liquid with ether; it forms white crystals, the solution of which in water becomes red with ferric chloride. The compound which yields pyrocatechin and gallic acid was obtained by Flückiger from Australian, but not from Malabar, kino. Kino yields about 1.3 per cent. of ash.

Other Varieties of Kino.—African or Gambia Kino exudes naturally from Pter. erinaceus, *Poiret*, of Western Africa, and agrees with the Bengal kino in behavior: it is not an article of commerce.

Australian or Botany Bay Kino is usually referred to Eucalyptus resinifera, *Smith* (Myrtaceæ), but F. von Mueller sent exudations from sixteen different species to Wiesner (1871), who found the products of E. rostrata, *Schlechtendal*, E. corymbosa, *Smith*, E. piperita, *Smith*, and of some others, to agree well with Malabar kino, while the exudation of E. resinifera, E. gigantea, *Hooker*, and others contains much gum, which is colored red by a kino-like substance. A kino-like substance is occasionally obtained from E. globulus, *Labillardière*.

Bengal or Palas Kino, *Butea gum*, from Butea frondosa, *Roxburgh* (Leguminosæ), is in dark ruby-colored tears and fragments, of which only about one-half or less is soluble in hot alcohol, the remainder being mucilaginous matter. According to Eissfeldt, it does not contain pyrocatechin, but yields this compound on dry distillation. When incinerated, Butea gum leaves about 1.8 per cent. of ash.

Jamaica, West Indian, or Caracas Kino, from Coccoloba uvifera, *Linné*, or *sea-side grape* (Polygonaceæ), is obtained by boiling the wood and bark and evaporating the decoction. It resembles Malabar kino in appearance, but is of a brown tint, less glossy, and has a bitterish rather than a sweetish taste; it is soluble in both alcohol and water to the extent of about 90 or 93 per cent. The tannin of this kino seems to be closely related to, if not identical with, that of the officinal article. The plant named is a large tree of the West Indies and Southern Florida, and has a heavy, hard, and durable violet-brown wood. Whether the wood of Coccoloba floridana, *Meissner* (C. parvifolia, *Nuttall*), or *pigeon plum*, of Southern Florida, may yield kino has not been ascertained.

Off. Prep.—Pulv. catechu comp., Pulv. kino comp., *Br.*; Tinctura kino, *U. S.*, *Br.*

Medical Action and Uses.—This medicine is more lenitive than other astringents, in consequence, probably, of the pectin it contains. Its modified astringency renders it in some degree a local tonic. It is chiefly used in the treatment of *diarrhœa* and of that form of gastric disorder known as *pyrosis*. In the former it may be profitably employed when pure astringents would be too irritating, and is generally associated with opium, as it also should be in the treatment of water-brash. It has sometimes been given with apparent advantage to check *sweating* in phthisis, urination in *diabetes*, and bleeding in *menorrhagia*. Its solution may be used as an injection in *diarrhœa*, *dysentery*, and *leucorrhœa*, as a dressing for flabby *ulcers*, and as a gargle in ulcerated *sore throat*. In powder it has been employed as a *hæmostatic.* But as a local application it is inferior to other astringents, and especially to tannin.

Kino may be prescribed in powder in the *dose* of from 10 to 20 grains (Gm. 0.60–1.30). An infusion may be made with 120 grains (Gm. 8) of kino in 8 fluidounces of boiling water. When cool it should be strained and given in doses of 1 or 2 tablespoonfuls. Owing to the tendency of its gummy matter to coagulate, it is less eligible than catechu as an ingredient of chalk mixture.

KRAMERIA, *U. S.*—Rhatany.

Krameriæ radix, Br.; *Radix ratanhiæ*, P. G.; *Radix ratanhæ.—Rhatany-root*, E.; *Ratanhia*, Fr.; *Ratanhawurzel*, G.

The root of Krameria triandra, *Ruiz et Pavon* (*Flor. Peruv.;* Steph. and Church, *Med. Bot.*, plate 72; Bentley and Trimen, *Med. Plants*, 30, 31), and of Krameria tomentosa, *Saint-Hilaire.*

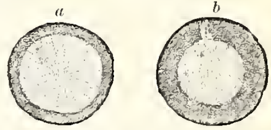
Nat. Ord.—Polygalaceæ, Kramerieæ.

Origin.—The *ratanhia* is a low shrub with spreading branches, a native of Bolivia and Peru, and grows in sandy localities in the mountains at an altitude of 3000 to 8000 feet (900–2440 M.); it has a striking appearance from the sessile leaves, which are densely covered with silvery hairs, and from the flowers, which have four scarlet sepals arranged in the form of a cross and four small dissimilar red petals. The root is chiefly exported from Payta, and is therefore distinguished in commerce as *Payta* or *Peruvian rhatany.*

Kr. tomentosa was proved by Cotton to be identical with Kr. grandiflora, *Berg*, and Kr. Ixina, *Linné*, var. granatensis, *Triana.* The species Kr. Ixina, as recognized by most botanists, extends from North-eastern Brazil northward to Mexico, Venezuela, and the West Indian islands, and exists in several well-marked varieties; it has longer petiolate leaves and loose terminal racemes of red flowers with five dissimilar petals. The root is exported from the Colombian ports of Sabanilla, Cartagena, and Santa Marta, and is known in commerce as *Savanilla* or *New Granada rhatany.*

Description.—Payta rhatany-root has several knotty heads, and consists of a woody main root, which is 1 or 1½ inches (25–38 Mm.) thick and from 2 to 4 inches (5–10 Cm.) long, when it divides into several spreading and bent branches, 10 to 18 inches (25–45 Cm.) long and varying in thickness from ⅛ to ½ inch (3–12 Mm.). The latter constitute what is sometimes called *long rhatany*, while the less desirable heads and main root are called *short* or *stumpy rhatany.* The bark is smooth, or in the older roots scaly; of a peculiar rust-brown or blackish-brown color; from 1/12 to ⅛ inch (2–3 Mm.) thick; somewhat resinous in the outer, and rather fibrous and brownish-red in the inner, layer. The wood is from six to ten times thicker than the bark, of a pale-brownish or reddish color, and is radially striate by numerous fine medullary rays, very tough, and nearly tasteless. The bark, like the wood, is inodorous, but has a strongly astringent taste, which accounts for the superiority of the *long* root. The tincture made with alcohol gives, with an alcoholic solution of lead, a brownish-red precipitate and a brown-red filtrate (Flückiger).

Fig. 170.



Rhatany-Root: *a*, Payta root; *b*, Savanilla root.

Savanilla rhatany-root resembles the Peruvian rhatany, but is always less knotty and more slender; its bark has a distinct purplish hue, is smooth or longitudinally somewhat wrinkled, occasionally deep-fissured, and ⅛ to ⅙ inch (3–4 Mm.) thick; the wood is only three or four times thicker than the bark, the tannin of which appears to differ somewhat from that of the first variety. The alcoholic tincture yields with alcoholic solution of lead acetate a purplish-gray precipitate and a colorless filtrate. Both roots tinge the saliva brown-red; the coloring matter is contained in the bark-parenchyma, in which also small subglobular starch-granules are found; the small bundles of bast-fibres are radially arranged, and accompanied by cells with fine crystals of calcium oxalate.

Payta rhatany alone is recognized by the German Pharmacopœia, while those of the United States, Great Britain, and France admit also the Savanilla variety.

Constituents.—The most important constituent is *ratanhia-tannic acid*, of which Wittstein (1854) obtained nearly 18 per cent. from the bark of Payta rhatany in the form of a red amorphous powder. It is precipitated dark-green by ferric salts and flesh-colored by gelatin, but not precipitated by tartar emetic; on dry distillation *pyrocatechin* distils over. Grabowski (1867) observed that by fusion with potassa the tannin is decomposed into *protocatechuic acid* and *phloroglucin*, and that the *ratanhia-red* of Wittstein, which is obtained by boiling with dilute sulphuric acid, has the same composition, $C_{26}H_{22}O_{11}$, as the similar product obtained by Rochleder (1866) from the tannin of the horse-chestnut, and by Rembold (1868) from that of tormentil. The tannins obtained from the three plants appear to have the composition $C_{26}H_{24}O_{11}$. The other constituents of rhatany-root are wax, gum, and uncrystallizable sugar.

Savanilla rhatany contains essentially the same constituents. Wittstein obtained from the bark of Payta rhatany, by means of ether, 17.8 per cent., and subsequently, by alcohol, 17 per cent., of extract, while Savanilla rhatany yielded respectively 3.2 and 34 per cent. The ethereal extracts contained the tannin described above, but the tannins of the alcoholic extracts appeared to differ in several reactions.

From an extract of rhatany formerly exported from South America, Wittstein isolated a crystalline body which he regarded as identical with *tyrosin*, but which Städeler and Ruge (1862) found to be $C_{10}H_{13}NO_3$; they named it *ratanhin*. Gintl (1869) proved it to be identical with the *angeline* of Peckolt, obtained from the *resina d'angelim pedra*, the exudation of Ferreira (Andira, *Saldanha*) spectabilis, *Allemao*, and suggested that some kino-like extracts from this and allied plants had been used as substitutes or adulterations of the extract of rhatany.

Other Rhatany Roots have occasionally appeared in commerce.

PARA, BRAZILIAN, OR CEARA RHATANY was described by Berg (1865) and by J. G. S. Cotton (1868) in two varieties as *rhatanhia des Antilles*. It has a dark gray-brown or blackish bark, which adheres firmly to the flexible wood, and is longitudinally striate or transversely short-fissured, sometimes dotted with circular warts, and breaks with a glossy somewhat resinous fracture. The relative proportion of bark to wood is about the same as in the Savanilla variety, but the bark is not deep-fissured and is destitute of a purple tint. Its alcoholic tincture behaves nearly like that of the former root. Flückiger and Hanbury refer it to Krameria argentea, *Martius*, which is known in Brazil as *ratanhia da terra*. Several other species of Krameria besides the two named are indigenous to Brazil.

KRAMERIA CISTOIDEA, *Hooker*, a native of Chili, produces a root which, according to Schroff (1869), closely resembles Payta rhatany; the wood of the thick main root is pale-reddish in the outer layer and brown-red in the centre.

TEXAS RHATANY has been described by Berg; it is derived from Kr. secundiflora, *De Candolle*, and consists of a roundish root-stock about 2 inches (5 Cm.) thick, from which a number of long roots emanate which have a blackish-brown, internally reddish, bark of the same thickness as the wood.

Off. Prep.—Extract. krameriæ, *U. S.*, *Br.*; Extr. krameriæ fluid., *U. S.*; Infusum krameriæ, Pulv. catechu comp., *Br.*; Syrup. krameriæ, *U. S.*; Tinct. krameriæ, *U. S.*, *Br.*

Medical Action and Uses.—In small doses slightly tonic, in larger doses astringent, in still larger doses rhatany causes dyspeptic uneasiness and oppression, with constipation—effects probably due to its astringent qualities. It has been chiefly employed to restrain *hæmorrhages* of every variety, but is most efficient in those of the passive sort, and particularly in that form of uterine hæmorrhage in which the flow, without being profuse, is habitual. It is not without utility, as an internal medicine, in *uterine leucorrhœa*. It may be used with benefit in atonic and chronic *diarrhœa* and in *incontinence of urine* from debility of the urinary organs.

Locally, it is applied by injection to the treatment of *dysentery*, vaginal *leucorrhœa*, and *gleet*, and has enjoyed considerable reputation as a remedy for *fissure of the anus*. Its mode of action is thought to consist partly in constringing the walls of the rectum, and thereby preventing the formation there of a large fecal mass, which tends to stretch the fissures and render defecation more painful. But it appears also to promote directly the healing of the fissures by limiting the amount of blood that reaches them. The application of it consists merely in emptying the rectum with an emollient enema, and half an hour later throwing into the bowel a solution of 60 or 90 grains (Gm. 4–6) of extract of rhatany in 5 ounces of water. This enema is employed night and morning, and on both occasions it is retained for only a few moments, or else it is allowed to run out at once, and is again thrown into the bowel; and this process is renewed for several minutes at a time. The bowels are meanwhile prevented from becoming confined by the use of appropriate food or of gentle laxatives, such as sulphur, cassia, etc., or, as has been especially recommended, the administration of powdered belladonna-root in the dose of a grain or less (Gm. 0.06), given at night. The administration of the enemas, which is painful at first, gradually and indeed rapidly ceases to be so, and if steadily persevered in a cure is usually effected.

A watery solution of rhatany or its extract is of service in the treatment of *fissured* *nipples.* A mixture of the extract with white of egg may also be employed. The part should be cleansed when the child nurses, which ought to be as seldom as possible. In non-syphilitic *ozæna* an infusion of rhatany is sometimes serviceable, introduced into the nostrils with a sponge or injected with a nasal douche several times a day. The addition of chlorinated soda is advantageous, or chloride of lime may be added to the infusion in the proportion of from 5 to 10 grains (Gm. 0.30–0.60) to the ounce of liquid, which, after standing for a time, should be strained.

Administration.—Powdered rhatany is seldom employed, but may be prescribed in *doses* of from 10 to 30 grains (Gm. 0.50–2.0); the extract, fluid extract, and tincture are officinal.

LABDANUM.—Labdanum.

Resina ladanum.—Labdanum, Ladanum, E., Fr., G.

A resinous exudation of Cistus creticus, *Linné*, C. cyprius, *Lamarck*, C. ladaniferus, *Linné*, and of other species of Cistus. Bentley and Trimen, *Med. Plants*, 24.

Nat. Ord.—Cistaceæ.

Collection.—The resinous exudation of these handsome shrubs, indigenous to Greece and the Levant, is collected during hot weather by means of the *labdanisterion*, consisting of a wooden handle with many narrow leather bands on one end, which are drawn over the branches, the resin being afterward scraped off, and often kneaded together with sand and other material. An inferior kind is obtained from the wool and hairs of sheep and goats which feed on the plants, either by combing or after shearing, by boiling with water.

Description.—Labdanum is met with in two forms—either as blackish or dark-brown masses, which soften and become glutinous in the hands, and are gray upon the fresh fracture, the color soon becoming darker, or as cylindrical rolls about the thickness of a finger and rolled spirally into flat pieces. Sometimes it is also in cylindrical sticks somewhat of the shape of liquorice. Good labdanum is insoluble in water, almost completely soluble in alcohol, fusible, burns when ignited with a bright flame, and has an agreeable balsamic odor and a bitter taste. The roll and stick labdanum are frequently adulterated or artificially made.

Constituents.—According to Guibourt, cake labdanum contains 86 per cent. of resin and volatile oil, 7 of wax, 1 of extractive matter, and 6 per cent. of insoluble impurities. Pelletier found in roll labdanum only 20 per cent. of resin and 72 per cent. of sand.

Medical Action and Uses.—The singularly grateful odor of this resin led to its being made use of in the most ancient times for the fumigation of rooms and clothing, and as a medicine both internally and externally for the same purposes as other aromatic resins. It was used internally and by fumigation for chronic *bronchitis*, and locally in *leucorrhœa* and other uterine affections; it was also prized as a *diuretic*. Later it became an ingredient of various stimulant plasters. Its use is now obsolete.

LABURNUM.—Laburnum.

Golden chain, Bean trefoil, E.; *Faux ébénier, Cytise,* Fr.; *Goldregen, Bohnenbaum,* G.

Cytisus Laburnum, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—This is a tall shrub or low tree indigenous to Southern Europe, and planted in this country for ornament. It grows to the height of 15 or 20 feet (4.5–6 M.), and has a smooth bark. The leaves are on slender petioles, trifoliate, with nearly sessile, oval-oblong, obtuse, and mucronate leaflets, which are about 2 inches (5 Cm.) long, smooth and dark-green above, soft hairy and grayish beneath; they have a somewhat saline, bitterish, and slightly acrid taste. The golden-yellow flowers are in long hanging racemes, and produce linear, obtuse legumes containing glossy, dark-brown, nearly reniform *seeds* of a disagreeable bitter and acrid taste.

Constituents.—Chevallier and Lassaigne obtained the bitter principle of the ripe seed in an amorphous condition and named it *cytisin*. T. Scott Gray (1862) obtained, in addition thereto, *laburnic acid* and two neutral bitter principles, *cystin* (*cytistin?*) and *laburnin*, which are present chiefly in the seed and bark. These principles appear to be the more or less impure alkaloid *citysine* of Husemann and Marmé (1865). This is white, crystallizable, inodorous, of a bitterish and somewhat caustic taste and strong alkaline reaction, easily soluble in water and alcohol, but nearly insoluble in ether, chloroform, benzol, and carbon bisulphide; it melts at 154.5° C. (310° F.), and is sublimable in thin needles or scales. Warm nitric acid colors it orange-yellow; sulphuric acid and potassium dichromate, yellow, brown, and green. The salts are mostly deliquescent, and crystallize with difficulty. Its composition is $C_{20}H_{27}N_3O$. The leaves contain only traces of it; it is likewise found in the seeds of other species of Cytisus.

Physiological Action.—*On Animals:* According to Dr. Gray (*Edinb. Med. Jour.*, vii. 908, 1025), its effects upon dogs, cats, and rabbits are nearly identical. The decoction, however administered, is apt to cause vomiting, and also languor and muscular relaxation, the breathing and pulse-rate are accelerated, and there is always a greater or less tendency to sleep, which, however, is never comatose or profound. No irritant effects due to laburnum or any of its constituents are found after death. Fatal doses induce vomiting, and then more or less of the symptoms before enumerated, but with spasm rather than resolution; death follows gradually, the heart continuing to pulsate until the end. After death the brain and spinal cord are engorged, as are also the veins of the right side of the heart, but the lungs are collapsed and the left side of the heart is empty. Cytisin, laburnin, and laburnic acid, considered as separate active elements of laburnum, appear to act in very nearly the same manner.

On Man: In medicinal doses it induces a slight degree of languor and tendency to sleep, rather confines than relaxes the bowels, and very slightly, if at all, increases the urinary secretion. Larger doses are very apt to produce a somewhat soporific effect, and are sure to excite vomiting and sometimes purging, as well as some quickness of the pulse and giddiness. The same effects are induced by cytisin, and each of the other alleged proximate principles appears to cause some drowsiness and contraction of the pupils. In cases of poisoning by the bark or berries, which have been very numerous in Europe, the effects observed are remarkably uniform. They comprise the following phenomena: Vomiting, pain in the stomach, which is sometimes excruciating; purging; dryness, heat, and constriction of the throat; faintness, languor, vertigo, drowsiness, or a narcotic sleep, with slow and stertorous breathing, followed by insomnia; the eyes are dull and sunken, the pupils dilated, and the eyelids dusky; the pulse is very weak or fluttering, varying between 90 and 100; thirst is usually marked, and in the worst cases muscular twitchings of the neck and face are observed. No headache or other pain, except that in the stomach, is complained of, nor do general convulsions occur. In one or two instances the urine has been temporarily grass-green (*Med. Record*, xii. 696). In no case has death been observed.

Medical Uses.—Laburnum was recommended by Dr. Gray in *bilious dyspepsia*, with periodical attacks of bilious vomiting, diarrhœa, and constipation in the intervals, to be taken in such small doses as not to sicken the patient, thrice daily before meals and continued for 6 or 8 weeks. He also regarded it as an efficient medicine for children who *vomit* after eating, as a palliative of *whooping cough*, of the *nausea* and sickness of pregnancy, of *asthma* connected with emphysema of the lungs, etc. These recommendations have not, as yet, been confirmed by experience. Their author proposes for use a decoction of laburnum concentrated until it attains a specific gravity of 1.034, to be given in *doses* of from 2 to 40 minims. The *dose* of the extract is stated to be from $\frac{1}{10}$ grain to 1 grain (Gm. 0.006–0.06); of cytisin, from $\frac{1}{2}$ grain to 4 grains (Gm. 0.03–0.26); of laburnic acid, from 1 to 6 grains (Gm. 0.06–0.40); and of laburnin, from 5 to 12 grains (Gm. 0.30–0.80).

In cases of *poisoning* the stomach should be evacuated by warm water and ammonia and alcohol administered internally.

LAC, *Br.*—MILK.

Lac vaccinum.—Lait, Fr.; *Milch*, G.

The fresh milk of the cow, Bos Taurus, *Linné*.

Class Mammalia; Order Ruminantia.

Description.—Cow's milk is an opaque white liquid having a faint alkaline or neutral reaction, a slight peculiar odor, and a bland and sweet taste; its specific gravity is about 1.030. Viewed under the microscope, it is seen to be a clear and transparent liquid in which a large number of minute globules are suspended. On standing, these rise to the surface as a yellowish stratum, the *cream*, which constitutes about 5.0 per cent. of the milk, and consists mainly of fat mixed with some casein and retaining some serum. By churning the globules unite to form *butter*, and the liquid which separates, and is known as *buttermilk*, is essentially a solution of *milk-sugar* and the saline constituents of milk, and contains some casein and butter. The milk from which the cream has been separated is called *skim milk*. If left to itself, it becomes acid and separates the casein in a coagulated condition called *curds*; the same effect is produced by rennet and by acids. The liquid separated from the coagulum is called *whey*, and contains chiefly milk-sugar and some salts. The blue color sometimes observed in milk, according to Reiset (1883), is due to a blue fungus.

Milk possesses great emulsifying capacity, forming permanent emulsions on agitation with ether, chloroform, alcohol, benzin, carbon disulphide, etc., as was shown by Gust. Pile (1883); a mixture of equal volumes of milk and chloroform separates but slightly after several hours. Milk produces a blue color with tincture of guaiacum, unless it had been heated to about 80° C. (176° F.) or a mineral acid or caustic alkali had been added.

Constituents.—The chemical constituents of the milk of mammals are qualitatively alike, but quantitatively vary very much for different species, for different individuals, and even for the same individual, depending in the latter case upon the length of time since the last birth, upon the kind and quantity of food, and upon the exertion or rest of the individual. The following table is compiled from the averages given by Lehmann and others (*Physiol. Chemistry*):

	Milk of					
	Woman.	Cow.	Mare.	Goat.	Sheep.	Sow.
Albuminoids (protein compounds)	2.5	4.1	1.7	5.0	4.5	6.2
Fat (butter)	3.6	4.0	0.8	3.7	4.2	5.8
Milk-sugar	6.5	4.2	8.8	4.5	5.0	5.3
Salts (chiefly phosphates)	0.5	0.7	0.4	0.6	0.7	0.9
Total solids	13.1	13.0	11.7	13.8	14.4	18.2
Water	86.9	87.0	88.3	86.2	85.6	81.8

The albuminoids consist of *casein* and *lactoprotein*. Casein is not coagulated by heat, but on evaporating its aqueous solution it becomes insoluble and separates in the form of a thin skin; acetic and other acids coagulate it; so does rennet, and after this ceases to have any further effect, acetic acid will produce another coagulation. The protein compounds of the different milks, however, vary slightly in their behavior to some reagents. Schmidt-Muehlheim (1883) showed that fresh milk contains between .08 and .19 per cent. of *peptone*, and that this quantity is increased at the expense of the casein by digestion at 40° C. (104° F.). To obtain the peptone the protein is precipitated with table-salt and acetic acid, and afterward the peptone by phosphotungstic acid; this precipitate, dissolved in caustic soda, shows the reactions of peptone. (See Ovum.)

Butter, as obtained by the churning of cream, is a very complex mixture of fats with small quantities of an odorous principle, casein, milk-sugar, salts, and water; the fats are glycerides of butyric, capronic, caprinic, myristic, palmitic, stearic, and oleic acids, some of which are gradually decomposed, whereby the liquid fatty acids are liberated and the butter turns *rancid*.

As stated above, milk left to itself becomes acid; the change takes place in consequence of the fermentation of milk-sugar (see Saccharum Lactis) induced by the casein, whereby *lactic acid* is generated. The change is prevented, for some time at least, by the addition of certain compounds, for which purpose borax has been recommended; but boric acid, in the proportion of 1 to 1000 milk, as recommended by Hirschberg (1871), is preferable, as not altering the taste. Salicylic acid (1 to about 5000 milk) has also been found serviceable. If kept in vessels closed by Appert's method, it separates into several strata, but remains unchanged, provided it had been heated for some time to 120° C. (248° F.). Naegeli, and afterward C. Loew (1882), showed that milk preserved at a lower heat gradually becomes intensely bitter and brown, the albuminoids being peptonized and partly converted into leucin, tyrosin, and ammonia, and the milk-sugar into lactose and glucose. More recently, *concentrated* or *condensed milk* has been introduced, which is simply fresh milk mixed with a certain proportion of sugar and evaporated at a low temperature to the consistence of a thick syrup or soft extract, in which condition it will keep well.

Adulteration.—When milk is mixed with water its specific gravity is lowered; skim-milk, on the other hand, has a higher density. To detect adulterations, the quantity of the solids is determined by evaporation to dryness; from this the amount of fat is ascertained by treating with ether or petroleum benzin, and the residue is either incinerated to determine the amount of mineral constituents and estimate the albuminoids and sugar combined by the loss in weight, or the residue insoluble in ether is treated with alcohol and water, which leave casein and dissolve the sugar and salts. Since the milk residue is dried and afterward exhausted with difficulty, some chemists prefer to evaporate the milk mixed with a known quantity of dry sand, calcium sulphate, or similar material.

Various instruments, called *lactometers*, have been constructed with the view of ascertaining rapidly the purity of milk by determining either the density, the degree of opacity, the percentage of cream, or the amount of butter.

Pharmaceutical Uses.—Milk is used in preparing Mistura scammonii, *Br.*, and in the preparation of wheys, which are officinal in several European pharmacopœias.

Serum lactis, Serum lactis dulce.—Whey, *E.;* Petit-lait, *Fr.;* Molken, *G.*—Take of fresh cows' milk 200 parts, rennet wine 1 part; mix and warm to 35° or 40° C. (95° or 104° F.), and after coagulation strain from the curd.

Serum lactis acidum, s. Serum lactis, *F. Cod.*—Acid whey, *E.;* Petit-lait acidule, *Fr.;* Saure Molken, *G.*—Heat fresh cows' milk 100 parts to boiling, add 1 part of potassium bitartrate (or 0.1 part of citric acid dissolved in 1 part of water), and when completely coagulated strain.

Serum lactis aluminatum.—Alum whey, *E.;* Petit-lait alumineux, *Fr.;* Alaunmolken, *G.*—It is prepared like the preceding, except that 1 part of powdered alum is used to effect the coagulation.

Serum lactis tamarindinatum.—Tamarind whey, *E.;* Petit-lait tamariné, *Fr.;* Tamarinden-Molken, *G.*—The coagulation of 100 parts of milk is effected with 4 parts of tamarinds, and the strained whey has a brownish color.

Koumys or Kumiss is fermented mares' milk, which is extensively employed as a beverage and for medicinal purposes by the Kirgheez, Kalmucks, Turkomans, Nogays, and other nomad tribes of the Russian Empire. The process for preparing it differs somewhat with the different tribes, but in all cases consists in inducing fermentation by the addition of yeast to fresh mares' milk, and in stirring this occasionally; the product obtained in about 12 hours is known as *ssaumal* or *staumgal;* on being kept for several days it becomes much stronger, of a more decided acid taste, and very sparkling from the confined carbonic acid gas. For the preparation of koumys from cows' milk the following directions are given by Wilckens (1874): A clean champagne-bottle is filled with the fresh milk, 20 or 30 Gm. of sugar are added, and compressed yeast about the size of two peas; the bottle is well corked, the cork tied securely, and the milk kept in a warm room for 2 days, and frequently shaken during that time; afterward the bottle is placed in an upright position in the cellar, and after 3 more days the koumys is fit for use. The proportions used by Dr. L. Wolff (1880) are: Grape-sugar ½ ounce, water 4 ounces, compressed yeast 20 grains, cows' milk sufficient for a quart champagne-bottle; ferment for 3 or 4 days at 10° C. (50° F.) or less; this koumys will keep 4 or 5 days. According to Jagielski (1874), the fermentation, once started, will continue in corked bottles and at a low temperature, resulting in an increase of alcohol, carbonic acid, and lactic acid; cows' milk is preferable for the preparation of koumys, this being free from disagreeable odor and taste. For special purposes the milk is somewhat diluted before fermentation or the whey only used in making koumys.

Kephir or Kefir is likewise fermented milk, but fermentation is produced by a substance of unknown origin, called kephir-ferment or kephir-seed. This liquid has been long in use by the Caucasian mountaineers. Through an investigation made with the ferment by E. Kern (1881) it became known in Europe, and is now to some extent used medicinally.

Medical History.—In the Hebrew Scriptures milk is constantly referred to for its precious qualities as food, and no more striking figure could be employed to represent the exuberant riches of a country than that it was a "land flowing with milk and honey;" that is to say, suitable for raising herds and grain. Milk is the most essential article of food for man before his teeth are matured for mastication, as well as in that second childhood when "the grinders cease because they are few," especially when it is associated with wine, which is "the milk of old age." Not less does it become the essential and most salutary food of man when at any period of his life he is enfeebled by disease. The qualities that adapt it to these several states or conditions of life are—the facility of eating it, for it requires no mastication; the rapidity of digesting it, since it needs but little change to convert it into assimilable material; and the small amount of waste which it involves and of digestive power which it requires, since the fecal residue of its digestion is less than from any other food.

The ancients used milk from the cow, the camel, the mare, the ass, the goat, and the sheep, and attributed to several of these products special virtues or defects; thus, sheep's milk was considered binding, ass's and goat's milk rather relaxing, and to cow's milk intermediate qualities were ascribed. A full summary of the subject is furnished by Pliny, who represents human milk as the most nutritious, and goat's milk next in strength, and calls to memory the myth that Jupiter was suckled by a goat. The mildest milk, according to Pliny, is the camel's. He very correctly remarks that crude milk is more flatulent and less wholesome than boiled milk. He states that milk is used for all manner of internal inflammations, including those of the kidneys, bladder, bowels, throat, and lungs, and externally for itching and watery eruptions of the skin, and refers to its employment, as Celsus also did, in the cure of phthisis. He speaks of its value in other cachexiæ, and especially of the cure of chronic gout by ass's milk, and also of milk in general in the treatment of dysentery and of poisoning by colchicum, conium, etc. He refers particularly to ass's milk in marasmus and other wasting diseases, and to the use in affections of the spleen of milk from goats that had fed on ivy. He describes the mode of preparing whey, and its uses in epilepsy, melancholy, paralysis, and diseases of the skin. Milk was also applied topically in ophthalmia and in ulcerations of the mouth, throat, and uterus. According to Galen, cows were fed with certain medicinal plants in order to render their milk curative of particular diseases. Arabian physicians used a milk diet in consumption. About the beginning of the eighteenth century the milk treatment enjoyed a great vogue under the influence of F. Hoffmann. Since 1865, when Karell prescribed the systematic use of skim-milk as the sole remedy for various chronic diseases, his method has been adopted by prominent physicians in several countries. The secretion with the milk of various drugs and medicines is a subject of much importance, but cannot occupy us here. (See Stumpf, *Deutsches Archiv für klinische Medicin*, Jan. 18, 1882; Dolan, *Practitioner*, xxvi. 85, 165, 251, 331, 477.)

Medical Action and Uses.—The special action of milk, considered as a therapeutical agent, is that, while it affords sufficient nutriment, it moderates the stimulating action of the blood and restricts the excrementitious waste derived from the food, thereby enabling the organs which are obstructed by blood, by secretions, or by more or less plastic exudations to purge themselves of these hindrances to a free and normal action. In a word, it gives rest, which is the primary condition of cure, and removes hindrances to a return of that functional activity which is an essential condition of health. The milk treatment is essentially a "hunger treatment," and is analogous to that natural and instinctive abstinence from food which is observed in all acute febrile diseases and in the greater number of chronic disorders, and which is the cry of Nature to be let alone—to be spared that officious assiduity which is as mischievous in dietetics as in medicinal therapeutics. This we conceive to be the simple explanation of the curative powers of milk. Dr. S. Weir Mitchell has stated that during the treatment by skim-milk patients always lose weight at first, and that so long as its use is continued uric acid completely disappears from the urine, which becomes pale and whey-like, while the feces grow pale, hard, and odorless. Tortured as it may be by physiological experiment, milk reveals no special action upon this or that organ or anatomical element, but so modifies the whole system as to restore its soundness without the aid of drugs, or else enables them to produce results which without its aid they would have been unable to accomplish. It is perhaps not always remembered that milk and alcohol in the form of "milk punch" contain at once the most perfect nutrient and the most efficient condiment that could possibly be used under the circumstances in which this preparation is usually employed.

Of all forms of food that can be used in *fevers* and *inflammations*, there is no doubt that milk is the best whenever the decline of the fever and the process of wasting have begun. Before this period watery preparations of starchy products, especially of barley and rice, are sufficient, but as soon as tissue-waste shows itself a portion of milk should be added to them, and gradually increased until it forms the principal part of the nourishment or is supplemented by the stimulant operation of beef-tea. In less acute affections, and especially in those attended with suppuration or an excessive discharge of blood, serum, or mucus, nothing so well as milk maintains the strength without tending to excite fever. When inflammatory or ulcerative lesions exist in the stomach or bowels the use of milk can hardly be dispensed with. In *simple gastric ulcer* it is the one remedy which may be depended upon for a permanent cure; and in *cancer* of the stomach or bowels it is infinitely the best palliative, and the only one, by means of which life may with any certainty be prolonged. But in these and similar cases the quantity of the milk employed must be carefully adjusted to the tolerance of the digestive organs, and, if necessary, its retention favored and its assimilation promoted by the addition of lime-water or by preceding the administration of each portion with a dose of bismuth. The same remarks apply to *dysentery*, both in its acute and chronic forms. provided that in the acute disease whey or milk-and-water or buttermilk is employed rather than pure milk. The last is most efficient in the chronic form, if it be administered with a due regard to its tolerance by the patient. In almost all of the gastric disorders in which vomiting depends upon irritability of the stomach lime-water and milk in equal proportions, and in small *doses* at a time, form one of the most efficient remedies. M. Debove has proposed that in order to introduce into the stomach the largest necessary quantity of milk there should be added to the skim-milk to be given a proportion of desiccated milk in pulverulent form, so that the percentage of nutritive matter in the mixture shall be much greater than in milk alone. In not a few cases *albuminuria* due to desquamative nephritis has been cured by the persistent use of an exclusive milk diet. and in others by an association with it of ferruginous-saline mineral waters or of officinal preparations of iron. Even in those less curable cases of interstitial nephritis associated with hepatic and cardiac lesions there can be no doubt that this method tends to remove the dropsy. and at the same time to quiet the morbid violence of the heart's action. while it greatly improves the nutrition of the system. Some years ago several physicians announced the cure of *diabetes* by a milk diet, but longer observation showed that they must have been deceived and that its treatment by milk aggravates the disease. In regard to a milk diet in *chronic diseases of the lungs*, whether tuberculous or bronchitic. with their associated affections pleurisy and emphysema, it suffices to say that. as a rule. it is contraindicated. as affording too little nutriment when there is need of all that can be assimilated. In point of fact, a milk diet, as such, never cured, or even ameliorated. any one of them; but its use has been followed by favorable results, even in consumption. when it has been associated with other favorable hygienic influences, such as a pure, dry atmosphere, active and regular exercise, a complete change in the habits of living, abstention from the use of perturbative drugs, and a nutritious diet fitted to compensate for the defects of the milk regimen in this respect. In almost every cachectic condition milk is the most reliable article of food. Different kinds of milk. and especially ass's and goat's milk, have been reputed to be remedies for consumption and *scrofula*; and beyond a doubt a milk diet, with an appropriate regimen in other respects, is a very efficient means of invigorating the strumous constitution. Lime-water, which has always had a similar reputation, should be associated with the milk. A milk-and-vegetable diet has long been used in the treatment of *epilepsy*, and its operation is intelligible by analogy when we consider that every remedy that has been most useful in this disease. from the time of Aretæus. who declared, "from flesh in particular the patient is to be entirely restricted," down to the introduction of the bromides, has been a sedative of the nervous and circulatory systems. Milk is one of the most convenient and efficient antidotes for nearly all corrsive *poisons*, acids, alkalies, and metallic salts, because with some of them it forms compounds that are not readily soluble, and all of them it envelops in its curd, and thus tends to prevent inflammation or absorption until proper emetics can be administered.

The close analogies of milk and chyle led to the use of the former by its injection into the veins, which was tried by Donné in 1842, and without causing any alarming symptoms. Later it was employed fruitlessly by Bovell and by Herepath in *cholera*, and about 1860 by Hodder of Toronto in a case of complete collapse. in which reaction and recovery followed. Subsequently. Dr. Howe, and then Dr. Thomas of New York. made use of the same method, the one in *phthisis*, the other in *traumatic hæmorrhage*, and in no case did any alarming symptoms arise when the milk employed was perfectly fresh. The latter physician pronounced it a safe and legitimate remedy, expressing his conviction that the intravenous injection of milk will answer nearly as good a purpose as that of blood. and predicting for it a brilliant and useful future. Subsequently, however, Dr. Howe performed a number of experiments upon dogs, depleting the animals, and then injecting into the veins or the arteries a less amount of milk than that of the blood abstracted. Thus he removed by depletion from 8 to 16 ounces of blood, and replaced it with from 6 to 10 ounces of milk. All of the animals died, but two dogs bled in the same manner, and not injected, recovered. Certain experiments of Brown-Séquard proved that much smaller quantities of milk, such as 95 Gm. (℥iij), might, under similar circumstances, be tolerated. Afterward, Wolfsberg found that animals would bear the injection of milk to the extent of three-fourths of 1 per cent. of the quantity of blood abstracted. but that more than this speedily destroyed them. He also was unable to preserve the life of dogs by this treatment; their weight declined, and they died of inanition without obvious disease. Meanwhile, attempts were made to preserve or prolong life by this treatment in patients affected with various diseases by Hunter and Pepper in America and Macdonnell and Meldon in Europe, with results which do not sustain the favorable anticipations referred to above, and which led Dr. Thomas to state that intravenous injection of milk should be used not only in hæmorrhage, but also in Asiatic cholera, pernicious anæmia, typhoid fever, and puerperal convulsions. Dr. Howe, who was the first in this country to employ it, declares not only that his own experience gives him little faith in its utility, but that "it is a dangerous operation, and one that should only be resorted to when blood cannot be obtained." In several cases the patient was attacked with vertigo, dimness of vision, twitching of the eyeballs, and dyspnœa. In other cases it conferred no sensible or lasting advantage, but only postponed the fatal result. Dr. Pepper, who employed it in a case of progressive organic anæmia, effected no material relief, and is of opinion that in cases of intense anæmia connected with serious but curable disease, although doubtless of much service, the severe symptoms following the operation and the possible dangers attending it render it improper to perform it until all other remedies have failed. It is difficult to conceive on what rational grounds such an operation should ever have been undertaken. Its proposers would seem to have considered that the elaborate mechanism provided by nature for the digestion of milk in infancy is useless or superfluous—that the casein which requires the action of the gastric juice, and the butter which needs the bile and pencreatic secretions, to fit them for absorption and nutrition, need not be subjected to any such preparation, but might at once be mixed with the blood and converted directly into tissue! That the water and salts, and possibly even the sugar, may, when so introduced, be capable of sustaining life for a short time, is rendered probable by the results of saline injections into the veins in epidemic cholera; but in regard to milk as a whole experience has confirmed the plainest deductions from physiological law, and proved the operation to be dangerous as well as irrational. These conclusions have been confirmed by the more recent experiments of Moutard-Martin and Richet, and of Demetre Culcer (*Bull. de thérap.*, xcvii. 136; xcviii. 89), who found that death was caused by caseous emboli in the medulla oblongata; and by Béchamp and Baltus, who conclude that the operation cannot form a substitute for the transfusion of blood (*Archives gén.*, Août, 1879, p. 228). It should perhaps be added that Dr. Meldon of Dublin claims to have rescued a phthisical patient from death for at least 6 months by a single intravenous injection of 3½ ounces of milk. He performed the operation, only as a last resort, in ten cases, four of which were cured, and were all of them cases of "pernicious anæmia" (*Med. News and Abstract*, xxxviii. 265). Such a result was unparalleled when it was announced in 1880, and has not been matched since then.

Milk may be used topically as an emollient and demulcent. It is a popular remedy for *ophthalmia* in infants, and especially in nursing infants, to instil the mother's milk in the eyes, and human and warm cow's milk are applied to various local cutaneous inflammations, such as *erythema*, *intertrigo*, *otorrhœa*, etc. A poultice made by stirring breadcrumb in hot milk is in common use to promote suppuration in *abscesses*. If its application is long continued, it is apt to render the skin sodden and wrinkled. It should be prevented from adhering by the addition of a little lard or glycerin.

Administration.—According to Karell, a chief apostle of the "milk cure," it is essential that the patient abstain from all other food but milk, and that he should take it at fixed hours and in determinate quantities. The milk, we are told, must be skimmed, but that degree of exaction is not required by others who employ the method. It should be warmed, not hot, in winter, cool, but not iced, in summer, and should be swallowed by small mouthfuls and slowly. If the stools are consistent, the quantity of milk may be gradually increased until from 4 to 6 pints a day are taken. Almost always a primary effect of the treatment is to produce constipation, which must be overcome by a little castor oil or rhubarb or by a roasted apple or stewed prunes. Sometimes much more energetic modes of treatment are called for. If, on the other hand, the milk food undergoes decomposition, producing flatulence or diarrhœa, a certain proportion of lime-water should be mixed with it, or the milk should not be taken unless it has been boiled. When its use is attended with a coated tongue and dyspeptic symptoms the cause is generally a febrile condition, originating in the imperfectly-digested milk contained in the alimentary canal. If the patient is thirsty, he may drink pure water or carbonated water. Toward the third week of this process, if he grows weary of it, he may be allowed a little stale bread once a day, or grits or other analogous preparations may be added to the milk. To carry out this discipline requires the patient to be endowed with a degree of courage approaching heroism; but in certain cases it brings a due reward: the flesh and strength, which had before been declining under the combined influence of pain, indigestion, and scanty nourishment, begin to improve, and thus persons of resolution are encouraged to endure their martyrdom.

It may be stated here that *condensed milk* is in many cases a valuable substitute for fresh milk in all cases of sickness calling for the use of milk, and especially when good milk cannot be procured from the cow. This is notoriously the case at most of our sea-side resorts, and it occurs also where the drinking-water is unduly mineralized.

SERUM LACTIS, *Whey*. This preparation, which contains little else than sugar of milk and a fractional percentage of salts, and is nutritious chiefly through its watery element, has been used from time immemorial as a drink in fevers. It is agreeable to the taste, or may be rendered so by lemon-juice or by tamarinds, as was the custom in Sydenham's day, and is also more or less diuretic and laxative. Taken copiously and hot, it was at that time the favorite diaphoretic at the commencement of febrile attacks due to cold. When whey is drunk to the extent of a pint or two every day, and for several weeks together, it tends to derange the stomach, impair the appetite, and produce diarrhœa, and is therefore improper in all chronic diseases in which the digestive organs are already enfeebled. On the other hand, it may, as far as it goes, prove useful in chronic blood disorders like *gout*, *rheumatism*, and *gravel*, with congestion of the brain or of the portal circulation, owing to its depurative and somewhat diuretic qualities, which it owes to the salts which it contains. But in Germany, where alone the "whey cure" is systematically employed, it is pursued in localities in which pure air and exercise and the various food, to say nothing of the mineral waters usually taken at the same time, doubtless have much more to do with the cure of disease than the systematic drinking of whey. *Wine-whey* is made by adding to a pint of milk, at a boiling heat, from 2 to 8 ounces of sherry wine, straining off the whey, and sweetening it. It is a mildly stimulant and nutritive drink, much used in the *typhoid state* of febrile diseases.

BUTTERMILK, or the thin sour milk separated from the cream by churning, contains casein, but very little butter. Even by many persons in health it is considered a most refreshing drink, and there is no form of *fever* in which it is not apt to be relished, probably on account of its acidulous taste. It is one of the very best remedies that can be employed in acute and even in chronic *dysentery*, promptly allaying the tenesmus and modifying the bloody and mucous stools of the acute form, and lessening the frequency of the evacuations in the chronic disease. Its effects in *typhoid fever* are scarcely less striking. It renders the discharges less numerous and moderates the tympanites. It should be given in doses of from 2 to 4 ounces every three or four hours, and always as fresh as possible.

KOUMYS is a drink imitated from the Tartars, and which may be considered a peculiar form of milk punch, since it contains the saline and protein constituents along with the sugar, fat, and lactic acid of the milk, together with carbonic acid and alcohol, the latter constituents varying with the time employed in the fermentation. It is therefore a nourishing and stimulating drink, sometimes even an intoxicating one, since the longer it is kept the more alcohol it contains. One analysis states that at the end of 16 days it yields upward of 20 parts of alcohol in 1000. The effects of drinking 2 or 3 glasses of koumys are identical with those of alcohol—a general diffusive glow, a quickening of the pulse, a pleasurable excitement of mind and body. Like alcohol, indulged in overmuch it impairs the appetite for food, tends to constipate the bowels, renders one dull and sleepy, and augments the urinary solids. Moderately used, it promotes digestion and nutrition, or at least increases the weight by augmenting the fat, precisely like milk punch. Like that familiar drink, it is of more or less use in various wasting diseases, including *consumption* and *nervous exhaustion*, chronic *dyspeptic* disorders, chronic *diarrhœa*, *anæmia*, *chlorosis*, *malarial cachexiæ*, etc. In the 2d edition of the Dispensatory we made use of the following words: "It is not to be wondered at that in Germany a counterfeit koumys is prepared with milk, lemon, and rum. There is good reason to fear that the general fondness for sparkling wines and other effervescing drinks may tend to render fashionable a draught which, under the disguise of a medicine, partakes more or less of their intoxicating qualities, and may become the prime cause of a baleful habit of intoxication. There is much danger also lest its votaries overlook the essential conditions of its utility—active exercise in the open air and those other hygienic measures upon which the utility of alcohol and other hydrocarbons in all chronic wasting diseases essentially depends." More recently, as we learn from Stange (*Von Ziemssen's Handbuch der allgemeine Therapie*, 1883, i. 403), "favorable results from the koumys treatment can be expected only in the steppes of Russia, where not only is the preparation properly made, but a dry, hot climate exists, which is essential to the success of the method. The proper koumys can only be prepared from the milk of a special race of mares fed on the peculiar grasses of the steppes alone and subjected to no labor." And Dr. Carrick of St. Petersburg stated to the Medico-Chirurgical Society of Edinburgh that "the best effect of the koumys cure was to be got not only by taking the remedy itself, but by going to the Russian steppes to partake of it there" (*Edinb. Med. Jour.*, xxvii. 167).

LACCA.—Lac.

Resina (Gummi) lacca.—Laque, Gomme lacque, Fr.; *Lack, Gummilack*, G.

A resinous exudation produced by the puncture of Coccus Lacca, *Kerr.*

Origin.—The hemipterous insects thus named congregate in large numbers upon the tender branchlets of various East Indian (mostly laticiferous) trees, and become surrounded with the resinous exudation, which gradually hardens. The impregnated, much-enlarged female insects, imbedded in the resin, contain a red coloring matter, in which the young larvæ are developed. These finally eat a passage through the incrustating material and escape. The branches are collected with the incrustation, which is considered more valuable if still containing the red coloring matter. Among the trees yielding lac are the following: Aleurites laccifera, *Willdenow* (Croton, *Linné*) (Nat. Ord. Euphorbiaceæ); Ficus indica, *Roxburgh*, F. bengalensis, *Linné*, F. religiosa, *Linné*, F. Tsjela, *Hamilton* (Nat. Ord. Urticaceæ); Schleichera trijuga, *Willdenow* (Nat. Ord. Sapindaceæ); Butea frondosa, *Roxburgh*, s. Erythrina monosperma, *Lamarck* (Nat. Ord. Leguminosæ). According to Stillman (1880), lac may also be collected from Acacia Greggii, *Gray*, and from the *creasote-bush* or *stinkweed*, Larrea mexicana, *Moricand*, s. L. glutinosa, *Engelmann*, which plants grow from Western Texas to Mexico and Southern California.

Description.—The thin branches, almost completely covered with numerous small resin-nodules, constitute the *stick-lac.* The separate nodules or tears are red-brown, and contain in the interior a dark blackish-red powder; after the escape of the young insects the resin is brown. The same resin, after having been detached from the twigs, constitutes the *seed-lac* or *grain-lac.* It is in irregular fragments of the size of a pea and smaller, yellowish-brown or reddish, somewhat shiny, and nearly tasteless. After boiling the stick-lac or seed-lac with water, fusing the resin, and congealing it upon a smooth surface, *shellac* is obtained; it comes in thin, glossy, and more or less transparent fragments. Sometimes *grape-lac* and *lump-lac* have been distinguished, the former of which consists of agglutinated incrustations separated from the twigs; the latter is identical with shellac, except that it has not been congealed in thin layers. When chewed, stick-lac softens and colors the saliva purplish-red, a slight bitterish and astringent taste being perceived; when burned, it gives off a strong and agreeable odor. The water in which red stick-lac has been boiled on being treated with alum yields *lac-dye.*

Shellac is soluble in potassa, soda, borax, and hydrochloric and acetic acids, and when digested with ammonia in close vessels swells to a gelatinous mass. By treating the alkaline solution with chlorine or sulphurous acid bleached shellac is obtained.

In the year 1876–77 the importation of stick- and seed-lac amounted to 47,000 pounds, and of lac-dye to 454,781 pounds. In 1882 nearly 3,250,000 pounds of shellac and about 40,000 pounds of lac-dye were imported.

Constituents.—Lac is a complex body, containing, according to Unverdorben, five distinct resins, besides wax, fat, and coloring and extractive matter. The resins which may be separated by their different behavior to alcohol, ether, and alkalies are present in seed-lac, according to Hatchett and John, to the amount of 66 or 68 per cent., but shellac contains fully 90 per cent. of resin. The wax has been found to vary in amount between about 2 and 6 per cent.

Uses.—Shellac is used in the preparation of *varnish* and of *sealing-wax*, the latter by fusing from 5 to 8 parts of it with 1 part of turpentine and coloring the mixture with a suitable pigment. *Varnish* suitable for blackboards is made by digesting and intimately mixing shellac, mastic, sandarac, white turpentine, emery-flour, and lampblack, of each 1 ounce, and alcohol 2 pints. A solution, made without heat, of 1 part of powdered bleached shellac in 2 or 3 parts of a saturated solution of borax is recommended by Geissler (1880) as an excellent *starch-gloss*, also as a *varnish* for maps and prints. An *ink* useful for laboratory purposes is obtained by mixing lampblack with a solution of 100 grains of shellac and 20 grains of borax in 4 ounces of water.

Medical Action and Uses.—Having in a slight degree some of the qualities of the resins, lac has been used in combination with astringents as an application to indolent *ulcers*, especially of a scrofulous and scorbutic sort. It is rarely employed in medicine.

LACMUS.—LITMUS.

Lacca cœrulea, Lacca musica.—Tournesol, Laque bleu, Fr.; *Lackmus,* G.

A blue pigment obtained from Lecanora tartarea, *Acharius,* Roccella tinctoria, *Ach.,* R. fusiformis, *Ach.,* and from other lichens.

Preparation.—The lichens are powdered, mixed with some potash and urine or other ammoniacal liquid, and exposed to the air. The liquid acquires a red, purple, and finally blue color, and is mixed with sufficient chalk to be formed into small rectangular cakes. It is manufactured in Holland.

Description.—Litmus is in earthy, friable cakes of a deep-blue or purplish-blue color and a slight saline and somewhat pungent taste. It effervesces with acids, and is partly soluble in water with a blue, and in dilute alcohol with a purplish-blue, color, which is changed to red by acids.

Constituents.—Besides the earthy matter, Kane (1841) separated from litmus four coloring matters—namely, *erythrolein,* a purplish-red fatty matter, soluble in ether, fusible at 38° C. (100° F.), and yielding with ammonia a purple-colored solution; *erythrolitmin,* red, crystalline, insoluble in ether, soluble in alcohol, and changed to blue by alkalies; *azolitmin,* brown-red, amorphous, insoluble in alcohol, turned blue by ammonia; and *spaniolitmin,* present in minute quantity only, light-red, soluble in water.

Pharmaceutical Uses.—Litmus is employed as a reagent for acids and alkalies. Litmus-paper is made by making a strong aqueous solution of the coloring matter (*tincture of litmus*), and dipping white unsized paper into it. To make *red litmus-paper,* dilute hydrochloric acid is carefully added to the blue solution until the color has just changed to red, carefully avoiding excess of the acid. When litmus is used for testing by gaslight the change of color is best observed through a green glass. By treating litmus with alcohol, afterward with water, purifying the aqueous extract with alcohol acidulated with acetic acid, and removing every trace of the acid by dissolving in water and evaporating repeatedly with alcohol, nearly pure brown-red azolitmin is obtained, from which test-paper extremely sensitive to both acids and alkalies may be prepared.

Allied Pigments.—Archil or orchil, *E.,* Orseille, *Fr., G.,* is made from the same lichens which yield litmus. The lichens are heated for a week with diluted ammonia, when sulphuric acid and table-salt are added. Archil is a pasty mass of a deep-purple color.

Cudbear, *E.,* Orseille de terre, *Fr.,* Persio, *G.,* is made in precisely the same manner, except that, instead of adding acid and salt, the mixture is dried and powdered.

The lichens which are used for the production of the above pigments contain a number of chromogenes, which are ternary compounds, and in the presence of water and ammonia are converted into various nitrogenated red pigments. The most important of these chromogenes, as far as they have been investigated, are—*erythric acid,* $C_{20}H_{22}O_{20}$, *alphaorsellic acid,* $C_{32}H_{28}O_{14}$, *betaorsellic acid,* $C_{34}H_{32}O_{15}$, and *evernic acid,* $C_{34}H_{32}O_{14}$. On being boiled for a long time with water or baryta they yield *lecanoric acid,* $C_{16}H_{14}O_7$, afterward *orsellic acid,* $C_8H_8O_4$, and finally *orcin,* $C_7H_8O_2$, which crystallizes in large colorless needles, has a sweet taste, turns red in contact with air, and yields with ammonia *orcein,* $C_7H_7NO_3$; this is brown, and dissolves in alkalies with a beautiful red color. Orcin is also obtained from aloes by fusing it with caustic potassa.

Medical Uses.—The only use of litmus in medicine is to determine the acidity or alkalinity of the animal fluids. Litmus-paper is a necessary adjunct of all apparatus for examining the urine.

LACTUCA, *Br.*—LETTUCE.

Herba lactucæ; Herba lactucæ virosæ.—Laitue vireuse, Fr.; *Giftlattich,* G.

The flowering herb of Lactuca virosa, *Linné.* Woodville, *Med. Bot.,* t. 31; Bentley and Trimen, *Med. Plants,* 160, 161.

Nat. Ord.—Compositæ, Ligulifloræ.

Description.—This biennial herb, which grows to the height of 3 to 6 feet (.9–1.8 M.), has a cylindrical, somewhat prickly, pale-green, and often purplish-spotted stem. The large radical leaves are petiolate, obovate-oblong, obtuse, irregularly spinously toothed, wavy or nearly entire at the margin, pale-green beneath, and prickly on the midrib. The stem-leaves are smaller, alternate, horizontal, sessile, with a sagittate amplexicaul base and an acute spinous apex, otherwise resembling the radical leaves, the floral ones reduced to small pointed bracts. The flower-heads form a loose terminal panicle and are on short axillary peduncles; the involucre is oblong or conical, and composed of imbricated lanceolate bracts in about three rows; the florets are neutral, pale-yellow, ligulate; the akenes are oval, flattened, black, and prolonged into a long whitish beak, bearing at its apex a pappus consisting of numerous soft white capillary bristles. The plant has a disagreeable rather narcotic odor and a bitter and saline taste.

It is indigenous to Western and Southern Europe, is less frequent in Central Europe, and has been naturalized in some parts of New England. It is closely allied to L. Scariola, *Linné*, which is indigenous to Europe, but is found more frequently in the central part, and is distinguished from the preceding mainly by its spinescent, deeply-cut, toothed or pinnatifid vertical leaves, but possesses the same disagreeable odor and taste, though in a rather milder degree.

Constituents.—The older analyses by Pfaff, Dublanc, and others have demonstrated the presence of principles common in herbs; among the inorganic constituents potassium nitrate was found by Pfaff and Bley. More recently, the investigations have been confined to lactucarium, which is partly obtained from this plant.

Off. Prep.—Extractum lactucæ, *Br.*

Medical Action and Uses.—The ancients ascribed to strong-scented lettuce soporific and anaphrodisiac properties, and its juice was even used by them for adulterating opium. It was held to be peculiarly adapted to allay wakefulness produced by overstimulation of the mind. Whatever may have been the virtues of lettuce in ancient Greece, they are certainly very faintly represented by the plant which grows in this country and in Western Europe. They are contained in their most concentrated and available form in lactucarium.

LACTUCARIUM, *U. S., P. G.*—Lactucarium.

Lactucarium, Fr., G.; *Giftlattichsaft*, G.

The concrete milk-juice of Lactuca virosa, *Linné*, obtained by incision and spontaneous evaporation.

Origin and Collection.—Lactuca virosa and L. Scariola, *Linné*, have been described above. L. sativa, *Linné*, is the common garden lettuce. L. altissima, *Bieberstein*, a tall Caucasian herb, is cultivated in Auvergne in France for lactucarium; Planchon regards it as a variety of L. Scariola, *Linné.* We prepared (1867) very efficient lactucarium from several varieties of L. canadensis, *Linné*, of this country, but found the milky juice, which yielded from 22 to 32 per cent. of air-dry residue, to congeal rapidly and to dry into irregular tears. Commerce is supplied with lactucarium almost exclusively from Germany and Great Britain from plants cultivated for the purpose; a small quantity is also produced in Austria. Thomas Fairgrieve, who described the preparation in 1873, states that he cultivates L. virosa, var. montana. The collection of the milky juice is commenced about the middle of July or beginning of August, when the flowers are just appearing, and is continued for 6 or 8 weeks (until the latter part of September). The collectors proceed over the field, cutting the head of each stalk and scraping the juice into their vessels, one person who cuts being followed by two who collect the juice. This process is repeated six or seven times a day, a new cut being made each time a little lower down the stalk. In the evening, when the juice has thickened into a viscous mass, it is turned out of the vessels, suitably divided, and dried by the aid of heat, about 5 days being required for it.

In Germany, near the town of Zell on the Mosel, the collection lasts from May to September; the milky juice is taken up by the finger and transferred to hemispherical earthen cups, in which it quickly hardens, so that it can be turned out. It is then dried in the sunshine until it can be cut into four pieces, when the drying is completed by exposure to the air for some weeks on frames (*Pharmacographia*).

The lactucarium prepared in France by Aubergier is rarely if ever met with in this country. Fairgrieve obtained 1 pound of lactucarium from 4 pounds of juice, and estimates the average yield of each plant to be between 40 and 50 grains. By frequently puncturing the stems, Schütz (1823) obtained from L. sativa, scariola, and virosa, respectively, 17, 25, and 56 grains of lactucarium. The extract of lettuce-leaves was medicinally employed by Dr. H. J. Collin of Vienna (1780), but lactucarium was first introduced into medicine by Dr. J. R. Coxe of Philadelphia (1799).

Description.—German lactucarium generally comes in sections of plano-convex circular cakes which are of a gray-brown color externally, usually white or yellowish, and of a waxy lustre internally. English or Scotch lactucarium is met with in irregular-sized angular pieces of a brown color and earthy appearance. Both kinds have a strongly bitter taste and a strong narcotic odor, suggesting that of opium; they are powdered with difficulty, and on trituration with water are not emulsionized except after the addition of gum-arabic. When lactucarium is prescribed in mixtures, A. Vogeler (1881) recommends triturating it with a little spirit of nitrous ether before adding the water, when it is readily divided in the liquid.

What is usually sold here as French lactucarium is Extractum Lactucæ (see p. 644).

Tests.—Lactucarium on being treated with boiling water should become soft without melting, and yield a bitter filtrate, which while hot should be clear, and on cooling become turbid; this liquid should not be colored blue by iodine (absence of starch), but should become clear on the addition of ammonia or of alcohol; the ammoniacal liquid should yield a copious precipitate with solution of calcium sulphate (presence of oxalic acid), and the alcoholic solution should not be affected by ferric chloride (absence of tannin, etc.)—*P. G.*

Constituents.—Lactucarium has been analyzed by Walz (1840), Aubergier (1842), Wackenroder (1844), Lenoir (1847), Ludwig (1847), Kromayer (1861), and O. Schmidt (1875, 1879). Nearly one-half the weight of lactucarium is soluble in alcohol, but dilute alcohol dissolves only between 36 and 44 per cent. 50 to 60 per cent. of lactucarium consists of *lactucerin* or *lactucon*, $C_{16}H_{26}O$, which was obtained crystallized by Lenoir (1847) by exhausting lactucarium with boiling alcohol and recrystallizing the product; it forms thin colorless needles, which are inodorous and tasteless, insoluble in water, soluble in alcohol, and more freely so in ether, chloroform, benzin, and fixed and volatile oils; it appears to vary somewhat in different lactucariums. The bitter taste of lactucarium is due to three principles, two of which are usually amorphous and freely soluble in water, while the crystallizable *lactucin*, $C_{11}H_{12}O_3.H_2O$, requires over 60 parts of cold water for solution, but dissolves more readily in hot water and in alcohol. Kromayer (1861) obtained only 0.3 per cent., which does not perhaps represent the whole amount present, but the much larger yields (18 to 28 per cent.) previously observed by Buchner and Ludwig must be due to impurities. Lactucin forms pearly scales or rhombic plates when crystallized from very dilute alcohol, has a neutral reaction, turns red and brown with alkalies, and is deprived of bitter taste; it is not a glucoside, but reduces from alkaline cupric solutions cuprous oxide. *Lactucic acid* and *lactucopicrin* have been found in the mother-liquor of lactucin; the former is light-yellow, amorphous, crystallizes on long standing, is colored red by alkalies, reduces alkaline copper solutions, is precipitated by lead subacetate, and is insoluble in carbon disulphide, petroleum benzin, ether, and chloroform. Lactucopicrin is brown, amorphous, insoluble in ether, soluble in alcohol, not precipitated by subacetate of lead, and appears to be produced by oxidation of lactucin.

The other constituents of lactucarium which have been observed by different investigators are—a trace of volatile oil, asparagin, mannit, sugar, albumen, gum, caoutchouc, resin, oxalic, citric, and malic acids, and between 8 and 10 per cent. of ash. Flückiger obtained from German lactucarium, by means of carbon disulphide, an amorphous mass which is fusible below 100° C. and separates from alcohol as a syrupy liquid.

Hiland Flowers (1879) noticed that the milk-juice of L. canadensis does not possess a bitter taste until the plant is in bloom, when the lactucarium collected from it has the same constituents as European lactucarium.

Off. Prep.—Extract. lactucarii fluid., Syrupus lactucarii, *U. S.*

Medical Action and Uses.—The utility of retaining lactucarium as an officinal medicine is very doubtful. It may possibly be desirable as a hypnotic for very impressionable persons, with whom faith in a remedy supplies its want of intrinsic efficiency. If it have any virtues of the sort ascribed to it, they would peculiarly adapt it to cases of infantile disease. The *dose* of lactucarium is indefinite. 2 grains (Gm. 0.10) may be given to an infant.

Lamellæ, *Br.* (see page 1661).

LAMINARIA, *P. G.*—Laminaria.

Laminaire digitée, Fr.; *Laminaria, Riementang*, G.

Laminaria Cloustoni, *Edmonston*, s. L. digitata, *Lamouroux*.
Nat. Ord.—Algæ, Fucoideæ.

Origin.—The Linnæan name, Laminaria digitata, has, according to Ferd. Cohn (1864), been applied to two different Algæ which are found in the North Atlantic Ocean. Laminaria flexicaulis, *Le Jolis* (s. L. stenophylla, *Harvey*), has a glossy, dark-brown, flexible stem, which on drying becomes thin like a fibre. Laminaria Cloustoni, however, has an erect, rigid, light-brown stem, 3 to 6 feet (0.9–1.8 M.) long, at the base 2 inches (5 Cm.) thick, divided below into spreading root-like branches, and at the apex prolonged into a flat and digitately divided frond which is 3 to 5 feet (0.9–1.5 M.) long, 1 to 3 feet (30–90 Cm.) broad, leathery, and olive-green. The plant grows upon rocks at a depth of 10 to 15 fathoms in the Atlantic and Pacific Oceans and northward in the Arctic Sea. The lower cylindrical portion only is employed.

Description.—Laminaria is met with in commerce in irregular cylindrical pieces, which are ½ inch (12 Mm.) or less thick, deeply wrinkled, of a brown or gray-brown color externally, lighter and darker brown internally, of a horn-like texture, and breaking with a smooth and horny fracture. Immersed in water, it becomes softer and swells to from four to six times its usual diameter. Two layers are readily distinguished, the central one being whitish and composed of large cells, while the outer one is formed of smaller cells, has a brownish color, and contains a zone of axially somewhat elongated large mucilage-cells. For medical use it is turned into cylindrical or conical pieces.

Constituents.—Laminaria contains the usual constituents of marine Algæ. (See CHONDRUS.) Stenhouse isolated from it mannit.

Allied Plants.—LAMINARIA SACCHARINA, *Lamouroux*, has a flattish stem and linear or oblong entire fronds. After having been washed with water it acquires a sweet taste, and, like Lam. esculenta, *Lamouroux*, is eaten. The ash of all these species is used for obtaining iodine.

For some years past the soft root of one or two species of *tupelo*, *Nyssa* (Nat. Ord. Cornaceæ), has been used in Europe for tents. The species adapted for this purpose are Nyssa grandidentata, *Michaux filius*, and N. capitata, *Walter* (N. candicans, *Michaux*); both grow in the Southern United States not far from the sea-coast. The first species is known as *cotton-gum*, *large tupelo*, and, in Louisiana, *olivier à larges feuilles;* the second species is called *tupelo-gum*, *sour-gum*, and *Ogeechee lime*. The wood is light, white, of a spongy texture, and when dry swells to about double its usual thickness from the absorption of water.

Medical Action and Uses.—The porosity of its stalks and the quality they possess, when dried, of absorbing water, and thereby increasing in bulk even as much as fourfold, have rendered laminaria a very convenient substitute for compressed sponge. The following summary of the qualities of sea-weed tents, applied particularly to the uterus, was made by Dr. J. Braxton Hicks: 1, they may be made of any size, but much smaller than sponge tents; 2, they have more distending power; 3, they do not retain the secretions so as to produce much offensiveness; 4, by their greater rigidity they can be more readily applied, especially in a tortuous canal. On the other hand, their rigidity makes them less suitable in cases where the uterus readily bleeds or is very tender, and in cases where the os is somewhat dilated by a polypus or growth distending it. For *dilatation of the os uteri* in a natural state, and for the induction of premature labor, these tents are less suitable than sponge tents or the India-rubber bag. In cleanliness, certainty of action, ease of introduction, and small size they are not equalled by those made of any other material. By fastening several together the physician is enabled to effect any degree of dilatation he may desire. They are, however, no less likely than other uterine tents to produce metritis. According to Landau, the *tupelo* tents recommended by Tiemann are superior to any other for the same reasons above assigned in favor of laminaria tents (*Times and Gaz.*, Mar. 1881, p. 327). Bougies of laminaria have been employed to dilate *strictures* of the *urethra*. For this purpose they were covered with several coats of varnish or with glycerin before introduction, and allowed to remain in place for several hours. Similar instruments have been made use of for dilating the Eustachian tube.

LAPPA, *U. S.*—BURDOCK.

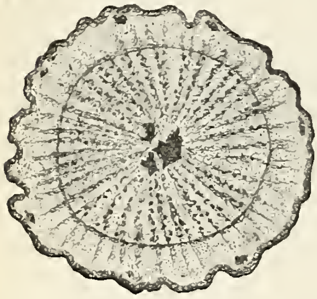
Radix bardanæ.—Bardane, *Glouteron*, Fr.; *Klettenwurzel*, G.

The root of Lappa officinalis, *Allioni* (Arctium Lappa, *Linné*, A. majus, tomentosum, and minus, *Schkuhr*.).

Nat. Ord.—Compositæ, Cynareæ.

Origin.—We follow Gray in uniting the three forms, which are often regarded as distinct, and described as Lappa major, *Gaertner*, L. tomentosa, *Lamarck*, and L. minor *De Candolle*. They are found in waste places and along roadsides in Northern Asia and throughout Europe, and have been naturalized in North America, where the variety major is more frequently met with than the others. They are coarse-looking biennial weeds, with branching stems 2 to 4 or 6 feet (.6, 1.2, or 1.8 M.) high, and cordate-oblong, nearly entire or toothed, rough, petiolate leaves. The globose involucre has the numerous scales appressed at the base and contracted to a recurved sharp point above. The numerous tubular florets are purplish, or, rarely, whitish; the akenes are flattened and have a pappus of numerous short bristles. The variety major has rather large heads with a smoothish involucre; var. tomentosa has the involucre and peduncles woolly; var. minor has the heads much smaller, the involucre at first cottony, finally smooth, and the leaves usually unequally rounded or tapering at base. They bloom from July to September. The root should be collected in the autumn of the first year's growth or early in the succeeding spring; 6 or 7 parts of the fresh yield 1 part of air-dry root.

Fig. 171.



Burdock-Root: transverse section.

Description.—The root is nearly simple, 10 to 18 inches (25–45 Cm.) long, about 1 inch (25 Mm.) thick, fusiform, gradually tapering, fleshy, and when dry longitudinally wrinkled, rounded at the top, and often with a tuft of white, soft-hairy leaf-stalks. It has a grayish-brown color externally, pale-brownish internally, the cross-section displaying a thickish bark, which in the inner layer is radially striate and by a dark cambium-line separated from the meditullium; this is about four times thicker, has finely porous ligneous rays, and the medullary rays of about the same width. The latter, as well as the parenchyma of the bark, are frequently partly destroyed, leaving merely the white dead tissue, which is spongy and full of holes. Burdock has a rather disagreeable but weak odor, and a mucilaginous afterward sweetish and bitterish taste.

Constituents.—Burdock-root is free from starch, but contains in its stead *inulin*. (See INULA.) Mucilage, sugar, a bitter principle, a little resin, and some tannin have been observed in it.

Allied Drugs.—FRUCTUS LAPPÆ, S. SEMEN BARDANÆ. Burdock-fruit is about ¼ inch (6 Mm.) long, obovate-oblong, somewhat curved, angular, and flattened, roughish wrinkled, brown-gray mottled with black, mostly deprived of the setaceous pappus, the short base of the style projecting from the centre of the apical scar; inodorous; taste oily and bitter. The bitter principle has not been isolated. *Tinctura lappæ fructus* has been proposed to be made from 4 troyounces of the ground fruit by percolating with a mixture of alcohol 3 parts and water 1 part until a pint of percolate is obtained.

FRUCTUS SILYBI, S. SEMEN CARDUI MARIÆ.—Mary thistle, *E.*; Chardon Marie, *Fr.*; Stechkörner, Frauendistel, *G.*—from Silybum marianum, *Gaertner*, s. Carduus marianus, *Linné*, a syngenesious biennial of Southern Europe. The akenes are ⅙ or ⅕ inch (4 or 5 Mm.) long, not curved, obovate, flattened, smooth, glossy, light-brown with black or blackish striæ, oblique at the apex, and crowned by a yellowish margin, from the centre of which the base of the style projects; inodorous; taste mucilaginous, oily, and somewhat bitter.

Medical Action and Uses.—Burdock has had the reputation in Europe and in this country of being a depurative through its diaphoretic and diuretic virtues, and by a gradual and insensible modification of nutrition. It has been in vogue for the cure of *rheumatism*, *gout*, chronic *cutaneous diseases*, and chronic *pulmonary catarrhs*; it has been reputed to be diuretic (especially its seeds), and to promote the discharge of *urinary deposits*; to be alterative also, and beneficial in constitutional *syphilis* and *scrofula*. These virtues, if they are real, would indicate that the medicine operates by promoting all the secretions, much as sarsaparilla is supposed to do. But, like that medicine, burdock is seldom given unless associated with more active agents. Externally, the expressed juice of the leaves, the fresh leaves bruised, and liniments made by boiling the leaves or the roots with oil have been much used as popular remedies for *burns*, *wounds*, *ulcers*, and *eruptions*. Although an agent of secondary value, it is not quite just, as has been done, to call it "one of the illusions of the materia medica." Burdock is generally given in a decoction prepared by boiling 2 ounces of the recent bruised root in 3 pints of water (Gm. 64 in Gm. 1500) to 2 pints. At least a pint (Gm. 500) of this decoction should be taken daily. Possibly the concentrated syrup or fluid extract, equally diluted, would answer quite as well. According to Dr. Squibb, a tincture made with 1 pound of the ground seed to a gallon of whisky, and allowed to stand for 2 weeks before decanting, may be taken in *doses* of 2 or 3 teaspoonfuls immediately after meals. He cites a case in which a similar preparation cured an inveterate *psoriasis* (*Ephemeris*, Sept. 1882, p. 115).

LARICIS CORTEX, *Br.*—LARCH-BARK.

Ecorce de mélèze, Fr.; *Lärchenrinde*, G.

The bark, deprived of its outer layer, of Larix europæa, *De Candolle* (Abies Larix, *Richard*, Pinus Larix, *Linné*).

Nat. Ord.—Coniferæ, Abietineæ.

Origin.—The European larch is a forest tree of Southern and Central Europe, where it grows chiefly in mountainous localities up to an altitude of about 5000 feet (1500 M.). It is often cultivated in Europe, and has been introduced into North America as an ornamental tree. It attains a height of 80 to 100 feet (24–30 M.), has the narrow linear deciduous leaves in fascicles of twenty to forty, and oblong ovoid erect cones which are about 1 inch (25 Mm.) long. The bark is collected from the trunk and the branches.

Description.—The bark has a brown-gray, or when older a reddish-brown, fissured, corky layer, which is to be removed. The liber has a reddish or pinkish hue; the inner surface is smooth, of a yellowish or pale-brown color. It breaks with a short somewhat fibrous fracture, displaying rather indistinct medullary rays and some resin-ducts. Larch-bark has an agreeable terebinthinate odor and a balsamic and astringent taste.

Constituents.—Stenhouse (1861) found larch-bark to contain a good deal of peculiar *tannin*, which yields olive-green precipitates with salts of iron, turns red on being boiled with dilute sulphuric acid, but does not yield any *sugar*, which, however, is contained in the decoction of the bark, together with a considerable quantity of *mucilage* and *resinous matter*. He obtained also a volatile acid by evaporating the warm infusion of the bark to a syrupy consistence and then distilling it. The *larixinic acid*, $C_{10}H_{10}O_5$, crystallizes partly in the neck of the retort; the remainder is obtained by carefully concentrating the distillate and purifying the product by sublimation. The bark of the branches and of trees not over 30 years old yields the largest proportion. It forms long colorless crystals resembling those of benzoic acid, sublimes at 93° C. (199.4° F), fuses at 150° C. (302° F.), and has a bitterish and astringent taste and a camphoraceous odor. Its combinations with alkalies are red-brown and decomposed by carbonic acid; baryta solution causes a bulky precipitate; ferric salts produce a purple color, and on boiling it with silver salts the metal is separated; nitric acid oxidizes it to oxalic acid. It is sparingly soluble in ether and freely soluble in alcohol and hot water. It is allied to pyrogallic acid and pyrocatechin.

Other Products of the Larch are Venice turpentine and Briançon manna.

The bark of the American larch, Larix americana, *Michaux*, which is more slender and has shorter leaves and smaller cones, deserves to be investigated.

Off. Prep.—Tinctura laricis, *Br.*

Medical Action and Uses.—Its action does not differ from that of other terebinthinate and balsamic remedies, but its flavor is less disagreeable. With the inner bark a saturated tincture has been prepared, and highly recommended in *chronic bronchitis* and in chronic inflammation of the *urinary* mucous membrane. It has also been used in *purpura hæmorrhagica*. The *dose* of the tincture is from 20 to 30 minims (Gm. 1.30–2).

LAUROCERASI FOLIA, *Br.*—CHERRY-LAUREL LEAVES.

Folia laurocerasi.—Feuilles de laurier-cerise, Fr.; *Kirschlorbeerblätter*, G.

The fresh leaves of Prunus Laurocerasus, *Linné* (Cerasus Laurocerasus, *Loiseleur*). Steph. and Church, *Med. Bot.*, plate 117; Bentley and Trimen, *Med. Plants*, 98.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The cherry-laurel is a small evergreen tree, or is frequently a shrub 15 to 20 feet (4.5–6 M.) high, with a smooth brownish bark and pale-green branches, and produces pendulous racemes of dark-purple, shining, cherry-like drupes. It is a native of Western Asia from Northern Persia to Asia Minor, but it has been naturalized in Southern Europe, and is cultivated in the open air as an ornamental shrub northward to Southern Germany and England.

Description.—The leaves are leathery, glossy, and dark-green above, pale-green beneath, oblong in outline, narrowed above to an obtuse point and below to a short petiole. They are about 4 to 6 inches (10–15 Cm.) long and 1½ to 2½ inches (38–62 Mm.) wide, somewhat revolute on the margin, with distant and small but sharp serratures. The midrib is quite prominent on the lower surface, and has near its base one or two pairs of depressed glands. The unbroken fresh leaves are inodorous, but when broken they have a strong bitter-almond odor; their taste is aromatic, bitter, and somewhat astringent.

Constituents.—Cherry-laurel leaves contain some sugar, tannin, wax, fat, and, according to Stange (1823), an acid allied to, if not identical with, malic acid. The same author recognized also the production of *benzoic acid* from the volatile oil in the presence of oxygen. Liebig and Wöhler did not succeed in isolating amygdalin, from which they suppose the volatile oil to be derived. F. L. Winckler (1839) obtained the bitter principle as a soft, transparent, wine-yellow mass, which, when treated with dilute sulphuric acid and manganic binoxide, yielded a distillate of a very agreeable odor which did not contain hydrocyanic acid. When treated with emulsion of sweet almonds the taste became gradually less bitter, and the odor of bitter almonds became afterward apparent. It seems, therefore, as if the leaves contained a compound from which amygdalin must be first produced before the volatile oil can be obtained, which has the same composition as oil of bitter almonds. Broeker (1867) observed that the watery distillate is strongest in hydrocyanic acid if the leaves were collected in the summer. Schoonbroodt (1869) obtained from the aqueous extract, on treatment with ether, some bitter crystals which reduced cupric oxide.

Off. Prep.—Aqua laurocerasi, *Br.*

Medical Action and Uses.—Cherry-laurel leaves are officinal in the British Pharmacopœia, chiefly as the source from which cherry-laurel water is obtained. Their medicinal virtues depend upon the hydrocyanic acid which they furnish, and are treated of under Aqua Laurocerasi and Acidum Hydrocyanicum. The bruised fresh leaves are used as anodyne applications to *painful parts.*

LAURUS.—Laurel.

Bay, *Sweet bay*, E.; *Laurier commun*, Fr.; *Lorbeer*, G.

European pharmacopœias recognize the leaves, fruit, and expressed oil of Laurus nobilis, *Linné.* Bentley and Trimen, *Med. Plants*, 221.

Nat. Ord.—Lauraceæ.

Origin.—The bay tree is indigenous to the Levant and grows wild in the countries bordering the Mediterranean. It is a small tree or large shrub with umbellate clusters of yellowish flowers.

Description.—1. Folia lauri. They are 3 or 4 inches (7–10 Cm.) long, an inch (25 Mm.) or more broad, shortly petiolate, coriaceous, smooth, pellucid-punctate, oblong or oblong-lanceolate, rather acute at both ends, entire, glossy above and veined beneath. The veins form, with the midrib, an acute angle, send off numerous lateral branches forming a network of small meshes, and disappear near the margin of the leaf without prominently anastomosing. The dry leaves are of a yellowish- or brownish-green color. They have a pleasant aromatic odor and an aromatic and bitterish taste.

2. Fructus (Baccæ) lauri, *P. G.* The so-called *bay-berries* are oval or subglobular drupes about $\frac{1}{3}$ to $\frac{1}{2}$ inch (8–13 Mm.) long. When dry, they are greenish-black or blackish-brown, slightly wrinkled, and fragile, the integuments, including the reddish-brown endocarp, being thin and brittle. The loose oval seed is easily separated into the two plano-convex brownish cotyledons, which have an aromatic oily and bitter taste.

3. Oleum lauri (s. laurinum, s. lauri expressum, s. lauri unguinosum), *P. G.* It is obtained in Southern Europe by expressing the bruised fruit between warm plates after steeping it in hot water. It has the consistence of lard, a granular appearance, a green color, and an aromatic odor and taste. It melts near 40° C. (104° F.) to a clear dark-green liquid, is soluble in ether, partly soluble in alcohol, and does not yield its coloring matter to water. When agitated with warm alcohol the alcoholic solution should not become red on the addition of ammonia (absence of turmeric). Fictitious oils, if colored with curcuma and indigo, leave these behind when dissolved in ether.

Constituents.—The leaves and fruit contain a volatile oil. The volatile oil of bay-berries is pale-yellow, of the spec. grav. 0.94, congeals at a low temperature, contains oxygen, and is easily soluble in alcohol; it contains hydrocarbons, $C_{10}H_{16}$, boiling at 171° C. (340° F.) and 250° C. (482° F.), and four oxygenated constituents (Staub). Gladstone (1863) had found eugenol, while Blas (1865) could not detect this, but proved the presence of a little lauric acid. Bley (1834) obtained from old berries .22 per cent. of volatile oil. The seeds contain, according to Bonastre (1824), about 20 per cent. of fat, 2 per cent. of volatile oil, and 1.5 per cent. of resin. The expressed fat was analyzed by A. Staub (1879), who determined, besides volatile oil and chlorophyll, the presence of a little acetic acid and the glycerides of oleic, linoleic, lauric, myristic, palmitic, and stearic acids. *Lauric acid*, $C_{12}H_{24}O_2$, discovered by Marsson (1842), has been found in many vegetable and a few animal fats; it melts at 43.5° C. (110.3° F.), and volatilizes with the vapors of boiling water (Goergey, 1848). Schmidt and Roemer found little free acid in the freshly-expressed oil, but the fruit contained 2 to 3 per cent. of fatty acids.

Medical Action and Uses.—Bay leaves and berries were anciently held in high esteem as stimulant, stomachic, and astringent, and in substance or decoction were much used for the stings of insects, eruptions of the scalp, and vaginal relaxation with leucorrhœa; a decoction of the root-bark was given internally in diseases of the urinary organs and in dropsy, and was regarded as a powerful emmenagogue. More efficient medicines have supplanted it, and it is now seldom used except in the form of its volatile and fixed oils for relieving *local rheumatic* and other *pains*. In Europe the fresh leaves continue to be employed for flavoring pastry and rendering it more digestible.

LAVANDULA, *U. S.*—LAVENDER.

Flores lavandulæ, P. G.; *Flores lavendulæ.—Lavender-flowers*, E.; *Fleurs de lavande*, Fr.; *Lavendelblüthen*, G.

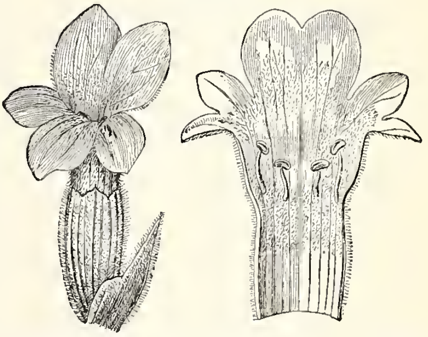
The flowers of Lavandula vera, *De Candolle* (L. Spica, var. *a*, *Linné;* L. angustifolia, *Ehrhart;* L. officinalis, *Chaix*). Bentley and Trimen, *Med. Plants*, 199.

Nat. Ord.—Labiatæ, Ocymoideæ.

Origin.—Lavender is a native of Southern Europe from Italy to Spain, and of Northwestern Africa, growing upon sunny hillsides and mountains. It is extensively cultivated as an ornamental garden-plant, and in Europe also for the purpose of distilling the volatile oil. (For an account of the cultivation of lavender at Hitchin, England, see *Proc. Amer. Phar. Assoc.*, 1876, pp. 819–821.) The plant is shrubby, about 2 feet (60 Cm.) high, has a brown-gray bark, which is much cleft when old, opposite, sessile, entire, and linear leaves, with revolute margins and long-stalked terminal spikes, with the lower whorls of flowers remote from the others. The flowers are collected in June and July before fully expanded, and require to be carefully dried.

Description.—The flowers grow in the axil of rhombic-obovate, pointed, brownish, and glandular bracts of nearly the length of the calyx. The latter is about ⅙ inch (4 Mm.) long, tubular, thirteen-nerved, contracted and naked at the mouth, with the upper tooth roundish-rhomboid and the remaining four teeth obsolete, densely covered with short hairs and minute glands, and of a blue-gray color. The corolla exceeds the calyx, and is violet-blue, tubular, enlarged above, hairy and glandular on the outside, and two-lipped, the upper lip being erect and two-lobed, and the smaller lower lip spreading and three-lobed. The four stamens are quite short and inserted in the middle of the hairy corolla-tube. Lavender-flowers have an agreeable aroma, which becomes more apparent on bruising and rubbing them, and a bitterish aromatic somewhat camphoraceous taste.

FIG. 172.



Lavender-flower, with bract and corolla cut open; magnified 4 diameters.

Constituents.—Besides some tannin, resin, and other widely-diffused principles, lavender-flowers contain volatile oil, when fresh yielding about 1 per cent. (See OLEUM LAVANDULÆ.)

Allied Plants.—LAVANDULA SPICA, *Chaix*, s. L. LATIFOLIA, *Ehrhart.*—Spike lavender, *E.;* Aspic, Lavande mâle, *Fr.;* Spiklavendel *G.*—The plant has spatulate leaves, rather short and dense spikes, and lance-linear bracts. The calyx is finely velvety-hairy, not blue, and about the same length as the calyx-tube. The plant is cultivated in Southern France and Northern Africa, and volatile oil is distilled from it.

LAVANDULA STŒCHAS, *Linné.*—Arabian or French lavender, *E.;* Stœchas, *Fr.;* Schopflavendel, *G.*—This small shrub grows near the Mediterranean, where the flowering spikes are used. These are short-stalked, about ⅘ inch (2 Cm.) long, and have the small dark-purple flowers in the axil of conspicuous rhombic or obovate, sometimes three-lobed, purple-colored bracts; the odor is strongly aromatic, camphoraceous.

OCYMUM BASILICUM, *Linné.*—Sweet basil, *E.;* Grand basilic, *Fr.;* Basilienkraut, *G.*—This annual herb is indigenous to tropical Asia and Africa, and is frequently cultivated in gardens.

The branching and more or less pilose stem is 1 to 2 feet (30–60 Cm.) high: the long petiolate leaves are oblong-ovate, somewhat toothed, smooth, and beneath glandular-punctate; the flowers are in somewhat interrupted spikes, the calyx short and ciliate, and the corolla white or reddish, with a short tube, a broad four-lobed upper lip, and a descending spatulate lower lip. The herb has a strong and agreeable aromatic odor and a balsamic and cooling taste; it contains volatile oil and a little tannin.

Medical Action and Uses.—Lavender is a stimulant aromatic, remarkable for its refreshing perfume. It is seldom used internally, unless in the form of oil or spirit, and then associated with other medicines. The infusion (ʒj to Oj = Gm. 4 to Gm. 60) is said, when too freely taken, to occasion colic. Fomentations made with lavender enclosed in bags allay *local pains*, like other plants of the Labiatæ family.

Ocymum basilicum (basil or sweet basil) is a well-known potherb used for seasoning certain kinds of food, and has the same general qualities as thyme, sage, etc. It has long been a popular remedy for mild nervous or hysterical disorders, and in Buenos Ayres its fresh juice is said to be used as an anthelmintic, and to possess the advantage of not tending to produce unpleasant symptoms. Its essential oil was formerly in vogue as a carminative and nervine (*Med. Record*, xvi. 325).

LEDUM.—Marsh Tea.

Marsh cistus, *Wild rosemary*, E.; *Lédon*, *Romarin sauvage*, Fr.; *Porsch*, *Sumpfporst*, *Wilder Rosmarin*, G.

The leaves of Ledum palustre, *Linné*.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—This shrub flourishes in marshy locations in the northern sections of North America, Asia, and Europe. It is about 3 feet (90 Cm.) high, and has white or pale rose-red five-petalled flowers in umbellate clusters.

Description.—The leaves are coriaceous, about an inch (25 Mm.) long, linear or lance-linear, obtuse, with a revolute margin, dark-green, smooth, glossy, and with depressed veins above, and clothed with a rusty wool on the lower side. They have a peculiar heavy aromatic odor and a bitter aromatic somewhat camphoraceous taste.

Constituents.—Meissner's results (1827) with marsh tea were further investigated by Willigk (1852) and others. The tannin, *leditannic acid*, $C_{15}H_{20}O_8$, is a reddish powder which dissolves in water and alcohol and colors ferric salts dark-green. The volatile oil, ¾ to 1½ per cent., is obtained from plants grown in swampy localities; it is yellow, pungently aromatic, and contains a stearopten, *ledum camphor*, probably $5C_{10}H_{16}.4H_2O$, which has been examined by Grassmann (1831), Buchner (1856), Trapp (1869), Iwanow (1876), and by Hjelt and Collan (1882); it is in silky needles, sublimable, melts at 101° C. (213.8° F.), and boils at 174° C. (345.2° F.). Fröhde (1861) recognized in the volatile oil the presence of valerianic and other volatile acids, and of *ericinol*, $C_{10}H_{16}O$; this is likewise contained in other ericaceous plants or obtainable from them as a decomposition-product of the glucoside *ericolin*, $C_{34}H_{56}O_{21}$, which was discovered by Rochleder and Schwarz (1852), and is inodorous, hygroscopic, brown-yellow, bitter, soluble in water, alcohol, and alcoholic ether, nearly insoluble in ether, chloroform, and benzin, and not precipitated by lead salts. Thal (1883) gives to ericolin the formula $C_{26}H_{30}O_3$, and to ericinol $C_{20}H_{26}O$; combining with water, the latter forms *hydroericinol*, $C_{10}H_{20}O_4$, which is a thick, brown-yellow, balsamic, not bitter fluid. Thal obtained ericolin from over thirty species of Ericaceæ. The remaining constituents of marsh tea are citric acid, resin, wax, and other ordinary vegetable principles.

Allied Plants.—LEDUM LATIFOLIUM, *Aiton*, known as *Labrador tea* and *James tea*, is indigenous to the Northern United States and to British America. The leaves resemble the preceding, but are broader, elliptic-oblong, and occasionally slightly heart-shaped at the base. They probably contain the same constituents.

ANDROMEDA POLIFOLIA, *Linné*, indigenous to marshes of Northern Asia, Europe, and America, is also known as *wild rosemary*. The leaves are about an inch (25 Mm.) long, linear-lanceolate, acute, strongly revolute at the margin, greenish-white beneath, not aromatic, of a somewhat acrid taste; otherwise resembling the preceding. They are considered to possess acrid and somewhat narcotic properties.

Medical Action and Uses.—This plant has been ranked with acrid-narcotic medicines, and is stated, in large doses, to occasion headache, restlessness, sleeplessness, dyspnœa, cough, dilatation of the pupils, a sort of intoxication, with pain in the limbs, increased secretion of urine, saliva, and especially of sweat, with itching and an eruption of papules or pustules on the skin. It is said to have been used in the manufacture of beer to render it more intoxicating. It was formerly employed in diarrhœa, dysentery, whooping cough, croup, gouty and rheumatic pains, and all sorts of chronic cutaneous eruptions. Its use for such purposes is, however, obsolete. The *dose* is stated to be from 5 to 15 grains (Gm. 0.30–1). An infusion may be prepared with from 5 to 10 parts of the leaves in from 100 to 200 parts of hot water. A strong decoction of the plant is used to destroy *cutaneous parasites* in horses and neat cattle and to cleanse bedsteads of *vermin*, and the leaves and twigs of the fresh plants are laid among woollen clothing to protect it against moths.

LEONURUS.—Motherwort.

Agripaume, *Cardiaire*, Fr.; *Herzgespann*, *Wolfstrapp*, G.

Leonurus Cardiaca, *Linné.*

Nat. Ord.—Labiatæ, Stachydeæ.

Description.—Motherwort is a perennial herb growing in waste places and near dwellings throughout Europe, Northern Asia, and North America. It is 3 or 4 feet (.9 or 1.2 M.) high, and has a quadrangular rather rough stem. The lower leaves are roundish, often heart-shaped at the base, and palmately five- to seven-lobed; the upper ones are oblong, acutely three-lobed, and have a wedge-shaped base. The pale-purplish flowers have awl-shaped or spiny-toothed calyx-teeth, and are in dense axillary cymules. The plant has a rather unpleasant aromatic odor and a bitter taste.

Constituents.—It evidently contains volatile oil; the bitter principle has not been isolated.

Allied Plants.—Of the numerous plants belonging to the tribe Stachydeæ, the following seem to deserve a brief notice (see also Marrubium and Scutellaria):

Stachys palustris, *Linné*—Hedge nettle, *E.;* Ortie rouge, *Fr.;* Stinknessel, Sumpfziest, *G.* —grows in wet places in Europe and North America. The stem is stiff-hairy. The leaves are mostly sessible, about 3 inches (7 Cm.) long, varying between ovate and linear-lanceolate, round or heart-shaped at the base, rather obtuse, hairy, and on the margin crenately serrate. The flowers are in whorls of six to ten, have sharply subulate calyx-teeth, and a purple somewhat spotted corolla.

Betonica officinalis, *Linné*—Wood-betony, *E.*—is a native of Southern Europe and grows sparingly in Massachusetts. It is rough-hairy, has cordate-oblong leaves, the cauline ones few, and purplish or whitish soft-hairy flowers in whorls of six to ten.

Galeopsis tetrahit, *Linné.*—Hemp nettle, *E.;* Chanvre batard, Galeopside, *Fr.;* Hanfnessel, Hohlzahn, *G.*—Introduced from Europe into North America. The stem is densely bristly-hairy below the joints; the leaves are about 2 inches (5 Cm.) long, ovate, usually acute, rather rounded at the base, coarsely serrate. The flowers are in dense axillary clusters, have long spiny-toothed calyx-teeth, and a white or yellowish corolla, with a purple spot on the lower lip.

The allied species, Gal. ochroleuca. *Lamarck*, and G. grandiflora, *Roth*, at one time attracted attention in Europe as the principal ingredients of a nostrum sold as *Blankenheim tea* or *Lieber's consumption herbs;* the former species is the Herba galeopsidis of European pharmacopœias.

Ballota nigra, *Linné.*—Black horehound, *E.;* Marrube noir (fétide), *Fr.;* Schwarzer Andorn, *G.*—Sparingly naturalized in New England. The stem is hairy, often red-brown; the leaves are about 1½ inches (2 Cm.) long, wrinkled, hairy, ovate, slightly heart-shaped, acute, and crenately toothed, The reddish-purple flowers are in axillary clusters of five to nine.

Lamium album, *Linné.*—Dead nettle, *E.;* Ortie morte, *Fr.;* Taubnessel, *G.*—It has likewise been introduced from Europe; has ovate, heart-shaped, pointed, and coarsely serrate, somewhat hairy, petiolate leaves, and white or whitish flowers in dense axillary clusters and with slender calyx-teeth. Lamium amplexicaule, *Linné*, and L. purpureum, *Linné*, are more frequent in the United States; they have roundish leaves and smaller purplish flowers.

Many other species of the above genera have been employed in Europe and Asia, and, like the above, contain volatile oil and a bitter principle.

Medical Action and Uses.—A decoction of motherwort is sometimes used in Europe to promote digestion and quicken the functions of the skin. There also L. lanatus is regarded as a vascular stimulant and diuretic and as a general tonic; it is employed in *dropsy*, especially of hepatic origin, and is stated to impart to the urine a dark-brown color; it is also used in chronic *gout* and *rheumatism* and to relieve *uterine obstructions.* A hot infusion may be prepared with ½ ounce to 1 ounce of the plant to a pint of water (Gm. 16–32 in Gm. 500).

LEPTANDRA, *U. S.*—Leptandra.

Culver's Root, *Culver's Physic*, *Black-root*, E.; *Racine de leptandra*, *s. de véronique de Virginie*, Fr.; *Leptandra-Wurzel*, G.

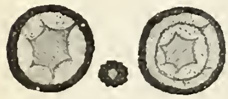
The rhizome, with the rootlets, of Leptandra virginica, *Nuttall* (Veronica virginica, *Linné*). Bentley and Trimen. *Med. Plants*, 196.

Nat. Ord.—Scrophulariaceæ.

Origin.—Leptandra is indigenous to Canada, and to the United States as far west as the Mississippi Valley; in its southern locations it grows in mountain-valleys, and farther north in low grounds and rich woodlands. It sends up an obtusely-angular stem, 3 to 6 feet (0.9–1.8 M.) high, has the short-petioled, lanceolate, and serrate leaves in verticils of four or five, and the white flowers with the two much-exserted stamens in panicled spikes 3 to 6 inches (7–15 Cm.) long. It flowers in July and August, and produces ovate, two-celled, and many-seeded capsules.

Description.—The rhizome is 4 to 6 inches (10–15 Cm.) long, and about ¼ inch (6 Mm.) thick, horizontal, somewhat bent, and branched, blackish-brown to brown-black, nearly free from wrinkles, but the bark is sometimes transversely fissured. The upper side has short remnants of the stems or cup-shaped scars $\frac{3}{4}$ to 2 inches (2–5 Cm.) apart; the numerous rootlets, which are chiefly attached to the lower side, are blackish, about $\frac{1}{16}$ inch (1.5 Mm.) thick, longitudinally wrinkled, quite fragile, and therefore usually detached and much broken. The rhizome is hard, and breaks with a woody fracture, showing a large purplish-brown pith and a few medullary rays dissecting the yellowish wood, which is eight to ten times thicker than the blackish-gray bark. The ligneous cord of the rootlets is of about the same thickness as the bark. Leptandra has no odor; its taste is bitter and feebly acrid.

Fig. 173.



Leptandra virginica: transverse sections of rhizomes and rootlets.

Constituents.—According to the analysis of Prof. Wayne (1856), leptandra contains, besides widely-diffused principles, like tannin, gum, resin, and a trace of volatile oil, a principle having the nauseous bitter taste of the drug, and therefore deserving to be called *leptandrin*. It is soluble in water, alcohol, and ether, and was obtained by precipitating the infusion with subacetate of lead, removing the excess of lead from the filtrate by sodium carbonate, and passing the liquid through a column of animal charcoal; this was washed with water and then treated with boiling alcohol, and the extract left on evaporation treated with ether; on evaporating the ether spontaneously a portion of leptandrin crystallized; the remainder was contaminated with coloring matter, which prevented it from crystallizing. The so-called *leptandrin* of the eclectics, which is obtained by precipitating the concentrated tincture with water, appears to owe its efficacy to the accidental presence of the principle described. From the mother-liquor of this eclectic preparation Wayne (1859) obtained *mannit*. F. F. Mayer (1863) observed the bitter principle to be at least partly precipitated by tannin, and that portion to be a glucoside; he also found *saponin*, some *citric acid*, and a small quantity of a *volatile alkaloid*. Prof. Lloyd (1880) reported the presence of a considerable amount of glucose, and that the bitter taste of the tincture is destroyed by boiling with dilute sulphuric acid.

Off. Prep.—Extract. leptandræ, Extract. leptandræ fluidum, *U. S.*

Medical Action and Uses.—Although this medicine has long been in use and is officinal, we do not learn that it has commended itself to educated physicians by its peculiar virtues, although they are sufficiently marked to merit greater attention. The root, when fresh or recent, acts violently as an emeto-cathartic, and the impure resin obtained from it, and ignorantly called leptandrin, as if it were itself the proximate active principle of the plant, produces similar effects when the dose is excessive. Like all gastro-intestinal irritants, it probably promotes the secretions of the mucous glands, the pancreas, and the liver, but has no specific influence upon the last-named organ, as has been confidently assumed. According to Rutherford, its stimulant action on the liver is "very feeble," and it resembles podophyllin in its operation. The *dose* of the powder is stated to be from 20 to 60 grains (Gm. 1.30–4), and of leptandrin from 2 to 4 grains (Gm. 0.10–0.20). It has also been given in tincture and fluid extract.

LEVISTICUM.—Lovage.

Radix levistici, P. G.—*Livèche*, *Ache de montagne*, Fr.; *Liebstöckel*, G.

The root of Levisticum officinale, *Koch*, s. Ligusticum Levisticum, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Lovage is indigenous to the mountainous districts of Southern Europe, and has a stem about 4 feet (1.2 M.) high, terminal umbels of yellow flowers, and elliptical or oval fruits with winged ribs, and one or more oil-tubes in each groove. The plant is sometimes cultivated in gardens.

Description.—The root is altogether about 16 inches (40 Cm.) long, 1 or 1½ inches (25–38 Mm.) thick, several-headed, indistinctly annulate, longitudinally wrinkled, somewhat branched below, and is yellowish-brown externally and pale-yellowish internally. It has a thick bark, which is radially striate from the medullary rays, fissured in the outer portion, and contains numerous orange-yellow resin-cells arranged in irregular concentric circles. The meditullium is denser, but soft, and has narrow medullary rays and in the upper portion a central pith. It has a strong balsamic odor, somewhat resembling that of angelica, and a mucilaginous, aromatic, and pungent taste.

The root of Ligusticum actæifolium, *Michaux*, which is indigenous to the Southern United States, is similar in appearance and properties.

Constituents.—Lovage was analyzed by Trommsdorff (1836), Riegel (1840), and others, and found to yield a thickish volatile oil containing much stearopten, various resins, some soft, others hard (one having a bitter and pungent taste), sugar, mucilage, and other common principles.

Allied Drugs.—Pimpinella Saxifraga and P. magna, *Linné*, Radix pimpinellæ, *P. G.*—Small burnet saxifrage, *E.;* Grand boucage, *Fr.;* Pimpinell, Bibernell, *G.*—Indigenous to Europe and Asia. The root resembles the preceding, but is brown-yellow or blackish, usually one-headed, not over ⅗ inch (15 Mm.) thick, finely annulate above and wrinkled and verrucose below; the bark is very thick, spongy, either white or yellowish, contains numerous resin-cells (in the medullary rays), and encloses a porous radiate yellow wood. The constituents are similar to those of the preceding.

Tinctura pimpinellæ, *P. G.*, is made with 1 part of the root to 5 parts of alcohol sp. grav. .892.

Laserpitium latifolium, *Linné.*—The root was formerly known as *Radix gentianæ albæ*, from its resemblance in shape to that of gentian-root, but it is externally brownish-white, internally white, and contains yellow resin-cells in the thick spongy bark. Kütz (1883) isolated from it bitter *laserpitin*, $C_{15}H_{22}O_4$, which separates from hot benzin in monoclinic crystals, and is easily soluble in chloroform, ether, benzol, and carbon disulphide.

Peucedanum officinalæ, *Linné.*—The root is externally blackish, internally brownish-yellow, and has a rather thick bark containing numerous orange-colored resin-cells in radial rows, and enclosing a soft porous wood, with resin-cells in the medullary rays. (For *peucedanin*, see p. 813.)

Medical Action and Uses.—Levisticum belongs to the large class of plants containing an essential oil and a resin, which have always been employed as carminatives, diuretics, emmenagogues, and digestive stimulants. It has been much used in flatulent *dyspepsia*, *amenorrhœa*, and *dropsy*, especially in Germany, where it is prescribed as a substitute for angelica. It is administered in decoction or infusion (Gm. 5–10 in Gm. 100), in tablespoonful doses. *Pimpinella saxifraga* is endowed with similar properties, and was formerly much used to expel the mercury remaining in the system after the treatment of syphilis. The root of *Laserpitium latifolium* is an active cathartic. *Peucedanum officinale* was in ancient, and even in modern times, employed as a diuretic, aromatic, and nervine medicine.

LIATRIS.—Liatris.

Nat. Ord.—Compositæ, Eupatorieæ.

Description.—The genus Liatris embraces principally North American perennial herbs with tuberous roots, simple and erect stems, alternate and entire leaves, and handsome rose-purple flower-heads with an oblong imbricate involucre, naked receptacle, and a pappus composed of many bristles. The flowers are usually in terminal spikes or racemes.

Liatris spicata, *Willdenow.* The tuberous rhizome is known as *Button snake-root*, *Devil's bit*, and *Colic-root.* It is ½ inch (12 Mm.) or more in diameter, somewhat tuberculate from short branches, and marked with several cup-shaped stem-scars. It is slightly wrinkled and of a brown color externally, and internally of a dingy white, with streaks of brown. Its odor is somewhat balsamic and its taste warm and bitterish.

L. squarrosa, *Willdenow*, and L. scariosa, *Willdenow*, are known as *Rattlesnake's master.* The rhizomes resemble the preceding, but are more elongated, irregularly ovate, and beset with a few wiry rootlets. Internally they are of a brownish color.

L. odoratissima, *Willdenow*, *Vanilla-plant* or *Deer's tongue.* The radical leaves are obovate-spatulate, obtuse, about seven-veined, narrowed below; the stem-leaves are oval or oblong, and clasping at the base. All the leaves are rather fleshy, pale-green, and smooth, and after drying have a very agreeable odor.

Constituents.—The rhizomes appear to contain volatile oil and resin. The leaves of the deer's tongue were found by Procter (1859) to contain coumarin, which is frequently separated upon the surface in crystals.

Pharmaceutical Uses.—Their agreeable and persistent odor renders deer's tongue leaves serviceable in the preparation of sachet powders, etc., as suggested by Dr. A. W. Miller (1875).

Medical Action and Uses.—L. spicata is one of the numerous "snake-roots," which owe whatever virtue they possess to being diaphoretic when administered in hot decoction in consequence of the acrid or stimulant principle they contain. Its qualities adapt it to relieve flatulent *colic*. It is also diuretic, and is used in *nephritic complaints*. L. odoratissima has an odor resembling that of vanilla, for which reason it is sometimes mixed with smoking tobacco and introduced into cigars. Other species, L. scariosa and L. squarrosa, are especially high in popular esteem as antidotes to the *rattlesnake's bite*, both internally and locally, and are employed in *gonorrhœa* and also to prepare gargles for *sore throat*. Liatris is administered in decoction and tincture.

LIGUSTRUM.—PRIVET.

Troène, Fr.; *Rainweide, Hartriegel*, G.

Ligustrum vulgare, *Linné*.

Nat. Ord.—Oleaceæ.

Description.—The privet is a shrub 8 or 10 feet (2.4–3 M.) high, indigenous to Southern Europe; it is cultivated for ornament and in hedges, and is naturalized in the United States. The *leaves* are opposite, elliptic-lanceolate, smooth, thickish, entire on the margin, and about 2 inches (5 Cm.) long; they have a bitterish and astringent taste. The *flowers* are in panicles, the calyx short, the corolla funnel-shaped, four-lobed, white, and of a sweetish agreeable odor. The *berries* are globular-oval, black externally, dark-purple internally, two-celled, and contain two or four ovate-oblong acute seeds.

Constituents.—According to Stenhouse (1854), the leaves contain a principle which yields *quinone*. The bitter principle, *ligustrin*, was not completely isolated by Polex (1839) and Kromayer (1854). It appears to be insoluble in absolute alcohol and ether, and to be allied to *syringin*, the bitter principle of *lilac*, Syringa vulgaris, *Linné*. *Ligustron* is a crystalline, bitter, and fusible principle obtained by Kromayer.

Medical Action and Uses.—The leaves and bark are strongly astringent. They were formerly used to restrain diarrhœa and hæmorrhages, and are still employed in gargles for various forms of *sore mouth* and *throat*.

LIMONIS CORTEX, *U. S., Br.*—LEMON-PEEL.

Cortex fructus citri, P. G.; *Écorce (Zeste) de citron de limon*, Fr.; *Citronenschale, Limonenschale*, G.

The rind of the recent fruit of Citrus Limonum, *Risso* (C. medica, var. β, *Linné*). Steph. and Church, *Med. Bot.*, plate 92; Bentley and Trimen, *Med. Plants*, 54.

Nat. Ord.—Aurantiaceæ.

Origin.—The lemon is a native of the north-western part of India, where it is found in the forests up to an altitude of about 4000 feet (1200 M.). It is extensively cultivated in the basin of the Mediterranean, and the culture has also been introduced into the southern parts of the United States, into Australia, and into most tropical and subtropical countries. Several varieties have been produced from the original stock, of which, besides the lemon, the following are quite distinct:

C. MEDICA, *Risso*, *Citron* or *Cedrat* (Bentley and Trimen, *Med. Plants*, 53). Its flowers are purplish externally; the fruit is 4 to 6 inches (10–15 Cm.) long, ovate-oblong, has a rugged and thick rind, and contains an acid juice.

C. LIMETTA, *Risso*, *Sweet lime*. Its flowers are white; the fruit is smaller than the lemon, oval or roundish, has a smoother and thin rind, and contains an insipidly sweet juice.

C. LUMIA, *Risso*, has likewise a sweet pulp. The *sour lime* is the fruit of Citrus acida, *Roxburgh*, C. acris, *Miller*, and perhaps other varieties.

The *lemon tree* is 12 to 15 feet (3.5–4.5 M.) high, irregularly branched, and spiny in the leaf-axils; the leaves are oval or ovate-oblong, somewhat serrate, leathery, glossy above, and articulated with the wingless or slightly-winged petiole. The flowers are mostly solitary, have a small calyx, five petals, which are purplish-pink externally, and numerous stamens. The fruit, 2 to 3 inches (50–75 Mm.) long, varies in shape between oval and obovate, has a nipple-shaped apex, a yellow nearly smooth but glandular pericarp, and is divided into eight to twelve cells, each with two or three seeds.

Description.—Lemon-peel forms either narrow bands or oblong and curved sections; the outer surface has a deep lemon-yellow color, and is somewhat uneven from numerous oil-glands imbedded in the tissue. This portion has an agreeable odor and an aromatic slightly bitter taste; it is the only part which possesses any medicinal value. The white spongy tissue underneath, which is inodorous and nearly tasteless, should be rejected. The Pharmacopœia now directs it to be "in narrow thin bands, with very little of the spongy white inner layer adhering to it."

Constituents.—The principal constituent is volatile oil. (See OLEUM LIMONIS.) The bitter taste is probably due to hesperidin (see page 289). The white portion is colored black by ferric salts; the principle which gives rise to this color has not yet been isolated.

Off. Prep.—Infus. aurantii comp., Infus. gentianæ comp., *Br.;* Spiritus limonis, *U. S.;* Syrupus limonis, *U. S.*, *Br.;* Tinctura limonis, *Br.*

Medical Uses.—Lemon-peel is used in medicine, as in cookery, for the sake of its flavor.

LIMONIS SUCCUS, *U. S., Br.*—LEMON-JUICE.

Succus citri.—Lime-juice, E.; *Suc de citron* (*de limon*), Fr.; *Citronensaft*, *Limonensaft*, G.

The juice of the fruit of Citrus Limonum, *Risso.*

Origin.—(See the preceding article.) The juice is obtained by expressing the ripe fruit.

Description.—Lemon-juice is a slightly turbid, yellowish liquid which has the agreeable odor of lemon and an acid taste. The odor is usually due to the presence of a little volatile oil from the rind, but even without the latter lemon-juice has a slight odor distinct from that of the peel. Stoddard determined its usual specific gravity to be 1.044, and each fluidounce to contain 44 grains of citric acid (about 9¼ per cent. = 42.5 grains in 1 Imperial fluidounce); its acid strength, however, is subject to variation. The U. S. P. requires it to contain about 7 per cent. of citric acid, and to have a specific gravity not less than 1.030. According to H. M. Witt (1854), lemon-juice yields from 0.2 to 0.5 per cent. of ash; W. W. Stoddart (1868) obtained between 0.26 and 0.6 per cent. Lemon-juice speedily undergoes decomposition, the citric acid decreasing in quantity, at first slowly, afterward rapidly, as shown by Stoddard. Various methods for its preservation have been suggested, most of which, however, fail to preserve the juice in condition for medicinal use. It has been proposed to concentrate it by evaporation or freezing before bottling it, or to exclude the air by a stratum of fixed oil; the flavor, however, is considerably modified. A better method is to clarify the juice by adding half its volume of strong alcohol; the decanted liquid is then freed from alcohol at a very moderate heat, and the remaining liquid put into suitable bottles, which are heated to near the boiling-point for about an hour, and then hermetically sealed. The juice may be preserved by the same method without the previous treatment with alcohol, but the flavor will be impaired on keeping.

Constituents.—Lemon-juice contains from 7 to 10 per cent. of citric acid and 0.5 to 1 per cent. of gum and sugar. Witt found the principal constituents of the ash to be potassa 44.34, lime 7.61, and phosphoric acid 7.56 per cent. Cossa (1872) obtained 15 per cent. of phosphoric acid.

Off. Prep.—Mistura potassii citratis, *U. S.;* Syrupus limonis, *U. S.*, *Br.*

Medical Uses.—(See ACIDUM CITRICUM.)

LINARIA.—TOAD FLAX.

Herba linariæ.—Snapdragon, *Ramsted*, *Butter-and-eggs*, E.; *Linaire commune*, Fr.; *Leinkraut*, *Flachskraut*, *Löwenmaul*, G.

Linaria vulgaris, *Miller*, s. Antirrhinum Linaria, *Linné.*

Nat. Ord.—Scrophulariaceæ.

Description.—The toad flax is a European perennial, now extensively naturalized in North America. It is 1 or 1½ feet (30–45 Cm.) high, has alternate, sessile, lance-linear, almost three-nerved, smooth, and light-green leaves, 1 or 1½ inches (25–38 Mm.) long;

and terminal racemes of showy yellow flowers, which have a personate corolla about ⅝ inch (17 Mm.) long, and at the base continued into a curved spur of the same length. When fresh the herb has a slight disagreeable odor and a bitterish somewhat acrid taste.

Constituents.—The flowers were analyzed by Riegel (1843); they contain a yellow coloring matter, mucilage, sugar, and tannin. Walz obtained an acrid principle, resin, and volatile *linarosmin* and *antirrhinic acid.*

Pharmaceutical Preparation.—UNGUENTUM LINARIÆ. 2 parts of the dry plant are macerated with 1 part of alcohol, and then digested with 10 parts of lard until the alcohol has evaporated; the fat is expressed, strained, and stirred until congealed.

Medical Action and Uses.—Common toad flax is used in Germany for *jaundice, dropsy,* and *diseases of the skin,* and an ointment is made with it for the cure of *hæmorrhoids.* A decoction is prepared with ℥ss–℥j in water f℥viij–f℥xvi (Gm. 15–30 in Gm. 250–500).

LINIMENTA.—LINIMENTS.

Embrocations, E., Fr.; *Linimente, Einreibungen,* G.

Liniments are liquid or semi-liquid preparations which are intended for external use and are applied to the skin by friction. The vehicle may be oil or alcohol, or sometimes water; many are perfect solutions, others mechanical mixtures which should be well agitated before they are used; a few are of a soft solid consistence at the ordinary temperature, but become liquid when applied to the skin. The U. S. Pharmacopœia now uses cotton-seed oil in place of olive oil, formerly directed.

LINIMENTUM ACONITI, *Br.*—LINIMENT OF ACONITE.

Liniment d'aconite, Fr.; *Akonitliniment,* G.

Preparation.—Take of Aconite-Root, in No. 40 powder, 20 ounces; Camphor 1 ounce; Rectified Spirit a sufficiency. Moisten the aconite with 20 fluidounces of spirit, and macerate in a closed vessel for 3 days; then transfer to a percolator, and, when the liquor ceases to pass, continue the percolation with more of the spirit, allowing the liquor to drop into a receiver containing the camphor until the product measures 30 fl. oz.—*Br.*

This liniment is one-third weaker than the fluid extract, and differs also in containing camphor. With proper manipulation the aconite-root is practically exhausted by the above process. Procter (1853) had suggested an aconite liniment which was dropped from the present Pharmacopœia, but may be prepared from the fluid extract of aconite-root by mixing 4 fluidounces of it with ½ fluidounce of glycerin and evaporating the mixture to 4 fluidounces.

Medical Uses.—This liniment is convenient for using aconite locally and as an addition to other anodyne applications. It is chiefly employed for the relief of *neuralgia* by saturating with it disks or pledgets of cloth, which are then applied to the painful part. Mixed with an equal quantity of soap liniment, it is said effectually to remove the pain of *dry gangrene.*

LINIMENTUM AMMONIÆ, *U. S., Br.*—LINIMENT OF AMMONIA.

Linimentum ammoniatum, P. G.; *Linimentum volatile, Linimentum ammoniacale.—Volatile liniment,* E.; *Liniment ammoniacal (volatil), Savon ammoniacal,* F.; *Flüchtiges Liniment, Flüchtige Salbe,* G.

Preparation.—Water of Ammonia 30 parts (130 grains); Cotton-seed oil 70 parts (300 grains); to make 100 parts (430 grains or 1 fluidounce). Mix them.—*U. S.* The proportions by measure are ammonia-water 12 fluidrachms, cotton-seed oil 29 fluidrachms.

Take of solution of ammonia 1 fluidounce; olive oil 3 fluidounces. Mix together with agitation.—*Br.*

The German Pharmacopœia directs 3 parts of olive oil and 1 part of poppy-seed oil, and the French Codex 9 parts of expressed oil of almonds to 1 part of ammonia-water. The fixed oil is partly decomposed, with the formation of an ammonia soap, by means of which the water and oil are kept well mixed, forming an opaque emulsion. Using cotton-seed oil, the mixture will be liquid at ordinary temperature, and it will be more perfect and less apt to separate if the oil be old, but not rancid, or if mixed with about 10 per cent. of olive oil. The other formulas produce stiffer liniments, which may be kept fluid, as suggested by Rother (1872), by the addition of a little alcohol. On being kept, the liniment becomes thicker, and finally forms a stiff and even granular mass, which Rother prevents by the addition of a minute quantity of oleic acid.

Linimentum ammoniæ camphoratum.—Camphorated volatile liniment, *E.;* Liniment ammoniacal camphré, *Fr.;* Flüchtiges Kampfer-liniment, *G.*—The French Codex and German Pharmacopœia direct it to be made precisely like volatile liniment, except that camphor liniment is substituted for the almond and olive oil.

Medical Uses.—This preparation represents the stimulant rather than the counter-irritant virtues of ammonia. It is used to relieve local pains of a *neuralgic* or *rheumatic* nature, and to palliate both pain and congestion in the forming stage of various inflammations, as *sore throat*, *laryngitis*, *bronchitis*, and *pleurisy*. If prevented from evaporating it may vesicate the skin.

LINIMENTUM BELLADONNÆ, *U. S., Br.*—Liniment of Belladonna.

Liniment de belladone, Fr.; *Belladonna-Liniment*, G.

Preparation.—Fluid Extract of Belladonna 95 parts (437 grains or 1 oz. av.); camphor 5 parts (23 grains); to make 100 parts (460 grains or 1 fluidounce). Dissolve the camphor in the fluid extract.—*U. S.*

Take of belladonna-root, in No. 40 powder, 20 ounces; camphor 1 ounce; rectified spirit a sufficiency. Moisten the belladonna with 20 fluidounces of spirit, and macerate in a closed vessel for 3 days; then transfer to a percolator, and, when the liquor ceases to pass, continue the percolation with more of the spirit, allowing the liquor to drop into a receiver containing the camphor until the product measures 30 fluidounces.—*Br.*

Considering the belladonna-root used in both formulas to be of equal efficiency, the second liniment is one-third weaker.

Medical Uses.—Belladonna liniment is a convenient and efficient preparation for allaying the local pains which belong to *neuralgia*, *rheumatism*, *sprains*, etc. It is advantageously associated with aconite liniment.

LINIMENTUM CALCIS, *U. S., Br.*—Lime Liniment.

Liniment of lime, E.; *Liniment calcaire*, *Savon calcaire*, Fr.; *Kalkliniment*, G.

Preparation.—Solution of Lime, Cotton-Seed Oil, each 50 parts (8 oz. av.); to make 100 parts (16 oz. av. or nearly 1 pint). Mix them.—*U. S.*

Take of solution of lime, olive oil, each 2 fluidounces. Mix together, with agitation. —*Br.*

A lime soap is formed by this process, which keeps the excess of the oil emulsionized for a short time, the two separating together from the aqueous liquid.

The French Codex directs the separation of the soft saponaceous mass resulting from the agitation of 9 parts of lime-water with 1 part of expressed oil of almonds, and its preservation for use.

Medical Uses.—This liniment is much employed in the treatment of *burns*, both those which are recent and superficial and those which involve the skin, in their ulcerative stage. It is not only a protective, but, as an astringent of a special kind, it hastens the restoration of the injured tissues. It may be used to prevent pitting in confluent *small-pox*. It is applied most efficiently on cloths, which should not be allowed to get dry.

LINIMENTUM CAMPHORÆ, *U. S., Br.*—Liniment of Camphor.

Oleum camphoratum, P. G.; *Linimentum camphoratum.*—*Camphorated oil*, E.; *Liniment camphré*, *Huile camphrée*, Fr.; *Kampferliniment*, *G.*

Preparation.—Camphor 20 parts (2 oz. av.); Cotton-Seed Oil 80 parts (8 oz. av.); to make 100 parts (10 oz. av.). Dissolve the camphor in the oil.—*U. S.*

Take of camphor 1 ounce; olive oil 4 fluidounces. Dissolve the camphor in the oil.—*Br.* Dissolve camphor 1 part in olive oil 9 parts.—*F. Cod.*, *P. G.*

A simple solution of camphor in oil, which is best obtained by employing the camphor as a fine powder or by digesting the mixture in a closed bottle at a moderate heat.

Souley's *carbolized camphor liniment* is made by dissolving pure carbolic acid 9 parts and camphor 25 parts in absolute alcohol 9 parts and adding olive oil 35 parts.

Off. Prep.—Linimentum chloroformi, Linim. hydrargyri, Linim. terebinth. acet., *Br.*

Medical Uses.—It is used as an anodyne and discutient for *sprains*, *bruises*, and *glandular swellings* and for the relief of *rheumatic pains*. It is also serviceable in preventing the ill effects of pressure by surgical apparatus and by decubitus.

LINIMENTUM CAMPHORÆ COMPOSITUM, *Br.*—Compound Liniment of Camphor.

Liniment ammoniacal camphré anglais, Fr.; *Ammoniak- und Kampfer-Liniment*, G.

Preparation.—Take of Camphor 2½ ounces; Oil of Lavender 1 fluidrachm; Strong Solution of Ammonia 5 fluidounces; Rectified Spirit 15 fluidounces. Dissolve the camphor and oil of lavender in the spirit; then add the solution of ammonia gradually, shaking them together until a clear solution is formed.—*Br.*

Medical Uses.—The characteristic of this preparation, as distinguished from simple liniment of camphor, is that it is rendered stimulant, and even rubefacient, by the strong water of ammonia it contains. It is a convenient liniment in cases of local *rheumatic*, *neuralgic*, and *traumatic pains*.

LINIMENTUM CANTHARIDIS, *U. S.*—Liniment of Cantharides.

Huile de cantharides térébenthinée, Fr.; *Spanischfliegen-Liniment*, G.

Preparation.—Cantharides, in No. 60 powder, 15 parts (1½ oz. av.); Oil of Turpentine a sufficient quantity; to make 100 parts (10 oz. av.). Digest the cantharides with 100 parts (10 oz. av.) of oil of turpentine in a close vessel by means of a water-bath for 3 hours; then strain and add enough oil of turpentine through the strainer to make the liniment weigh 100 parts (10 oz. av. or about 11 fluidounces).—*U. S.*

Cantharidin is soluble in oil of turpentine; the digestion may be effected in a bottle partly closed by a stopper. (See also Liquor Epispasticus.)

Oleum cantharidatum, *P. G.*, is made by digesting for 10 hours coarsely-powdered cantharides 3 parts in rape-seed oil 10 parts. The filtered oil is of a green-yellow color.

Medical Uses.—This is a very powerful stimulant and counter-irritant preparation. Its advantages over turpentine liniment on the one hand and over blisters upon the other are not apparent, and unless carefully used it may occasion troublesome irritation, and even ulcers, where it is applied, and may be conveyed by the patient's fingers to the eyes, genitals, etc.

LINIMENTUM CHLOROFORMI, *U. S.*, *Br.*—Liniment of Chloroform.

Liniment au chloroforme, Fr.; *Chloroform-Liniment*, G.

Preparation.—Commercial Chloroform 40 parts (2 oz. av.); Soap Liniment 60 parts (3 oz. av.); to make 100 parts (5 oz. av. or nearly 4 fluidounces). Mix them.—*U. S.*

Take of chloroform, liniment of camphor, each 2 fluidounces. Mix.—*Br.*

Chloroform 1 part, expressed oil of almond 9 parts.—*F. Cod.* The preparation bearing the same name in the three pharmacopœias differs essentially in composition as well as in the proportion of chloroform.

Medical Uses.—The purpose of this preparation was probably to prolong, and at the same time mitigate, the local anæsthetic action of chloroform. But the object is better accomplished by a mixture of chloroform and soap liniment, to which tincture of aconite-root may be added.

LINIMENTUM CROTONIS, *Br.*—Liniment of Croton Oil.

Liniment crotoné, Fr.; *Krotonöl-Liniment*, G.

Preparation.—Take of Croton Oil 1 fluidounce; Oil of Cajeput, Rectified Spirit, each 3½ fluidounces. Mix.—*Br.*

This is simply a solution of croton oil in alcohol and oil of cajeput, and has the odor of the latter.

Medical Uses.—There is an apparent incongruity in associating a prompt but transient irritant, like oil of cajeput, with one whose operation is slow and is scarcely active until the characteristic croton pustulation is produced. Possibly, the rubefaction of the skin by the one oil was intended to hasten the more permanent action of the other. But the preparation has little to recommend it before an extemporaneous solution of croton oil in olive oil, with or without the addition of oil of cajeput, cloves, or cassia.

LINIMENTUM HYDRARGYRI, *Br.*—Liniment of Mercury.

Linimentum mercuriale.—Liniment mercuriel, Fr.; *Quecksilber-Liniment*, G.

Preparation.—Take of Ointment of Mercury 1 ounce; Solution of Ammonia, Liniment of Camphor, each 1 fluidounce. Liquefy the ointment of mercury in the liniment of camphor with a gentle heat; then add the solution of ammonia gradually, and mix with agitation.—*Br.*

This may be prepared in a wide-mouthed vial if the ointment and liniment are digested together and frequently agitated until the lumps have disappeared, when the ammonia-water should be added and well incorporated by shaking. The liniment has a gray color from the finely-divided mercury.

Medical Uses.—The camphor and ammonia in this preparation are intended by their stimulant action to promote the discutient and absorbent action of the mercury. As it must be applied with friction, there is great danger of its causing salivation. It is less efficient in promoting the resolution of enlarged and indurated *glands*, etc. than are mercurial ointments and plasters, especially those containing the iodides of mercury.

LINIMENTUM IODI, *Br.*—Liniment of Iodine.

Liniment ioduré, Fr.; *Jodliniment*, G.

Preparation.—Take of Iodine 1¼ ounces; Iodide of Potassium ½ ounce; Glycerin ¼ ounce; Rectified Spirit 10 fluidounces. Dissolve the iodine, iodide of potassium, and glycerin in the spirit.—*Br.*

This is much stronger than the Tinctura iodi, from which it also differs in containing about 2½ per cent. of glycerin. The potassium iodide adapts the liniment for use with a small quantity of aqueous liquids by preventing the precipitation of the iodine.

Medical Uses.—As it is probable that a very minute proportion, if any, either of iodine or of iodide of potassium is absorbed by the sound skin, it must be concluded that this liniment will be less efficient as a local application than either the simple or compound iodine ointment, in both of which the active ingredients are kept longer in contact with the integument than they can be in a liniment.

LINIMENTUM OPII, *Br.*—Liniment of Opium.

Anodyne liniment, E.; *Liniment opiaeé*, Fr.; *Opiumliniment*, G.

Preparation.—Take of Tincture of Opium, Liniment of Soap, each 2 fluidounces. Mix.—*Br.*

The *liniment savonneux opiacé* of the French Codex was made by triturating 5 parts of powdered soap with 90 parts of expressed oil of almonds, and adding 5 parts of tincture of opium; it must be well agitated.

Medical Uses.—Being merely a mixture of laudanum and soap liniment, its fixed proportions are rather embarrassing than convenient. The quantity of laudanum used should vary with the condition of the affected part as to delicacy, the degree of pain, etc.

LINIMENTUM PLUMBI SUBACETATIS, *U. S.*—Liniment of Subacetate of Lead.

Liniment saturné, *Beurre de saturne*, *Baume universelle*, Fr.; *Bleiliniment*, G.

Preparation.—Solution of Subacetate of Lead 40 parts (2 oz. av.); Cotton-Seed Oil 60 parts (3 oz. av.); to make 100 parts (5 oz. av. or nearly 4¾ fluidounces). Mix them.—*U. S.*

This yields a yellowish-white opaque emulsion which does not separate on standing, but gradually stiffens. It is made extemporaneously by weighing the materials into a vial and then agitating well.

Medical Uses.—A convenient discutient liniment for *sprains*, *bruises*, *chilblains*, *inflamed glands*, and *chapped hands*.

LINIMENTUM POTASSII IODIDI CUM SAPONE, *Br.*—LINIMENT OF IODIDE OF POTASSIUM AND SOAP.

Liniment savonneux ioduré, Fr.; *Jodkalium-Seifenliniment*, G.

Preparation.—Take of Curd Soap, cut small, 2 ounces (16 parts); Iodide of Potassium $1\frac{1}{2}$ ounces (12 parts); Glycerin 1 fluidounce (8 fluid parts); Oil of Lemon 1 fluidrachm (1 fluid part); Distilled Water 10 fluidounces (80 fluid parts). Reduce the soap to fine shreds, and mix this with the water and glycerin in a porcelain dish over the water-bath. When the soap is dissolved pour the liquid into a mortar in which the iodide of potassium has previously been powdered. Mix briskly, and continue the trituration until the mixture is cold. Set aside for an hour; then rub well the oil of lemon into the cream-like product.—*Br.*

Medical Uses.—This liniment is even more objectionable than liniment of iodine, since it contains only the iodic salt, and no iodine, as the latter preparation does. The clinical evidence of any real benefit being derived from it through its iodide of potassium has never been furnished. If cutaneous absorption of the iodide of potassium be desired, it will be secured much more readily by the prolonged application of compresses saturated with a strong solution of the iodide and their protection by a water-proof covering.

LINIMENTUM SAPONIS, *U. S.*, *Br.*—SOAP LINIMENT.

Linimentum saponato-camphoratum liquidum, P. G.—*Spiritus nervinus camphoratus*; *Liquid opodeldoc*, E.; *Liniment savonneux camphré*, Fr.; *Flüssiger Opodeldok*, G.

Preparation.—Soap, in shavings, 10 parts (8 oz. av.); Camphor 5 parts (4 oz. av.); Oil of Rosemary 1 part (350 grains or 7 fluidrachms); Alcohol 70 parts (56 oz. av. or 4 pints and $1\frac{7}{8}$ fluidounces); Water a sufficient quantity; to make 100 parts (80 oz. av.). Digest the soap in 14 parts ($11\frac{1}{5}$ oz. av. or $10\frac{3}{4}$ fluidounces) of water until it is dissolved; dissolve the camphor and oil in the alcohol; mix the solutions and filter through paper, adding enough water, through the filter, to make the liniment weigh 100 parts (80 oz. av. or about 5 pints).—*U. S.*

Take of hard soap, in fine shavings, 2 ounces; camphor 1 ounce; oil of rosemary 3 fluidrachms; rectified spirit 16 fluidounces; distilled water 4 fluidounces. Mix the water with the spirit, and add the oil of rosemary, the soap, and the camphor. Macerate for 7 days at a temperature not exceeding 70° F., with occasional agitation, and filter.—*Br.*

Both Pharmacopœias use soap made with olive oil and soda, which is more soluble in the alcohol than soap made with animal fat, but both omit to state whether or not the soap is to be dried before being weighed. The details of the first process are rapidly executed: the soap on being digested with the water in a tared vessel yields a thick and smooth almost jelly-like solution, to which sufficient hot water should be added to compensate for the loss by evaporation; the alcoholic solution of the oil and camphor is then added, the mixture rapidly stirred, and the vessel well closed and allowed to cool. If white Castile soap is used the liniment will have a pale-yellowish color, and is at once ready for use, but if mottled soap is employed the preparation will be turbid, and should be filtered, when it will have a brownish color, due to the iron held in solution. With the slight reduction in the amount of soap, as compared with the process of 1870, the preparation is less liable to have a portion of the soap deposited in cold weather than formerly. Barckhausen (1872) suggested the use of a potassa soap made of rape-seed oil, which has the advantage of not separating from the alcohol even at the freezing temperature; and a soap made from castor oil has been suggested by C. H. Clark and L. E. Sayre in 1872. To accomplish the same result, the German Pharmacopœia uses a potassa soap of olive oil.

Allied Preparations.—LINIMENTUM SAPONATO-CAMPHORATUM, s. BALSAMUM OPODELDOC.—Opodeldoc, Steer's opodeldoc, *E.*; Baume opodeldoch, Baume de savon, *Fr.*; Opodeldok, *G.*—Digest, in a suitable vessel, of tallow soap 30 parts, camphor 24 parts, and 90 per cent. alcohol 250 parts; when dissolved add oil of thyme 2 parts, oil of rosemary 6 parts; agitate with 10 parts of animal charcoal, add ammonia-water 10 parts; filter rapidly by means of a well-covered funnel, collect the filtrate in suitable wide-mouthed vials, and allow it to congeal.—*F. Cod.*

The German Pharmacopœia uses soap 6 parts, camphor 2 parts, alcohol 81 parts, and glycerin 5 parts; the warm solution is filtered; then it adds oil of thyme 0.4 part, oil of rosemary 0.6 part, and ammonia-water 5 parts. The liniment is solid at the ordinary temperature, but readily liquefies at the temperature of the body, and is white or yellowish, opalescent, and somewhat translucent.

Linimentum saponato-ammoniatum. Dissolve 1 part of Castile soap in 30 parts of water and 10 parts of alcohol, and add 15 parts of ammonia-water.—*P. G.* 1872.

Spiritus saponatus, *P. G.*—Tincture of soap, *E.;* Teinture de savon, *Fr.;* Seifenspiritus, *G.* —Digest olive oil 6 parts, solution of potassa (sp. gr. 1.144) 7 parts, and alcohol 7 parts until saponified; add alcohol to replace that which may have evaporated; afterward add alcohol 23 parts and water 17 parts.—*P. G.* It is a yellowish liquid of an alkaline reaction.

Saponimentum is an alcoholic solution of neutral soap, combined with other medicaments.

Medical Uses.—An anodyne and discutient preparation, used for the same purposes as camphor liniment, but more efficient, because more stimulant, than that preparation. The *opodeldoc balsam* (P. G.), again, is more stimulant than the officinal preparation.

LINIMENTUM SINAPIS COMPOSITUM, *U. S., Br.*—Compound Liniment of Mustard.

Liniment sinapisé composé, Fr.; *Zusammengesetztes Senfliniment*, G.

Preparation.—Volatile Oil of Mustard, 3 parts (24 grains); Extract of Mezereum 2 parts (16 grains); Camphor 6 parts (48 grains); Castor Oil 15 parts (120 grains); Alcohol a sufficient quantity; to make 100 parts (800 grains). Dissolve the extract of mezereum and the camphor in 70 parts (560 grains or 1½ fluidounces) of alcohol; then add the oil of mustard and castor oil, and finally enough alcohol to make the product weigh 100 parts (800 grains or about 2 fluidounces).—*U. S.*

Take of oil of mustard 1 fluidrachm; ethereal extract of mezereon 40 grains; camphor 120 grains; castor oil 5 fluidrachms; rectified spirit 4 fluidounces. Dissolve the extract of mezereon and camphor in the spirit, and add the oil of mustard and castor oil.—*Br.*

The solution is readily effected on maceration in a vial. The second formula yields a somewhat stronger preparation.

Medical Uses.—It was doubtless intended in this compound to provide a powerful counter-irritant and revulsive, and it is described as a useful embrocation. We should hesitate to employ it without feeling more assured than at present of its being safe. The sores made by mezereon or by mustard are very intractable. Moreover, if the oil of mustard is in such proportion as to produce its proper effect, it will do so long before the mezereon has begun to act. Hence one or the other ingredient of the liniment would seem to be superfluous.

LINIMENTUM TEREBINTHINÆ, *U. S., Br.*—Liniment of Turpentine.

Linimentum terebinthinatum, P. G.—*Liniment térébenthiné*, Fr.; *Terpentinliniment*, G.

Preparation.—Resin Cerate 65 parts (13 oz. av.); Oil of Turpentine 35 parts (7 oz. av. or 7⅞ fluidounces); to make 100 parts (20 oz. av.). Add the oil to the cerate, previously melted, and mix them thoroughly.—*U. S.*

Take of soft soap 2 ounces; camphor 1 ounce; oil of turpentine 16 fluidounces. Dissolve the camphor in the oil of turpentine; mix the soap with 2 fluidounces of water; then rub these fluids together until they are thoroughly mixed.—*Br.*

Oleol of chamomile, oil of turpentine, equal parts.—*F. Cod.* Potassium carbonate 6 parts, green soap 54 parts, oil of turpentine 40 parts.—*P. G.*

The first formula yields what is known as *Kentish liniment;* the cerate should be melted at a low heat, and then the oil gradually added, with continued stirring. The second process is a considerable modification of the former, and requires continued trituration of the soap in a mortar, with the gradual addition of the oil, in order to obtain a uniform mass. The liniments of the French and German Pharmacopœias differ from each other and from the foregoing.

Medical Uses.—This preparation was originally employed in the treatment of *burns* and *scalds*, which it protects from the irritating influence of the air, while it maintains a moderate stimulation which tends to prevent the ulterior effects of those injuries in which the vitality of the tissues is more or less impaired. It is essential for its successful use that the primary dressing should not be removed for 24 hours, and that the liniment should not be continued longer than is necessary to establish a healthy action in the part. This preparation is also serviceable in superficial *erysipelas* or *erythema* arising from traumatic causes, and in *frost-bite* without active inflammatory phenomena.

LINIMENTUM TEREBINTHINÆ ACETICUM, *Br.*—LINIMENT OF TURPENTINE AND ACETIC ACID.

Liniment térébenthiné acétique, Fr.; *Terpenthin- und Essig-Liniment*, G.

Preparation.—Take of Oil of Turpentine 4 fluidounces (4 fluid parts); Glacial Acetic Acid 1 ounce (1 part); Liniment of Camphor 4 fluidounces (4 fluid parts). Mix.—*Br.*

Medical Uses.—This preparation is essentially "St. John Long's liniment," which name it derived from a quack who professed to cure almost every painful local disease by its application. It is particularly efficient in *neuralgia* when applied over the points of exit of the trunks or the terminal distribution of the affected nerves. It should then be employed so as to vesicate the part superficially and over a small area. It may also be applied to relieve other local pains and inflammations, such as limited *muscular rheumatism*, and to the epigastrium to allay *vomiting* depending on inflammation of the stomach.

LINTEUM.—LINT.

Linteum carptum.—*Charpie*, Fr., G.

Preparation and Description.—Lint was originally made from bleached linen cloth by scraping it until it became soft and woolly. At the present time it is almost exclusively prepared by means of machinery from a fabric woven for this purpose, and is known as *patent lint* in distinction to the hand-made lint. It is in rather thick but very soft and fleecy sheets, and when viewed under the microscope shows the bast-cells of flax as long cylindrical tubes, which are slightly thickened in a few places and somewhat pointed toward both ends. The cell-walls are very thick by concentric deposits, leaving only a small central cavity. Immersed in an ammoniacal solution of copper, they swell considerably, and are ultimately dissolved without leaving any residue. These cells resemble the bast-fibres of hemp, but the latter are thinner, blunt at the ends, with a still smaller cavity in the centre, and adhere more firmly together, hence the coarser appearance of hemp fabrics.

Cotton is now often more or less substituted for linen, and lint made in this way is known as *cotton lint*. The fibre of cotton is described on page 744, and may be readily distinguished from linen fibre by the microscope.

Tests for Linen and Cotton.—Boiled with a concentrated solution of potassa, the linen fibre turns bright yellow within 2 minutes, while cotton fibre remains white or becomes pale-yellowish. Dipped in a solution of *rosolic acid*, which is known in commerce as aurin or yellow corallin, and afterward in a concentrated solution of sodium carbonate, linen fibre is dyed rose-red, while cotton fibre remains white. When immersed in a tincture of *madder*, linen fibre acquires a yellowish-red, but cotton fibre a light-yellow, color. Cold concentrated *sulphuric acid* does not materially alter linen fibre within 1 or 2 minutes, while cotton fibre is destroyed in the same time. When rubbed with a *fixed oil*, linen fabric remains white and opaque, but cotton becomes translucent.

Surgical Action and Uses.—The purpose of lint is to provide a soft and unirritating covering for *wounds*; to protect them from the air and the foreign particles floating in it; to moderate and graduate the pressure of bandages and other surgical apparatus; to absorb the more liquid discharges; and to be introduced into wounds which are not intended to heal immediately. Of the different forms of lint, that which is made of old linen by picking apart its threads is the most elastic and absorbent, and by far the most comfortable to the patient; that which is made by scraping old linen is very suitable for small wounds and abrasions; and the so-called patent lint is the least eligible unless its threads are unravelled so as to form a soft mass. But the last-mentioned lint, when made of cotton, as it usually is, does not absorb discharges nearly as well as that derived from linen, chiefly on account of the oil which adheres to it. Of late years cotton lint has been prepared entirely free from oil, and therefore possessing a greater absorbent power, and is at the same time impregnated with carbolic acid, so as to render it disinfectant. But a defect of all cotton lint is, that as soon as it becomes saturated with liquids it entirely loses its elasticity, which is not the case with old linen lint or charpie. A substance analogous to charpie is oakum, which consists of tarred ropes picked into shreds. Its value, derived from the tar impregnating it and the greater looseness of its texture, is counterbalanced by the harshness of the material. It was first suggested by Surgeon Ruschenberger, U. S. N., in 1862.

LINUM, *U. S.*—Flaxseed.

Lini semina, Br.; *Semen Lini*, P. G.—*Linseed*, E.; *Semence* (*Graine*) *de lin*, Fr.; *Leinsamen*, *Flachssamen*, G.

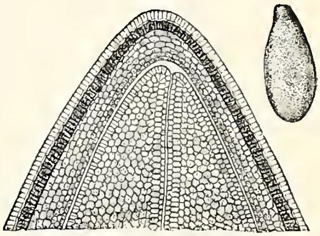
The seed of Linum usitatissimum, *Linné.* Woodv., *Med. Bot.*, plate 3; Bentley and Trimen, *Med. Plants*, 39.
Nat. Ord.—Linaceæ.

LINI FARINA, *Br.*—Flaxseed Meal.

Linseed meal, E.; *Farine de lin*, Fr.; *Leinsamenmehl*, *Leinmehl*, G.

Origin.—Flax is probably indigenous to the Mediterranean basin, but has been cultivated for so long a period, and grows so spontaneously wherever it has been introduced, that it is difficult to determine its native country. It has an annual stem about 2 feet (60 Cm.) high, alternate linear-lanceolate leaves, and terminal flowers with five ovate, pointed, and three-nerved sepals and five fugacious blue-veined and short-clawed petals. The fruit is an ovate five-celled and ten-seeded capsule, each cell being again imperfectly divided. As cultivated in the various tropical and temperate countries, several varieties have been observed, differing in the shape and size of the seeds and more markedly in other characters. The seeds are principally imported from Russia and Germany. (See Oleum Lini.)

Fig. 174.



Flaxseed, magnif. 3 diam., and transverse section near edge, magnif. 65 diam.

Description.—Flaxseed is $\frac{1}{6}$ to $\frac{1}{4}$ inch (4–6 Mm.) long, oblong-ovate, considerably flattened, but the sides convex and the edges obtuse, rounded below and oblique at the apex, beneath which the hilum is located in a slight depression. The testa is of a yellowish-brown color, glossy, and covered with a transparent epithelium, which swells very considerably in water; the kernel consists of a very thin endosperm and two large plano-convex oily greenish or yellowish cotyledons having the shape of the seed, with the radicle projecting into the pointed end. The brown coloring matter is contained in the inner cell-row of the testa; the albumen and cotyledons are composed of thin-walled parenchyma, the cells being filled with proteids and oil, but are free from starch. The seed is inodorous, and has a mucilaginous, bitterish, and oily taste.

Placentæ seminis lini, *P. G.*, are the press-cakes obtained in preparing linseed oil, and on grinding yield the so-called *cake meal.* These press-cakes are of a dingy-gray color, and their powder shows under the microscope fragments of the brown-yellow testa of linseed, but none of the blackish-brown testa of rape-seed, and yields with boiling water and on filtering a mucilaginous liquid, which when cold is not colored blue by iodine. But cake meal is not recognized by the U. S. Pharmacopœia, which requires that "ground flaxseed, for medicinal purposes, should be recently prepared, free from unpleasant or rancid odor, and, when extracted with disulphide of carbon, should yield not less than 25 per cent. of fixed oil." The Br. P. and F. Cod. likewise order the ground seeds.

Constituents.—The most important constituents of flaxseed are the *mucilage* and *fixed oil*, the latter (see Oleum Lini), according to Chevallier (1844), being contained in the embryo to the extent of about 30 to 39 per cent., the former in the epithelium to the extent of about 15 per cent. The mucilage is $C_{12}H_{20}O_{10}$, and by nitric acid is converted into mucic acid. Besides the above, Leo Meyer (1826) found protein compounds, a small portion of wax, resin, sugar, malates, acetates, and other salts, which are dissolved with the mucilage. The ash amounts to about 3 per cent., and consists of phosphates, with some sulphates and chlorides of potassium, calcium, and magnesium.

Off. Prep.—1. Of flaxseed: Farina lini, Infus. lini, *Br.* 2. Of flaxseed meal: all cataplasms, except Catapl. fermenti, *Br.*

Medical Action and Uses.—The union of oil and mucilage in flaxseed adapts it for external application in the many cases in which an emollient is required, and the ready absorption of at least the water in its infusion has led to its internal use as a diluent and diuretic. Flaxseed tea is universally employed in *inflammations* of the mucous membranes of the *respiratory*, *digestive*, and *urinary* organs. It serves as the basis of numerous ptisans, and is injected into the rectum, vagina, and bladder in irritations of those organs It forms an ordinary drink in *renal* and *vesical* irritations. The tea is made with $\frac{1}{2}$

ounce of flaxseed to a pint of boiling water, macerated for 2 hours and strained. It may be taken in any convenient quantity. The compound infusion (U. S. P. 1870) contains liquorice, which adapts it to bronchial affections. Flaxseed mucilage is prepared by boiling the seed. It is commonly used to cover *erysipelatous* and other inflammations of the skin, *burns*, etc., but is objectionable if allowed to get dry, by rendering the skin stiff; it is also apt to become sour and irritating. For the purposes last mentioned acetate of lead is sometimes dissolved in it. It precipitates the solution of subacetate of lead.

The flaxseed poultice is prepared by gradually pouring boiling water upon flaxseed meal and stirring the mixture until it acquires the proper consistence. As it tends to render the skin white, wrinked, and sodden, and to excite a pustular eruption, the part to which it is applied should first be covered with sweet oil, fresh lard, or glycerin; or, as directed officinally (British Pharmacopœia), olive oil should be mixed with the meal of which the poultice is made. Wherever applied, it should be kept in close contact with the skin. It may be medicated by the addition of narcotic tinctures or watery solutions, of astringents, stimulants, etc.

LIQUIDAMBAR.—Sweet Gum.

A balsamic exudation from Liquidambar styraciflua, *Linné.*

Nat. Ord.—Hamamelaceæ, Balsamifluæ.

Origin.—The sweet gum tree, also called *bilsted* and *copalm*, is a handsome North American tree, from 40 to 60 feet (12–18 M.) high, growing from Connecticut and Illinois southward to Florida and westward to Mexico. It has a reddish, fine-grained, and compact wood and a thick gray deeply-furrowed astringent bark, that of the branches being usually furnished with thick wing-like ridges of cork. The leaves are dark-green, round in outline, palmately five to seven-lobed, and the lobes serrate. The fruit is capsular, beaked, aggregated in globular heads, together with the indurated scales. The leaves, fruit, and bark when bruised have an agreeable odor; the taste of the bark is balsamic and astringent, and that of the other parts mentioned aromatic and acidulous. In its southern locations the tree yields a balsamic exudation from incisions made in the bark.

Description.—Sweet gum, also called *gum wax*, exudes in the form of a thick liquid having the density of syrup and a yellowish color. On standing it thickens, becomes darker in color, and finally hard at the ordinary temperature, and breaks with a resinous fracture, which is of a variegated appearance, the color being brown, with lighter (and even white) spots and streaks. It softens somewhat by the warmth of the hand, and when heated fuses to a yellowish-brown liquid. It has a very pleasant balsamic odor and taste, the latter being followed by pungency. It dissolves completely, fragments of bark excepted, in alcohol, ether, and chloroform, the alcoholic solution having a slight acid reaction.

Constituents.—A pretty complete analysis of sweet gum was made by William L. Harrison (1874). He obtained, by distillation with a solution of sodium carbonate in water, 3½ per cent. of an aromatic oily hydrocarbon, having the properties of *styrol*, but which was found by Flückiger to be not converted into metastyrol; the aqueous liquor in the retort, on being supersaturated with acid, yielded 5½ per cent. of *cinnamic acid*. The portion insoluble in the alkaline liquor was partly dissolved in hot petroleum benzin, the solution yielding *styracin* on cooling, and finally left a dark-brown nearly tasteless and inodorous resin. The sweet gum examined contained 9 per cent. of impurities. On treating sweet gum with warm petroleum benzin, cinnamic acid and styracin are taken up, and crystallize together on cooling; they may then be separated with weak ammonia, which dissolves the cinnamic acid only. Harrison observed also that by heating sweet gum with a small quantity of water and stirring frequently a gray-colored mixture is obtained resembling storax. The presence of cinnamic acid in sweet gum was previously proved by Hanbury (1857) and Procter (1866). It will be observed that sweet gum agrees in composition with storax, which in addition contains water mechanically mixed with it.

Pharmaceutical Uses.—A *syrup of sweet gum* is made by the officinal process for syrup of tolu, and is much employed in some parts of the Southern States. A *syrup of sweet-gum bark* is likewise used and prepared by the officinal process for syrup of wild cherry (Dr. C. W. Wright, 1856). According to L. Hughes (1876), an ethereal solution of sweet gum is very serviceable for extinguishing the mercury in preparing mercurial ointment.

Medical Action and Uses.—These appear to be identical with those of storax;

and indeed the latter is defined by the United States Pharmacopœia to be "a balsam prepared from the inner bark of Liquidambar orientalis." Its action is that of an aromatic resin, operating particularly upon the respiratory and urinary mucous membranes. It is employed in the treatment of chronic profluvia of these parts, such as *bronchitis*, *cystitis*, *pyelitis*, and *gleet*. Externally, it was used formerly in an ointment for the treatment of *scabies* (as storax now is), and for various purposes to which resin cerate is applied, including *frost-bite*, indolent *ulcers*, and *burns*. A decoction, and also a syrup prepared from the bark, are said to be used in the Western and Southern States in the treatment of infantile *diarrhœa* and *dysentery*. The former is sometimes made with milk. The bark, like the leaves, is astringent.

LIQUORES.—Solutions.

Solutés, Fr.; *Lösungen*, G.

With the exception of infusions, decoctions, and syrups, and of those aqueous liquids containing volatile oils or gases, all aqueous solutions are, by the U. S. Pharmacopœia, designated *Liquores;* the British and some other pharmacopœias embrace under the same head also aqueous solutions of gases. The German Pharmacopœia is inconsistent in its designation, lime-water, chlorine-water, and lead-water being placed among *Aquæ*, while ammonia-water is regarded as a *liquor*. Gutta-percha solution and blistering liquid alone have a menstruum other than water.

LIQUOR ACIDI ARSENIOSI, *U. S.*—Solution of Arsenious Acid.

Liquor arsenici chloridi, U. S. 1870.—*Liquor arsenici hydrochloricus*, Br.—*Solution of chloride of arsenic*, *Hydrochloric solution of arsenic*, E.; *Liqueur arsénicale hydrochlorique*, Fr.; *Chlorarsenik-Lösung*, G.

Preparation.—Arsenious Acid, in small pieces, 1 part (20 grains); Hydrochloric Acid 2 parts (40 grains); Distilled Water a sufficient quantity; to make 100 parts (2000 grains). Boil the arsenious acid with the hydrochloric acid, and with 25 parts (500 grains or 9 fluidrachms) of distilled water, until solution has been effected. Filter the liquid. and pass enough distilled water through the filter to make the solution weigh 100 parts (2000 grains, measuring 35 fluidrachms).—*U. S.*

Arsenious acid in powder 87 grains; hydrochloric acid 2 fluidrachms; distilled water sufficient to make 1 pint (Imperial).—*Br.*

Arsenious and hydrochloric acids, when heated together, and then distilled, unite to form volatile *arsenious chloride*, As_2Cl_6, which, on being dissolved in water, is decomposed again into the compounds from which it was prepared. The officinal solutions, therefore, contain simply the two acids.

Properties.—The solution is colorless, has an acid reaction, and an acidulous taste. Sulphuretted hydrogen yields at once a bright-yellow precipitate of sulphide of arsenic. In arsenic strength it corresponds with Fowler's solution, containing 1 per cent. of arsenious acid, or 4.57 grains (4 grains, U. S. 1870) to the fluidounce, or 4.35 grains (4 grains, *Br.* 1867) to the Imperial fluidounce; Valangin's solution contained 0.38 per cent. of arsenious acid, or 1¾ grains to the fluidounce. The pharmacopœial solutions have the specific gravity 1.009 *U. S.*, 1.010 *Br.*

The strength is determined as follows: "If 25 Gm. of solution of arsenious acid be boiled for a few minutes with 2 Gm. of bicarbonate of sodium, the resulting liquid should not decolorize less than 48.5 Ccm. of the volumetric solution of iodine (corresponding to 1 per cent. of arsenious acid of the required purity)."—*U. S.* "442 grains boiled for 5 minutes with 20 grains of bicarbonate of sodium, and then diluted with 6 fluidounces of distilled water, to which a little mucilage of starch has been added, does not give with the volumetric solution of iodine a permanent blue color until 875 grain-measures have been added."—*Br.*

Allied Preparation.—Liquor arsenici bromidi. Clemens's formula (1876), somewhat modified in the manipulation, is as follows: Mix 1 part each of powdered arsenious acid and pure carbonate of potassium, and dissolve in about 10 parts of boiling water; then add 80 parts of water and 2 parts of bromine, set aside at a moderate temperature until the liquid has become colorless, and add sufficient water to make the solution weigh 100 parts. It is said to improve by age. *Bromide of arsenic*, $AsBr_3$, is crystalline, melts near 25° C. (77° F.), boils and volatilizes without decomposition near 220° C. (428° F.), and is decomposed by water, with the formation of arsenious and hydrobromic acids. The above solution probably contains bromide and arsenate of potassium.

Medical Uses.—The advantages of this preparation, which contains the same proportion of arsenic as Fowler's solution, are far from being apparent. Indeed, its action has been pronounced very uncertain. It may be given in *doses* of from 3 to 5 drops, largely diluted and after meals.

LIQUOR AMMONII ACETATIS, *U. S., Br.*—SOLUTION OF ACETATE OF AMMONIUM.

Liquor ammoniæ acetatis, Liquor ammonii acetici, P. G.; *Acetas ammonicus liquidus, Spiritus Mindereri.—Spirit of Mindererus*, E.; *Acetate d'ammoniaque liquide, Esprit de Mindérérus*, Fr.; *Ammoniumacetat-Lösung, Essigsaure Ammonium-lösung*, G.

Preparation.—Diluted Acetic Acid 100 parts (weight or measure prescribed); Carbonate of Ammonium a sufficient quantity. Add a sufficient quantity of carbonate of ammonium gradually to the diluted acetic acid until the latter is neutralized. This preparation should be freshly made when required for use.

Solution of acetate of ammonium may also be prepared in the following manner: Carbonate of ammonium 10 parts (2½ oz. av.); acetic acid 28 parts (7 oz. av.); distilled water 142 parts (35½ oz. av.). Dissolve the carbonate of ammonium in 80 parts (20 oz. av. or 19¼ fluidounces) of distilled water, and filter the solution. To the acetic acid add 62 parts (15½ oz. av. or 14⅞ fluidounces) of distilled water. Keep the solutions in separate, well-stopped bottles, and when solution of acetate of ammonium is to be dispensed weigh equal quantities of each solution and mix them.—*U. S.*

Strong solution of ammonium acetate 4 fl. oz., distilled water sufficient for 20 fluidounces.—*Br.* Spec. grav. 1.022.

LIQUOR AMMONII ACETATIS FORTIOR.—Add crushed carbonate of ammonium 17½ oz. gradually to 45 oz. of acetic acid; then add more of the acid (about 5 oz.) until a neutral liquid results, and add sufficient water to yield 60 fluidounces of product. Preserve in bottles free from lead.—*Br.* Spec. grav. 1.073.

The directions of the U. S. Pharmacopœia indicate that the solution is to contain some carbonic acid. The first formula directs the *neutralization* of the acetic acid, which, however, cannot be ascertained by litmus-paper, owing to the carbonic acid remaining in solution. Turmeric-paper is preferable, in so far as it more readily indicates even a slight excess of ammonium carbonate by the brown color produced; but the exact point of neutralization cannot be ascertained. Under the circumstances the taste is as reliable as test-paper. After the pricking sensation upon the tongue caused by the carbonic acid has disappeared the taste should be saline and free from alkalinity. This result is accomplished by the second process, provided that translucent ammonium carbonate is used in making one of the solutions. The correct weights of the alkaline and acid solutions having been taken, they are mixed in a graduate, and after the violent effervescence has subsided the liquid is poured into the vial. For the *extemporaneous* preparation by this process of 4 fluidounces of this solution, dissolve 110 grains of ammonium carbonate in 880 grains (or 15½ fluidrachms) of distilled water; mix 308 grains (or 5 fluidrachms and 10 minims) of acetic acid with 682 grains (or 12 fluidrachms) of distilled water, and add the acid liquid to the first solution. After effervescence has ceased the liquid will measure about 33 fluidrachms.

Properties.—It is "a clear, colorless liquid, free from empyreuma, of a mildly saline taste and a neutral or slightly acid reaction; sp. gr. 1.022. It is wholly volatilized by heat. When heated with potassa it evolves vapors of ammonia, and when heated with sulphuric acid it gives out vapor of acetic acid. It should not be darkened by hydrosulphuric acid or sulphide of ammonium (absence of metals). It contains about 7.6 per cent. of acetate of ammonium."—*U. S.* In this description no notice is taken of the presence of carbonic acid gas in the liquid, which is evidently intended by the process.

The British Pharmacopœia directs the preparation of a neutral solution which is somewhat stronger: the undiluted acetic acid being used, less carbonic acid is retained by the liquid, and may be expelled by trituration or stirring at first, and toward the close of the reaction by warming the liquid until it has no effect upon test-paper, after which it is to be properly diluted. In place of ammonium carbonate, ammonia-water may be used to effect the neutralization, as directed by the German Pharmacopœia, which requires the neutralized liquid to be heated to boiling for a short time, in order to expel traces of empyreumatic matter likely to be present in the ammonia-water. The description corresponds with the one given above, but the solution is to have the specific gravity 1.032–1.034, to contain 15 per cent. of ammonium acetate, and to be not rendered turbid by barium nitrate (absence of sulphate), nor, after acidulation with nitric acid, by silver nitrate (absence of chloride).

Acetic acid decomposes ammonium carbonate, carbonic acid gas being given off and ammonium acetate remaining in solution; $4HC_2H_3O_2 + N_4H_{16}C_3O_8$ yields $3CO_2 + 4NH_4C_2H_3O_2 + 2H_2O$. When long kept in contact with air the solution acquires an alkaline reaction.

Off. Prep.—Mistura ferri et ammonii acetatis, *U. S.*

Physiological Action.—Experiments upon animals show that this preparation, in large doses, affects them energetically—in rabbits causing fatal tetanic spasms and dissolution of the gastric mucous membrane. Given to healthy men, it does not appear to occasion any decided symptoms, except a little warmth of the skin and in the abdomen, headache, and loss of appetite. Upon the skin it acts as an irritant, and may even vesicate it. Judged by its apparent effects in disease, it seems to be stimulant, diaphoretic, diuretic, and expectorant, and sometimes causes transient giddiness and exhilaration.

Medical Uses.—It is generally held to be efficient in the forming stage of *catarrh*, *sore throat*, and *muscular rheumatism*, and in the *eruptive fevers* when the eruption is slow to appear. It is the best diaphoretic in epidemic catarrh or *influenza*. In low forms of *fever* it is often of signal advantage, helping to sustain the powers of life until the crisis is past. In this way it is peculiarly valuable in *typhus*, in which, like other appropriate stimulants, it lowers the pulse and temperature, moistens the dry tongue, and moderates the delirium. It is reported to have been peculiarly efficacious in the treatment of epidemic *pseudo-membranous bronchitis.*

In *sick headache* few remedies are so successful as a teaspoonful or two of this solution repeated every hour. In *alcoholic intoxication* it frequently dissipates at once the signs of drunkenness. It is reported to be an efficient remedy in *dysmenorrhœa* and *menorrhagia.* It is an adjuvant in the treatment of scarlatinous *dropsy*, and is perhaps not without advantage in chronic *eruptions of the skin.*

Externally, it is a valuable discutient in *contusions*, *glandular swellings*, *mammary engorgements*, *commencing abscesses*, *hydrarthrosis*, and even acute *hydrocele.* It has been found beneficial in *impetigo capitis.*

The *dose* of the officinal solution is from ½ fluidounce to 1½ fluidounces (Gm. 15–45), diluted with sweetened water.

LIQUOR AMMONII CITRATIS, *Br.*—SOLUTION OF CITRATE OF AMMONIUM.

Citrate d'ammoniaque liquide, Fr.; *Ammoniumcitrat-Lösung*, G.

Preparation.—Strong Solution of Ammonium Citrate 5 fl. oz.; Distilled Water sufficient for 20 fluidounces.—*Br.* Spec. grav. 1.062.

LIQUOR AMMONII CITRATIS FORTIOR.—Neutralize citric acid 12 oz. with ammonia 11 fluidounces or sufficient, and add distilled water sufficient to yield 20 fluidounces of product. Store in bottles free from lead.—*Br.* Spec. grav. 1.209.

Citric acid combines with ammonia, forming ammonium citrate and water. The two solutions are clear and colorless, have a saline taste, and should not change either litmus- or turmeric-paper.

Medical Action and Uses.—This solution is perhaps more palatable than solution of acetate of ammonia, but its medicinal effects are in no wise different. *Dose*, from 2 to 4 fluidrachms (Gm. 8–16).

LIQUOR ANTIMONII CHLORIDI, *Br.*—SOLUTION OF CHLORIDE OF ANTIMONY.

Liquor stibii chlorati, *Antimonium muriaticum liquidum*, *Butyrum antimonii* (*s. stibii*), *Chloridum* (*s. Chloruretum*) *stibicum.*—*Liquid butter of antimony*, E.; *Chlorure* (*Beurre*) *d'antimoine liquide*, *Huile d'antimoine*, Fr.; *Spiessglanzbutter*, G.

A solution of $SbCl_3$ (molecular weight 226.2) in hydrochloric acid.

Preparation.—Purified Black Antimony 1 pound; Hydrochloric Acid 4 pints. Place the black antimony in a porcelain vessel, pour upon it the hydrochloric acid, and, constantly stirring, apply to the mixture, beneath a flue with a good draught, a gentle heat, which must be gradually augmented as the evolution of gas begins to slacken, until the liquid boils. Maintain it at this temperature for 15 minutes; then remove the vessel from the fire, and filter the liquid through calico into another vessel, returning what passes through first, that a perfectly clear solution may be obtained. Boil this down to the bulk of 2 pints (Imperial), and preserve it in a stoppered bottle.—*Br.*

Hydrochloric acid decomposes sulphide of antimony, with the production of antimonious chloride, which dissolves in the acid liquid, and hydrogen sulphide, which escapes; $Sb_2S_3 + 6HCl$ yields $2SbCl_3 + 3H_2S$. Provision must be made to carry off the offensive gas either through a flue or by working in the open air. The powdered sulphide and the acid may be left in contact for several hours, during which time the reaction will partly take place; the mixture should afterward be slowly heated until the boiling-point is reached and the disengagement of sulphuretted hydrogen ceases. The insoluble mineral impurities are then filtered off, either through calico, or, preferably, through a material which is not corroded by the acid liquid, such as gun-cotton, asbestos, or glass-wool. The arsenic naturally contained in the antimony is partly evolved, and the remainder is removed as arsenious chloride by boiling the filtered liquid and concentrating it as directed, this arsenic compound being much more volatile than the antimonious chloride. The French Codex directs the liquid to be concentrated by evaporation, and the residue to be distilled—an operation requiring great care in case notable quantities of lead chloride be present.

Properties.—It is a yellowish or yellowish-red liquid having the spec. gr. 1.47, and yielding with water a white precipitate of antimonious oxychloride (*powder of Algaroth*), $(SbCl_3)_2 5Sb_2O_3$. This precipitate is completely soluble in an aqueous solution of tartaric acid, and the solution, when treated with hydrogen sulphide, yields an orange-brown precipitate of sulphide of antimony, which, when dried at 100° C., should weigh about 22 grains for every fluidrachm of the officinal solution. When free from other metals the solution is colorless; as prepared from the crude sulphide, however, it always contains ferric chloride.

Antimonium chloride of the French Codex is a soft white, translucent, crystalline, and very caustic mass, which melts to a clear liquid at 73° C. (163.5° F.) and boils at 223° C. (433.5° F.). On exposure to the air it fumes and absorbs moisture, deliquescing to a clear oily liquid, which is precipitated by more water. The salt is soluble in cold alcohol, and this solution, when boiled, precipitates antimonious oxychloride.

Impurities.—*Lead*, if present, will mostly crystallize from the cold liquid; what remains dissolved may be recognized by a drop of dilute sulphuric acid, which will cause a white precipitate. *Copper* is recognized by the blue color obtained on treating the liquid with an excess of ammonia. *Arsenic* is detected by rendering the liquid strongly alkaline with potassa, adding a little pure zinc, and heating to boiling. The vapors, on coming in contact with filtering-paper moistened with a drop of solution of silver nitrate, will then color the latter black.

Pharmaceutical Uses.—In the preparation of Antimonii oxidum, *Br.*

Surgical Action and Uses.—Butter of antimony is one of the most powerful caustics employed in surgery, and from its readily penetrating into *wounds* has been used to cauterize those inflicted by rabid animals and venomous serpents. It has also been applied to *malignant pustule, warts, condylomata*, and *chancres*. "Pure chloride of antimony has been used as an application to *staphyloma* by some German surgeons; a camel's-hair pencil or a point of lint is dipped in the deliquescent salt and applied to the tumor until a whitish crust is perceived, when the whole is washed away by means of a large camel's-hair pencil dipped first in milk and afterward into milk and water" (Neligan).

Several instances of poisoning by this preparation are on record in which, besides abrasions of the mouth and throat, or even a charred appearance of these parts, there was more or less complete general collapse. In one case recovery took place after 4 or 5 drachms, and in another after an ounce, had been taken. In a fatal case the dose was 3 ounces, and on inspection after death the interior of the alimentary canal from the mouth down to the jejunum presented a black appearance, as if the parts had been charred (Taylor).

The proper *antidotes* for poisoning by chloride of antimony are chalk and magnesia or its carbonates, combined with demulcent drinks. Tannic acid and the substances containing it are also recommended.

LIQUOR ARSENII ET HYDRARGYRI IODIDI, *U. S., Br.*—SOLUTION OF IODIDE OF ARSENIC AND MERCURY.

Liquor arsenici et hydrargyri iodidi, U. S. 1870; *Solutio Donovani.—Donovan's solution*, E.; *Soluté d'iodo-arsénite de mercure, Liqueur de Donovan*, Fr.; *Jodquecksilber-Arsenik-Lösung, Donovansche Tropfen*, G.

Preparation.—Iodide of Arsenic 1 part (41 grains); Red Iodide of Mercury 1 part (41 grains); Distilled Water, a sufficient quantity; to make 100 parts (4100 grains). Triturate the iodides with 15 parts (615 grains or 11 fluidrachms) of distilled water until they are dissolved. Filter the liquid, and pass enough distilled water through the filter to make the solution weigh 100 parts (4100 grains or 9 fluidounces).—*U. S.*

Iodide of arsenium, mercuric iodide, each 45 grains; distilled water sufficient for 10 fluidounces Imperial.—*Br.*

This is a solution of the two iodides in very nearly the proportion of their molecular weights, and containing them mixed, but not chemically combined. The present preparation contains about 4 per cent. more of each of the two iodides than that of 1870.

Properties.—It is of a light-yellow color, has a metallic taste, and gives precipitates with solutions of silver, alkalies, and salts of the alkaloids. The 9 fluidounces represent very nearly 7 grains of metallic arsenic and about 18 grains of mercury.

Medical Uses.—The combination of arsenic and mercury in this preparation was proposed for the treatment of *syphilitic* diseases of the skin, and was thought to be especially useful in those of the squamous form, although mercury alone is apt to aggravate them. Yet many consider that in these cases the compound is more injurious than useful. The efficacy of Donovan's solution is shown in cutaneous affections apparently free from syphilitic taint when they have become chronic and have resisted arsenic alone. Among these may be mentioned *impetigo* and *sycosis*; in the latter it should be associated with epilation. The best authorities deny that it has any curative influence in *lupus*. The *dose* is 5 drops (Gm. 0.30), gradually increased and taken after meals, well diluted.

LIQUOR ATROPIÆ, *Br. 1867.*—SOLUTION OF ATROPIA.

Soluté d'atropine, Fr.; *Atropin-Lösung*, G.

Preparation.—Take of Atropia 4 grains; Rectified Spirit 1 fluidrachm; Distilled Water 7 fluidrachms. Dissolve the atropia in the spirit, and add this gradually to the water, shaking them together.—*Br.* 1867.

Medical Uses.—This solution contains in each minim $\frac{1}{120}$ grain of atropia. It may be administered hypodermically in the *dose* of 1 minim, and cautiously increased. It is employed for *dilating the pupil* by instilling it into the eye, care being taken, by pressure on the punctum lachrymale, to prevent its passage into the nostril.

LIQUOR ATROPINÆ SULPHATIS, *Br.*—SOLUTION OF SULPHATE OF ATROPINE.

Soluté de sulfate d'atropine, Fr.; *Schwefelsaure Atropinlösung*, G.

Preparation.—Take of Sulphate of Atropine 9 grains (1 part); Camphor-Water 16½ fluidrachms (99 fluid parts). Dissolve.—*Br.*

The two preceding solutions are best prepared in small quantity only, that decomposition, which is likely to result from long keeping, may be prevented. Combining the atropine with benzoic or boracic acid does not, in the experience of Tichborne (1877), prevent the appearance of fungoid growth, but *solution of salicylate of atropine*, made of 2.7 grains of atropine and 1.3 grains of salicylic acid to 1 ounce of distilled water, was found to keep indefinitely. Camphor-water prevents decomposition better than distilled water.

Medical Uses.—This preparation is identical with solution of atropia in its strength, action, uses, dose, and mode of application. For acting upon the iris discs of paper or gelatin impregnated with either solution may be introduced between the eyelid and the eyeball.

LIQUOR BISMUTHI ET AMMONII CITRATIS, *Br.*—SOLUTION OF CITRATE OF BISMUTH AND AMMONIUM.

Liquor bismuthi.—Solution of ammonio-citrate of bismuth, E.; *Soluté de citrate de bismuth ammoniacal*, Fr.; *Wismuth-Ammoniak-Citrat-Lösung*, G.

Preparation.—Take of Citrate of Bismuth 800 grains; Solution of Ammonia, Distilled Water, of each a sufficiency. Rub the citrate of bismuth to a paste with a little of the water; add the solution of ammonia, gradually and with stirring, until the salt is just dissolved. Dilute with distilled water to form 1 pint (Imperial).—*Br.*

In the former edition of the Br. P. a concentrated solution of bismuth nitrate in nitric acid was mixed with double the quantity of citric acid theoretically necessary for the formation of bismuthous citrate; and this acid liquid was neutralized with ammonia. Thus prepared, the solution contained ammonium citrate and bismuthous citrate, or a double salt of these two compounds, and in addition thereto a notable quantity of ammonium nitrate. N. G. Bartlett (1865), however, showed—and his observations were corroborated by Méhu (1873)—that the neutral bismuthous citrate dissolves in ammonia, and that on evaporation a dry salt is obtained which is again soluble in water, and for which Rother (1876) gives the formula $(NH_4)_3C_6H_5O_7.Bi3HO$. These observations have led to several modifications of the former formula, by which contamination with ammonium nitrate is at the same time avoided. These modifications are based upon the preparation of *bismuth citrate*—1, by double decomposition between bismuth nitrate and potassium or sodium citrate; or 2, by first preparing bismuthous hydrate or subcarbonate, and treating this with the equivalent quantity of citric acid; or 3, as suggested by Rother, by boiling for a short period equivalent quantities (10 parts) of bismuth subnitrate and (7 parts) of citric acid with some water. This latter process has been adopted by the U. S. P. (see page 318), while the Br. P. prepares its *Bismuthi citras* from a solution of bismuthous nitrate in nitric acid, diluted with water as much as possible, by precipitating it with sodium citrate. These precipitated citrates frequently contain small quantities of bismuthous chloride and sulphate as impurities, and these two salts remain insoluble on treating the citrate with ammonia, which should be added merely until it remains permanently in slight excess. By filtering, weighing the dried undissolved residue, and deducting it from the original weight of the bismuthous citrate, the actual weight of the latter is readily ascertained, and the strength of the solution may thus be adjusted.

BISMUTHI ET AMMONII CITRAS, *Br.*, is prepared from the above solution (see p. 318), the heat for drying in scales being limited to 37.8° C. (100° F.) to avoid loss of ammonia.

Properties.—The solution of the British Pharmacopœia is colorless, and has a saline slightly styptic taste and the specific gravity 1.07. It is neutral or slightly alkaline to test-paper, and mixes with water without change. Potassa yields a precipitate of bismuth hydrate, and liberates ammonia; hydrochloric acid produces a precipitate of basic salt, which is redissolved by an excess of acid. 2 fluidrachms of the officinal solution, treated with sulphuretted hydrogen, yield a black precipitate, which after drying weighs about 7 grains. Each fluidrachm represents 3 grains of bismuthous oxide.

Medical Uses.—If, as we have endeavored to show elsewhere, the action of bismuth is entirely local and depends upon its insolubility, the use of its soluble salts is irrational. Yet the solubility of this preparation is set forth as a ground of its superiority over the oxide and the subnitrate! As an astringent it is quite superfluous, although it seems to have been employed in cases of flaccidity of the *vagina, rectum*, etc. The officinal *dose* is stated to be from 30 minims to 1 fluidrachm (Gm. 2–4).

LIQUOR CALCIS, *U. S., Br.*—SOLUTION OF LIME.

Aqua calcariæ, P. G.; *Aqua calcariæ ustæ, Aqua calcis, Calcaria soluta, Oxydum calcicum aqua solutum.—Lime-water*, E.; *Eau (Liqueur) de chaux*, Fr.; *Kalkwasser*, G.

An aqueous solution containing about 0.16 per cent. of hydrate of calcium, $Ca(HO)_2$.

Preparation.—Lime 1 part (½ oz. av.); Water, Distilled Water each a sufficient quantity. Slake the lime by the gradual addition of 6 parts (3 ounces) of water, then add 30 parts (15 ounces) of water, and stir occasionally during half an hour. Allow the mixture to settle, decant the liquid, and throw this away. Now add to the residue 300 parts (150 oz. av. or 9 pints) of distilled water, stir well, wait a short time for the coarser particles to subside, and pour the liquid, holding the undissolved lime in suspension, into a glass-stoppered bottle. Pour off the clear liquid when wanted for use.—*U. S.*

Wash slaked lime 2 oz. with distilled water until the filtrate acidulated with nitric acid is not rendered turbid by nitrate of silver. Put the washed lime into a stoppered bottle containing 1 gallon of distilled water, and shake well for 2 or 3 minutes. After 12 hours the excess of lime will have subsided, and the clear solution may be drawn off with a siphon as it is required for use, or transferred to a green glass bottle furnished with a well-ground stopper.—*Br.*

When water is added to burned lime or calcium oxide, this is converted into *calcium hydrate*, $Ca2HO$, which dissolves in the excess of water. If used for this purpose, the lime should be prepared from marble, when it will be nearly pure; but if made from ordinary limestone it usually contains alkalies which are readily soluble in water, hence it should be treated with a portion of the water, and this rejected to remove the impurities mentioned. The water should be kept, at a low temperature, upon the lime to retain the solution saturated, and this should be drawn off as needed

Properties.—Lime-water is a clear, colorless, inodorous solution of a slight alkaline disagreeable taste, but of a strong alkaline reaction to test-paper; its specific gravity is 1.0015 at 15° C. (59° F.) When exposed to air it becomes covered with a pellicle of calcium carbonate; the same compound is formed with the loss of the alkaline reaction if carbonic acid gas is passed through the solution and the solution heated to expel the excess of the gas (absence of alkalies or alkali carbonates). If lime-water is heated to boiling, it becomes turbid from the separation of some calcium hydrate, which dissolves again on cooling. On the addition of test-solution of oxalic acid, lime-water yields a white precipitate of calcium oxalate, which is insoluble in acetic, but soluble in hydrochloric, acid.

Tests.—Since at 15° C. (59° F.) lime requires about 780 parts of water for solution, 1 fluidounce (U. S. measure) of lime-water contains 0.57 grain of lime or 0.75 grain of calcium hydrate, which is equal to .125 and .165 per cent. respectively. At 21° C. (70° F.) 800 parts of water are required for solution, indicating .125 per cent. of calcium oxide or .166 per cent. of calcium hydrate—not 0.15 per cent. of the latter, as stated in the Pharmacopœia; a saturated solution of lime of this strength is obtained at 32° C. (90° F.). According to Thomas Maben (1883), 1 part of CaO is soluble

at	10°	20°	30°	40°	60°	80°	99°C.
in	770	791	862	932	1136	1362	1650 parts of water,
or	.129	.126	.116	.107	.088	.073	.06 per cent. CaO.

On mixing 100 Ccm. of lime-water with 4.4 Ccm. of volumetric solution of oxalic acid, the liquid does not acquire an acid reaction, indicating at least .123 per cent. of CaO. "10 ounces require for neutralization at least 180 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5 grains of calcium oxide (CaO)."—*Br.*

Pharmaceutical Uses.—In preparing Argenti oxidum, Lotio hydrargyri flava, Lotio hydrargyri nigra, *Br.*, and Linimentum calcis, *U. S.*, *Br.*

Medical Action and Uses.—Lime-water is destitute of caustic qualities, but is astringent and styptic, diminishing more or less the secretion of parts to which it is directly applied and of the mucous membranes and glands when taken internally. It is a valuable lotion in various diseases of the skin, especially *eczema capitis* and *ulcers*. In the former the affected part should be thoroughly cleansed with warm water and soap before the lime-water is applied. In all cases of chronic *mucous* or *purulent discharges* from the nostrils, fauces, auditory canal, vagina, urethra, or rectum, it is one of the simplest and best washes. It is said to destroy *ascarides of the rectum.* With flaxseed oil or sweet oil it forms the officinal liniment so useful in the treatment of *burns.*

Internally, as already indicated, it appears to escape in part the neutralizing influence of the gastric acids, for it has long been used to diminish the mucous secretion in *chronic bronchitis*, and to modify the urine and the lining membrane of the urinary passages in *calculous* and other disorders of the urino-genital organs. In vesical diseases lime-water is sometimes injected into the bladder through a catheter after properly cleansing the organ. It would seem, whether employed in the one or the other manner, to act by diminishing the irritability of the vesical mucous membrane. Lime-water is one of the most useful remedies for excessive *vomiting* produced by irritability or ulcer of the stomach, especially when the matters rejected are very acid. In the vomiting of tubercular phthisis and of simple and cancerous gastric ulcer milk with lime-water is sometimes the only nutriment that can be retained. The constipation that results from the internal use of lime-water, as well as its beneficial operation in chronic bronchitis, proves that it is not fully acidified in the stomach. In *diarrhœa* attended with acid stools and the associated colic and tympanites belonging to acid gastro-intestinal fermentation, and which is so prevalent during hot seasons, especially among infants, lime-water added to their milk in the proportion of from one-fourth to one-half is a very efficient remedy. The *aphthous* condition of the mouth and fauces, and the *thrush* fungus that forms there under these circumstances, are often removable by lime-water. In *chronic diarrhœa*, dependent on whatever cause, this solution, given with milk as the almost exclusive food, will usually mitigate, and in appropriate cases cure, the disease. The most signal triumphs of this simple method are achieved in *chronic dysentery* and in cases of *typhoid fever* protracted by the persistence of the intestinal ulcers. Even in tubercular *phthisis* it sometimes suspends the discharges for a considerable time. In all these affections it diminishes *tympanites*, and in certain cases in which that symptom appears to be the result of intestinal fermentation, lime-water is one of the best remedies. This preparation has been extolled as a remedy for *diabetes*, and the highest testimony in its favor exists, so far as relates to its power of lessening the secretion of sugar. It in like proportion diminishes thirst and voracious appetite. It should be given with milk, or, if that is contraindicated, with cream, and in quantity not less than 1 or 2 pints daily. In *hydruria* or diabetes insipidus it is more efficacious still. It has been recommended in *rachitis* and *osteomalacia*, and is very useful in gouty (acid) *dyspepsia*, especially when taken during the first stages of digestion. The *cutaneous eruptions* so often associated with gouty disorders are usefully treated by the internal use of lime-water.

The demonstration that false membranes are soluble in lime-water led to the use of gargles and the spray of this liquid and the vapors of slaked lime in *pseudo-membranous pharyngitis* (diphtheria) and in *laryngitis* and *bronchitis* of the same type. The result has been the cure of a large number of cases in which the nature of the disease was abundantly demonstrated by inspection or by the rejection of false membranes. To be successful the inhalation should be almost uninterrupted. As often as possible the patient should be confined in a dense vapor of slaking lime, and with this the use of atomized lime-water should be alternated, while the room is kept filled with the vapor. Other treatment, except stimulants, is of little use. It may perhaps be questioned whether the good results of this method are due to the solvent action of the lime or to the softening influence of the watery vapor which holds it in solution. Possibly, both influences contribute to the result, but the latter is probably the most efficient.

Lime-water is an appropriate antidote to *arsenious acid*, with which it forms an innocuous compound.

The *dose* of lime-water is from ½ ounce to 6 ounces (Gm. 32–190), given from one to four times a day with an equal quantity of milk or weak animal broth.

LIQUOR CALCIS CHLORINATÆ, *Br.*—SOLUTION OF CHLORINATED LIME.

Chlorure de chaux liquide, Fr.; *Chlorkalk-Lösung*, G.

Preparation.—Take of Chlorinated Lime 1 pound; Distilled Water 1 gallon. Mix well the water and the chlorinated lime by trituration in a large mortar, and, having transferred the mixture to a stoppered bottle, let it be well shaken several times for the space of 3 hours. Pour out now the contents of the bottle on a calico filter, and let the solution which passes through be preserved in a stoppered bottle.—*Br.*

The solution has the odor, taste, and general properties of chlorinated lime (see page 361). The Br. P. requires the solution to contain at least 1.9 (about 2) per cent. of available chlorine, which is ascertained by the following test: 80 grains by weight, mixed with 20 grains of iodide of potassium dissolved in 4 fluidounces of water, when acidulated with 2 fluidrachms of hydrochloric acid give a red solution, which requires for the discharge of its color 450 grain-measures of the volumetric solution of hyposulphite of soda.

Medical Action and Uses.—This solution is convenient as a *deodorizer* of decomposing organic matter, as an *excitant* of the skin in low fevers, as a stimulant of chronic *cutaneous eruptions*, and for the various purposes enumerated under CHLORINATED LIME.

LIQUOR EPISPASTICUS, *Br.*—BLISTERING LIQUID.

Linimentum cantharidis, Br. 1864.—*Liqueur vésicant*, Fr.; *Blasenziehende Flüssigkeit*, G.

Preparation.—Take of Cantharides, in powder, 5 ounces; Acetic Ether a sufficiency, Mix the cantharides with 3 fluidounces of acetic ether; pack in a percolator, and at the expiration of 24 hours pour acetic ether over the contents of the percolator, and allow the solution to pass slowly through until 20 fluidounces are obtained. Keep the liquid in a stoppered bottle.—*Br.*

As formerly made with acetic acid and ether, the blistering liquid contained the entire amount of cantharidin in solution. Tichborne preferred to use in place of acetic acid an equivalent amount of glacial acetic acid, as thereby less water is introduced into the powder. Brady has shown that when spontaneously evaporated from the skin the film left is not uniform, but thickest at the circumference. Deane (1876) recommended the discarding of the officinal solvents, and the substitution of acetic ether, which dries more uniformly and takes up a larger amount of cantharidin.

Medical Action and Uses.—This liquid is intended to produce a rapid vesication, which is effected chiefly by the acetic acid, although the irritation is maintained by the cantharides. It should be well rubbed into the skin with a small mop or piece of sponge attached to a handle, until redness is produced, and should be used only on limited portions of the skin.

LIQUOR FERRI ACETATIS, *U. S., Br.*—SOLUTION OF ACETATE OF IRON.

Liquor ferri acetici, P. G.—*Solution of ferric acetate*, E.; *Acétate ferrique liquide*, Fr.; *Ferriacetat-Lösung*, G.

An aqueous solution of ferric acetate $Fe_2(C_2H_3O_2)_6$; molecular weight 465.8—containing 33 per cent. of the anhydrous salt.

Preparation.—Solution of Tersulphate of Iron 100 parts (25 oz. av. or 18 fluidounces 1½ fluidrachms); Glacial Acetic Acid 26 parts (6½ oz. av. or 6 fluidounces); Water of Ammonia 80 parts (20 oz. av. or 20 fluidounces); Water, Distilled Water, each a sufficient quantity; to make 100 parts (25 oz. av.). To the water of ammonia, diluted with 200 parts (50 oz. av. or 3 pints) of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 350 parts (87½ oz. av. or 5¼ pints) of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with 600 parts (150 oz. av. or 9 pints) of cold water; again drain it on the strainer, and repeat the operation until the washings cause but a slight cloudiness with test solution of chloride of barium. Then allow the excess of water to drain off, and press the precipitate, folded in the strainer, until its weight is reduced to 70 parts (17½ oz. av.) or less. Add the precipitate to the glacial acetic acid contained in a capacious porcelain capsule, and stir occasionally until the oxide is entirely dissolved. Finally, add sufficient cold distilled water to make the solution weigh 100 parts (25 oz. av.), and filter if necessary. Solution of acetate of iron should be kept in well-stopped bottles protected from light.—*U. S.*

This formula is modelled after that of the German Pharmacopœia for 1872, but yields a product differing from it not only in strength, but also in composition. The first step is the precipitation of ferric hydrate, which must be accomplished at a low temperature, the iron solution being poured slowly, and with continued stirring, into the ammoniacal liquid, which must remain in slight excess, and the precipitate being washed with cold water by decantation until barium salts show scarcely any reaction with the clear liquid. After draining the precipitate upon a strainer, this is folded and pressure applied to it very gradually—an operation which requires patience to avoid bursting of the press-cloth. The pressure should be very slowly increased until the residue no longer adheres to the cloth as a soft pulpy mass, but may be readily removed in the form of a somewhat firm cake, the weight of which should not exceed 70 parts (17½ oz. av.). It is then transferred to a glass or porcelain vessel and somewhat broken up with a porcelain spatula, when the glacial acetic acid may be added to it in small portions to avoid heating of the mixture; this is set aside in a cool and dark place, occasionally stirred, and after solution has been effected diluted with distilled water until it weighs 100 parts (25 oz. av. = 20⅝ fluidounces). It is advisable to allow the liquid to settle, to pour off the clear portion from any slight sediment that may be present, and to filter the small quantity of turbid liquid by itself. (For formula of *Br. P.*, see p. 1663.)

Properties.—Solution of ferric acetate is "a dark red-brown, transparent liquid, of an acetous odor, a sweetish, faintly styptic taste, and a slightly acid reaction; sp. gr. 1.160. The diluted solution affords a brown-red precipitate with water of ammonia, and a blue precipitate with test solution of ferrocyanide of potassium. When heated with sulphuric acid the solution evolves acetous vapors."—*U. S.* On heating the liquid a red-brown precipitate is produced, which does not redissolve on cooling. If the solution be largely diluted with water until it has a mere yellowish color, the addition of solution of potassium sulphocyanide will occasion a blood-red color. On exposure to the light a partial reduction to ferrous salt takes place. As prepared by the pharmacopœial directions, and provided the acetic acid be of the proper strength, the liquid will be a solution of normal ferric acetate having the composition given above. The ferric hydrate, however, will completely dissolve in two-thirds the quantity of acid ordered, the salt then dissolved having the composition $(FeHO)_2(C_2H_3O_2)_4$; and this is the compound which has been largely employed in Europe. It is more readily affected than the preceding by the influence of light and heat, and is more easily decomposed, even in the dark, with the formation of a brown precipitate, if the ferric hydrate had not been thoroughly washed; precipitates which have been produced under the circumstances indicated are not dissolved on the addition of acetic acid.

The German Pharmacopœia recognizes a solution of the basic acetate, mixed with about 12 per cent. of the normal acetate; this solution has the specific gravity 1.081–1.083, and contains between 4.8 and 5 per cent. of iron.

Tests.—The tests of purity are in both pharmacopœias substantially alike. If a few drops of the liquid be added to freshly-prepared test solution of ferricyanide of potassium, the mixture should acquire a pure greenish-brown color without a trace of blue (absence of ferrous salt). If the iron be completely precipitated from the solution by an excess of ammonia, a portion of the filtrate should not yield a white or a dark-colored precipitate with hydrosulphuric acid (zinc, copper); another portion should leave no fixed residue on evaporation and gentle ignition (fixed alkalies, alkaline earths, zinc, copper); and a third portion of the filtrate on being acidulated with nitric acid should not be rendered turbid by test solution of barium nitrate (sulphate) or of silver nitrate (chloride). "10 Gm. of the solution mixed with a few drops of nitric acid, carefully evaporated and ignited, should yield a residue weighing 1.13 Gm."—*U. S.* If all loss has been avoided in making the solution, the residue left on ignition will weigh 1.147 Gm.

Pharmaceutical Uses.—Solution of ferric acetate, diluted with water, may be used as a test for free mineral acids, which change the color from red to brown.

FERRI ACETAS. The clear solution obtained in the cold by saturating acetic acid with ferric hydrate, decanting, instead of filtering from the insoluble matter, and evaporated at a temperature of about 60° C. (140° F.), leaves a scaly basic salt, which is again soluble in cold water.

Off. Prep.—Tinctura ferri acetatis, *U. S.*

Medical Action and Uses.—Besides possessing the special virtues of chalybeate preparations, this compound is astringent, and indeed may be used as a styptic, both internally and topically. The *dose* of the German preparation after which this one is formed is from 5 to 15 grains (Gm. 0.06–1) as a tonic or internal astringent. In much larger doses and well diluted with water it has been given as an antidote to *arsenious acid.*

LIQUOR FERRI CHLORIDI, *U. S.*—SOLUTION OF CHLORIDE OF IRON.

Liquor ferri perchloridi fortior, Br.; *Liquor ferri sesquichlorati*, P. G.; *Liquor ferri muriatici oxydati, Ferrum sesquichloratum solutum.—Solution of ferric chloride, Strong solution of perchloride of iron*, E.; *Solution de perchlorure de fer, Chlorure ferrique liquide*, Fr.; *Eisenchloridlösung, Flüssiges Eisenchlorid*, G.

The specific gravities of the officinal solutions of ferric chloride are—1.405 *U. S.*, 1.42 *Br.*, 1.280 to 1.282 *P. G.*, 1.26 *F. Cod.*, and they contain 37.8 per cent. *U. S.* (with some free hydrochloric acid), about 39 per cent. *Br.*, 29.8 per cent. *P. G.*, and 26 per cent. *F. Cod.*, of anhydrous ferric chloride.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 15 parts (3¾ oz. av.); Hydrochloric Acid 86 parts (21½ oz. av.); Nitric Acid, Distilled Water, each a sufficient quantity; to make 100 parts (25 oz. av.). Put the iron wire into a flask capable of holding double the volume of the intended product. Pour upon it 54 parts (13½ oz. av.) of hydrochloric acid previously diluted with 25 parts (6¼ oz. or 6 fluidounces) of distilled water, and let the mixture stand until effervescence ceases; then heat it to the boiling-point, filter through paper, and, having rinsed the flask and iron wire with a little boiling distilled water, pass the washings through the filter. To the filtered liquid add 27 parts (6¾ oz. av.) of hydrochloric acid, and pour the mixture, slowly and gradually, in a stream, into 8 parts (2 oz. av.) of nitric acid contained in a capacious porcelain vessel. After effervescence ceases apply heat, by means of a sand-bath, until the liquid is free from nitrous odor. Test a small portion with freshly-prepared test solution of ferricyanide of potassium. Should this reagent produce a blue color, add a little more nitric acid and evaporate off the excess. Finally, add the remaining 5 parts (1¼ oz. av.) of hydrochloric acid and enough distilled water to make the whole weigh 100 parts (25 oz. av. or 17 fluidounces and 1 fluidrachm).—*U. S.*

Mix iron wire 4 oz., hydrochloric acid 12½ fl. oz., and water 7 oz.; when effervescence ceases, heat to boiling, filter, rinse the flask and contents with a little water, and pour this over the filter; add to the filtrate hydrochloric acid 7 fl. oz.; then pour the solution in a slow, continuous stream into 1½ fl. oz. of nitric acid, the evolution of red fumes being promoted, if necessary, by a slight application of heat. Evaporate the product until no more nitrous fumes escape and a precipitate begins to form; then add hydrochloric acid 1 fl. oz. and sufficient water to produce 17½ fl. oz. of the solution.—*Br.*

Liquor ferri perchloridi, *Br.* Mix strong solution of perchloride of iron 1 fluidounce with distilled water sufficient for 4 fluidounces. Its spec. grav. is 1.11.

The reactions which take place in the preparation of ferric chloride and the proper manipulations to ensure success have been described. (See Ferri Chloridum, page 676.) The solution of the U. S. Pharmacopœia differs from the similar solutions of the other pharmacopœias in containing 1.6 per cent. uncombined HCl, or 500 grains of officinal hydrochloric acid, to the pint; the difference in density has been stated above.

Properties.—Solution of ferric chloride is a reddish-brown liquid, which has a faint odor of hydrochloric acid, an acid reaction, and a strongly styptic taste. It may be mixed with water and alcohol in all proportions without producing a precipitate. Diluted with water, it gives a brown precipitate with ammonia or potassa, a white one with silver nitrate (chloride), and a dark-blue precipitate of Prussian blue with potassium ferrocyanide. It is not altered by exposure to the sunlight, except in the presence of various organic matters, by which the salt is partly reduced to ferrous chloride; and it remains clear when heated to boiling unless ferric oxychloride be present, when it becomes turbid, a slight turbidity being best observed in reflected light. On being evaporated to dryness a reddish-brown salt is left, which at a red heat is partly decomposed and partly volatilized.

Tests.—The same reactions which are used for determining the purity of the salt (see Ferri Chloridum, page 676) are likewise employed for this solution. On adding a crystal of ferrous sulphate to a little of the solution, and afterward a few drops of strong sulphuric acid, a black color should not be produced near the crystal (absence of nitric acid). A freshly-prepared solution of potassium ferricyanide should color the solution olive-brown, but not blue (ferrous salt). Diluted with water and boiled, it acquires a darker color, but remains clear (oxychloride). Test solution of barium chloride should not cause a precipitate (sulphate). Mixed with excess of ammonia-water and filtered, the liquid should be colorless (copper); a portion of the filtrate, tested with hydrosulphuric acid or acidulated with acetic acid and tested with potassium ferrocyanide, should not be precipitated (copper, zinc); another portion of the filtrate, evaporated to dryness and ignited, should leave no residue (alkalies, alkaline earths, zinc, copper). Paper saturated with solution of starch and zinc iodide on being held near the surface of the solution should not acquire a blue color (free chlorine). "10 Gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 1.86 Gm."—*U. S.* 2 fluidrachms of the solution, diluted with water, and mixed with an excess of ammonia-water, yield a reddish-brown precipitate which, when washed and ignited, weighs between 30 and 32 grains.—*Br.*

Pharmaceutical Uses.—Martin's hæmostatic, which is used in France, consists of selected pieces of spunk which are saturated with ferric chloride.

Adrian's hæmostatic is made by dissolving 15 Gm. of sodium chloride in 60 Gm. of water, and adding 25 Gm. of solution of ferric chloride specific gravity 1.26.

Ferrum albuminatum is a compound of ferric chloride and albumen which has been recently introduced in Europe, and for which J. Biel (1878) has given the following process: 10 Gm. of dry soluble egg-albumen are dissolved in 100 Gm. of distilled water; the clear solution is mixed with 1.75 Gm. of crystallized ferric chloride (see page 675) previously dissolved in 24 Gm. of distilled water; 20 Gm. of 90 per cent. alcohol are now added, and sufficient water to make 200 Gm. This concentrated solution will keep in the dark without alteration; for dispensing, to obtain the *Liquor ferri albuminati*, 1 part of it is diluted with 4 parts of distilled water, and then contains 0.033 per cent. of metallic iron, the strength generally adopted in Europe. It is more convenient, however, to evaporate the concentrated solution at a temperature not exceeding 40° C. (104° F.), when the compound is obtained in golden-yellow transparent scales containing 3.34 per cent. of iron, and yielding the solution by dissolving them in one hundred times their weight of distilled water.

Liquor ferri perchloridi, *Br.*, Solution of perchloride of iron (see formula on page 900), is intended to take the place of the tincture of ferric chloride, as it retains the iron salt in an unchanged condition.

Off. Prep.—Tinct. ferri chloridi (perchloridi), *U. S.*, *Br.*

Action and Medical Uses.—The action of a poisonous dose of ferric chloride is described by Béranger-Féraud and Porte as follows: An acrid and styptic taste in the mouth is followed by epigastric distress, vomiting, colic, diarrhœa with bloody stools, diminution or suppression of urine, cramps and paresis of the legs, cerebral congestion with delirium or collapse, labored breathing, and general cyanosis. After death the mucous membrane of the mouth and throat is dry and hard, and the saliva is mixed with black particles. After a very large dose of a concentrated solution of the salt eschars may be found in the stomach (*Annales d'Hygiène publique*, Avril et Juin, 1879). The local effects of the preparation are illustrated by the following: In a case of epistaxis a druggist tamponned the nasal passages for several days and repeatedly with a ferric chloride solution. The patient died, and at the autopsy gangrenous inflammation of the upper air-passages was observed, with iron stains extending through the cribriform plate of the ethmoid bone to the arachnoid membrane of the brain (*Phila. Med. Times*, xi. 576). It is used chiefly for the styptic and astringent qualities which it possesses in a high degree. Its efficiency as an internal medicine is displayed in various *passive hæmorrhages*, particularly of the stomach, bowels, uterus, and urinary passages. It is useful in several profluvia, as *leucorrhœa*, *hydruria*, nocturnal *incontinence of urine*, and *vesical catarrh*. It is reported to control *seminal emissions* due to irritability of the urethra or spermatic ducts. In chronic *dysentery* it is one of the best of the astringent medicines appropriate to that affection; it may be prescribed internally and by enema. This preparation is more frequently employed locally as a styptic and astringent in *epistaxis*, hæmorrhage from *leech-bites*, from the jaw after the *extraction of teeth*, from the *tonsils*, from *cancer of the uterus*, from the *umbilical* cord, from the rectum in *hæmorrhoids*, from the uterus after *abortion*, and from *vascular growths* in the cavity of that organ. It is of interest to learn, if possible, in what manner the solution acts in arresting hæmorrhage. Undoubtedly it coagulates the blood itself. If a small artery is allowed to bleed into a saucer containing a mixture of 2 parts liq. ferri perchlor. (*B. P.*) and 1 of water, this mixture converts almost instantaneously six or eight times its bulk of blood into a tough, hard clot, and for a long time preserves it from putrefaction (Connel). But Broca has shown that this coagulating action is not instantaneous, but needs about half a minute for its completion; so that if the liquid is applied to a part from which the blood is flowing freely its styptic influence cannot be exerted upon the vessels from which the blood escapes. But such an influence is essential to an arrest of the hæmorrhage. Hence in applying it with this object every effort must be made by pressure and otherwise to suspend for a time the escape of blood.

One of its most valuable applications is that for the arrest of *post-partum hæmorrhage* caused by uterine inertia. Dr. Barnes, who first brought it into vogue, made use of a mixture of ½ pint of the stronger solution of the chloride (*B. P.*) with 1½ pints of water. He directed that a tube about 9 inches long should be carried by the hand to the fundus of the uterus previously freed from coagula, and that the liquid should be very slowly injected, care being taken that no air accompanied it. Basing his judgment on clinical observation alone, he declared that his conviction of the utility of this operation was too deep to permit him to hesitate to pursue it or to urge others to do the same. Such appears to have been the general estimate of the operation by the gynæcologists of London, although even in that city several cases of death were attributed to its use by Drs. Bantock, Protheroe, Smith, and Snow Beck. Indeed, the last-named gentleman stated that he had seen nine or ten cases in which death resulted from the injection of solution of chloride of iron into the uterus to arrest hæmorrhage. In Edinburgh the great majority of leading obstetrical practitioners agreed that its employment for this purpose is either useless or worse than useless. Some of those who condemn the injection into the uterus of a solution of chloride of iron advocate the introduction into the organ of the hand containing a sponge saturated with a solution of equal parts of the tincture and water, and the expression there of the liquid after the removal of the clots as far as possible. Pollard ascribes the grave consequences of the injection of the solution into the uterus to its escaping into the peritoneal cavity from the Fallopian tubes or to its entering the uterine veins, and causing either embolism or phlegmasia alba dolens (*British Med. Jour.*, Apr. 24 and May 1, 1880). In *pulmonary hæmorrhage* a weak solution of the chloride has been successfully used in the form of an atomized spray. It may be employed to check *gastric hæmorrhage* in any of the various conditions in which that accident occurs. This powerful styptic has been used to cure *aneurisms*, varicose, sacculated, and others; but, although the operation is successful in coagulating the blood in the tumor, it has so often happened either that the tumor suppurated, or that purulent infiltration took place around it, or that fatal embolism occurred, that the operation is no longer considered warrantable. (Compare *Med. Record*, xxiii. 672.) It has been most successful in erectile tumors of the scalp, and safest when the tumors, previously blistered or not, have been covered with compresses wet with the astringent solution. *Varicose veins* have been treated by injections of this preparation, pressure being maintained between the point operated upon and the heart. In chronic *ophthalmia* with varicose enlargement of the blood-vessels it affords probably the best chance of cure. As a local application in *diphtheria* it appears to excel all other stimulants and caustics. In the same manner it cures *chilblains* and is advantageous in *zona.* It is useful in repressing fungous granulations everywhere, but especially in cases of *ingrown toe-nail* and in ulceration of the *gums.* It also forms one of the best dressings for *hospital gangrene*, hardening the tissues and correcting the fetor. A solution of 1 part of the chloride in 2 of water has been applied with alleged curative effects in certain *scrofulous ulcers* that had resisted all other treatment (*Bull. de thérap.*, xcix. 190). A weak solution (one-sixteenth) has been used as an injection for the radical cure of *hydrocele.* In *prolapsus of the rectum* it has been efficiently employed, the protruding bowel being well painted with the solution and then reduced, after which it is retained by means of a tampon moistened with a diluted solution of the medicine. *Dose*, from 1 to 10 minims (Gm. 0.06–0.60), mixed with syrup and largely diluted.

As the teeth are very actively and injuriously attacked by this preparation, they should be carefully guarded against its action by administering the liquid through a glass tube and by thoroughly washing the mouth after its use.

Albuminate of iron has been used by Donitz in Japan both internally and hypodermically in the treatment of "kakke" (*Medical Record*, xvi. 515). The preparation does not seem to have been approved elsewhere.

LIQUOR FERRI CITRATIS, *U. S.*—SOLUTION OF CITRATE OF IRON.

Liquor ferri citrici, Citras ferricus liquidus.—Citrate de fer liquide, Fr.; *Eisencitrat-Lösung, Flüssiges Eisencitrat*, G.

An aqueous solution of ferric citrate, $Fe_2(C_6H_5O_7)_2$; molecular weight 489.8—containing about 35.5 per cent. of the anhydrous salt.

Preparation.—Solution of Tersulphate of Iron 105 parts (10½ oz. av.); Citric Acid 30 parts (3 oz. av.); Water of Ammonia 84 parts (8½ oz. av. or 8½ fluidounces); Water a sufficient quantity; to make 100 parts (10 oz. av.). To the water of ammonia, previously diluted with 200 parts (20 oz. av. or 19½ fluidounces) of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 1000 parts (100 oz. av. or 6 pints) of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with 1200 parts (120 oz. av. or 7¼ pints) of cold water. Again drain it on a strainer, and repeat the operation until the washings cause but a very slight cloudiness with test solution of chloride of barium; then allow the excess of water to drain off. Transfer the moist precipitate to a porcelain dish, add the citric acid, and heat the mixture, on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid and evaporate it, at the above-mentioned temperature, until it weighs 100 parts (10 oz. av.)—*U. S.*

The first part of the process consists in preparing ferric hydrate; the reaction has been explained (see page 688). The hydrate retains a considerable quantity of water, so that on the addition of citric acid the mixture becomes liquid as the acid is dissolved and ferric citrate formed. The solution is aided by the application of heat, which should never exceed 66° C. (151° F.), but is best kept at 60° C. (140° F.) to prevent decomposition. The digestion must be continued for several hours until the acid has taken up as much iron as can combine with it, when it is filtered and evaporated as directed.

Properties.—The solution is inodorous, has a dark-brown color, a slightly ferruginous taste, an acid reaction, and the specific gravity 1.260. When evaporated spontaneously or at a moderate heat in thin layers it forms transparent, garnet-red scales, which are readily detached from the glass or porcelain plate; 100 parts of the solution should yield 43 to 44 parts of scales, and these, on being incinerated, should leave 11 parts of incombustible residue. The solution is rendered darker, but is not precipitated, by alkalies in the cold, but when boiled with potassa or soda a red-brown precipitate of ferric hydrate is produced, and the filtrate, if neutralized with acetic acid and then boiled with test solution of calcium chloride, yields a white granular precipitate of calcium citrate. The solution gives with potassium ferrocyanide a greenish-blue precipitate, which becomes dark-blue on the addition of hydrochloric acid.

Tests.—On boiling the solution with potassa or soda, ammoniacal vapors should not be given off. On the addition of a few drops of hydrochloric acid, followed by a concentrated solution of potassium acetate, a crystalline precipitate should not be produced (absence of tartrate). On evaporating the solution to dryness and igniting the residue the ash left should not have an alkaline reaction (alkalies).

Pharmaceutical Uses.—In preparing Ferri citras and Ferri et ammonii citras, *U. S.*

Medical Uses.—This solution forms a convenient mode of dispensing citrate of iron. *Dose*, 10 minims or about 5 grains (Gm. 0.60 or Gm. 0.30) of the salt.

LIQUOR FERRI ET QUININÆ CITRATIS, *U. S.*—SOLUTION OF CITRATE OF IRON AND QUININE.

Liquor chinini ferro-citrici.—*Soluté de citrate de fer et de quinine*, Fr.; *Ferrichinincitrat-Lösung*, G.

Preparation.—Citrate of Iron and Ammonium 65 parts (780 grains = 13 drachms); Quinine, dried at 100° C. (212° F.) until it ceases to lose weight, 12 parts (144 grains); Citric Acid 28 parts (336 grains); Alcohol 30 parts (360 grains or 1 fluidounce); Distilled Water a sufficient quantity; to make 200 parts (2400 grains or 5½ oz. av.). Dissolve the citrate of iron and ammonia in 200 parts (2400 grains or 5¼ fluidounces) of distilled water, contained in a tared porcelain capsule, heat the solution to 60° C. (140° F.) on a water-bath, add the citric acid, and when it is dissolved add the quinine, stirring the mixture until a perfect solution has been obtained. Evaporate this to 160 parts (1920 grains or 4⅜ oz. av.), allow it to cool, add the alcohol, and finally enough distilled water to make the whole weigh 200 parts (2400 grains or 5½ oz. av.)—*U. S.* The quantities indicated will yield a little over 4½ fluidounces.

The pharmacopœial citrate of iron and quinine is slowly and with some difficulty soluble in water, while the salt of the same name in the British Pharmacopœia is readily soluble in water, and was on that account preferred for use in mixtures. The solution which has now been adopted contains a salt closely analogous to the latter and a definite proportion of quinine; it is readily prepared with ordinary care. Starting with quinine sulphate, not less than 220 grains of this salt should be used for precipitating the alkaloid; the precautions to be observed are mentioned under QUININA; the yield will be about 10 per cent. more than is required for the quantity indicated above. The dried quinine does not dissolve as rapidly as the freshly-prepared hydrate, but the temperature during digestion should not be raised above 60° C. (140° F.), to prevent the reducing action of the citric acid upon the ferric compound; for the same reason the concentration of the liquid should be effected at the same temperature.

Properties.—This solution is "a dark greenish-yellow to yellowish-brown liquid, transparent in thin layers, odorless, having a bitter and mildly ferruginous taste and a slightly acid reaction. On supersaturating the diluted solution with a slight excess of ammonia the color of the liquid is deepened and a white, curdy precipitate is thrown down, which is soluble in ether and answers to the reaction of quinine. (See QUININA.) A small portion of the filtrate, when mixed with test solution of ferrocyanide of potassium, does not produce a blue color or precipitate unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test solution of chloride of calcium, and the new filtrate heated to boiling, a white granular precipitate is produced. On heating the solution with potassa vapor of ammonia is evolved."—*U. S.*

Tests.—"The solution contains 6 per cent. of (anhydrous) quinine. It may be assayed as follows: Dilute 8 Gm. of the solution with water to 30 Ccm., introduce it, with any rinsings, into a glass separator, add an aqueous solution of 0.5 Gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 Ccm. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule on a water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 Gm."—*U. S.* That the solution has not been prepared simply by dissolving quinine sulphate in the iron citrate is shown, aside from the different color, by its not yielding a precipitate with barium chloride after having been acidulated with hydrochloric acid. On evaporating the solution to dryness and igniting the residue an ash is left which has not an alkaline reaction upon test-paper (absence of fixed alkalies).

Off. Prep.—Vinum ferri amarum, *U. S.*

Medical Action and Uses.—A convenient and agreeable preparation of a medicine very generally used in the form of bitter wine of iron. *Dose*, 10 to 15 minims (Gm. 0.60–1).

LIQUOR FERRI NITRATIS, *U. S.*—SOLUTION OF NITRATE OF IRON.

Liquor ferri pernitratis, Br.—*Solution of ferric nitrate, Solution of pernitrate of iron*, E.; *Azotate (Pernitrate) de fer liquide*, Fr.; *Eisennitrat-Lösung, Ferrinitrat-Lösung*, G.

An aqueous solution of ferric nitrate $Fe_2(NO_3)_6$; molecular weight 483.8—containing about 6 per cent. of the anhydrous salt.

Preparation.—Solution of Tersulphate of Iron 18 parts (9 oz. av. or 52½ fluidrachms); Water of Ammonia 15 parts (7½ oz. av. or 7½ fluidounces); Nitric Acid 7 parts (3½ oz. av. or 19 fluidrachms); Distilled Water, Water, each a sufficient quantity; to make 100 parts (50 oz. av.). To the water of ammonia previously diluted with 40 parts (20 oz. av. or 19¼ fluidounces) of cold water, add, constantly stirring, the solution of tersulphate of iron, previously diluted with 100 parts (50 oz. av. or 3 pints) of cold water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with 100 parts (50 oz. av. or 3 pints) of cold water. Again drain it on a strainer, and repeat the operation until the washings cause but a very slight cloudiness with test solution of chloride of barium. Then allow the excess of water to drain off, place the precipitate in a capacious porcelain dish, and add the nitric acid, stirring till a clear solution is obtained. Finally, add sufficient distilled water to make the whole weigh 100 parts (50 oz. av. or 45¾ fluidounces).—*U. S.*

Take of fine iron wire, free from rust, 1 ounce; nitric acid 4½ fluidounces; distilled water a sufficiency. Dilute the nitric acid with 16 ounces of the water, introduce the iron wire into the mixture, and leave them in contact until the metal is dissolved, taking care to moderate the action, should it become too violent, by the addition of a little more distilled water. Filter the solution, and add to it as much distilled water as will make its bulk 1½ pints (30 fluidounces).—*Br.*

Both formulas aim at the production of ferric nitrate, Fe_26NO_3. If the directions of the British Pharmacopœia are followed, the iron is taken up, with the evolution of red vapors, the reaction being as follows: $Fe_2 + 8HNO_3$ yields $Fe_26NO_3 + 2NO + 4H_2O$. Considerable heat is produced, and may rise to such a degree that nitric acid is vaporized; the reaction must therefore be closely watched, and, if it should become too violent, moderated by the addition of some cold water. This difficulty was sought to be avoided in the process of the U. S. P. 1870 by first forming ferrous nitrate and converting this into the ferric salt. Berzelius observed that, besides ferrous nitrate, ammonium nitrate is also formed and no gas evolved if a mixture of iron, water, and nitric acid is kept below the temperature of 50° C. (122° F.), when $2Fe_2 + 10HNO_3$ yields $4(Fe2NO_3) + NH_4NO_3 + 3H_2O$. The formation of ammonia is a secondary reaction, and depends upon the action of the nascent hydrogen upon the excess of nitric acid; it is lessened, but not entirely prevented, by a stronger acid and at a higher temperature, and augmented as the temperature and the acid strength are decreased, sometimes to such a degree that considerable ferrous hydrate is separated. It follows from this that solutions thus prepared are apt to vary in their composition.

The present formula of the U. S. P. is essentially that of F. T. Bower (1876). Ferric hydrate is first prepared, and, after washing it well, is dissolved in the nitric acid. Care should be taken that the latter has the proper specific gravity; weaker acids will yield darker-colored basic compounds, some of which are insoluble or sparingly soluble in water.

Ordway (1865) found that weak solutions of *ferrous nitrate*, which are free from excess of acid, may be concentrated at 60° C. (140° F.), but must then be evaporated at a lower temperature to prevent oxidation. The green crystals obtained in the cold cannot be dried without decomposition. *Ferric nitrate* has been obtained in deliquescent colorless or purplish crystals, which are cubes when containing $12H_2O$, or prisms with $18H_2O$.

Properties.—The solution has a reddish-brown, or, if the acid is somewhat in excess, a pale-amber, color, which becomes darker on heating and lighter again on cooling. It is perfectly transparent, inodorous, has a strongly styptic taste and an acid reaction, and remains unaltered on exposure to light and air, except in the presence of organic compounds, by many of which it is deoxidized. It gives a red-brown precipitate with ammonia and other alkalies and alkali carbonates, and a dark-blue precipitate with potassium ferrocyanide. When mixed with a solution of ferrous sulphate, and then with strong sulphuric acid, it assumes a blackish-brown color. The specific gravity is 1.050 *U. S. P.*, 1.107 *Br. P.*

Tests.—Ferricyanide of potassium, nitrate of silver, and nitrate of barium should not disturb the solution, proving the absence of ferrous salt, chloride, and sulphate. If precipitated with an excess of ammonia, the filtrate evaporated to dryness, and the salt heated to redness, no residue should be left (other metals). "10 Gm. of the solution, when precipitated by water of ammonia in excess, yield a precipitate which, when washed, dried, and ignited, should weigh 0.2 Gm."—*U. S.* The ferric oxide obtained from a fluidrachm of the solution by precipitating with ammonia, washing, and igniting, is required to weigh 2.6 grains.—*Br. P.*

Medical Action and Uses.—This preparation differs in its properties from the other acid compounds of iron. It is much more astringent than the vegetable acid salts or than the iodide of iron, and less harsh than the sulphuric and muriatic acid compounds. It is used chiefly in chronic *diarrhœa* dependent upon debility of the system or following dysentery, when no febrile complication exists. It is also profitably employed in *leucorrhœa* affecting feeble and lymphatic females, both internally and locally, and in *menorrhagia* occurring under similar conditions. The *dose* is about 10 drops (Gm. 0.60), largely diluted. As an injection, from 10 to 30 drops (Gm. 0.60–2) in a fluidounce of water may be employed.

LIQUOR FERRI SUBSULPHATIS, *U. S.*—SOLUTION OF SUBSULPHATE OF IRON.

Solution of basic ferric sulphate, Solution of persulphate of iron, Monsel's solution, E.; *Liqueur hémostatique de Monsel*, Fr.; *Basisch-schwefelsaure, Eisenoxydlösung, Monsel's Eisenlösung*, G.

An aqueous solution of basic ferric sulphate, $Fe_4O(SO_4)_5$; molecular weight 719.6—containing 43.7 per cent. of the salt.

Preparation.—Sulphate of Iron 77 parts (7700 grains or 17⅝ oz. av.); Sulphuric Acid 7 parts (700 grains or 1⅝ oz. av.); Nitric Acid, Distilled Water, each a sufficient quantity; to make 114 parts (11400 grains or 26 oz. av. and 25 grains). Mix the sulphuric acid with 11 parts (1100 grains or 2½ oz. av.) of nitric acid and with 50 parts (5000 grains or 11½ oz. av., or 11 fluidounces) of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling-point, add the sulphate of iron (one-fourth of it at a time), stirring after each addition until effervescence ceases. Should the addition of a few drops of nitric acid cause a further evolution of red fumes, cautiously add nitric acid until red fumes cease to be evolved. Then keep the solution in brisk ebullition until nitrous vapors are no longer perceptible and the liquid assumes a deep ruby-red tint. Lastly, add enough distilled water to make the solution weigh 114 parts (11400 grains or 26 oz. av. and 25 grains = 16 fluidounces and 45 minims). Solution of subsulphate of iron is to be dispensed when solution of persulphate of iron is prescribed by the physician.—*U. S.*

This process is a slight modification of that proposed by Dr. Squibb (1860). On introducing the ferrous sulphate in small portions into the heated acids a black color is produced from the union of nitric oxide with ferrous sulphate, which disappears with the copious evolution of red nitrous vapors as fast as the sulphate dissolves in the hot liquid. The mixture foams most toward the end of the process, and after the liquid has again subsided a little of it should be tested with nitric acid to ensure its complete oxidation. The amount of sulphuric acid used is insufficient for forming the normal ferric sulphate. A basic or oxysulphate is the result, which has the composition $Fe_4O(SO_4)_5 + aq$ or $5(Fe_23SO_4).Fe_26HO$. The mineral *copiapite* is a crystallized hydrate of the same combination. Other more basic ferric sulphates are known, some being soluble, others insoluble in water.

Properties.—Monsel's solution is a deep red-brown liquid, being nearly of a syrupy consistence, and of the spec. grav. 1.555. It is almost inodorous, has a very astringent but not caustic taste, and an acid reaction, and mixes with water and alcohol in all proportions without decomposition. On dropping sulphuric acid into it the color becomes lighter, and with a larger quantity (½ volume) of the acid a separation of whitish anhydrous ferric sulphate takes place (difference from solution of tersulphate). Diluted with distilled water, it yields a red-brown precipitate with ammonia or potassa, a dark-blue one with potassium ferrocyanide, and a white one insoluble in nitric or hydrochloric acid with barium chloride. When evaporated at a moderate heat upon a glass or porcelain plate, it yields transparent, deliquescent scales, and at a somewhat higher temperature is converted into a yellowish powder which is less deliquescent.

Tests.—The solution, diluted with 5 parts of water, should be colored olive-brown, but not blue, with freshly-prepared solution of potassium ferricyanide, and it should not yield a white precipitate with silver nitrate (absence of ferrous salt and chloride). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). "10 Gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 1.938 Gm."—*U. S.* The filtrate obtained in applying this test, on being evaporated to dryness and then ignited, should leave no fixed residue (absence of other salts).

Medical Uses.—This preparation is chiefly used as a local styptic in cases of *hæmorrhage* from parts not readily subjected to pressure, as the nasal cavities, the sockets from which teeth have been extracted, the uterus, vagina, rectum, etc. It has the advantage of being less irritating than other acid salts of iron. It is generally applied by means of a wooden or glass brush or a fragment of compact sponge. Where pressure can also be made it should not be omitted. An atomized solution of it has been found successful in some cases of *hæmoptysis.* For this purpose from 1 to 10 minims (Gm. 0.06–0.60) should be dissolved in a fluidounce of distilled water. Internally, it may be prescribed in the *dose* of from 5 to 10 minims (Gm. 0.30–60), properly diluted.

LIQUOR FERRI TERSULPHATIS, *U. S.*—Solution of Tersulphate of Iron.

Liquor ferri persulphatis, Br.; *Liquor ferri sulfurici oxydati*, P. G.—*Solution of normal ferric sulphate*, *Solution of persulphate of iron*, E.; *Persulfate de fer liquide*, Fr.; *Ferrisulfatlösung*, *Schwefelsaure Eisenoxyd-Lösung*, G.

An aqueous solution of normal ferric sulphate, $Fe_2(SO_4)_3$; molecular weight 399.8—containing 28.7 per cent. of the salt.

Preparation.—Sulphate of Iron 80 parts (8 oz. av.); Sulphuric Acid 15 parts (1½ oz. av.); Nitric Acid, Distilled Water, each a sufficient quantity; to make 200 parts (20 oz. av.). Mix the sulphuric acid with 11 parts (1 oz. av. and 45 grains) of nitric acid and with 50 parts (5 oz. av. or 4⅞ fluidounces) of distilled water in a capacious porcelain capsule, and, having heated the mixture to the boiling-point, add the sulphate of iron (one-fourth of it at a time), stirring, after each addition, until effervescence ceases. Should the addition of a few drops of nitric acid cause a further evolution of red fumes, cautiously add nitric acid until red fumes cease to be evolved. Then continue the heat until the solution acquires a reddish-brown color and is free from nitrous odor. Lastly, add enough distilled water to make the whole weigh 200 parts (20 oz. av. = 14½ fluidounces).—*U. S.*

Take of sulphate of iron 8 ounces; sulphuric acid, nitric acid, each 6 fluidrachms; distilled water 12 fluidounces or a sufficiency. Add the sulphuric acid to 10 ounces of the water, and dissolve the sulphate of iron in the mixture with the aid of heat. Mix the nitric acid with the remaining 2 ounces of the water, and add to this acid, warmed, the solution of sulphate of iron. Concentrate the whole by boiling, until, by the sudden disengagement of ruddy vapors, the liquid ceases to be black and acquires a red color. A drop of the solution is now to be tested with red prussiate of potash, and if a blue precipitate forms, a few additional drops of nitric acid should be added and the boiling renewed, in order that the whole of the sulphate may be converted into persulphate of iron. When the solution is cold, make the quantity 11 fluidounces (Imperial measure) by the addition, if necessary, of distilled water.—*Br.*

The reaction which takes place in these processes is precisely the same as in making the subsulphate of iron, the only difference being that the sulphuric acid is used in sufficient quantity to form normal ferric sulphate, $Fe_2 3SO_4$. The reaction is explained by the equation $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3(Fe_2 3SO_4) + N_2O_2 + 4H_2O$. From 80 parts of ferrous sulphate, 200 parts *U. S.*, 160 parts *P. G.*, 158.5 parts *Br.*, of the solution are prepared.

Properties.—Solution of normal ferric sulphate is a dark reddish-brown liquid, having no odor, a very astringent and at the same time acid taste, and an acid reaction. It is miscible in all proportions with alcohol and water without causing decomposition. Its behavior to ammonia, potassium ferrocyanide, and barium chloride is the same as that of the subsulphate, but for the precipitation of the anhydrous salt about 3 volumes (instead of ½ volume) of sulphuric acid is required. The pharmacopœial solution contains 28.76 per cent. *U. S.*, 35.94 per cent. *P. G.*, 36.3 per cent. *Br.*, of anhydrous ferric sulphate, and has the spec. grav. 1.320 *U. S.*, 1.428 to 1.430 *P. G.*, 1.441 *Br.* Hager gives the following densities for solutions containing of the anhydrous salt—

25	26	27	28	28.5	29	29.5	30	31	32 per cent.
1.271	1.284	1.297	1.310	1.316	1.323	1.330	1.337	1.351	1.365.

Tests.—The absence of ferrous salt, chloride, nitric acid, and foreign salts is determined in precisely the same manner as for the subsulphate (see above). The German Pharmacopœia requires the solution to contain a minute amount of basic salt, which is determined by adding 3 drops of the solution to 10 Ccm. of volumetric solution of sodium hyposulphite, and heating the mixture very slowly to the boiling-point, when a few floccules of ferric oxide should be separated; the ferric hyposulphite which is at first formed changes into ferrous hyposulphite, FeS_2O_3, and ferrous tetrathioniate, FeS_4O_6; and no further change takes place on careful heating if only normal sulphate was present, but in the presence of oxysulphate ferric oxide is deposited, while in the presence of free acid sulphurous acid gas is liberated and sulphur is separated, causing a whitish turbidity. The same test may also be applied to the solution of ferric chloride, the results being the same as described. "10 Gm. of the solution, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 1.147 Gm."—*U. S.* 1 fluidrachm of the solution, diluted with water and mixed with an excess of ammonia-water, should yield a precipitate which, when washed and ignited, weighs 11.44 grains.—*Br.*

Pharmaceutical Uses.—In preparing magnetic oxide of iron and ferric oxide as an antidote to arsenic, or for preparing the solutions of acetate, citrate, and nitrate of iron, and various tartrates and citrates containing iron; also in preparing, by double decomposition, Tinct. ferri acetatis, *Br.*, and in forming the double salt Ferri et ammonii sulphas, *U. S.*

Medical Uses.—It may be used for the same purpose as the subsulphate, but is not as eligible, because it is more irritating and less astringent.

LIQUOR GUTTA-PERCHÆ, *U. S., Br.*—SOLUTION OF GUTTA-PERCHA.

Liqueur de gutta-percha, Fr.; *Guttapercha-Lösung*, *Traumaticin*, G.

Preparation.—Gutta-Percha, in thin slices, 9 parts (1 oz. av.); Commercial Chloroform 91 parts (10 oz. av. and 50 grains); Carbonate of Lead, in fine powder, 10 parts (1 oz. av. and 50 grains); to make 100 parts (11 oz. av.). Add the gutta-percha to 70 parts (8 oz. av.) of the chloroform contained in a bottle, cork the latter well, and shake it occasionally until the gutta-percha is dissolved. Then add the carbonate of lead, previously mixed with the remainder of the chloroform, and, having several times shaken the whole together at intervals of half an hour, set the mixture aside until the insoluble matters have subsided and the solution has become perfectly clear. Lastly, decant the liquid and preserve it in small, cork-stoppered vials.

The British Pharmacopœia has the same process, but directs 1 oz. av. of gutta-percha and 8 fluidounces (11.92 oz. av.) of chloroform, or for 9 parts of the former 107.2 parts of the latter. The proportion directed by the U. S. P. 1870 was 9 to 102 parts; the present Pharmacopœia requires only 91 parts of chloroform, which, if the gutta-percha be of good quality, gives a rather thick solution. This preparation has been sometimes called *chloro-percha*.

Crude gutta-percha does not yield a clear solution with chloroform, but on standing the impurities will rise to the surface more rapidly if, according to Maschke (1857), the solution is agitated with 1 or 1½ per cent. of water. Hodgson (1861) proposed carbonate of lead with the same object in view, the impurities subsiding with the lead compound. Other heavy and insoluble compounds may be used with the same result, of rendering the solution clear and almost or entirely colorless. Other solvents, which are cheaper than chloroform, are employed for the purification of gutta-percha on the large scale (see page 754).

Off. Prep.—Charta sinapis, *U. S.*, *Br.*

Medical Uses.—The various applications of this solution are enumerated under GUTTA-PERCHA. They consist, briefly, in the adhesive and protective qualities of the film formed by the rapid evaporation of the solvent, and the facility with which the solution is applied.

LIQUOR HYDRARGYRI NITRATIS, *U. S.*—SOLUTION OF NITRATE OF MERCURY.

Liquor hydrargyri nitratis acidus, Br.; *Liquor hydrargyri nitrici oxydati*, *Hydrargyrum oxydatum nitricum solutum.—Solution of mercuric nitrate*, *Acid solution of nitrate of mercury*, *Solution of pernitrate of mercury*, E.; *Azotate* (*Nitrate*) *mercurique liquide*, *Nitrate acide* (*Pernitrate*) *de mercure*, Fr.; *Mercurinitrat-Lösung*, *Quecksilberoxydnitrat-Lösung*, G.

A liquid containing in solution about 50 per cent. of mercuric nitrate, $Hg(NO_3)_2$; molecular weight 327.7, with some free nitric acid.

Preparation.—Red Oxide of Mercury 40 parts (8 oz. av.); Nitric Acid 45 parts (9 oz. av. or 3 fluidounces and 45 minims); Distilled Water 15 parts (3 oz. av. or $2\frac{7}{8}$ fluidounces); to make 100 parts (20 oz. av. or 9 fluidounces and 68 minims). Mix the nitric acid with the distilled water, and dissolve the red oxide of mercury in the mixture. Keep the solution in glass-stoppered bottles.—*U. S.*

Take of mercury 4 ounces; nitric acid 5 fluidounces; distilled water 1½ fluidounces. Mix the nitric acid with water in a flask, and dissolve the mercury in the mixture without the application of heat. Boil gently for 15 minutes, cool, and preserve the solution in a stoppered bottle.—*Br.*

Mercury 100 parts; nitric acid 150 parts; water 50 parts. Dissolve and evaporate to 225 parts.—*F. Cod.*

The mercury is dissolved in the two last processes by the action of nitric acid, with the extrication of red nitrous vapors to form mercuric nitrate; $3Hg_2 + 16HNO_3$ yields $6(Hg2NO_3) + 2N_2O_2 + 8H_2O$. It is necessary to apply some heat, particularly at the close of the reaction, to convert into mercuric any mercurous salt which may be present. The United States process yields the same solution more rapidly, and involves simply a combination of the mercuric oxide with nitric acid, water being liberated; $HgO + 2HNO_3$ yields $Hg(NO_3)_2 + H_2O$. The present pharmacopœial solution is a little weaker than that of 1870, the latter requiring 43.66 parts of mercuric oxide and 48.66 parts of nitric acid to obtain 100 parts; it was nearly identical with that of the French Codex, which represents 43.5 per cent. of mercuric oxide against about 35 per cent. of the British preparation.

Properties.—The solution is colorless, and has a slight odor of nitric acid, a strong acid reaction, and a caustic and metallic taste. Its specific gravity is 2.100 *U. S. P.*, about 2.0 *Br.* A crystal of ferrous sulphate dropped into it soon becomes surrounded with a dark-colored liquid (nitrate). Dropped upon copper, a deposit of mercury is at once produced, and the diluted solution gives a yellow precipitate with soda or potassa solution and a scarlet-red precipitate with potassium iodide; this latter precipitate is soluble in an excess of the precipitant. Nearly one-fourth of the nitric acid is uncombined, and prevents the separation of a basic salt on dilution with water. Evaporated by heat on a glass or porcelain dish, a white salt is left, which on the further application of heat is decomposed, assuming a yellow, red, and brown color, and is finally completely volatilized. The solution, mixed with alcohol and heated, produces *fulminating mercury*, which is very explosive.

If the solution is kept over sulphuric acid until crystals have been separated, the syrupy liquid will have the composition $Hg2NO_3.2H_2O$, and the crystals of mercuric nitrate contain less water, their composition being $2(Hg2NO_3).H_2O$. If the liquid is further concentrated by heat, nitric acid is given off, and the solution contains then basic nitrates, which are crystallizable, but when largely diluted with water are converted into more basic insoluble white or yellowish compounds.

Tests.—The characters given are sufficient to determine the quality of the preparation. On the addition of water no precipitation should occur (free nitric acid). Diluted hydrochloric acid should occasion no precipitate, potassa solution a yellow (not black), and potassium iodide a scarlet-red (not yellow or green) precipitate (absence of mercurous salt).

Allied Preparations.—MILLON'S TEST SOLUTION. Dissolve with a gentle heat mercury in an equal weight of strong nitric acid, dilute the solution with twice its bulk of water, and decant from the precipitate; the liquid must contain some free nitric and nitrous acid. A solution of nearly the same mercury strength, but containing no nitrous acid, is obtained by diluting the pharmacopœial (*U. S.*) solution of mercuric nitrate with an equal bulk of water. Millon's reagent is used as a reagent for proteids, the mixture, as well as the precipitate, acquiring a red color on boiling.

Hydrargyri protonitras; Nitras (azotas) hydrargyrosus, *F. Cod.*—Mercurous nitrate, *E.;* Azotate mercureux, *Fr.;* Mercuronitrat, Salpetersaures Quecksilberoxydul, *G.*—Mercury 4 parts, nitric acid 3 parts, water 1 part: after 24 hours collect the crystals, wash them with a little diluted nitric acid, and dry.—*F. Cod.* The salt forms colorless monoclinic plates or prisms having the composition $Hg_2(NO_3)_2 2H_2O$, mol. weight 559.4; it melts at 70° C. (158° F.), is completely soluble in a little warm water, but is by more water decomposed into a soluble acid and an insoluble basic salt; the solution imparts to the skin a purplish-red color, turning black.

Liquor hydrargyri nitrici oxydulati, s. Hydrargyrum oxydulatum solutum, s. Liquor Bellostii.—Solution of mercurous nitrate, *E.;* Liqueur de Belloste, *Fr.:* Mercuronitrat-Lösung, *G.* —Dissolve without heat mercurous nitrate 100 parts in nitric acid 15 parts and water 885 parts. On exposure to the air oxidation to mercuric nitrate takes place.

Medical Action and Uses.—It is not used internally. Locally, its action is powerfully caustic, destroying the life of the tissue to which it is directly applied and inflaming the surrounding parts. The slough separates as a yellowish scab. When swallowed by mistake, it produces the effects of a powerful corrosive poison, including intense pain, vomiting, purging, collapse, and speedy death, after which the fauces have been found vesicated and discolored and the stomach presenting brown eschars. Applied to an ulcerated surface, even of small extent, it has caused salivation, and a weak solution of it used in the treatment of itch has occasioned fatal poisoning, with symptoms of corrosion and salivation also.

This preparation is employed to stimulate sluggish restorative processes and to remove indurated tissues. It is a valuable application in chronic and indurated *ulcers* of the neck of the uterus of whatever nature, but most so, of course, in simple ulcers. Tubercles and ulcers of the skin belonging to *lupus* have sometimes been treated advantageously by this caustic while appropriate internal medicines were administered. It is advised that it should be applied daily. It is an efficient remedy for *acne* by destroying the diseased sebaceous follicles. It has been recommended as the most successful of local applications to all forms of *syphilitic* sores of the skin, tongue, throat, etc. The strength of the solution employed must vary with the object in view. In lupus and acne the pure liquid must be used, and applied by means of a pointed glass rod or brush or a wooden splinter, so as accurately to limit the caustic action to the diseased tissue. When ulcers of the throat are to be treated, 1 or 2 minims of the acid in an ounce of water (Gm. 0.06–0.12 to Gm. 32) may be used as a gargle or with an atomizer, care being taken that the spray is not inhaled; or by means of a sponge-mop a mixture of a fluidrachm of the solution with an ounce of water (Gm. 4 to Gm. 32) may be applied. For cutaneous ulcers a lotion may be made with 30 minims of the solution and an ounce (Gm. 2 to Gm. 32) of water.

LIQUOR HYDRARGYRI PERCHLORIDI, *Br.*—SOLUTION OF PERCHLORIDE OF MERCURY.

Liquor hydrargyri bichloridi.—Solution of corrosive sublimate, Solution of mercuric chloride, E.; *Chlorure de mercure et d'ammoniaque liquide, Soluté de sel Alembroth,* Fr.; *Sublimat-Lösung,* G.

Preparation.—Take of Perchloride of Mercury, Chloride of Ammonium, each 10 grains; Distilled Water 1 pint (Imperial). Dissolve.—*Br.*

This is a colorless solution of the *sal Alembroth* of the alchymists, having the saline and metallic taste of the salts from which it is made. It yields white precipitates with alkalies and their carbonates, and is decomposed by vegetable juices and the medicinal extracts. It contains ½ grain of corrosive sublimate to the (Imperial) fluidounce, and is of one-half the strength of the similar solution which was formerly recognized by the Prussian and other European pharmacopœias. By substituting emulsion of bitter almond for the water *Gowland's cosmetic lotion* is obtained.

Liqueur de Van Swieten, *F. Cod.*, is a solution of 1 part of corrosive sublimate in 100 parts of alcohol and 900 parts of water.

Medical Action and Uses.—The object of this preparation appears to be to render the solution of corrosive sublimate more perfect than that in water alone. The average *dose* is 1 fluidrachm (Gm. 4), containing $\frac{1}{16}$ grain (Gm. 0.004) of corrosive sublimate.

LIQUOR IODI COMPOSITUS, *U. S.*—Compound Solution of Iodine.

Liquor iodi, Br.; *Liquor iodinii compositus*, U. S. 1870.—*Solution of iodine, Lugol's solution*, E.; *Soluté ioduré de Lugol*, Fr.; *Lugol'sche Jodlösung*, G.

Preparation.—Iodine 5 parts (107 grains); Iodide of Potassium 10 parts (214 grains); Distilled Water 85 parts (1819 grains or 4 fluidounces); to make 100 parts (2140 grains or about 4⅝ fluidounces). Dissolve the iodine and iodide of potassium in the distilled water. Keep the solution in well-stopped bottles.—*U. S.*

Take of iodine 22 grains; iodide of potassium 33 grains; distilled water 1 fluidounce. Dissolve.—*Br.*

Solutions of potassium iodide dissolve iodine in different proportions, weak solutions taking up 1 atom of I for each molecule of KI, or 76.5 parts for 100 parts of the salt. The dissolved portion, therefore, has the composition KI_2. The proportion of iodine to potassium iodide in the second formula approaches the composition given, but the formula of the United States Pharmacopœia directs a larger amount of the salt and its iodine strength is greater. Viewed as free iodine held in solution by potassium iodide, 1 part of the former is represented by 20.0 parts (*U. S. P.*) and 22.4 parts (*B. P.*) of the solution.

Properties.—The solution is of a dark brown-red color, having the caustic taste of iodine and imparting to starch-paste a dark-blue color. When boiled, iodine is given off, but the whole of it does not volatilize until the liquid is evaporated to dryness and the residuary mass heated nearly to redness. When agitated with chloroform, ether, or bisulphide of carbon, the solution is decolorized. "12.66 Gm. of the solution, mixed with a little gelatinized starch, should require for complete decoloration 50 Ccm. of the volumetric solution of hyposulphite of sodium."—*U. S.*

Allied Preparations.—Causticum iodi, *Lugol's caustic.* Iodine and potassium iodide, of each 1 part, water 2 parts. By substituting glycerin for the water *Hebra's iodine caustic* is obtained.

Medical Action and Uses.—This preparation is considerably stronger in the proportion of its active ingredients than the compound *tincture* of iodine, and is thought to be more efficient, although there is no satisfactory evidence in favor of that opinion. 20 minims (Gm. 1.15) of it contain about 1 grain (Gm. 0.06) of iodine. The average *dose* is 4 drops (Gm. 0.25). It should be administered in a large portion of water.

LIQUOR LITHIÆ EFFERVESCENS, *Br.*—Effervescing Solution of Lithia.

Aqua lithiæ effervescens.—*Lithia-water*, E.; *Eau de lithine*, Fr.; *Lithion-wasser*, G.

Preparation.—Take of Carbonate of Lithia 10 grains; Water 1 pint. Mix in a suitable apparatus, and pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

This is a solution of lithium carbonate in water rendered more agreeable by the carbonic acid gas. Each fluidounce contains ½ grain of the carbonate, the amount of which is best ascertained by evaporating a known measure of it. The residue should answer to the tests for lithium carbonate.

Medical Uses.—This is merely an agreeable form for the administration of lithia; it may be given in the *dose* of from 4 to 12 fluidounces (Gm. 120–380).

LIQUOR MAGNESII CARBONATIS, *Br.*—Solution of Carbonate of Magnesium.

Aqua magnesio-effervescens.—*Fluid magnesia*, E.; *Eau magnésienne, Magnésie liquide*, Fr.; *Magnesiawasser, Kohlensaure Magnesialösung*, G.

Preparation.—Take of Sulphate of Magnesia 2 ounces; Carbonate of Soda 2½ ounces; Distilled Water a sufficiency. Dissolve the two salts separately, each in ½ pint of water. Heat the solution of sulphate of magnesia to the boiling-point, then add to it the solution of carbonate of soda, and boil them together until carbonic acid ceases to be evolved. Collect the precipitated carbonate of magnesia on a calico filter, and wash it with distilled water until what passes ceases to give a precipitate with chloride of barium. Mix the washed precipitate with a pint of distilled water, and, putting them into a suitable apparatus, pass into it pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk. Let the mixture remain in contact with excess of carbonic acid, retained there under pressure, for about 24 hours; then filter the liquid to remove any undissolved carbonate of magnesia, and again pass carbonic acid gas into the filtered solution. Finally, keep the solution in a bottle securely closed to prevent the escape of carbonic acid. The solution contains about 13 grains of carbonate of magnesia in a fluidounce.—*Br.*

The first part of the above process embraces the preparation of magnesium oxycarbonate, $(MgCO_3)_3.Mg2HO$, which is the officinal Magnesii carbonas. By the subsequent operation this is dissolved in water by the aid of carbonic acid gas in excess, whereby magnesium carbonate, $MgCO_3$, and bicarbonate, MgH_22CO_3, are formed.

Properties and Tests.—It is a colorless solution, which should effervesce on opening the vessel, carbonic acid escaping, and has a slightly acidulous taste free from bitterness. The white mass left by evaporating a fluidounce and calcining the residue should weigh 5 grains and answer to the tests for magnesia. When the solution is exposed to cold, prismatic crystals of magnesium carbonate, $MgCO_3.5H_2O$, appear, which on exposure to the air lose water and become $MgCO_3.3H_2O$.

Medical Uses.—The intention of this preparation is apparently to provide an agreeable form of magnesia for administration in cases of constitutional *gout* and other disorders attended with an excess of *acid* in the system and acid urinary deposits. An extemporaneous mixture of magnesia with carbonated water answers the same purpose, and so do the granular effervescing vegetable salts of magnesia. The *dose* is 1 or 2 fluidounces (Gm. 32–64).

LIQUOR MAGNESII CITRATIS, *U. S., Br.*—SOLUTION OF CITRATE OF MAGNESIUM.

Liquor magnesiæ citratis, Br. Add.; *Liquor magnesii citrici.—Limonade au citrate de magnésie, Limonade purgative citro-magnésienne* Fr.; *Magnesiumcitrat-Lösung, Magnesia-Limonade*, G.

Preparation.—Carbonate of Magnesium 200 grains (13 Gm.); Citric Acid 400 grains (26 Gm.); Syrup of Citric Acid 1200 grains (80 Gm. or 2 fluidounces); Bicarbonate of Potassium, in crystals, 30 grains (2 Gm.); Water a sufficient quantity. Dissolve the citric acid in 2000 grains (4⅜ fluidounces) or about 120 Gm. of water, and, having added the carbonate of magnesium, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of 12 fluidounces, or about 360 Ccm., containing the syrup of citric acid. Then add enough water, previously boiled and filtered, to nearly fill the bottle, drop in the bicarbonate of potassium, and immediately close the bottle with a cork, which must be secured with twine. Lastly, shake the mixture occasionally until the bicarbonate of potassium is dissolved.—*U. S.*

Take of carbonate of magnesia 100 grains; citric acid 200 grains; syrup of lemon ½ fluidounce; bicarbonate of potash, in crystals, 40 grains; water a sufficiency. Dissolve the citric acid in 2 ounces of the water, and, having added the carbonate of magnesia, stir until it is dissolved. Filter the solution into a strong half-pint bottle, add the syrup and sufficient water to nearly fill the bottle; then introduce the bicarbonate of potash, and immediately close the bottle with the cork, which should be secured with string or wire. Afterward shake the bottle until the bicarbonate of potash has dissolved.—*Br.*

When magnesium carbonate and citric acid are brought together in the presence of water carbonic acid gas is given off and magnesium citrate formed. The normal salt has the composition $Mg_32C_6H_5O_7$, is but slightly soluble in water, and crystallizes from its solutions with $14H_2O$. The salt, $MgHC_6H_5O_7$, is much more soluble in water, and it is this compound at which both pharmacopœias aim in the above formulas. The reaction occurs as follows: $(MgCO_3)_3.Mg2HO + 4H_3C_6H_5O_7$ yields $4MgHC_6H_5O_7 + 3CO_2 + 5H_2O$. A slight excess of citric acid is employed, which is subsequently neutralized with potassium bicarbonate, whereby some potassium citrate is formed and carbonic acid gas liberated, the latter remaining with the hermetically-corked solution. Carbonate of magnesium, as ordinarily met with, varies much less in composition than calcined magnesia after some exposure to the atmosphere; the former compound is therefore very properly used in preference to the latter.

To prepare the solution, ten times (or any other convenient multiple) of the officinal quantities of citric acid and magnesium carbonate are weighed out and mixed with the corresponding quantity of water; after the magnesia has dissolved the liquid is passed through a paper filter, equally divided among the requisite number of bottles, into each of which the necessary quantity of syrup is introduced; sufficient water, previously boiled and filtered, is then added to each bottle, after which the potassium bicarbonate in crystals is dropped in. The corks are then inserted and securely fastened by twine, and the bottles laid upon their sides in a cool place. Prepared in this way, the crystals will gradually dissolve in the syrup, and this will slowly mix with the lighter saline solution, unless it be wanted for immediate use, when, by slight agitation, the syrup and bicarbonate are dissolved in the aqueous liquid.

The solution is colorless, free from sediment, and of a pleasant acidulous taste free from bitterness. The present formula differs from that of 1870 only in ordering 30 instead of 40 grains of potassium bicarbonate; the latter quantity makes a more effervescent solution.

Allied Preparations.—LIQUOR MAGNESII ACETATIS.—Solution of magnesium acetate, *E.;* Soluté d'acétate de magnésie, *Fr.;* Magnesiumacetat-Lösung, *G.*—Renaud proposed a solution made by dissolving 40 parts of magnesium carbonate in sufficient acetic acid (137 parts), filtering, and evaporating to 100 parts. It is a colorless syrupy liquid, having a bitterish taste less pleasant than the citrate, and containing nearly 60 per cent. of the dry acetate, $Mg(C_2H_3O_2)_2$ (mol. weight 142). The dry salt is white, gum-like, very deliquescent, and freely soluble in water and alcohol.

ELIXIR MAGNESII ACETATIS. Solution of magnesium acetate 66 parts; alcohol 14 parts; syrup of orange-peel (or of lemon-peel) 70 parts. This contains 25 per cent. of the dry salt, but less alcohol than directed by Garot's formula.

Medical Action and Uses.—This medicine has come into popular use as a purgative, and, if its constitution could be depended upon, would answer a useful purpose. But as it sometimes purges violently, and in other cases fails of any purgative effect, it ought not to be employed where certainty and uniformity of action are important. It should generally be given in divided doses of 4 or 6 ounces (Gm. 120–190) every hour until the desired operation is produced.

Acetate of magnesium was introduced as a substitute for citrate of magnesium, probably on account of its greater cheapness, it being assumed to possess the same mode of action as the citrate. A committee of the Pharmaceutical Society of Paris reported it to be a purgative whose slight taste and great solubility recommended it. It is, however, less soluble than the citrate and of a less agreeable taste. It does not seem to have been approved by physicians.

LIQUOR MORPHINÆ ACETATIS, *Br.*—SOLUTION OF ACETATE OF MORPHINE.

Soluté d'acétate de morphine, Fr.; *Essigsaure Morphinlösung,* G.

Preparation.—Take of Acetate of Morphine 9 grains; Diluted Acetic Acid 18 minims; Rectified Spirit ½ fluidounce; Distilled Water 1½ fluidounces. Mix the acid, the spirit, and the water, and dissolve the acetate of morphine in the mixture.—*Br.*

Medical Uses.—Each fluidrachm contains ½ grain (Gm. 4 and Gm. 0.03) of acetate of morphine, the decomposition of which is prevented by the spirit.

LIQUOR MORPHINÆ HYDROCHLORATIS, *Br.*—SOLUTION OF HYDROCHLORATE OF MORPHINE.

Soluté de hydrochlorate de morphine, Fr.; *Salsaure Morphinlösung,* G.

Preparation.—Take of Hydrochlorate of Morphine 9 grains; Diluted Hydrochloric Acid 18 minims; Rectified Spirit ½ fluidounce; Distilled Water 1½ fluidounces. Mix the hydrochloric acid, the spirit, and the water, and dissolve the hydrochlorate of morphine in the mixture.—*Br.*

This and the preceding solution are about four times the morphine strength of the *Liquor morphiæ sulphatis* (*U. S. P.* 1870), which was made by dissolving 1 grain of morphine sulphate in 1 fluidounce of water. (For *Liq. morph. bimecon.* see p. 1109.)

In some parts of the United States a much stronger solution is prescribed under the name of *Magendie's solution of morphine.* It is prepared by dissolving 16 grains of sulphate of morphine in 1 fluidounce of water, and is therefore *sixteen times stronger* than the preceding. *Magendie's solution* is prepared in France by dissolving 0.8 Gm. (12¼ grains) of morphine acetate in 30 Gm. (1 fluidounce) of water, and is therefore considerably weaker than the solution known by the same name in the United States.

Medical Uses.—Each fluidrachm (Gm. 4) of this solution contains ½ grain (Gm.

0.03) of muriate of morphine, and its *dose* is from 10 to 60 minims (Gm. 0.60–4.) It will be observed that it contains 4 grains of the morphine salt to the ounce of water, while the solution of sulphate of morphine (*U. S. P.* 1870) contains but 1 grain to the fluidounce. Trousseau recommended, for hypodermic injection, a solution of muriate of morphine in glycerin, which preserves the salt from decomposition.

LIQUOR PEPSINI, *U. S.*—SOLUTION OF PEPSIN.

Liquid pepsin, E.; *Pepsine liquide*, Fr.; *Pepsinlösung*, G.

Preparation.—Saccharated Pepsin 40 parts (400 grains); Hydrochloric Acid 12 parts (120 grains); Glycerin 400 parts (4000 grains or 9⅛ oz. av.); Water 548 parts (5480 grains or 12½ oz. av. = 12 fluidounces); to make 1000 parts (10,000 grains or 22⅞ oz. av.). Dissolve the saccharated pepsin in the water, previously mixed with the hydrochloric acid. After solution add the glycerin, let the mixture stand 24 hours, and filter. —*U. S.*

The solvent action of pepsin upon proteids being materially lessened through the presence of alcohol, Prof. E. Scheffer (1870) proposed to discard the wine of pepsin and similar alcoholic preparations in favor of an aqueous solution prepared by acting upon the mucous membrane of the hog's stomach and preserved by glycerin. Subsequently, in 1871, he employed saccharated pepsin, and this formula has been adopted with very slight modification. Selldén (1873) prefers dissolving the freshly-precipitated pepsin in glycerin.

Properties.—Solution of pepsin is a colorless or pale-yellowish liquid, transparent, of a very slight odor, and of a pleasant acidulous and sweet taste. When made directly from the mucous membrane it becomes mouldy on keeping and acquires an unpleasant fetid odor. These objectionable features are avoided by the use of properly-prepared saccharated pepsin. (See also PEPSINUM.)

Medical Uses.—The advantage of this preparation over pepsin that is merely mixed with powdered sugar of milk (*Pepsinum saccharatum*) is, that it is rendered more active by the hydrochloric acid it contains, and more permanent by the glycerin in which it is partly dissolved. In a fresh state it is probably as efficient as pepsin itself in preventing the fermentation of food in the stomach and the flatulence which results, with all their consequences. The *dose* for a child is 2 or 3 fluidrachms (Gm. 8–12), and for an adult from half a fluidounce to a fluidounce (Gm. 16–32).

LIQUOR PLUMBI SUBACETATIS, *U. S.*, *Br.*—SOLUTION OF SUBACETATE OF LEAD.

Liquor plumbi subacetici, P. G.; *Acetum plumbicum*, *Acetum saturni*, *Plumbum hydrico-aceticum solutum*, *Subacetas plumbicus liquidus.*—*Goulard's extract*, E.; *Sous-acétate de plomb liquide*, *Extrait de saturne* (*de Goulard*), *Vinaigre de plomb* (*de saturne*), Fr.; *Bleiessig*, G.

An aqueous liquid containing in solution about 25 per cent. of subacetate of lead.—*U. S.* Specific gravity 1.228 *U. S.*, 1.275 *Br.*, 1.235 to 1.240 *P. G.*, 1.32 *F. Cod.*

Preparation.—Acetate of Lead 170 parts (1700 grains or 3⅞ oz. av.); Oxide of Lead 120 parts (1200 grains or 2¾ oz. av.); Distilled Water a sufficient quantity; to make 1000 parts (10,000 grains or 23 oz. av.). Dissolve the acetate of lead in 800 parts (8000 grains or 18¼ oz. av. or 17½ fluidounces) of boiling distilled water in a glass or porcelain vessel. Then add the oxide of lead, and boil for half an hour, occasionally adding enough hot distilled water to make up the loss by evaporation. Remove the heat, allow the liquid to cool, and add enough distilled water, previously boiled and cooled, to make the product weigh 1000 parts (10,000 grains or 23 oz. av.). Finally, filter the liquid in a well-covered funnel. Solution of subacetate of lead should be kept in well-stoppered bottles.—*U. S.*

Acetate of lead 5 oz. av.; oxide of lead 3½ oz. av.; distilled water 20 oz. av. Boil as above, and make the filtrate measure 20 Imperial fluidounces (19¼ fluidounces *U. S.*)—*Br.*

Acetate of lead 3 parts; oxide of lead 1 part; distilled water 8 parts. Boil and preserve the weight.—*F. Cod.*

Acetate of lead 3 parts; oxide of lead 1 part; water ½ part. Melt at the heat of a water-bath until the mixture has become white or nearly so; then add 9½ parts of water, set aside to settle, and filter.—*P. G.*

Several basic acetates of lead, soluble or insoluble in water, are known, which may be obtained by treating solutions of the neutral acetate with the requisite quantity of oxide of lead. The exact composition of the pharmacopœial solutions depends, therefore, upon the proportion of the two compounds named. Döbereiner, Berzelius, and others suggested to use them in the proportion of their molecular weights, so as to form $Pb(C_2H_3O_2)_2.Pb(HO)_2$. This proportion is closely adhered to by the U. S. and Br. Pharmacopœias, both authorities using nearly 6 molecules of the oxide to 5 of the acetate, so that the solutions must contain chiefly the acetate named, and in addition thereto a small quantity of the triplumbic acetate, $2Pb(C_2H_3O_2)_2.Pb(HO)_2$. On the other hand, the French and German preparations are made with very nearly 3 molecules of acetate to 2 of oxide of lead, and contain, therefore, about equal molecules of the two basic acetates. Both these salts are crystallizable from alcohol, in which solvent they are less freely soluble than in water. A still more basic triplumbic acetate, $Pb(C_2H_3O_2)_2.2Pb(HO)_2$, may also be obtained in white needles, but is insoluble in strong alcohol. In preparing these compounds a nearly insoluble sexplumbic acetate, $Pb(C_2H_3O_2)_2.5Pb(HO)_2$, is formed in variable proportions, and is filtered off. This insoluble compound is included in the total weight directed by three of the above formulas, while that of the British Pharmacopœia orders the filtrate to be brought to a definite measure. The filtered product, *U. S. P.*, weighs about 950 parts (about $21\frac{3}{4}$ oz. av. = 17 fluidounces).

The combination of the chemicals may be effected at the ordinary temperature by macerating the finely-levigated litharge with the solution of lead acetate in a corked bottle, and agitating occasionally until the sediment has become white; from 2 to 4 days are usually required. By boiling all the ingredients the same result is obtained in a much shorter time, and the process is preferable to that of the German Pharmacopœia.

Properties.—Solution of subacetate of lead is a colorless liquid having a sweet, astringent taste and an alkaline reaction to test-paper; the specific gravity has been given above. On exposure to air, or on being mixed with water containing air in solution, the solution yields a white precipitate of carbonate of lead. It unites readily with liquid and solid fats, and may be mixed with an equal bulk of alcohol without precipitating. Added to a solution of gum-arabic, a dense white precipitate is produced; otherwise it has the reactions of lead acetate.

Tests.—After acidulating the solution with acetic acid, ferrocyanide of potassium should produce a white precipitate free from any blue (iron) or red (copper) tint. When completely precipitated by an excess of sulphuric acid the filtrate, on being evaporated to dryness, should leave no residue or only a very slight one (absence of other salts). When precipitated by an excess of ammonia the filtrate should not have a blue color (absence of copper). "13.7 Gm. of the solution should require for complete precipitation 25 Ccm. of the volumetric solution of oxalic acid."—*U. S.* (284.5 grains of the solution and 500 grain-measures of the volumetric solution, *Br.*).

Off. Prep.—Cerat. plumbi subacet. (Ung. plumbi subacet. comp.), *U. S.*, *Br.*; Linimentum plumbi subacet., *U. S.*; Liquor plumbi subacet. dilutus, *U. S.*, *Br.*

Medical Action and Uses.—This solution has occasioned violent toxical symptoms when taken internally, which it never should be for medicinal purposes. It is employed whenever an astringent and local sedative action is required to allay pain or inflammation, to constringe flaccid tissues, or to lessen secretion. When applied to the denuded cutis its use should not be continued long, lest acute poisonous effects be developed. It is of common use, diluted, in the treatment of *contusions*, *sprains*, *excoriations*, *fractures*, *burns*, *wounds*, *abscesses*, *hernia*, *hæmorrhoids*, and various cutaneous *eruptions* of an inflammatory sort. It is best applied on soft cloths, lint, etc., which should be covered with a waterproof tissue. Spongio-piline is a convenient vehicle for its use. The mucilage of slippery elm or of quince-seeds causes a precipitation of the lead from this solution; flaxseed and sassafras-pith mucilages are less objectionable. For practical use the diluted solution is in most cases preferable.

LIQUOR PLUMBI SUBACETATIS DILUTUS, *U. S.*, *Br.*—DILUTED SOLUTION OF SUBACETATE OF LEAD.

Aqua plumbi, P. G.; *Aqua plumbica* (*vel saturnina*).—*Lead-water*, E.; *Eau de saturne*, *Eau blanche*, Fr.; *Bleiwasser*, *Kühlwasser*, G.

Preparation.—Solution of Subacetate of Lead 3 parts (90 grains or 77 minims); Distilled Water 97 parts (2910 grains or $6\frac{5}{8}$ oz. av. or $6\frac{3}{8}$ fluidounces); to make 100 parts (3000 grains = $6\frac{1}{2}$ fluidounces). Mix the solution of subacetate of lead with the distilled water, previously boiled and cooled. Keep the liquid in well-stopped bottles.—*U. S.*

Take of solution of subacetate of lead, rectified spirit, each 2 fluidrachms; distilled water 19½ fluidounces. Mix, and filter through paper. Keep the clear solution in a stoppered bottle.—*Br.*

The use of distilled water does not prevent the mixture from becoming turbid at once, the carbonic acid held in solution or contained in the atmosphere producing some carbonate of lead; this gas is therefore expelled by the previous boiling of water. Since, however, the decomposition will again take place when exposed to the atmosphere, it is best to prepare lead-water only in small quantities; for preparing 2 fluidounces of it 28¾ grains or 24¼ minims of Goulard's extract are required; the French and German Pharmacopœias order 2 per cent.

AQUA PLUMBI GOULARDI, AQUA VEGETO-MINERALIS GOULARDI VEL LOTIO PLUMBEA.—Goulard's lead-water, *E.;* Eau de Goulard, *Fr.;* Goulardsches Wasser, *G.*—This contains a little alcohol (*Br.*) or vulnerary spirit (*F. Cod.*), the latter being an aromatic alcohol.

Medical Uses.—It is this rather than the stronger solution of subacetate of lead that is commonly employed for the various purposes above indicated. When it is used as a lotion merely, and is not confined by dressings, it is rendered more efficient by the addition of alcohol, in the proportion of 3 or 4 drachms to a pint (Gm. 12–16 in Gm. 500) of the solution.

LIQUOR POTASSÆ, *U. S., Br.*—SOLUTION OF POTASSA.

Liquor kali caustici, P. G.; *Kali hydricum solutum, Lixivium causticum.—Solution of potash*, E.; *Potasse caustique liquide, Lessive caustique*, Fr.; *Aetzkalilauge, Kalilauge*, G.

An aqueous solution of hydrate of potassium, KHO; molecular weight 56.7—containing about 5 per cent. *U. S.*, 5.84 per cent. *Br.*, 15 per cent. *P. G.*, of the hydrate. Specific gravity 1.036 *U. S.*, 1.058 *Br.*, 1.142 to 1.146 *P. G.*

Preparation.—Bicarbonate of Potassium 90 parts (4½ oz. av.); Lime 40 parts (2 oz. av.); Distilled Water a sufficient quantity. Dissolve the bicarbonate of potassium in 400 parts (20 oz. av. or 19¼ fluidounces) of distilled water; heat the solution until effervescence ceases, and then raise it to boiling. Slake the lime and make it into a smooth mixture with 400 parts (20 oz. av. or 19¼ fluidounces) of distilled water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for 10 minutes. Remove the heat, cover the vessel tightly, and when the contents are cold add enough distilled water to make the whole mixture weigh 1000 parts (50 oz. av. = 47½ fluidounces). Lastly, strain it through linen, set the liquid aside in a well-stopped bottle until it is clear, and remove the clear solution by means of a siphon.

Solution of potassa may also be prepared in the following manner: potassa 56 parts (27 grains); distilled water 944 parts (455½ grains or 1 fluidounce); to make 1000 parts (a little over 1 fluidounce). Dissolve the potassa in the distilled water.

The potassa used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Potassa of any other strength, however, may be used if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute potassa (hydrate of potassium) contained therein. Solution of potassa should be kept in well-stopped bottles.—*U. S.*

Take of carbonate of potash 1 pound; slaked lime 12 ounces; distilled water 1 gallon (Imperial). Dissolve the carbonate of potash in the water, and, having heated the solution to the boiling-point in a clean iron vessel, gradually add the washed slaked lime, and continue the ebullition for 10 minutes with constant stirring. Then remove the vessel from the fire, and when, by the subsidence of the insoluble matter, the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green glass bottle furnished with an air-tight stopper, and add distilled water if necessary to make it correspond with the tests of specific gravity and neutralizing power.—*Br.*

On bringing together potassium carbonate and slaked lime in the presence of water a double decomposition is effected, resulting in the formation of potassium hydrate and calcium carbonate; $K_2CO_3 + CaH_2O_2$ yields $2KHO + CaCO_3$. This reaction cannot be completed in concentrated solutions, but occurs promptly in diluted liquids. The smallest quantity necessary for 1 part of potassium carbonate, according to Watson, is 8 parts of water; Mohr, however, prefers to use not less than 12 parts, and to concentrate the caustic liquor, if necessary, by evaporation. The decomposition may be effected in the cold by frequent agitation, but the resulting calcium carbonate is then light and retains much of the liquor, while at the same time silica, if present in the carbonate, is not completely removed. The British Pharmacopœia uses potassium carbonate and water in the proportion of 1 to 10; the United States Pharmacopœia, nearly in the proportion of 1 to 12½, having substituted the much purer bicarbonate for the carbonate. 1 part of slaked lime is sufficient to decompose 2.5 parts of potassium carbonate, containing 81 per cent. of the pure anhydrous salt, and for 1.8 parts of potassium bicarbonate if in boiling the solution of the latter carbonic acid was not given off, or for 3.6 parts of the latter salt if previously converted into normal carbonate by boiling. An excess of lime is, however, preferable to ensure complete decomposition; but the employment of an unnecessarily large quantity may be avoided by following the directions of the Pharmacopœia to add the milk of lime gradually in small portions to the boiling alkaline liquid; when this addition amounts to a quantity of lime equal to about one-half the weight of the potassium salt, a little of the boiling mixture may be poured upon a small moistened filter, and the filtrate collected in a test-tube containing some hydrochloric acid. Should effervescence occur, the boiling must be continued and more lime added, until on testing as before, a new filter being used each time, no effervescence is observed. The removal of the caustic liquor may be effected either by filtering it at once through muslin, or, better still, we think, by allowing the insoluble matter to subside, drawing off the clear liquor by means of a siphon, and transferring the sediment before it has become hard upon a muslin strainer, and washing the potassa out by means of distilled water. In all cases the liquid should be brought to the proper density by the addition of water, or, if necessary, by evaporation; if largely diluted by washing, the potassa solution may be employed for various chemical operations. A well-cleaned iron vessel is best adapted for the above operation.

Other methods for obtaining potassa solution adapted for special purposes have been recommended. Schubert decomposed potassium sulphate accurately by a hot solution of baryta. Hunter (1866) arrived at the same result by substituting lime for the baryta, and by boiling and filtering under a pressure of about 40 pounds to the square inch. F. Schulze (1861) heated a mixture of 1 part of pure potassium nitrate with 3 parts of ferrous oxalate to dull redness while hydrogen gas was being conducted to the bottom of the crucible. Wöhler's process (1853), to heat a mixture of 1 part of potassium nitrate and 2 of copper to dull redness, is apt to yield a product containing potassium nitrite if the mixture has not been intimate or if the heat is not continued long enough; Polacci (1872) found the solution in water to contain a little copper.

The following table, computed by Gerlach (1869), gives the specific gravity of potassa solution at 15° C. (59° F.), containing from 1 to 60 per cent. of potassium oxide, and the same percentage of potassium hydrate:

Percentage.	K_2O.	KHO.	Percentage.	K_2O.	KHO.	Percentage.	K_2O.	KHO.
1	1.010	1.009	21	1.230	1.188	41	1.522	1.425
2	1.020	1.017	22	1.242	1.198	42	1.539	1.438
3	1.030	1.025	23	1.256	1.209	43	1.554	1.450
4	1.039	1.033	24	1.270	1.220	44	1.570	1.462
5	1.048	1.041	25	1.285	1.230	45	1.584	1.474
6	1.058	1.049	26	1.300	1.241	46	1.600	1.488
7	1.068	1.058	27	1.312	1.252	47	1.615	1.499
8	1.078	1.065	28	1.326	1.264	48	1.630	1.511
9	1.089	1.074	29	1.340	1.276	49	1.645	1.527
10	1.099	1.083	30	1.355	1.288	50	1.660	1.539
11	1.110	1.092	31	1.370	1.300	51	1.676	1.552
12	1.121	1.101	32	1.385	1.311	52	1.690	1.565
13	1.132	1.111	33	1.402	1.324	53	1.705	1.578
14	1.143	1.119	34	1.418	1.336	54	1.720	1.590
15	1.154	1.128	35	1.431	1.349	55	1.733	1.604
16	1.166	1.137	36	1.445	1.361	56	1.746	1.618
17	1.178	1.146	37	1.460	1.374	57	1.762	1.630
18	1.190	1.155	38	1.475	1.387	58	1.780	1.641
19	1.202	1.166	39	1.490	1.400	59	1.795	1.655
20	1.215	1.177	40	1.504	1.411	60	1.810	1.667

Properties.—Potassa solution is a clear and colorless liquid of the specific gravity stated above, and has a strong alkaline reaction and a very caustic taste. The slight peculiar odor which it usually has is due to its action upon organic bodies which may have been derived from the atmosphere. It dissolves wool, skin, and other animal and many vegetable substances, and decomposes fats, forming therewith soluble soaps. It attracts carbonic acid from the air with great avidity, and must therefore be preserved in well-stopped bottles. Green glass, free from lead, is best adapted for the purpose, but is likewise somewhat decomposed by alkalies, which cause the stopper to become firmly fastened into the bottle unless protected by a thin layer of paraffin. Potassa solution decomposes the salts of ammonium, of the metals, and of all the alkaloids, and induces the decomposition of tannin and its derivatives; "a drop taken up by a platinum loop and held in a non-luminous flame imparts to it a violet tint."—*U. S.* As a test of identity, and considering the strong yellow color given by sodium compounds, the flame may be examined through a blue glass to cut off the color of sodium. It differs from soda solution in yielding a white crystalline precipitate with excess of concentrated solution of tartaric acid, and a yellow one on the addition of hydrochloric acid and platinic chloride.

Tests.—The solution should not effervesce, or at most should give off only isolated bubbles, when dropped into an excess of dilute hydrochloric acid (limit of carbonate). Carbonic acid is limited to about $\frac{1}{3}$ per cent. by the following test: Mix 1 part of potassa solution with 4 parts of lime-water; boil, and filter into nitric acid, when no effervescence should be observed.—*P. G.* When acidulated with nitric acid, potassa solution should give not more than a very slight turbidity with barium nitrate (sulphate), silver nitrate (chloride), or sodium carbonate (alumina, lime); and when the acidulated solution is evaporated to dryness the residue should form a clear or merely a slightly turbid (from presence of silica) solution in water, which should not be disturbed by test solution of magnesium (absence of phosphate). If neutralized with sulphuric acid, and then mixed with half its bulk of concentrated sulphuric acid and allowed to cool, the addition of ferrous sulphate should not produce a black or blackish-brown color (nitrate). Potassa solution should not be precipitated or colored black by hydrogen sulphide, either before or after being acidulated (absence of metals). The British Pharmacopœia demands that 462.9 grains (1 fluidounce Imperial) should require for neutralization 482 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5.84 per cent. by weight of potassium hydrate, or 27 grains in 1 (Imperial) fluidounce. The solution of the United States Pharmacopœia should require for 28 Gm. not less than 25 Ccm. of the volumetric solution of oxalic acid, and the (*U. S.*) fluidounce should contain 23.5 grains of pure potassium hydrate.

Pharmaceutical Uses.—By evaporating the solution it yields Potassa (Potassa caustica), *U. S.*, *Br.* It is employed in the officinal processes for the following: Hydrarg. oxidi flavum, *U. S.;* Potassii bromidum, Potassii iodidum, *Br.*

Physiological Action.—Solution of potassa possesses in a degree the caustic properties of the pure alkali, since it contains nearly 6 per cent. of the latter. The soapy feel which it gives to the fingers is due to its combination with the unctuous secretion of the skin. In medicinal doses and taken during or after a meal it speedily combines with the acids then abundantly secreted by the stomach, but if properly diluted and used when the stomach is empty it is absorbed, and tends to neutralize the acid secretions, especially the urine, along with which it is chiefly eliminated. Used habitually, it lessens the coagulability of the blood and dissolves out the hæmatin from the red corpuscles, giving rise to paleness and puffiness of the skin, passive hæmorrhages, general emaciation, and, in a word, to the ordinary phenomena of scurvy. This aplastic operation explains its efficacy in moderating a tendency to plastic exudations, in promoting the absorption of those already existing, and in modifying nutrition generally.

Medical Uses.—Solution of potassa limits or suspends the formation of *acid urinary deposits* and *concretions* by neutralizing the free acids through which they are formed, while it spares the urinary passages the irritation of their contact. But since these acids always proceed from some defect of primary assimilation, the mere neutralization of them when formed does not necessarily effect a radical cure, which must be sought by the use of remedies tending to bring the digestive powers and the work of digestion into due proportion and harmony. For this purpose dietetic and hygienic measures are the most efficient. The *dyspeptic symptoms* which call for solution of potassa and other antacid medicines are heartburn, sour eructations, aphthæ, œsophageal spasm, vomiting, cramp in the stomach, colic, and irregular diarrhœa. It is probable that such medicines, by correcting acidity, tend to promote the due digestion of food, and thereby indirectly to remove the debility of the system upon which *acid dyspepsia* depends.

Certain it is, that in cases of "uric-acid diathesis," as it has been called, the alkaline treatment, duly carried out, will sometimes suspend the faulty secretion for an indefinite period. It is true that this result is more usual after the liberal use of diuretic mineral waters, which probably cleanse the urinary channels of accumulated deposits, than from the use of solution of potassa or of any other alkali alone. The *tympanites* incident to this form of dyspepsia is best palliated by the medicine when it is given in a bitter infusion. *Strangury* from cantharides is said to be both prevented and relieved by 20 minims of solution of potassa, largely diluted. In *acne* of the face (gutta rosacea) the internal use of the medicine is sometimes very efficient, and it has been equally recommended for the prevention and cure of *boils* when they occur in successive crops. *Scrofulous glandular swellings* are doubtless diminished during a course of this medicine, but its debilitating effects upon the system should at the same time be counteracted by appropriate food and cod-liver oil. It is injurious in *phthisis*, but, on the other hand, useful in *chronic bronchitis*, especially when associated with emphysema and when expectoration is difficult and the sputa are scanty and tenacious. The mode of action implied in some of the preceding statements receives a further support by the successful use of solution of potassa to moderate *obesity*. The hypothesis invoked to explain its action is that "it increases the vital powers of metamorphosis, by saponifying in part the fat contained in the blood and enabling it to be burnt off as carbonic acid." We should incline to the opinion that it acts by slowly poisoning the victim, radically disorganizing his blood, and hindering his nutrition. For the purpose intended it has been given in the dose of 1 or 2 fluidrachms three times a day—a dose which probably no stomach could long receive with impunity. Experiments and observations in India furnish some reason for thinking that solution of potassa is an antidote to *serpents' bites*. They are not, however, conclusive. Nor is the statement more probable that if used to cauterize the bites of rabid animals it will prevent *hydrophobia*. The power of this solution to dissolve organic products has been used to soften the nail in cases of *ingrown nail*, and gradually to permit its removal, leaving the fungous granulations free from its irritation. It has been recommended to add solution of potassa to the lime-water used for atomized inhalation in *diphtheritic* affections of the throat and larynx, in the proportion of 10 or 15 drops to 5 or 6 ounces of lime-water diluted one-half with pure water. When swallowed in poisonous doses the proper antidote against its effects is vinegar or lemon-juice, followed by some bland oil.

Solution of potassa may be administered internally in the *dose* of from 10 minims to a fluidrachm (Gm. 0.60–4), largely diluted with a mucilaginous or sweetened aromatic or a bitter infusion. It should not be prescribed along with henbane, belladonna, or stramonium, whose medicinal properties it destroys.

LIQUOR POTASSÆ EFFERVESCENS, *Br.*—EFFERVESCING SOLUTION OF POTASH.

Aqua potassæ effervescens.—Potash-water, E.; *Eau alcaline gazeuse*, Fr.; *Alkalisches Mineralwasser*, G.

Preparation.—Take of Bicarbonate of Potash 30 grains; Water 1 pint (Imperial). Dissolve the bicarbonate of potash in the water and filter the solution; then pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

Properties and Tests.—The solution effervesces strongly when the containing vessel is opened, carbonic acid gas escaping; it is clear and sparkling, and has an agreeable acidulous taste. 10 fluidounces, after being boiled for 5 minutes, require for neutralization 150 grain-measures of the volumetric solution of oxalic acid. 5 fluidounces, evaporated to one-fith, and 12 grains of tartaric acid added, yield a crystalline precipitate which, when dried, weighs not less than 12 grains.

Medical Uses.—The remarks made under LIQUOR MAGNESIÆ CARBONATIS are applicable to this preparation.

LIQUOR POTASSII ARSENITIS, *U. S.*—SOLUTION OF ARSENITE OF POTASSIUM.

Liquor arsenicalis, Br.; *Liquor kalii arsenicosi*, P. G.; *Solutio arsenicalis Fowleri*, *Kali arsenicosum solutum.—Arsenical solution*, *Fowler's solution*, E. ; *Liqueur (solution) arsenicale de Fowler*, Fr.; *Fowler'sche Tropfen*, G.

The officinal solutions contain 1 part of arsenious acid in 100 parts by weight. *U. S.*, *Br.*, *F. Cod.*, *P. G.*

Preparation.—Arsenious Acid, in small pieces, 1 part (30 grains); Bicarbonate of Potassium 1 part (30 grains); Compound Tincture of Lavender 3 parts (90 grains = 100 minims); Distilled Water a sufficient quantity; to make 100 parts (3000 grains). Boil the arsenious acid and bicarbonate of potassium in a glass vessel with 10 parts (300 grains or 5 fluidrachms) of distilled water until the acid is completely dissolved. Then add the compound tincture of lavender, and enough distilled water to make the product weigh 100 parts (3000 grains or 6⅞ oz. av. = 6½ fluidounces). Lastly, set the mixture aside for 8 days, and then filter through paper.—*U. S.*

Take of arsenious acid, in powder, carbonate of potassium, each 87 grains; compound tincture of lavender 5 fluidrachms; distilled water a sufficiency. Place the arsenious acid and the carbonate of potash in a flask with 10 ounces of the water and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender and as much distilled water as will make the bulk 1 pint (Imperial).—*Br.*

The United States Pharmacopœia very properly directs the mixture of potassium salt and arsenious acid to be boiled in a small quantity of water, whereby a combination and solution is readily effected, the liquid containing potassium arsenite, which is probably HK_2AsO_3. When this is subsequently diluted with water and remains in contact with the air, it absorbs carbonic acid again, and the solution will then be identical with that of the British Pharmacopœia, which must be regarded merely as a solution of arsenious acid in the alkaline carbonate, from which a portion crystallizes again when the solution is long kept. On keeping 100 Gm. for 3 years, Ménière (1876) collected 0.15 Gm., or 15 per cent. of the amount originally dissolved. The precise circumstances under which this separation takes place have not been ascertained, but the separation is undoubtedly due to the gradual conversion of the arsenious acid into the crystalline modification, which is but sparingly soluble. Observations made by Fresenius, Dannenberg, and others indicate that in partially-filled bottles the arsenious acid is gradually oxidized to arsenic acid, which is considered to be far less poisonous than the former. It is evident, therefore, that Fowler's solution cannot be kept unchanged for an indefinite period, and it is advisable that it be prepared in no larger quantities than will be sufficient for a few months or a year, or that it be kept in small well-sealed bottles, whereby oxidation is prevented, as well as the appearance of a fungous growth which often takes place in Fowler's solution on exposure to the air. Delahaye (1882) regards the excess of alkali used as favoring this growth, and recommends reducing the potassium to the quantity absolutely necessary for retaining the arsenic in permanent solution, or, better still, replacing it by sodium bicarbonate, 2 parts of which will be sufficient for 3 parts of arsenious acid; these changes, however, do not prevent the development of mould, though they may possibly retard it.

Properties.—Fowler's solution is a reddish liquid, at first somewhat opalescent, having an alkaline reaction to test-paper and the odor of lavender; that of the French and German Pharmacopœias is colorless, and is flavored with compound spirit of melissa. Its specific gravity is 1.009. It gives the usual reactions of arsenic, and requires to be acidulated with hydrochloric acid before it will be precipitated by hydrogen sulphide.

Tests.—On being acidulated with hydrochloric acid the solution should not acquire a yellow color or deposit a yellow precipitate (absence of sulphide of arsenic).

The amount of arsenious acid contained in it is conveniently ascertained with iodine, with starch-paste as an indicator, which is not permanently colored blue until the arsenious has all been oxidized to arsenic acid, hydriodic acid being formed at the same time; $As_2O_3 + 5H_2O + 2I_2$ yields $2H_3AsO_4 + 4HI$. "If 24.7 Gm. of the solution are boiled with 0.5 Gm. of bicarbonate of sodium, the liquid, when cold, diluted with 100 Ccm. of water, and some gelatinized starch added, it should require from 48.5 to 50 Ccm. of the volumetric solution of iodine until the blue color ceases to disappear on stirring (corresponding to 1 per cent. of arsenious acid of the required purity)."—*U. S.* Or, "5 Gm. of solution, mixed with 20 Gm. of water, 1 Gm. of sodium bicarbonate, and a few drops of starch solution, should decolorize 10 Ccm. of the volumetric solution of iodine, and on the further addition of 0.1 Ccm. of the latter should acquire a blue color."—*P. G.* "442 grains (1 fluidounce), 10 grains of sodium bicarbonate, and 6 fluidounces of distilled water containing a little mucilage of starch, treated as described, require 875 grain-measures of the volumetric solution of iodine, indicating 4⅓ grains of arsenious acid."—*Br.*

Medical Uses.—The action and uses of this medicine have been sufficiently discussed elsewhere. (See ACIDUM ARSENIOSUM.) It is sufficient in this place to state that its efficacy is most conspicuous in *squamous diseases of the skin*, *intermittent fever*, *neuralgia*, especially of the trifacial, and in *nervous asthma*. The commencing *dose* should not exceed 5 drops (Gm. 0.30), nor should it be given when the stomach is empty, nor unless greatly diluted.

LIQUOR POTASSII CITRATIS, *U. S.*—SOLUTION OF CITRATE OF POTASSIUM.

Liquor kali citrici.—Citrate de potasse liquide, Fr.; *Kaliumcitrat-Lösung*, G.

Preparation.—Citric Acid 6 parts (60 grains); Bicarbonate of Potassium 8 parts (80 grains); Water a sufficient quantity. Dissolve the citric acid and the bicarbonate of potassium each in 40 parts (400 grains or 7 fluidrachms) of water. Filter the solutions separately, and wash the filters with enough water to obtain in each case 50 parts (500 grains) of solution. Finally, mix the two solutions, and when effervescence has ceased transfer the liquid to a bottle. This preparation should be freshly made when wanted for use.—*U. S.*

This is a solution of potassium citrate containing a little free carbonic acid, and differs from Mistura potassi citratis in the absence of the yellowish color and the agreeable lemon flavor. The improved manipulation suggested in the previous editions of this work, now adopted by the Pharmacopœia, consists in dissolving the chemicals separately and mixing the clear solutions; a sufficient amount of carbonic acid gas will thus be retained to render the liquid sparkling and impart to it a pleasant acidulous flavor aside from the mildly saline taste of potassium citrate. The quantities given above will almost exactly make 2 fluidounces of the solution, and this contains an excess of 3.4 grains of citric acid over the amount necessary for the production of normal potassium citrate, of which the solution contains nearly 9 per cent. The Pharmacopœia gives the specific gravity 1.059, which is obviously an approximation, the density varying with the carbonic acid retained. The direction to make the solution fresh as wanted is a commendable one, since aqueous solutions of citric acid undergo decomposition (see page 53).

POTIO RIVERI, *P. G.*, is less than one-third the strength of the preceding; it is made from citric acid 4 parts, water 190 parts, and crystallized sodium carbonate 9 parts.

POTION DE RIVIERE, *F. Cod.* Dissolve citric acid and potassium bicarbonate, of each 2 Gm., separately in water 50 Gm. and syrup 15 Gm.; the solutions are often dispensed in separate vials.

Medical Action and Uses.—This preparation is nearly identical in its action with Mistura potassii citratis, *U. S. P.*, and Liq. potassii effervescens, *Br. P.*, and with the effervescing draught prepared extemporaneously. When the intention is solely to affect the system after the absorption of the salt, either of the first two will lessen the tension of the capillaries and promote *diaphoresis;* but when it is intended at the same time to make an impression upon the stomach itself, the carbonic acid extricated during effervescence becomes an important part of the dose. The primary action of the gas is to stimulate organically, while it perhaps anæsthetizes, the gastric mucous membrane, as may be inferred from the many cases of gastric hyperæmia and irritation in which it allays *nausea* and *vomiting*. It may therefore be sometimes used with advantage when the stomach is disordered, although fever may be absent. Either solution may have its diaphoretic power increased by the addition of spirit of nitrous ether, of solution of morphine, or of antimonial wine or tartar emetic, in very small, non-nauseating doses.

The *dose* of the neutral mixture is a tablespoonful (Gm. 16); of the effervescing mixture, a tablespoonful (Gm. 16) of each of the two solutions should be mixed, and swallowed while effervescing. The dose should be repeated every hour until the object in view is attained or defeated.

LIQUOR POTASSII PERMANGANATIS, *Br.*—SOLUTION OF PERMANGANATE OF POTASSIUM.

Liquor potassæ permanganatis.—Soluté de permanganate de potasse, Fr.; *Kaliumpermanganat-Lösung*, G.

Preparation.—Take of Permanganate of Potassium 88 grains; Distilled Water 1 pint (Imperial). Dissolve.—*Br.*

The solution contains 1 per cent. of permanganate of potassium, and has the purple color and the chemical behavior of the salt.

Medical Uses.—The officinal solution, of 4 grains of the salt to an ounce of distilled water, appears unnecessary, since it is too weak for many purposes and too strong for others. (For its uses and doses see POTASSII PERMANGANAS.)

LIQUOR SODÆ, *U. S.*, *Br.*—SOLUTION OF SODA.

Liquor natri caustici, P. G.; *Natrum hydricum solutum.*—*Soude caustique liquide, Lessive des savonniers*, Fr.; *Aetznatronlauge*, G.

An aqueous solution of hydrate of sodium, NaHO; molecular weight 40—containing 5 per cent. *U. S.*, 4.1 per cent. *Br.*, 15 per cent. *P. G.*, 23 per cent. *F. Cod.*, of the hydrate. Specific gravity of the officinal solutions: 1.059 *U. S.*, 1.047 *Br.*, 1.33 *F. Cod.*, 1.159 to 1 163 *P. G.*

Preparation.—Carbonate of Sodium 180 parts (9 oz. av.); Lime 60 parts (3 oz. av.); Distilled Water a sufficient quantity. Dissolve the carbonate of sodium in 400 parts (20 oz. av. or 19¼ fluidounces) of boiling distilled water. Slake the lime, and make it into a smooth mixture with 400 parts (20 oz. av. or 19¼ fluidounces) of distilled water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for 10 minutes. Remove the heat, cover the vessel tightly, and when the contents are cold add enough distilled water to make the whole mixture weigh 1000 parts (50 oz. av. = 42 fluidounces). Lastly, strain it through linen, set the liquid aside in a well-stopped bottle until it is clear, and remove the clear solution by means of a siphon.

Solution of Soda may also be prepared in the following manner: Soda 56 parts; distilled water 944 parts; to make 1000 parts. Dissolve the soda in the distilled water. The soda used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Soda of any other strength, however, may be used if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute soda (hydrate of sodium) contained therein. Solution of soda should be kept in well-stopped bottles.—*U. S.*

Take of carbonate of soda 28 ounces; slaked lime 12 ounces; distilled water 1 gallon. Dissolve the carbonate of soda in the water, and, having heated the solution to the boiling-point in a clean iron vessel, gradually add the washed slaked lime, and continue the ebullition for 10 minutes, with constant stirring. Then remove the vessel from the fire, and when, by the subsidence of the insoluble matter, the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green glass bottle furnished with an air-tight stopper, and add distilled water, if necessary, to make it correspond with the tests of specific gravity and neutralizing power.—*Br.*

The process is quite analogous to that for the preparation of caustic potassa, and what has been said about the manipulation (see LIQUOR POTASSÆ) applies equally well in this case. 1 part of burned lime, if pure, is sufficient to decompose 5 parts of crystallized sodium carbonate; in both the above formulas the quantity of the former ordered may without disadvantage be reduced.

Properties.—Soda solution is a clear and colorless liquid of the density given above, and has a strong alkaline reaction and a very caustic taste; the peculiar slight odor which it usually has is solely due to the accidental presence of organic matters, which are likely to impart also a yellowish color. It dissolves various organic matters and tissues, and decomposes fats, forming soaps. It has a great affinity for carbonic acid, and should be preserved in well-stopped bottles made of glass free from lead, the stopper being protected by a thin layer of paraffin. In its chemical behavior it closely resembles potassa solution, but, unlike the latter, it does not yield a crystalline precipitate with excess of tartaric acid, except in concentrated solutions; with hydrochloric acid and platinum chloride it does not yield a yellow precipitate, and when, by means of a platinum wire, a drop of it is held in a non-luminous flame, an intense yellow color is imparted to the latter.

Tests.—Soda solution should not effervesce, or at most should evolve only isolated bubbles of carbonic acid gas, on being dropped into an acid. "If 1 part of it be boiled with 4 parts of lime-water, the liquid filtered into nitric acid should not cause any effervescence (not over ⅓ per cent. carbonic acid as carbonate)."—*P. G.* The solution acidulated with nitric acid should not cause more than a slight cloudiness with barium nitrate (sulphate), silver nitrate (chloride), or sodium carbonate (alumina, earths), and when evaporated to dryness and redissolved in water should leave only a minute quantity of insoluble matter (silica), and furnish a liquid which is not precipitated by test solution of magnesium (phosphate). The absence of nitrate and of heavy metals is shown as described for Liquor Potassæ. "To neutralize 20 Gm. of solution of soda should require not less than 25 Ccm. of the volumetric solution of oxalic acid."—*U. S.* 458 grains (1 fluidounce) of the solution require 470 grain-measures of the volumetric solution.—*Br.*

The following table by Gerlach (1869) gives the specific gravity at 15° C. (59° F.) of soda solution containing from 1 to 60 per cent. of sodium oxide and the same percentage of sodium hydrate:

Percentage.	Na_2O.	NaHO.	Percentage.	Na_2O.	NaHO.	Percentage.	Na_2O.	NaHO.
1	1.015	1.012	21	1.300	1.236	41	1.570	1.447
2	1.029	1.023	22	1.315	1.247	42	1.583	1.456
3	1.043	1.035	23	1.329	1.258	43	1.597	1.468
4	1.058	1.046	24	1.341	1.269	44	1.610	1.478
5	1.074	1.059	25	1.355	1.279	45	1.623	1.488
6	1.089	1.070	26	1.369	1.290	46	1.637	1.499
7	1.104	1.081	27	1.381	1.300	47	1.650	1.508
8	1.119	1.092	28	1.395	1.310	48	1.663	1.519
9	1.132	1.103	29	1.410	1.321	49	1.678	1.529
10	1.145	1.115	30	1.422	1.332	50	1.690	1.540
11	1.160	1.126	31	1.438	1.343	51	1.705	1.550
12	1.175	1.137	32	1.450	1.351	52	1.719	1.560
13	1.190	1.148	33	1.462	1.363	53	1.730	1.570
14	1.203	1.159	34	1.475	1.374	54	1.745	1.580
15	1.219	1.170	35	1.480	1.384	55	1.760	1.591
16	1.233	1.181	36	1.500	1.395	56	1.770	1.601
17	1.245	1.191	37	1.515	1.405	57	1.785	1.611
18	1.258	1.202	38	1.530	1.415	58	1.800	1.622
19	1.270	1.213	39	1.543	1.420	59	1.815	1.633
20	1.285	1.225	40	1.558	1.437	60	1.830	1.643

Pharmaceutical Uses.—In preparing Antimon. sulphurat., *U. S.*, *Br.;* Bismuthi oxid., Ferri oxid. magnet., Ferri peroxid. humid., Hydrarg. oxidi flav., Quiniæ sulph., *Br.;* Soda (Soda caust.), *U. S.*, *Br.;* Sodæ valerianas, *Br.*

Allied Preparation.—Sodium ethylate, C_2H_5NaO, or *caustic alcohol*, was recommended by Dr. B. W. Richardson (1870). Half a fluidounce of absolute alcohol is put into a two-ounce test-tube, immersed in water of 10° C. (50° F.), and metallic sodium is added in small pieces until the evolution of hydrogen ceases, when the temperature is raised to 37.8° C. (100° F.), and the addition of sodium continued until hydrogen ceases to be given off; the compound is then dissolved in half a fluidounce of absolute alcohol. According to Liebig (1837), the action is rapidly completed at 50° C. (122° F.), and on cooling the sodium ethylate crystallizes in large colorless laminæ. It may be rubbed into powder and preserved in well-stopped vials.

Liquor sodii ethylatis, *Br.*, is made by dissolving metallic sodium 22 grains in ethylic (absolute) alcohol 1 fluidounce, contained in a flask and kept cool by water. It is a colorless, syrupy liquid, of spec. grav. 0.867, becomes brown by keeping, and contains 19 per cent of NaC_2H_5O.

Medical Uses.—Solution of soda is seldom used therapeutically, and then chiefly in cases of "torpor of the liver." *Dose*, 10 to 60 drops (Gm. 0.60–4), largely diluted.

According to Dr. Richardson, the following are the results of applying *sodium ethylate* to the living tissues: 1, a removal of water from the tissue; 2, the destructive action of the resulting caustic soda; 3, coagulation from the alcohol that is reproduced; 4, prevention of decomposition in the resulting dead tissue. It was employed by Dr. Brunton in the treatment of *nævus* in 1871. He describes its action as follows: "Laid on dry parts of the body, the sodium ethylate is comparatively inert, creating no more change than the redness and tingling caused by common alcohol; but as soon as the part to which the substance is applied gives up a little water, the transformation described above occurs, caustic soda is produced in contact with the skin in proportion as water is eliminated, and there proceeds a gradual destruction of tissues which may be moderated so as hardly to be perceptible or may be so intensified as to act almost like a cutting instrument." "Applied direct to the unbroken skin, the destructive action is less painful than would be expected, and when pain is felt it may be checked quickly by dropping upon the part a little chloroform, which decomposes the alcohol, converting it into a chloride salt and ether." "The caustic alcohols may be used in combination with local anæsthesia from cold. A part rendered quite dead to pain by freezing with ether spray may be directly destroyed by the subcutaneous injection of caustic alcohol—a practice very important in the treatment of *poisoned wounds*. It is by no means improbable that *cystic tumors* may be cured by this simple subcutaneous injection of a little of those fluids after destruction of their sensibility by cold. Potassium and sodium alcohol, added to the volatile hydride of amyl, dissolve the hydride and produce a caustic solution." Dr. Brunton states that, compared with the action of nitric acid, there is but little destruction of the epidermis, and he considers that sodium ethylate acts as an astringent, and the pain is not so severe as that caused by nitric acid. In his cases hardly any scarring ensued. The ethylate affects but little the healthy skin; it restricts its action to the spot on which it is applied. Dr. Richardson (*London Lancet*, Feb. 12, 1881) has reported cases of *tattoo* and *mother's marks*, nasal *polypus*, *ozæna*, and *lupus* in which the caustic produced good results, as well as in minor affections, such as *warts*, small *melanotic growths*, *ringworm*, and *hæmorrhoids*.

Dr. Richardson states that the liberated alcohol coagulates the albuminous compounds in its neighborhood, and thus limits the caustic action of the soda. The red corpuscles become disintegrated, and then crystalline, while the white are for a time left unaffected. The risk of too great hæmorrhage from the rapid action of the ethylate in cases of pendent vascular tumors may be met by diluting the ethylate with alcohol, so as to promote coagulation; and the pain caused by it may be mitigated by mixing it with laudanum. It should be applied with a camel's-hair brush.

LIQUOR SODÆ CHLORATÆ, *U. S.*—Solution of Chlorinated Soda.

Liquor sodæ chlorinatæ, Br.; *Liquor natri chlorati*, *Liquor natri hypochlorosi*.—*Labarraque's solution*, E.; *Chlorure de soude liquide*, *Liqueur de Labarraque*, Fr.; *Chlornatronlösung*, *Bleichflüssigkeit*, G.

A solution of $NaCl.NaClO$ in water.

Preparation.—Carbonate of Sodium 100 parts (20 oz. av.); Chlorinated Lime 80 parts (16 oz. av.); Water, a sufficient quantity; to make 1000 parts (200 oz. av.). Mix the chlorinated lime intimately with 400 parts (80 oz. av. = 5 lb. av. or 77 fluidounces) of water in a tared vessel provided with a tightly-fitting cover. Dissolve the carbonate of sodium in 400 parts (80 oz. av. or 77 fluidounces) of boiling water, and immediately pour the latter solution into the former. Cover the vessel tightly, and when the contents are cold add enough water to make them weigh 1000 parts (200 oz. av. = 12½ lb. av. or about 11 pints). Lastly, strain the mixture through muslin, allow the precipitate to subside, and remove the clear solution by means of a siphon. Keep the product in well-stopped bottles.—*U. S.*

Take of chlorinated lime 16 ounces; carbonate of sodium 24 ounces; distilled water 1 gallon. Dissolve the carbonate of sodium in 2 pints of the distilled water; thoroughly triturate the chlorinated lime with 6 pints of the water and filter; mix well the solutions; again filter. Keep the solution in a stoppered bottle in a cool and dark place.—*Br.*

Dry chlorinated lime 100 Gm.; crystallized carbonate of sodium 200 Gm.; distilled water 4500 Gm. Triturate the chlorinated lime in a porcelain mortar with a portion of the water, and separate by decantation the finest portion; triturate the residue, add more of the water, and decant as before; repeat this operation until two-thirds of the water have been used. Dissolve the sodium salt in the remaining water, mix the two liquids, let settle, and filter.—*F. Cod.*

The process of the U. S. Pharmacopœia yields the chlorinated soda by double decomposition of chlorinated lime with sodium carbonate, whereby calcium carbonate is precipitated, the chlorinated soda remaining in solution, together with the sodium chloride resulting from the decomposition of the chloride of calcium present in the lime compound and with the excess of sodium carbonate employed. The solution of sodium carbonate is now directed to be boiling hot when added to the mixture of chlorinated lime and water, the object being the precipitation of a dense calcium carbonate. If no heat is employed, the precipitate will be very light and retain a large proportion of the liquid. But heat should not be applied after the mixture has been made, since the solutions of chlorinated alkalies are decomposed thereby into chloride and chlorate, oxygen being at the same time evolved; in the presence of much free alkali the decomposition takes place less readily. The French Codex directs the same process, the liquids being mixed without heating. For 80 parts of chlorinated lime, 100 parts *U. S.*, 160 parts *F. Cod.*, of crystallized sodium carbonate are used, and sufficient water to make a total weight of 1000 parts *U. S.*, 3840 parts *F. Cod.*; the chlorine strength of the former is therefore nearly four times that of the latter. The liquid which remains mechanically enclosed in the precipitate may be washed out upon a strainer by water and utilized for bleaching purposes, but owing to its uncertain strength is not adapted for medicinal use.

The Br. P. process differs from the preceding ones mainly in this, that the solution of chlorinated lime is filtered, and that an uncertain quantity of this liquid remains with the insoluble portion. The former directed chlorine gas to be passed into the dissolved sodium carbonate, whereby one-half of the salt is acted upon, resulting in the production of chloride and hypochlorite of sodium and the liberation of carbonic acid, which unites with the other half of the salt to form bicarbonate of sodium; $2Na_2CO_3 + Cl_2 + H_2O$ yields $NaCl.NaClO + 2NaHCO_3$. If the action of chlorine is continued, the hypochlorite of sodium is decomposed, chloride of sodium and hypochlorous anhydride being formed; $NaClO + Cl_2$ yields $NaCl + Cl_2O$. This last-mentioned compound, which has a yellowish color, seems to decompose the bicarbonate with difficulty.

Properties.—The solution is clear and colorless, not pale-greenish, as described by the U. S. Pharmacopœia, a yellowish color being imparted only when the process of the British Pharmacopœia has been followed and an excess of chlorine has been used. Its specific gravity is 1.044. It has a feeble odor of chlorine, and a saline somewhat styptic and sharp alkaline taste, and bleaches indigo, litmus, and vegetable colors like chlorine, but less energetically. With solution of ferrous sulphate it produces a brown precipitate of ferric hydrate, and with solution of lead salt a brown one of lead dioxide; the color of both precipitates is lighter, from carbonate present, if an excess of the metallic salts be used. On the addition of hydrochloric acid effervescence takes place, the gas consisting of carbonic acid and chlorine, the latter resulting from the mutual reaction of the hydrochloric and hypochlorous acids; thus: $NaCl.NaClO + 2HCl = 2NaCl + HCl + HClO$, and $HCl + HClO = Cl_2 + H_2O$. It is upon the amount of this *available chlorine* that the value of this preparation depends.

Tests.—Solution of chlorinated soda is not precipitated by ammonium oxalate (absence of calcium). "8.88 Gm. of the solution, when mixed with a solution of 2.6 Gm. of iodide of potassium in 200 Ccm. of water, and afterward with 18 Gm. of hydrochloric acid and a little gelatinized starch, should require, for complete decoloration, not less than 50 Ccm. of the volumetric solution of hyposulphite of sodium (corresponding to at least 2 per cent. of available chlorine)."—*U. S.* The chlorine set free liberates an equivalent quantity of iodine, which imparts a blue color to the solution containing starch, and this color disappears on the addition of the hyposulphite. The same process, but without starch, is used by the British Pharmacopœia, 70 grains of the chlorinated solution being mixed with a solution of 20 grains of potassium iodide in 4 fluidounces of water and acidulated with 2 fluidrachms of hydrochloric acid; the brown color should be discharged by 500 grain-measures of the volumetric solution of hyposulphite of sodium, (2½ per cent. Cl.).

A preparation analogous to the preceding in composition and identical in bleaching effects is *Liquor potassæ chloratæ, Chlorinated potassa solution* (Chlorure de potasse, *Fr.*; Chlorkalilösung, *G.*), which is perhaps better known by its French designation, *Eau de javelle.* It is obtained by substituting equivalent quantities of potassium carbonate for the sodium carbonate ordered in the above processes.

Physiological Action.—In animals it produces violent gastro-intestinal irritation, spasms, and death. In man the same symptoms occur from poisonous doses, together with the phenomena of collapse. In medicinal doses it appears to increase the perspiration and urine, to repress mucous profluvia, and to lessen glandular enlargements. Applied locally, it tends to prevent or suspend gangrenous ulceration.

Medical Uses.—Under the impression that its antiseptic qualities fitted it to counteract morbid processes which were theoretically supposed to depend upon putridity, it has been largely employed in *typhoid* fever and typhoid diseases generally, but without obvious advantage. But as a topical application to *gangrenous sores* and to other *unhealthy ulcers*, such as affect the mouth in *mercurialization*, in *diphtheria*, *scarlatina*, and *scurvy*, the nostrils in *ozæna*, the *uterus*, the *vagina*, and the *auditory canal*, it corrects the offensive odor of the secretions and stimulates the parts to separate dead tissue and assume a healthy action. For *simple ulcers* of an indolent aspect, especially such as result from *burns*, or which affect the *nipples* and the *genital organs* of females, this liquid generally acts as a wholesome stimulant.

It may be given internally in *doses* varying from 30 to 60 drops (Gm. 2–4) in water or some mild liquid, and repeated every two or three hours. As a gargle it should be diluted with 8 or 10 parts of water, and used of the same strength for an injection into the vagina, uterus, or bladder, and as a lotion for burns, excoriations, and cutaneous eruptions.

LIQUOR SODÆ EFFERVESCENS, *Br.*—EFFERVESCING SOLUTION OF SODA.

Aqua sodæ effervescens, Aqua alcalina effervescens.—Soda-water, E.; *Eau alcaline gazeuse*, Fr.; *Sodawasser*, G.

Preparation.—Take of Bicarbonate of Soda 30 grains; Water 1 pint. Dissolve the bicarbonate of soda in the water and filter the solution; then pass into it as much pure washed carbonic acid gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of seven atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

This corresponds to the effervescing solution of potash, and has the same physical properties. 10 fluidounces, after being boiled for 5 minutes, require for neutralization 178 grain-measures of the volumetric solution of oxalic acid.—*Br.*

The corresponding solution of the French Codex is made by dissolving 3.12 Gm. (48 grains) of bicarbonate of sodium, 0.23 Gm. (3½ grains) of bicarbonate of potassium, 0.35 Gm. (5½ grains) of sulphate of magnesium, and 0.08 Gm. (1¼ grains) of chloride of sodium in 650 Gm. (21 troyounces) of water, and impregnating the solution with carbonic acid gas.

Medical Uses.—This preparation appears to be superfluous. The quantity of bicarbonate of sodium required in any particular case can be administered in carbonated water.

LIQUOR SODII ARSENIATIS, *U. S., Br.*—SOLUTION OF ARSENIATE OF SODIUM.

Liquor sodæ arseniatis.—Solution of arseniate of soda, E.; *Liqueur (Soluté) d'arseniate de soude*, Fr.; *Arsensaure Natronlösung*, G.

Preparation.—Arseniate of Sodium, deprived of its water of crystallization by a heat not exceeding 149° C. (300° F.), 1 part (46 grains); Distilled Water 99 parts (4554 grains or 10⅜ oz. av. = 10 fluidounces); to make 100 parts. Dissolve the arseniate of sodium in the distilled water.—*U. S.*

Take of arseniate of sodium (rendered anhydrous by a heat not exceeding 300° F.) 9 grains; distilled water 2 fluidounces. Dissolve.—*Br.*

The *Liqueur arsenicale de Pearson* of the French Codex is made by dissolving 1 part of crystallized arseniate of sodium in 600 parts of distilled water, and is, therefore, only about one-tenth the strength of the above. 1 part of the exsiccated salt is contained in 100 *U. S.*, *Br.*, and about 1000 *F. Cod.*, parts.

The solutions are colorless, and give the reactions of ARSENIATE OF SODIUM, which see.

Medical Uses.—This preparation does not appear to possess any demonstrable advantages over the solution of arseniate of potassium. It may be employed in similar *doses*, or from 3 to 6 drops (Gm. 0.15–0.30), largely diluted and after meals.

LIQUOR SODII SILICATIS, *U. S.*—SOLUTION OF SILICATE OF SODIUM.

Liquor natrii silicici, P. G.; *Natrum silicicum solutum, Vitrium solubile.—Liquid glass, Soluble glass*, E.; *Silicate de soude liquide, Verre soluble, Verre liquide*. Fr.; *Natriumsilikat-Lösung, Wasserglas, Natronwasserglas*, G.

Origin.—The element *silicon* or *silicium* (Si: atomic weight 28) is an important constituent of many minerals and rocks. *Rock-crystal* is pure silica or silicic oxide, SiO_2, and *quartz, sand, amethyst, chalcedony, agate, flint*, and other minerals are chiefly composed of the same oxide. A combination of this oxide with alkali and other bases became known at an early date with the discovery of glass: and about 1640, Van Helmont noticed that the compound of silex and salt of tartar (potassium carbonate) would liquefy in a damp atmosphere. This liquid became known as *Liquor silicum*—Liquor of flints, *E.*; Liqueur des cailloux, *Fr.*; Kieselfeuchtigkeit, *G.* The usefulness of such a solution for rendering inflammable substances incombustible was proved by J. N. Fuchs (1818). In its preparation soda was soon substituted for potash, and the designation "liquid" or "soluble glass" applied indiscriminately to both compounds, which are used in calico-printing, as an addition to cheap soaps, in fresco-painting, for manfacturing artificial stone, for cements, and for other purposes. In 1880 the United States imported over 1,000,000 pounds, in 1882 only 106,101 pounds, of silicate of sodium.

Preparation.—Sodium silicate is usually made by fusing together a mixture of 1 part of fine sand or powdered flint and 2 parts of exsiccated carbonate of sodium, dissolving the product in boiling water, filtering, and evaporating; or 8 parts of exsiccated carbonate of sodium, 15 parts of fine sand, and 1 part of charcoal are used, the latter merely serving as a means for facilitating the decomposition of the carbonate, the gas evolved being partly carbonic oxide. L. Buchner recommended as a cheap material for its preparation 10 parts of powdered quartz, 6 parts of calcined sodium sulphate, and 1½ or 2 parts of charcoal. A mixture of soda and potash with silica is more readily fusible than the former. The proportion of the ingredients, however, is varied according to the use to be made of the compound, and a more glass-like and less-readily soluble mass is obtained by the fusion of 2 parts of silica and 3 parts of calcined soda.

Properties.—Silicate of sodium is a transparent glass-like mass, which may be obtained in crystals, Na_2SiO_3, with variable amounts of water of crystallization. On exposure the salt becomes superficially opaque, and it is slowly soluble in boiling water; but the alkaline solution may be evaporated to a thick syrupy consistence without separating a deposit on cooling. The solution, as met with in commerce, usually contains about 10 to 12 per cent. of soda (NaHO), and 20 to 24 per cent. of silica (SiO_2), and is a transparent or semi-transparent colorless or yellowish viscid liquid, which is inodorous, and has a saline and sharp alkaline taste and an alkaline reaction to test-paper. Its specific gravity varies between 1.30 and 1.40. On acidulating the solution with hydrochloric acid the mixture remains transparent, but the colorless silicic acid forms gradually a dense jelly. If the solution be previously diluted with 10 to 15 parts of water, the silicic acid liberated by the hydrochloric acid will remain dissolved or suspended until the liquid is boiled or evaporated. Alcohol added to the solution produces a gelatinous precipitate of sodium silicate. A drop of the liquid held in a non-luminous flame by means of a loop of platinum wire burns with the intense yellow color of sodium compounds.

Solution of sodium silicate should be preserved in glass or stone vessels, securely stoppered with cork or caoutchouc to prevent access of air and decomposition by carbonic acid gas. Stoppers of glass or stone may be used, but should be well coated with paraffin to prevent their becoming cemented to the neck of the vessel.

Tests.—The only test of purity mentioned by the Pharmacopœia is that a small quantity of the solution should not produce any caustic effect when applied to the skin (absence of an excessive amount of alkali). When mixed with an equal bulk of alcohol any caustic alkali present will remain in solution, and may be recognized by test-paper or estimated by volumetric solution of oxalic acid. On adding excess of hydrochloric acid to the solution, only a moderate effervescence should take place, showing that it has not been injuriously affected by exposure; and on evaporating the acid mixture to dryness a residue partly soluble in water should be left, which is not colored dark by hydrogen sulphide. Should the solution of sodium silicate be strongly alkaline, it may be boiled with gelatinous silicic acid, which will be dissolved by the free alkali.

Other Silicates.—Silicate of Potassium is obtained by fusing a mixture of 10 parts of carbonate of potassium, 15 parts of fine sand, and 1 part of charcoal. It closely resembles sodium silicate in all its properties, but is more easily fusible.

Silicate of Magnesium. This is found native, and constitutes several well-known minerals, such as *soapstone* or *steatite*, which consists of silicate of magnesium and aluminium; *talc*, or *French chalk* (Talcum, *P. G.*), also called steatite, having the composition $4MgSiO_3.SiO_2 4H_2O$; *Meerschaum*, having the formula $2MgO.3SiO_2$; and several others. These minerals are insoluble, tasteless, and yield a soft, slippery powder. *Asbestos* is likewise a silicate of magnesium.

Pulvis salicylicus cum talco, *P. G.* An intimate mixture of finely-powdered salicylic acid 3 parts, wheat starch 10 parts, and talc 87 parts.

Uses.—The tendency of this solution to lose its water rapidly by evaporation, and then to grow hard and tough, has rendered it very convenient for making immovable bandages. It is brushed over the part, previously covered with a dry bandage, and then bandages saturated with the solution are rapidly applied in as many layers as may be necessary. The part should remain at rest for an hour to two. Owing to the risk of strangulating the limb by the contraction of the solution in drying, it has been advised to use only washed bandages, and also to apply a thin layer of carded cotton over the roller that lies next the skin. The bandage may be easily removed with scissors when it has been softened with warm water.

LIQUOR STRYCHNINÆ HYDROCHLORATIS, *Br.*—SOLUTION OF HYDROCHLORATE OF STRYCHNIA.

Liquor strychniæ.—Soluté de strychnine, Fr.; *Strychninlösung*, G.

Preparation.—Take of Strychnine in crystals 9 grains; Diluted Hydrochloric Acid 14 minims; Rectified Spirit ½ fluidounce; Distilled Water 1½ fluidounces. Mix the hydrochloric acid with 4 drachms of the water, and dissolve the strychnine in the mixture by the aid of heat. Then add the spirit and the remainder of the water.—*Br.*

Medical Uses.—This solution, being stable, is convenient for medical prescription. The *dose* is from 5 to 10 minims (*i. e.* from $\frac{1}{20}$ to $\frac{1}{10}$ grain = Gm. 0.003–0.006) of muriate of strychnia.

LIQUOR ZINCI CHLORIDI, *U. S., Br.*—SOLUTION OF CHLORIDE OF ZINC.

Chlorure de zinc liquide, Solution de Burnett, Fr.; *Chlorzink-Lösung, Flüssiges Chlorzink*, G.

An aqueous solution of chloride of zinc, $ZnCl_2$; mol. weight, 135.7—containing about 50 per cent. of the salt.

Preparation.—Zinc, granulated, 240 parts (2400 grains or $5\frac{1}{2}$ oz. av.); Nitric Acid 12 parts (1200 grains or $2\frac{3}{4}$ oz. av.); Precipitated Carbonate of Zinc 12 parts (120 grains); Hydrochloric Acid, Distilled Water, each a sufficient quantity; to make 1000 parts (10,000 grains or $22\frac{7}{8}$ oz. av.). To the zinc, contained in a glass or porcelain vessel, add gradually enough hydrochloric acid to dissolve it; then strain the solution, add the nitric acid, evaporate to dryness, and bring the dry mass to fusion. Let it cool, dissolve it in 150 parts (1500 grains or $3\frac{1}{4}$ fluidounces) of distilled water, add the precipitated carbonate of zinc, and agitate the mixture occasionally during 24 hours. Finally, filter through white filtering-paper free from iron, and pass enough distilled water through the filter to make the product weigh 1000 parts (10,000 grains or $22\frac{7}{8}$ oz. av. = $14\frac{1}{8}$ fluidounces). —*U. S.*

Take of granulated zinc 1 pound; hydrochloric acid 44 fluidounces; solution of chlorine a sufficiency; carbonate of zinc $\frac{1}{2}$ ounce or a sufficiency; distilled water 1 pint. Mix the hydrochloric acid and water in a porcelain dish, add the zinc, and apply a gentle heat to promote the action until gas is no longer evolved. Boil for half an hour, supplying the water lost by evaporation, and allow the product to cool. Filter it into a bottle, and add solution of chlorine by degrees, with frequent agitation, until the fluid acquires a permanent odor of chlorine. Add the carbonate of zinc in small quantities at a time and with renewed agitation until a brown sediment appears. Filter the liquid into a porcelain basin, and evaporate until it is reduced to the bulk of 2 pints.—*Br.*

Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas, $Zn_2 + 4HCl$ yields $2ZnCl_2 + 2H_2$. The iron contained in the solution is first oxidized in the one case by nitric acid, and in the other by chlorine gas. To avoid contamination with nitrate, the former solution is evaporated to dryness, redissolved in water, and then treated with zinc carbonate, whereby ferric oxide is precipitated. The process of the British Pharmacopœia arrives at the same result in a similar manner, except that an evaporation of the liquid to dryness is not necessary. 1 pound of zinc yields about $33\frac{1}{2}$ ounces of zinc chloride, which are contained in 40 (Imperial) fluidounces of the solution. Using 10 grains for each part, the formula of the U. S. Pharmacopœia requires 845 parts ($19\frac{1}{4}$ oz. av.) of hydrochloric acid sp. gr. 1.16, or a correspondingly larger quantity of weaker acid, and yields very nearly $11\frac{1}{2}$ oz. of dry zinc chloride and $14\frac{1}{8}$ fluidounces of the solution. The two solutions are, therefore, practically identical. The spec. grav. is stated to be 1.555 *U. S.*, 1.460 *Br.*

Properties.—The solution is a colorless and inodorous liquid which has the disagreeable metallic taste of zinc salts, and is miscible with alcohol and water without producing a precipitate. Its reactions and tests are those of ZINCI CHLORIDUM, which see.

The French Codex directs 1 part of fused chloride of zinc to be dissolved in 2 parts of water, the solution to be of specific gravity 1.33. Sir William Burnett's liquid contained 200 grains of zinc in the Imperial fluidounce, and was stated to have the specific gravity 2.0 and to contain about 50 per cent. of $ZnCl_2$.

Medical Action and Uses.—Under the name of *Burnett's disinfecting fluid* a solution of chloride of zinc was extensively employed, and its utility probably suggested an officinal preparation for similar purposes. That solution has in numerous cases produced fatal mischief by being taken internally, occasioning all the phenomena due to a violent irritant poison, leaving in the mouth, œsophagus, and alimentary canal traces of its corrosive action, and giving the intestinal walls a leathery aspect and consistence. In some cases it is stated that the dead body showed no signs of putrefaction. The chief application of this solution is to *deodorizing* and *disinfecting* sinks, sewers, water-closets, dissecting-rooms, hospitals, etc. It has been made use of to preserve dead bodies by injecting it into the blood-vessels, but owing to its corrosive action upon steel such bodies are not suitable for dissection. Largely diluted (gtt. x to gtt. xx in water f℥iv) (Gm. 0.60–1.30 in Gm. 120), it has been used as an injection for *gonorrhœa* in both sexes and for *leucorrhœa;* also as a collyrium in *gonorrhœal* and in *diphtheritic ophthalmia.* It should be employed, if at all, with extreme caution, the weakest solution being first applied to test the susceptibility of the parts.

LIRIODENDRON.—Tulip-Tree Bark.

White-tulip bark, E.; *Écorce de tulipier*, Fr.; *Tulpenbaumrinde*, G.

The bark of Liriodendron tulipifera, *Linné.*

Nat. Ord.—Magnoliaceæ.

Origin.—The tulip tree or tulip poplar, also known as *white poplar*, *yellow poplar*, and *white wood*, is a stately tree 100 to 140 feet (30–42 M.) high, which is found in woodlands and rich soil throughout the United States from Vermont to Michigan and Eastern Kansas, and southward to the Gulf of Mexico. The trunk is from 5 to 7 feet (1.5–2 M.) in diameter, and furnishes a close-grained and light but strong wood. The leaves are alternate, petiolate, broad, three-lobed, with the terminal lobe broadest and emarginately truncate. The large flowers, which appear in May, are tulip-shaped, and have three sepals and six greenish-yellow (near the base orange-red) petals. The fruit consists of flat, indehiscent, one- or two-seeded capsules, with lance-oblong wings above, and cohering together in an elongated cone. The bark is collected from the branches and also from the trunk.

Description.—The branch-bark is in curved pieces or quills, which have a brown-gray or blackish-gray to purplish-brown outer surface marked with numerous small warts, their shallow scars or confluent lines forming more or less regular elongated meshes, which become longitudinally cleft in the older bark. The fissured, gray, corky layer is removed from the trunk-bark, which then consists exclusively of liber, has a pale-yellowish color, and a smooth very finely and closely striate inner surface. The dry bark breaks, when young, with a short, the older with a fibrous, fracture, and shows upon cross-section broad wedges of medullary rays and in the inner layers tangential rows of bast-fibres. The similar root-bark has a darker color. The slight odor of the fresh bark disappears almost completely on drying; the taste is somewhat pungently aromatic and bitter, combined with some astringency. When long kept the bark is said to become insipid; bark collected by us, and kept in a dry place for twelve years without special precaution, has still the characteristic taste in a marked degree.

Constituents.—The most important constituent appears to be the *liriodendrin* of Prof. Emmet (1831), which he obtained crystallized by concentrating the tincture made with strong alcohol, adding water until a permanent turbidity commenced to appear, and evaporating spontaneously. It forms white needles or prisms and small scales insoluble in water, soluble in alcohol and ether, fusible at about 82° C. (180° F.), and volatilizing, partly undecomposed, near 132° C. (270° F.). It is contained in the infusion of the bark and precipitated from it by an alkali. A portion is always obtained in an amorphous condition, but has the same bitter and pungent taste as the crystallized. Wallace Procter (1872) did not succeed in obtaining it crystallized by treating the alcoholic extract with petroleum benzin; it separated in transparent yellowish globules of a persistently bitter and acrid taste.

Medical Uses.—Used popularly as a domestic tonic by the country people, it was first introduced into medicine as a tonic by Dr. Benjamin Rush, who ascribed to it only the virtues of a simple bitter. Like other bitters, it has had some repute as a vermifuge and as an anti-periodic, and in warm infusion as a diuretic and sudorific. The *dose* of the powder is 1 or 2 drachms (Gm. 4–8). An infusion or decoction may be prepared with an ounce of the bark in a pint of water (Gm. 32 in Gm. 500), and given in the dose of 2 fluidounces (Gm. 64). A saturated tincture may be prescribed in the dose of a fluidrachm (Gm. 4).

LITHII BENZOAS, *U. S.*—Benzoate of Lithium.

Lithium benzoicum, *Benzoas lithicus.*—*Benzoate de lithine*, Fr.; *Lithiumbenzoat*, *Benzoesaures Lithion*, G.

Formula $LiC_7H_5O_2$. Molecular weight 128.

Preparation.—This salt is made by decomposing lithium carbonate with benzoic acid, and, according to Shuttleworth (1875), it is most advantageous to add the acid to the carbonate. 100 grains of the latter are heated with 900 grains (2 fluidounces) of distilled water, when 330 grains of salicylic acid or a sufficient quantity of it is added in small portions until effervescence is no longer produced. The filtrate is evaporated to dryness with constant stirring, and the salt rubbed to powder, or the hot somewhat concentrated solution may be set aside to crystallize on spontaneous evaporation. The yield will be 346 grains.

Properties.—Lithium benzoate is a white salt, forming either a light crystalline powder or small glistening pearly scales, which feel greasy to the touch and are sometimes aggregated to moss-like forms. Berzelius stated the salt to be hygroscopic, but Shuttleworth, and afterward Raskowsky (1866), showed it to be permanent in the air. It has a slight odor, like that of medicinal benzoic acid, or if free from aromatic compounds is inodorous; its taste is alkaline, somewhat cooling and sweetish; its reaction to test-paper is slightly acid. It dissolves at 15° C. (59° F.) in 4 parts (Hager), 3½ parts (Shuttleworth), 3 parts (Raskowsky), of water, and in 12 parts (Hager), 10 parts (Shuttleworth), of alcohol, and at the boiling temperature in 2.5 parts (Shuttleworth), 2 parts (Raskowsky), of water, and in 10 parts of alcohol (*U. S. P.*). When heated the salt melts, and at a higher temperature emits aromatic inflammable vapors of benzol and other decomposition-products of benzoic acid, a portion of the latter subliming unaltered; the black residue left behind contains charcoal and lithium carbonate. The aqueous solution of the salt is decomposed by mineral and organic acids, but not by carbonic acid gas, and yields with ferric chloride a flesh-colored precipitate soluble in hydrochloric acid and in alcohol.

Tests.—If the benzoic acid be separated from the salt by precipitation with diluted nitric acid, and thoroughly washed, it should respond to the tests of purity mentioned under Acidum Benzoicum. On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, 1 part of the residue should be completely soluble in 3 parts of absolute alcohol, which, when ignited, should burn with a crimson flame, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate (salts of alkalies). On dissolving another portion of the residue in a small quantity of water the solution should produce no precipitate with test solution of oxalate of ammonium (salts of alkaline earths). The aqueous solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals).—*U. S.*

Uses.—The medicinal effects of this compound rest upon theoretical expectation rather than upon clinical observation, in so far as they depend upon the lithia it contains. In 1874, Dalkiewicz and Mallez (*Practitioner*, xiii. 274) reminded the profession of the well-known doctrine that benzoic acid is converted into hippuric acid in the system, forming soluble salts, whereas the urates of the same basis are more or less insoluble. Undoubtedly, this view explained the efficacy of benzoic acid and of the benzoate of sodium in various *calculous disorders*. Lithium was then substituted for sodium in the compound on account of its greater solubility. There is not, however, a shadow of proof that this substitution is advantageous, or that the merits of the medicine, whatever they may be, are not due to the benzoic acid it contains. So far as laboratory experiments may have weight in such a question, it should be stated that the solvent power of benzoate of lithium has been found far inferior to that of borocitrate of magnesium upon uric acid calculi (Madsen, *Bull. de thérap.*, xcviii. 68).

LITHII BROMIDUM, *U. S.*—Bromide of Lithium.

Lithium bromatum, Bromuretum lithicum.—Bromure de lithium, Fr.; *Bromlithium, Lithiumbromid,* G.

Formula LiBr. Molecular weight 86.8.

Bromide of lithium should be kept in well-stopped bottles.

Preparation.—Yvon (1875) prepared the salt by dissolving lithium carbonate in hydrobromic acid and evaporating; or, 37 Gm. of the carbonate are converted into neutral sulphate, dissolved in a small portion of water, and mixed with a concentrated aqueous solution of 119 Gm. of potassium bromide; the mixture is well stirred, the liquid separated by filtration, evaporated to dryness, and treated with alcohol, which leaves potassium sulphate undissolved; the alcoholic solution is evaporated to dryness. A convenient method for preparing the salt consists in forming, first, ferrous bromide by gradually adding 399 grains of bromine to 300 grains of iron and 900 grains (2 fluidounces) of water; the green solution is filtered, heated, and in a flask agitated with 186 grains of lithium carbonate; when cool the liquid is filtered and evaporated, yielding 434 grains of lithium bromide. Lithium bromide may be obtained in crystals by evaporating its syrupy solution over sulphuric acid. The anhydrous salt contains nearly 92 per cent. of bromine.

Properties.—Lithium bromide is a very deliquescent salt, and on this account not readily obtainable in crystals, but usually kept in the form of a white powder more or less granular. It is inodorous, and has a somewhat pungent (very sharp, *U. S. P.*) and bitterish taste and a neutral reaction. It imparts a crimson color to flame, melts at a dull red heat, and at a white heat is slowly volatilized. It is freely soluble in alcohol, also in ether, and dissolves at 0° C. (32° F.) in .7 parts, at 34° C. (93.2° F.) in .51 parts, and at 103° C. (217.4° F.) in .37 parts, of water. The concentrated, but not the largely diluted, aqueous solution yields a white precipitate with ammonium carbonate. On the addition of a few drops of chlorine-water bromine is liberated, which dissolves in carbon disulphide with a brown-yellow or yellowish-brown color, without a violet tint (absence of and difference from iodide).

Tests.—"1 part of the salt should be completely soluble in 3 parts of absolute alcohol, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate (salts of alkalies). On dissolving a portion of the salt in a small quantity of water, the solution should produce no precipitate with test solution of oxalate of ammonium (salts of alkaline earths). The aqueous solution should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals)."—*U. S.* If a solution of 0.2 Gm. of the well-dried salt be mixed with a solution of 0.4 Gm. of nitrate of silver, a yellowish precipitate is obtained, which, collected upon a filter, should be completely dissolved by much ammonia-water (absence of iodide), while the filtrate from the precipitate should not be rendered turbid by test solution of silver nitrate (absence of more than 1 per cent. of chloride).

Allied Salts.—LITHII IODIDUM, IODIDE OF LITHIUM, LiI; mol. weight 133.6. It is obtained by dissolving lithium carbonate in hydriodic acid or by digesting a solution of iodide of calcium or iodide of iron with lithium carbonate in slight excess, filtering, and evaporating to dryness. It is a white crystalline salt, crystallizing with $3H_2O$ in deliquescent prisms, and on exposure acquires a yellow tint from liberated iodine. 1 Gm. of the dry salt requires for complete precipitation 1.27 Gm. of silver nitrate.

LITHII CHLORIDUM, CHLORIDE OF LITHIUM, LiCl; mol. weight 42.4. The process for preparing it from lepidolite is given below. It crystallizes in anhydrous cubes or octahedrons having a saline taste and melting at a red heat, and is freely soluble in alcohol and in spirit of ether. Exposed to the atmosphere, it forms prisms or needles containing $2H_2O$, and then deliquesces; at 0° C. (32° F.) it requires 1.6 parts, at 20° C. (68° F.) 1.24 parts, and at 100° C. (212° F.) 0.77 part, of water for solution. 1 Gm. of the dry salt requires 4 Gm. of silver nitrate for complete precipitation.

Medical Action and Uses.—In 1870, Dr. S. Weir Mitchell accidentally found that bromide of lithium seemed to cause a more rapid and intense sleepiness than the other bromides. He observed, moreover, that it was the most soluble salt of its class, that it contained a larger proportion of bromine than any other, and that, clinically, it excels them all as a hypnotic, and is efficient in smaller doses than the potassium bromide as an anti-epileptic. In 1877 he declared of this salt that it stood the test of his own experience, as well as that of many French and German therapeutists, who had come to regard it as the most valuable of the bromides. According to Levy, its action, compared with that of potassium bromide, is as follows: It acts with greater force and rapidity upon the spinal cord and nerves; the anæsthesia it produces begins in the nerves and is propagated to the cord; in other words, it is a sedative of morbid excitement in the spinal cord. It does not appear to act upon the heart.

Bromide of lithium was used in the treatment of *epilepsy*, as already stated, and apparently with very remarkable advantages, but its efficiency was differently estimated by some other physicians, of whom Echeverria regarded it as inferior to the potassium bromide, and Sée prescribed it without any favorable results. The *dose* has been variously stated at from 5 to 10 grains (Gm. 0.30–0.60) and from 10 to 20 grains (Gm. 0.60–1.30), three times a day in a simple bitter infusion. But much larger doses may be prescribed. It has also been used in *gout* with no demonstrable advantage.

LITHII CARBONAS, *U. S.*, *Br.*—CARBONATE OF LITHIUM.

Lithiæ carbonas, *Lithium carbonicum*, P. G.; *Carbonas lithicus.—Carbonate of lithia*, E.; *Carbonate de lithine*, *Carbonate lithique*, F.; *Lithiumcarbonat*, *Kohlensaures Lithion*, G.

Formula Li_2CO_3. Molecular weight 74.

Origin and Preparation.—Lithium was discovered by Arfvedson (1817) in petalite and other Swedish minerals, and by Berzelius (1822) in the mineral waters of Carlsbad, Marienbad, and Franzensbrunn. It is met with as phosphate in *montebrasite* and several other minerals, and as fluoride or silicate in *lepidolite*, *spodumene*, and others. It is found in minute quantities in the ashes of some plants and in many mineral springs, often as carbonate; the waters of the Mur spring at Baden-Baden and of a hot spring at Wheel-Clifford in Cornwall are the richest known, the latter, according to W. A. Miller (1864), containing 26.05 grains LiCl in the Imperial gallon. To prepare the carbonate, lepidolite is heated with sulphuric acid; the aqueous solution, containing impure lithium sulphate, may be freed from most of the sulphates of aluminium and the alkalies by crystallizing them as alum, or it is treated with lime to separate metallic oxides and earths, and then precipitated by barium chloride to remove sulphate, and by ammonium oxalate to remove calcium. After evaporating to dryness, chloride of lithium is dissolved by a mixture of alcohol and ether, and thus freed from the chlorides of rubidium, cæsium, sodium, and potassium, with which metals it is associated in the lepidolite. The concentrated aqueous solution of lithium chloride, treated with ammonium carbonate, yields a precipitate of lithium carbonate, which is washed with alcohol; the filtrate from the precipitate on being evaporated to dryness and ignited yields as chloride the lithium which had remained in solution.

Properties.—Carbonate of lithium is a light white amorphous powder or is in minute crystalline grains. It has the specific gravity 2.11, is permanent in the air, inodorous, has a mild alkaline taste and a distinct alkaline reaction, and imparts a carmine color to flame. It is insoluble in alcohol, and, according to Kremers (1856), dissolves at 13° C. (55.4° F.) in 130 parts, and at 102° C. (215.8° F.) in 128.5 parts, of water; the solution has an alkaline reaction, precipitates the salts of the heavy metals, and on boiling decomposes the ammonium salts. On heating the salt to dull redness it melts to a transparent liquid, loses a portion of its carbonic acid, and congeals on cooling to pearly oxycarbonate, which is permanent in the air; the fused salt corrodes glass, silver, and platinum. It dissolves with effervescence in dilute hydrochloric acid, and the solution, evaporated to dryness, leaves a residue of lithium chloride, which is soluble in spirit of ether, and the neutral solution of which yields a white precipitate with phosphate of sodium.

Tests.—Magnesium and calcium salts are the principal impurities; salts of heavier metals are rarely present. The salt, dissolved in nitric acid, should yield no precipitate with hydrogen sulphide either before or after neutralization with ammonia (absence of heavy metals), nor with barium nitrate (sulphate), silver nitrate (chloride), sulphuric acid (barium), nor, after neutralization, with ammonium oxalate (calcium) or lime-water (magnesium). 10 grains of the salt, neutralized with sulphuric acid and heated to redness, leave 14.86 grains of dry sulphate of lithium.—*Br.* Alkaline impurities are detected, after being converted into chlorides, by their insolubility in a mixture of equal volumes of alcohol and ether, as stated above.

Off. Prep.—Liquor lithiæ effervescens. *Br.*; Lith. citras. *U. S.*, *Br.*

Chemical Action.—When a calculus composed of uric acid and oxalate of lime is suspended in a warm solution of carbonate of lithium, it loses sensibly in weight; and when a portion of bone infiltrated with gouty concretions is placed in a solution of the salt, after two or three days the whole of the deposit disappears. In fact, the urate of lithium is the most soluble salt formed with uric acid. Garrod (*Times and Gaz.*, June, 1883, p. 691) and Jahns (*Amer. Jour. of Med. Sci.*, Jan. 1884, p. 262) show that, in laboratory experiments at least, carbonate of lithium is a much better solvent of uric acid concretions than sodium or magnesium salts. These facts have been adduced to explain the efficacy in chronic gout of numerous mineral springs in Europe and of the Gettysburg Spring in Pennsylvania.

Medical Uses.—Opinions are by no means uniform in regard to the value of carbonate of lithium in removing *uric acid deposits* and *gouty concretions*. On the one hand, it is asserted that when patients are voiding uric acid gravel it causes the deposit to diminish or to cease altogether, and that in *gout* it often diminishes the frequency of the attacks. At the same time it is stated to be powerfully diuretic. On the other hand, some authorities confidently affirm that they have seen no benefit arise from its use. Others, again, declare that it is suitable only for the treatment of chronic gout, that the daily dose of it should be small, and that its good effects become apparent only after several weeks' use. On the whole, there appears to be no substantial ground for a belief in its alleged virtues in gout and calculous diseases. Of late years sundry mineral waters have been vaunted as efficacious in these affections because they contained from $\frac{6}{10000}$ grain to 1 grain in a pint of the spring water. Such pretensions tend to bring the art of therapeutics into discredit.

Carbonate of lithium in solution is said to exhibit extraordinary powers in the solution of *false membrane.*

This medicine may be given in the *dose* of from 1 to 3 grains (Gm. 0.06–0.20) three times a day, dissolved in 3 or 4 ounces of hot water or preferably in carbonated water. Externally, it has been applied in an ointment or glycerate containing 1 part of the salt to 8 of the excipient.

LITHII CITRAS, *U. S., Br.*—Citrate of Lithium.

Lithiæ citras, Lithium citricum.—Citrate of lithia, E.; *Citrate de lithine,* Fr.; *Lithiumcitrat, Citronsaures Lithion,* G.

Formula $Li_3C_6H_5O_7$. Molecular weight 210.

Citrate of lithium should be kept in well-stopped bottles.

Preparation.—Take of Carbonate of Lithia 50 grains; Citric Acid, in crystals, 90 grains; warm Distilled Water 1 fluidounce. Dissolve the citric acid in the water, and add the carbonate of lithia in successive portions, applying heat until effervescence ceases and a perfect solution is obtained. Evaporate by steam- or sand-bath until the product has a specific gravity of about 1.230, and set aside for crystals to form. Dry the crystals and preserve them in a stoppered bottle.—*Br.* Thus prepared, the salt is crystalline, and contains $4H_2O$. Molecular weight 282.

On adding lithium carbonate to a solution of citric acid, carbonic acid gas is given off and lithium carbonate remains in solution, the reaction being explained by the equation: $3Li_2CO_3 + 2H_3C_6H_5O_7$ yields $2Li_3C_6H_5O_7 + 3CO_2 + 3H_2O$. The yield is equal to the weight of citric acid used. The U. S. P. 1870 directed a slight excess of citric acid, while the above formula orders a slight excess of lithium carbonate, for 50 grains of the latter require 94.6 grains of the acid. For dispensing in solution the salt may well be prepared extemporaneously, the proportion of citric acid to lithium carbonate being 1000 : 528.6 (or 10 : 5.3), with a yield of 1000 (or 10) parts; on triturating in a mortar with a small quantity of hot water the decomposition is readily effected. Hager recommends precipitation of the concentrated slightly acid solution with alcohol, when the normal salt, containing 2 molecules or 14.63 per cent. of water, is precipitated.

Properties.—Lithium citrate is a white amorphous powder which dissolves in 55 parts of water (Hager), and may be obtained crystallized from a concentrated solution on standing. According to C. Umney (1876), this salt contains $4H_2O$, three of which are given off at 100° C. and the fourth molecule at 115° F.; the crystallized as well as the anhydrous salt is fairly permanent in the air, and not deliquescent, as stated by the Pharmacopœia. The salt has a neutral reaction to test-paper, is inodorous, has a saline somewhat cooling taste, is soluble in glycerin, and insoluble or nearly so in alcohol. When heated it blackens, gives off the odor of burning citric acid, inflammable gases are evolved, and finally a white residue is left, which, if neutralized with hydrochloric acid, is soluble in alcohol, and the solution, ignited, burns with a carmine color. The salt is recognized as a citrate by mixing its aqueous solution with calcium chloride, filtering if necessary, and heating the clear liquid, when a precipitate of calcium citrate will be deposited.

Tests.—Other acids besides citric are detected by their several tests. Basylous impurities are recognized by igniting some of the salt, dissolving the residue in hydrochloric acid, evaporating to dryness, and testing as described in the preceding article. "20 gr. lose at 100° C. 3.8 grs., at 115.5° C. additional 1.3 gr., and at a low red heat leave 7.8 gr. of white residue."—*Br.* On heating a mixture of 20 grains of the salt with about 40 grains of sulphuric acid until carbonized, then evaporating to dryness and igniting, a white residue of lithium sulphate should be obtained weighing 15.7 grains.

Allied Salts.—Lithii borocitras. Edmund Scheibe (1880) has prepared three of these compounds, but regards the following two as most suitable for medicinal use. They are prepared by dissolving the ingredients in boiling water, evaporating the solution to dryness, and powdering or spreading the concentrated liquid upon glass for obtaining the salt in scales. For *lithium diborocitrate,* citric acid 20 parts, lithium carbonate 7 parts, and boric acid 12 parts are used; for *lithium monoborocitrate,* citric acid 20 parts, lithium carbonate 4 parts, and boric acid 6 parts.

Medical Action.—Like the vegetable salts of sodium and potassium, the citrate of lithium is decomposed in the body and excreted as a carbonate with the urine. Its operation is the same as that of the carbonate of lithium. Its *dose* may be stated at from 5 to 20 grains (Gm. 0.30–1.30).

LITHII SALICYLAS, *U. S.*—Salicylate of Lithium.

Lithium salicylicum.—*Salicylate de lithine*, Fr.; *Lithiumsalicylat*, G.
Formula $2LiC_7H_5O_3.H_2O$. Molecular weight 306.

Preparation.—Heat a mixture of 11 parts of salicylic acid, 3 of lithium carbonate and 25 of water until effervescence ceases; filter, wash the filter with water, evaporate, and keep in well-stopped bottles.

Properties.—The salt may be obtained crystallized in needles, but is usually met with as "a white powder, deliquescent on exposure to air, odorless or nearly so, having a sweetish taste and a faintly acid reaction; very soluble in water and alcohol. When strongly heated the salt chars, emits inflammable vapors, and finally leaves a black residue having an alkaline reaction, which imparts a crimson color to a non-luminous flame. On supersaturating the dilute aqueous solution with hydrochloric acid a bulky white precipitate is obtained which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether, and producing an intense violet color with ferric salts."—*U. S.*

Tests.—"The aqueous solution should be colorless and not effervesce on the addition of an acid (absence of carbonate). When agitated with 15 parts of concentrated sulphuric acid the salt should not impart any color to the acid within 15 minutes (absence of foreign organic matters). On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, the residue should respond to the tests of purity mentioned for the corresponding residue under Lithii Benzoas."—*U. S.* If 20 grains of the salt be heated with 40 grains of sulphuric acid, the mixture evaporated to dryness and ignited, a white residue of lithium sulphate should be left weighing not more than 7.2 grains.

Uses.—No evidence exists that this salt possesses any medicinal qualities that do not belong equally, if not much more decidedly, to sodium salicylate. The two salts are equally soluble in water, and there is no proof whatever that lithium salicylate displays any distinct physiological or therapeutical action. The average *dose* is variously stated at from 5 to 40 grains (Gm. 0.30–2.60). It is worthy of remark that while the U. S. Pharmacopœia contains no less than five lithium compounds, the German Pharmacopœia (1882) presents but one—the carbonate. It may well be doubted if even this one be not superfluous.

LOBELIA, *U. S., Br.*—Lobelia.

Herba lobeliæ, P. G.—*Indian tobacco*, E.; *Herbe de lobélie enflée*, Fr.; *Lobelienkraut*, G.

The leaves and tops of Lobelia inflata, *Linné.* Barton, *Med. Bot.*, t. 16; Bentley and Trimen, *Med. Plants*, 162.

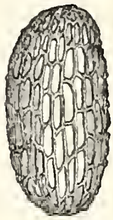
Nat. Ord.—Lobeliaceæ.

Origin.—The inflated lobelia is an annual herb, native of the North American continent, growing in dry open fields and on the borders of woods from the northern parts of Canada southward throughout the United States to Georgia and Mississippi. It flowers from July to September, and should be collected when some of the capsules have become inflated; the fresh herb, on drying, loses from 75 to 80 per cent. of moisture.

Description.—The herb grows from 12 to 20 inches (30–50 Cm.) high, and has a branching stem, which is somewhat furrowed and beset with spreading hairs. The leaves are alternate, 2 to 3 inches (50–75 Mm.) long, ovate or oblong, irregularly toothed, pubescent, and pale-green; the lower ones petiolate, the upper sessile and gradually reduced to bracts. The flowers are in long racemes, terminating the stem and branches. The calyx-tube is adherent to the ovary, has the limb divided into five narrow teeth, and becomes inflated in fruit. The pale-blue corolla is somewhat two-lipped and has the upper side of the tube split to the base. The five stamens are free from the corolla, and by the union of the filaments and anthers form a tube which encloses the single style. The fruit is a thin subglobular capsule which is two-celled, opens at the apex, and contains a large number of minute brown oblong seeds, the surface of which has, under the microscope, a reticulated appearance. It has an herbaceous somewhat irritating odor, and an herbaceous afterward burning and acrid tobacco-like taste.

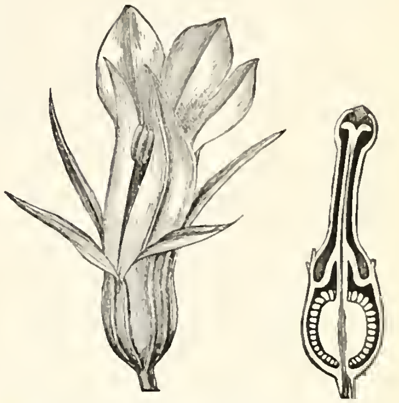
Constituents.—Lobelia owes its virtues, at least in part, to an alkaloid, *lobeline*, which was first recognized by Calhoun (1833), but isolated by Procter (1838). To obtain it, the tincture made with alcohol containing acetic acid is evaporated to a syrupy consistence, triturated with excess of magnesia, the filtrate agitated with ether, and the ethereal solution evaporated; the impure alkaloid requires purification by combining with an acid, treating with animal charcoal, and again decomposing with magnesia. W. D. Richardson (1872) obtained more alkaloid from the above mother-liquor by precipitation with potassium iodo-hydrargyrate. *Lobeline* is a yellow somewhat aromatic liquid having an acrid taste; it is lighter than water, is soluble in alcohol, ether, and fixed oils, and less so in water. Its salts, except the acetate, are crystallizable, are freely soluble in water, scarcely so in ether, and not altered by a boiling temperature, whereas the alkaloid is thereby deprived of its acrid taste. Richardson found it even to be altered by simple exposure to air, whereby it became resinified and unable to combine with acids. Bastick (1850) considered it volatile, but to evaporate not entirely unchanged. Lewis (1878) corroborated Richardson's observations, and observed that sulphuric acid and Fröhde's reagent impart a red-brown color, and that on boiling with dilute sulphuric acid or with potassa, glucose is liberated from the alkaloid.

Fig. 175.



Lobelia-seed, magnified.

Fig. 176.



Lobelia inflata, *Linné*, and section through stamens and pistil, magnified 5 diameters.

In 1871, Enders obtained the acrid principle *lobelacrin* by concentrating the tincture in the presence of charcoal, washing this with water, and exhausting with boiling alcohol (*Pharmacographia*). It forms warty tufts of a brown color, is soluble in ether and chloroform, slightly so in water, is decomposed by boiling with water, and yields sugar and *lobelic acid* under the influence of acids and alkalies. It is possible that the alkaloid, as heretofore obtained, has been more or less contaminated with this body, which, according to Lewis, is lobelate of lobeline.

The *lobelic acid* of Enders is probably identical with the compound of Pereira (1842), Procter, and Lewis bearing the same name. Procter obtained it from the decoction of the leaves by precipitating it with sulphate of copper and decomposing with hydrogen sulphide. It is crystallizable, soluble in ether, alcohol, and water, and yields with ferric salts an olive-brown, with copper sulphate a light-green, with lead acetate and baryta-water a yellow, and with silver nitrate a white afterward brown precipitate. The barium compound of Enders's acid is soluble in water.

Reinsch (1848) obtained from the herb also waxy, resinous, fatty, and gummy matters, and Procter from the seeds about 30 per cent. of rapidly-drying fixed oil.

Allied Species.—Lobelia syphilitica, *Linné* (*Great lobelia*). It is 2 to 3 feet (60–90 Cm.) high, has acute elliptic-oblong, irregularly-serrate leaves, and showy blue flowers in the axils of the upper leaves, forming a terminal raceme; the calyx has a short hemispherical tube, five long acute lobes, and at their base conspicuous deflexed appendages. It is met with in low grounds in the United States.

Lobelia cardinalis, *Linné* (*Cardinal-plant*). It is common in marshy and low grounds throughout the greater portion of the United States, attains a height of 2 to 3 feet (60–90 Cm.), is nearly smooth, has oblong-lanceolate, acute, and slightly-toothed leaves, and bears long racemes of large showy scarlet-red flowers on short pedicels in the axils of the leaf-like bracts.

Off. Prep.—Acet. lobeliæ, Extract. lobeliæ fluid., *U. S.*; Tinct. lobeliæ, *U. S.*, *Br.*; Tinct. lobeliæ æther., *Br.*

Physiological Action.—The effects produced by lobelia and its alkaloid upon animals are almost identical with those of tobacco and nicotine, but larger doses are required to develop them. Lobelia is ranked as a respiratory poison, and in the cat it greatly reduces the temperature.

The symptoms caused by lobelia in man are—nausea, salivation, malaise, præcordial distress, dyspnœa and dysphagia, burning and rawness in the fauces, eructation, vomiting, urination, general muscular relaxation, profuse sweating, the pulse becoming small, irregular, and slow, and, when the dose has been very excessive, extreme prostration, anxiety, contracted pupils, insensibility, and occasionally death, preceded by convulsions.

Many cases have been published of death from the maladministration of this drug by ignorant persons assuming to be practitioners of medicine.

Medical Uses.—The chief medicinal value of lobelia is in the treatment of *asthma*, whether the disease be purely spasmodic or associated with pulmonary emphysema, chronic bronchitis, heart disease, etc. It eliminates from the attack the bronchial spasm, which in the first-named affection constitutes the whole disease and in the others is a complication only. A fluidrachm (Gm. 4) of the tincture should be given every hour, or, if the symptoms are urgent, every half hour, until relief is obtained or the characteristic effects of the medicine are produced. Its efficacy in the other diseases mentioned, as well as in *whooping cough*, will depend mainly upon the predominance of the nervous element in them. Whenever dyspnœa is due to inflammatory changes in the bronchia, or to the presence in these tubes of secreted matters, rather than to spasm, lobelia displays special virtues that entitle it to be preferred before numerous "expectorants." It is of no more advantage in *inflammatory laryngitis* than various other nauseants and emetics, but it is decidedly more efficacious in *spasmodic laryngitis* than most other remedies of the same class. In almost all cases in which distress in breathing arises from a want of proper balance between the lungs and the heart, this medicine affords relief; as, for instance, when the lungs are congested by mitral obstruction and there is a tendency to œdema of those organs; and, again, when the lungs are themselves diseased so as to interfere with the cardiac circulation, as occasionally happens even in tuberculous consumption.

The *dose* of lobelia as an emetic is from 10 to 20 grains (Gm. 0.60–1.30), but for this purpose it is unnecessary, and may be dangerous. As an expectorant the dose is from 1 to 5 grains (Gm. 0.06–0.30). The preparations most frequently employed are the tincture and the vinegar of lobelia, of either of which the dose as an expectorant is from 10 to 60 minims (Gm. 0.60–4). In asthmatic attacks 1 or 2 fluidrachms (Gm. 4–8) should be administered every half hour or hour, according to the urgency of the symptoms. The dose of the fluid extract as a nauseant or expectorant is from 1 to 5 minims (Gm. 0.06–0.30).

Lobelia syphilitica was formerly used by the aborigines for the cure of syphilis, probably on account of its diaphoretic action, and at one time its virtues were maintained by several eminent physicians in Europe. They are not any longer believed in; nevertheless, there can be no doubt that, in so far as diaphoresis tends to cure syphilis, the disease may be palliated by lobelia. Older authorities describe it as being diaphoretic, and hence depurative. L. cardinalis possesses similar virtues, but in a less degree. It was used by the American Indians as an anthelmintic.

LOLIUM.—DARNEL.

Bearded darnel, E.; *Ivraie*, Fr.; *Lolch*, *Taumelkorn*, G.

The fruit (caryopsis) of Lolium temulentum, *Linné*, s. L. arvense, *Withering*. Bentley and Trimen, *Med. Plants*, 295.

Nat. Ord.—Graminaceæ.

Origin.—The bearded darnel grows on waysides and in grain-fields in Western Asia and throughout Europe, and has been introduced to some extent in most grain-growing countries; it is rare in the United States. It is an annual about 2½ feet (75 Cm.) high, with rather large leaves, and has an elongated inflorescence, the spikelets being nearly an inch (25 Mm.) long, about seven-flowered, somewhat compressed, alternate, sessile, appressed to the concave rachis, and about as long as the glumes.

Description.—The fruit is oblong-ovoid, nearly ¼ inch (6 Mm.) long, enclosed in the paleæ, grooved on the inner and convex on the outer surface, smooth, pale-brown, internally white, inodorous, and of a farinaceous afterward bitterish taste.

Constituents.—The chemical investigations undertaken for the purpose of isolating the poisonous principle have been recently (1875) reviewed by Wittstein. The deleterious properties of the plant, according to Ludwig and Stahl (1864), appear to be due to an acrid fixed oil and to an amorphous yellowish glucoside, which is soluble in water, alcohol, and ether, and has a bitter and acrid taste. Bley (1834) and Muratori (1837) ascribed them to an acid body, and Baillet and Filhol (1863) to a non-saponifiable oily compound. Bley (1838) obtained his *loliin* by precipitating the alcoholic solution of the aqueous extract with ether; the yield was only $\frac{1}{30}$ per cent. of a dingy-white powder having an acrid taste. The fruit contains the ordinary constituents of grain, among them from 30 to 50 per cent. of starch, the granules of which, according to Schwerdtfeger (1853), are about one-third the size of wheat starch, circular, with a moderately wide margin and a bright, strongly translucent surface without marks. On incineration, darnel-fruit leaves about 5 per cent. of ash.

Lolium perenne, *Linné*, called *ray-* or *rye-grass*, is a pasture grass, has a perennial creeping rhizome, the glumes shorter than the spikelets, and awnless or short-awned flowers. It is not poisonous.

Medical Action and Uses.—A large number of persons have at different times been poisoned by bread made with flour containing lolium. Upon different animals it acts differently: it is poisonous to dogs, sheep, and horses, but not to hogs, cows, and ducks, and quails are said to be fond of the seeds as food. Its effects have been known from ancient times to be narcotic and anæsthetic. They comprise the following symptoms: headache, vertigo, disturbed and sometimes yellow vision, ringing in the ears, paresis of the tongue, oppression in breathing, anxiety, vomiting, and sometimes purging, urination, general muscular trembling, cold sweating, and overpowering and deep sleep. In several cases the poisoning has proved fatal. There is reason to suspect that the old custom of using darnel to adulterate malt and distilled liquors is not wholly obsolete. The peculiar intoxication produced by some of these drinks strongly suggests such a fraudulent and wicked addition to them. Lolium has been mixed with poultices applied for the relief of local *pains*, pleuritic, neuralgic, and rheumatic, and, although it has been given internally, neither the grounds of its administration nor its alleged results are entitled to any confidence.

LOTIONES.—Lotions.

Washes, E.; *Lotions*, Fr.; *Waschungen*, G.

Lotions are liquid preparations, usually containing water as their principal vehicle, and are ordinarily applied by wetting lint or muslin with them, and keeping this upon the affected part.

LOTIO HYDRARGYRI FLAVA, *Br.*—Yellow Mercurial Lotion.

Aqua phagedænica.—Yellow wash, E.; *Eau phagédénique, Eau divine de Fernel*, Fr.; *Phagedänisches Wasser, Altschadenwasser*, G.

Preparation.—Take of Perchloride of Mercury 18 grains; Solution of Lime 10 fluidounces. Mix.—*Br.*

A double decomposition takes place, resulting in the formation of calcium chloride and finely-divided yellow mercuric oxide. It should be well shaken when used.

Surgical Action and Uses.—This preparation is stimulant, and even caustic. Its use is restricted almost exclusively to the treatment of indolent *chancres* and other *syphilitic ulcers*. It should be applied upon lint.

LOTIO HYDRARGYRI NIGRA, *Br.*—Black Mercurial Lotion.

Aqua phagedænica nigra, Aqua nigra, Aqua mercurialis nigra.—Black wash, E.; *Eau phagédénique noir*, Fr.; *Schwarzes Wasser*, G.

Preparation.—Take of Subchloride of Mercury 30 grains; Solution of Lime 10 fluidounces. Mix.—*Br.*

The chemical reaction between the two substances results in producing calcium chloride and black mercurous oxide. It must be well shaken when used.

Surgical Action and Uses.—The action of black wash appears to be mildly stimulant and astringent as well as protective. It may be applied on lint to *syphilitic* ulcers.

LUPINUS.—Lupin.

Lupin, Fr.; *Feigbohne, Wolfsbohne*, G.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The following species, annuals, natives of Europe and Western Asia and cultivated in gardens, have been employed:

L. ALBUS, *Linné*. It has palmately five- or seven-foliate leaves, with the leaflets obovate-oblong, 1 or 2 inches (25–50 Mm.) long, smooth above and white hairy beneath; the flowers are in terminal racemes on short pedicels, white and rather large; the legume is 3 or 4 inches (7–10 Cm.) long, flattish, and contains three to six depressed globular seeds having a bitter taste.

L. HIRSUTUS, *Linné*. It has spatulate-oblong leaflets and blue or rose-colored flowers in loose whorls, forming racemes.

L. LUTEUS, *Linné*. It is distinguished by its yellow flowers being in whorls, and these forming a dense raceme.

A large number of lupins are indigenous to the Western section and the Pacific coast of the United States, some of which, like L. polyphyllus and densiflorus, *Nuttall*, are cultivated in gardens. These, as well as the blue-flowered L. perennis, *Linné*, which grows in sandy soil in the Eastern portion of the United States, may possess similar properties.

Constituents.—Cassola (1835), and afterward Reinsch (1849), found the bitter principle of lupin to be insoluble in ether. Schulze and Barbieri (1878) obtained it crystalline from Lupinus luteus by preparing a tincture with diluted alcohol, precipitating with lead subacetate, decomposing the precipitate with sulphuretted hydrogen, and treating with hot water, on the cooling of which the bitter principle crystallizes in yellowish-white fine needles. This *lupinin*, $C_{29}H_{32}O_{16}$, is soluble in alkalies with a dark-yellow color, and on being boiled with dilute acids is split into sugar and *lupigenin*, $C_{17}H_{12}O_6$. Eichhorn (1867) obtained an alkaloid which was further investigated by Beyer, Siewert, Liebscher (1880), and Baumert (1881). *Lupinine*, $C_{21}H_{40}N_2O_2$, prepared from yellow lupin-seed, forms colorless rhombic prisms of a fruit-like odor and intensely bitter taste. Campani and Bettelli (1881) isolated an alkaloid from white lupin-seed. These seeds appear to contain several alkaloids.

Medical Action and Uses.—The bitterness of the seeds of *white lupin*, which render them unsuitable for food until they have been thoroughly soaked in water, seems to have increased the medicinal virtues for which the ancients esteemed them. They were bruised and applied to wounds made by venomous insects and animals, to ulcers to promote their healing, to swollen glands as discutients, and, mixed with wheaten flour, to various cutaneous affections. Internally, they were held to be stomachic, diuretic, anthelmintic, and emmenagogue. In recent times they have almost ceased to be employed in medicine, but in 1877, Donnabella (*Practitioner*, xxi. 211) reported that, having thrown into the rectum about 5 ounces of a decoction of lupins he soon began to feel general malaise, uneasiness of the head, obscuration of vision, heaviness of the eyelids, vertigo, excitement of mind, and a sense of constriction of the larynx and pharynx. Several months afterward he repeated the experiment with the same results. It is probable that this reporter used in his experiments some very different seeds from those of white lupin, since none of the ancient writers who treat of them at length make the least allusion to their being poisonous.

LUPULINUM, *U. S.*, *Br.*—LUPULIN.

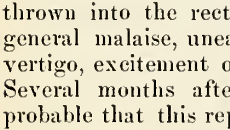
Glandulæ lupuli, P. G.; *Lupulina*, U. S. 1870.—*Lupuline*, *Lupulite*, Fr.; *Hopfenmehl*, *Lupulin*, G.

The yellow glandular powder separated from the strobiles of Humulus Lupulus, *Linné*.
Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—(See HUMULUS, page 769). On handling dry hops the glandular powder becomes detached, and is freed from fragments of the bracts, etc. by sifting; about 10 per cent. of the weight of the hops may be obtained.

Description.—Lupulin, when fresh, is a bright, brownish-yellow, afterward yellowish-brown, granular resinous powder, which has the aromatic odor and bitter and aromatic taste of hops. Under the microscope it is seen to consist of two hemispheres, the lower and firmer of which is somewhat obtusely conical or top-shaped, the upper one rounded, the surface of both reticulate. In the dry state the lower one nearly retains its shape, but the more delicate upper part collapses and forms a flattish hood. The glands contain a brown-yellow liquid which dries up to a resinous mass. Lupulin should be free from sand, which readily subsides from it when agitated with water.

FIG. 177.



Lupulin (fresh).

Constituents.—On distilling hops with water, Personne (1854) obtained *valerianic acid* and a *volatile oil*, which boils between 140° and 300° C. (284° and 572° F.), is colorless and neutral, but becomes resinous and acid on exposure, and consists of a lighter portion, $C_{10}H_{16}$, and *valerol*, $C_6H_{10}O$, from which by gradual oxidation valerianic acid is formed. The residue from the distillation when treated with lime yields a distillate of *valeral*, $C_5H_{10}O$. The *resin* of lupulin was examined by Vlaanderen (1858), who found it tasteless, combining with metals, and becoming more hydrated in the course of purification. The principal constituent of lupulin is wax, which Lermer (1863) found to be *myricin* (myricylic palmitate). He also isolated the bitter principle and called it *lupamaric acid* (Hopfenbittersäure). To prepare it, the ethereal extract of fresh hops is treated with 90 per cent. alcohol, which leaves the wax behind; the alcohol is evaporated, the residue dissolved in ether, and this solution agitated with strong potassa solution to remove resin; agitation with water now dissolves the potassium lupamarate, which is precipitated with copper sulphate, and the precipitate, decomposed by hydrogen sulphide, yields the acid in white crystals, becoming yellow on exposure, insoluble in water, but soluble in alcohol, ether, chloroform, carbon bisulphide, and oil of turpentine. Its composition is $C_{32}H_{50}O_7$.

Tests.—"On incineration, lupulin should yield less than 10 per cent. of ash. If exhausted with ether, lupulin should leave a residue weighing not over 30 per cent., and the ethereal tincture on being evaporated at a moderate temperature should leave a brown, soft extract having the odor of hop in a high degree."—*P. G.*

Pharmaceutical Uses.—Tinctura lupulinæ, U. S. 1870. Lupulin 4 troyounces; alcohol sufficient to obtain 2 pints of tincture; prepare by percolation.

Tinctura lupulinæ ammoniata. Lupulin 2 ounces; aromatic spirit of ammonia sufficient to obtain 1 Imperial pint (19¼ fluid ounces *U. S.*; Dr. Dyce Duckworth, 1868.)

Pills of lupulin may be prepared by triturating lupulin with a little ether until a plastic mass is obtained, which may be incorporated with camphor or with resins or oleoresins.

Off. Prep.—Extract. lupulinæ fluid., Oleores. lupulinæ, *U. S.*

Medical Action and Uses.—The account given of the operation of hop (see Humulus) makes an extended discussion of lupulin unnecessary, since it is upon this product that the virtues of hop chiefly depend. In doses of from 20 to 25 grains (Gm. 1.30–1.60) lupulin occasions a lively sense of warmth at the epigastrium, which afterward extends to the whole abdomen. Constipation, with colicky pain, is apt to ensue, but the appetite and digestion appear to be invigorated. It is alleged that full doses of lupulin diminish the frequency of the pulse. It certainly tends to allay the susceptibility which is a frequent cause of an excited circulation. Probably in this manner, rather than by a direct action upon the brain, it favors sleep and tends to repress that excitement which occasions *priapism*, *seminal emissions*, and *nocturnal incontinence of urine*. It has seemed to allay *irritability of the bladder* when opium was not tolerated. It may be prescribed in *doses* of from 5 to 10 grains (Gm. 0.30–0.60) and upward, mixed with jelly or syrup.

LYCIUM.—Matrimony-Vine.

Lycium vulgare, *Dunal*, s. L. barbarum, *Linné.*

Nat. Ord.—Solanaceæ.

Description.—This shrub is indigenous to the countries bordering on the Mediterranean, and is cultivated and wild in the United States. It is from 10 to 20 feet (3–6 M.) high, and has numerous slender, recurved branches, which are covered with a smooth brownish-gray bark and armed with few thorns. The leaves are 1 or 2 inches (2–5 Cm.) long, alternate, oblong-lanceolate, entire, smooth, shortly petiolate, and often clustered. The greenish-purple flowers have a tubular five-lobed corolla and produce oval red two-celled berries containing many reniform seeds. The bark and leaves have a sweetish and slightly bitter and acrid taste.

Constituents.—An alkaloid, *lycine*, $C_5NH_{11}O_2$, has been isolated by Husemann and Marmé (1863) by precipitating the decoction with subacetate of lead, removing the lead by sulphuric acid, and precipitating the filtrate with phosphomolybdic acid; the precipitate is mixed with prepared chalk, the mixture dried, and the alkaloid dissolved by alcohol. It forms white prisms, which are deliquescent, sparingly soluble in ether, and have an acrid taste free from bitterness. Husemann (1875) proved it to be identical with *betaine*, an alkaloid isolated by Scheibler (1866) from beet-root juice, and, like it, not preexisting in the plant, but formed from it during the process by the action of free acid. The leaves of lycium yielded a larger proportion than the branches.

Allied Species.—Lycium Afrum, *Linné*, of Northern Africa, and L. umbrosum, *Humboldt et*

Bonpland, of South America. The infusion of the leaves is used in erysipelas and skin diseases. Berberis Lycium, *Royle*, contains berberine (see page 315).

Medical Action and Uses.—There is nothing to establish a therapeutical character for Lycium vulgare, unless it be that lycine in the *dose* of 2 or 3 grains (Gm. 0.12–0.20) causes paralysis in frogs. L. umbrosum is said to be used in South America as a remedy for *erysipelas*, and an extract procured from Berberis lycium is alleged to share the qualities both of aloes and rhubarb, and to be useful when applied externally in cases requiring a stimulant and an astringent.

LYCOPERDON.—Puff-Ball.

Lycoperdon solidum, *Gronovius*, s. Pachyma Cocos, *Fries*.

Nat. Ord.—Fungi, Gasteromycetes.

Origin.—This curious product is found attached to the roots of fir trees in the southern part of the United States from Virginia westward to Kansas, and is known as *Indian bread* or *tuckahoe*. It likewise grows in China, where it is used under the name of *fuh-ling*. Currey and Kelley consider it to be an altered state of the root of the tree occasioned by the presence of a fungus, the mycelium of which traverses, disintegrates, and even obliterates, the wood and bark. This view is sustained by the result of the analyses made by R. T. Brown (1871) and J. L. Keller (1876).

Description.—The tuckahoe is an irregularly globular or elongated body, varying from a few inches to a foot (30 Cm.) or more in diameter, and from a few ounces to several pounds in weight. It is externally of an ashy-black, and has a rugose surface; internally it is whitish, fissured, more or less spongy, but firm, of a somewhat farinaceous appearance, sometimes quite compact, and breaks into irregular masses. It is without odor and has an insipid taste.

Constituents.—Brown found it to contain 14 per cent. of water, 0.93 of glucose, 2.63 of gum, 17.34 of pectose, 64.45 of cellulose, and 0.16 per cent. of ash; the nitrogen amounted only to 0.36 per cent. Keller's specimen yielded 77.27 per cent. of pectose, 3.76 of cellulose, and 3.64 of ash, the other constituents being nearly in the same proportion as in the former analysis.

Allied Plants.—Lycoperdon Bovista, *Linné*, s. Bovista gigantea, *Nees*.—Common puff-ball, *E.*; Vesse-loup, *Fr.*; Bovist, *G.*—This fungus forms globular or obconical masses of a more or less yellow, or when old dark-brown, color, and varying in size from a few inches to about 2 feet (60 Cm.) in diameter. The lower part has a spongy texture, and was formerly used like spunk (see page 716) for arresting hæmorrhages.

Lycoperdon cervinum, *Linné* (Scleroderma, *Persoon*), s. Elaphomyces granulatus, *Fries*.—Puff-ball, Hart's truffle, *E.*; Truffe de cerf, *Fr.*; Hirschbrunst, *G.*—Its size is about that of a walnut or smaller. It is brown, verrucose, internally purplish-brown, and was considered to possess stimulant properties.

Tuber cibarium, *Sibthorp* (Lycoperdon Tuber, *Linné*).—Truffle, *E.*; Truffe, *Fr.*; Trüffel, *G.*—It is of subterraneous growth, subglobular, about the size of a walnut, externally blackish and verrucose, internally white, marbled with brown, fleshy. Like some allied species, it is edible.

Physiological Action and Medical Uses.—In 1853, Dr. B. W. Richardson's attention having been directed to the fact that the smoke of the *common puff-ball* had been used in the country for stupefying bees in order to secure the contents of the hive without sacrificing the insects, he conceived the idea that it might be made use of as a surgical anæsthetic. He accordingly experimented upon dogs, cats, and rabbits, and in one case removed a tumor from a dog without any sign of pain being shown during the operation. When a moderate quantity was inhaled, gradually the narcotism came on and passed off slowly, the animal exhibiting all the symptoms of intoxication, with convulsions, and sometimes vomiting. It destroyed life slowly; a dog would inhale the fumes for 20 minutes or half an hour after being completely narcotized previous to expiring. The heart's beat in all cases survived the respiration. The lungs after death were pale; there was no sign of congestion in any organ; the blood retained its red color, but did not coagulate quickly; cadaveric rigidity set in within 2 or 3 hours. During recovery from protracted narcotism an animal would sometimes be quite conscious, although insensible to pain. Herapath made experiments which proved that the gas which is the active agent in producing the preceding phenomena is carbonic oxide, and his conclusion, confirmed by Snow, was accepted by Dr. Richardson. No practical application has been made of this curious discovery.

In 1869, Dr. Porcher stated concerning L. giganteum that it is found in abundance near

Charleston, S. C., particularly where the cattle are driven to graze. It is used sliced and fried in butter or stewed in milk like the common mushroom. A correspondent wrote to him, "I and a number of others have made several meals on *lycoperdon*, and I think I have discovered in myself well-marked evidences of its narcotic influence, and two other experimenters have described similar sensations to me." A case is also referred to in which a person "had been seriously affected in this way by too large a meal of lycoperdon." Dr. E. Thompson of Tyrone has reported its remarkable virtues as a hæmostatic, antiseptic, and anodyne dressing for *cancerous* ulcers and *bleeding wounds* (*Practitioner*, xxix. 288).

The powder of this fungus had previously been applied as a *hæmostatic* in slight and superficial wounds, and, like other dry absorbing powders, in *intertrigo*.

It is said to have been used as food by the Indians of the Southern States.

LYCOPODIUM, *U. S., P. G.*—LYCOPODIUM.

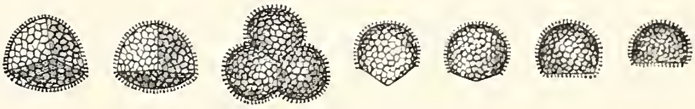
Semen lycopodii, Pulvis lycopodii, Sulphur vegetabile.—*Vegetable sulphur*, E.; *Lycopode, Soufre végétal*, Fr.; *Bärlappsamen, Streupulver, Hexenmehl, Blitzpulver*, G.

The sporules of Lycopodium clavatum, *Linné*, and of other species of Lycopodium. Bentley and Trimen, *Med. Plants*, 299.

Nat. Ord.—Lycopodiaceæ.

Origin.—The common *club-moss* is a low creeping perennial which is found in dry woods distributed over the greater portion of the globe, but is most frequent in northern countries. The stem is 2 to 4 feet (0.6–1.2 M.) long, with evergreen imbricated linear awl-shaped inflexed leaves, and with ascending very leafy branches 2 to 4 inches (5–10 Cm.) high, the fertile ones terminated by a long peduncle bearing two or three erect linear-cylindrical spikes, 1¼ to 2 inches (3–5 Cm.) in length, with roundish ovate bristly-pointed bracts, in the axils of which are kidney-shaped sporangia containing the sporules. The spikes are collected before they are fully matured, and after the powder has fallen out, it is separated by a sieve from the other parts. It is collected in Germany and other countries of Central Europe.

FIG. 178.



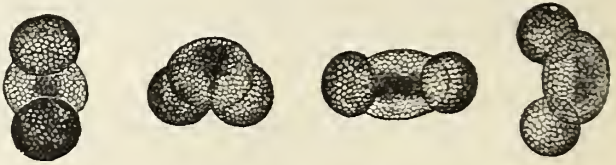
Sporules of Lycopodium.

Description.—Lycopodium is a fine, very mobile, pale-yellowish powder which is free from odor and taste. It floats upon water, and is wetted by it with difficulty and only after continued trituration, unless it has been previously washed with alcohol, ether, or chloroform to remove a superficial layer of oily matter; after boiling it sinks in water. When triturated it acquires a darker tint, becoming more coherent and greasy; when slowly heated it burns quietly, but when thrown into a flame it burns suddenly and with a hissing noise. Examined by the microscope, it is found to be rounded on one side, while the other forms a short three-sided pyramid. The entire surface is covered by fine polyhedric meshes except at the edges of the pyramid; but at its intersection with the rounded base short projections are observed.

Constituents.—Flückiger (1872) determined the presence in lycopodium of a much larger amount of fixed oil than the 6 per cent. observed by Bucholz (1807), and after rupturing the granules by long trituration with sand obtained 47 per cent. of a bland oil which does not solidify at −15° C. (5° F.). Bucholz found also in it 3 per cent. of sugar. Stenhouse obtained minute quantities of volatile bases, and Flückiger determined the ash to amount to 4 per cent., to be not alkaline, and to contain alumina and 1 per cent. of phosphoric acid. The substance of the cell-wall has been called *pollenin*; on treatment with potassa it is colored yellow, and then acquires a blue color with sulphuric acid and iodine.

Impurities and Adulterations.—The sporules of allied species of Lycopodium, particularly of L. complanatum, annotinum, and innundatum, *Linné*, which are found in both hemispheres, are sometimes collected; they are very similar in appearance and properties. Mineral substances like powdered *talc*, *gypsum*, etc. are detected by the larger amount of ash, and will readily subside when a little is agitated with carbon bisulphide or chloroform. Powdered *rosin* is detected by treatment with alcohol and evaporation of the tincture. Dextrin is soluble in water; its concentrated solution is precipitated by strong alcohol, and after having been boiled with dilute sulphuric acid it reduces red cuprous oxide from Trommer's solution. *Starch* is separated by carbon disulphide, in which it sinks, and sublimed *sulphur*, if present, will be dissolved by the liquid, and afterward obtained on evaporating it. Starch is also recognized by the blue color it acquires with solution of iodine. All admixtures are, however, easily detected by means of the microscope; the pollen of pine, which is sometimes found mixed with it, consists of an oval plano-convex cell, at each end of which is a smaller globular one projecting on the flat side.

Fig. 179.



Pollen of Pine.

Medical Uses.—This powder, on account of its extreme lightness and dryness, is used as a convenient protective for tender and raw surfaces of the skin in *intertrigo, erysipelas, eczema, herpes*, superficial *ulcers*, etc., and by druggists to place in boxes containing pills to prevent their adhering to one another. Lycopodium was formerly used as a dressing for unhealthy ulcers and in a variety of affections which required both stimulant and demulcent agents, particularly diseases of the *urinary organs* and *dysentery*. It was also given for the relief of chronic *bronchitis* and *rheumatism*. It is said (Cazin) that in Poland this powder is used upon the hair of persons affected with *plica Polonica*. But since it has been shown that this affection is not a disease, but only a result of filthiness (Kaposi), it has been cured by the free use of oil and the comb.

LYCOPUS.—BUGLEWEED.

Lycope de Virginie, Fr.; *Virginischer Wolfsfuss*, G.

The herb of Lycopus virginicus, *Linné*.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Bugleweed is a perennial herb growing in woods and shady moist places in Canada and in the United States southward to South Carolina. It flowers from July to September.

Description.—The stem is nearly smooth, about 12 to 18 inches (30–45 Cm.) high, obtusely quadrangular, and with slender runners at the base; the leaves are opposite, short-petioled, elliptic-lanceolate, toothed, wedge-shaped, and entire at the base, and glandular-punctate beneath; the flowers are small, in axillary clusters, purplish, and have a calyx with four ovate and bluntish but pointless teeth. The herb has a somewhat mint-like odor and a bitter and slightly aromatic taste.

Constituents.—The plant has most likely the general constituents of the Labiatæ, prominent among which is volatile oil, some resin, and a little tannin; in this case perhaps also a bitter principle. We know of no analysis of the plant.

Lycopus europæus, *Linné* (Water horehound, *E.*; Lycope d'Europe, *Fr.*; Wasserandorn, *G.*), has been used in Europe as *Herba marrubii aquatici*. It is indigenous to Europe and North America, and resembles the bugleweed, being mainly distinguished by the often taller, sharply four-angled stem, the more deeply and sinuate-toothed, at the base often pinnatifid, leaves, and the five triangular, sharp-pointed calyx-teeth. It varies somewhat in its foliage, and is not unfrequently collected with the preceding.

Medical Action and Uses.—Bugleweed is reputed to be astringent and sedative, to reduce the frequency of the pulse, to arrest *hæmorrhage* from the lungs, to allay coughing, and to be a mild narcotic. It has been compared with digitalis. As more than half a century has elapsed since such virtues were first ascribed to it, and it still continues to be neglected and generally unknown, it may be inferred that its supposed powers were in great part imaginary. It may be used in an infusion made with ½ ounce of the herb in a pint (Gm. 16 in Gm. 500) of boiling water. This quantity may be taken in a day.

L. europæus is said to have been used from time immemorial by the Piedmontese as a remedy for *intermittent fever*. It has also been employed to arrest passive *hæmorrhages* and *mucous discharges*.

LYTHRUM.—LOOSESTRIFE.

Herba salicariæ.—Purple willow-herb, E.; *Salicaire,* Fr.; *Rother Weiderich,* G.

Lythrum Salicaria, *Linné.*

Nat. Ord.—Lythraceæ.

Origin.—Loosestrife is a perennial herb growing in moist places in the New England States and in Europe and Northern Asia, and is sometimes cultivated in gardens. It flowers in July and August.

Description.—The stem is angular, 3 to 5 feet (0.9–1.5 M.) high. The leaves are opposite or whorled in threes, lanceolate, sessile, clasping with the heart-shaped base, roughish downy on the lower side, about 3 inches (75 Mm.) long. The flowers are rather large, in axillary cymes, apparently whorled, form a long, interrupted, wand-like spike, and have six purple or sometimes whitish petals and twelve stamens. The herb has a mucilaginous, mildly astringent taste. The blackish-brown, branching, and fibrous root is astringent.

Constituents.—Loosestrife appears to contain mucilage and tannin as its principal constituents.

Allied Plants.—CUPHEA VISCOSISSIMA, *Jacquin* (Meehan, *Nat. Flowers,* i. p. 41), is said to have been used with advantage in diarrhœa. It is found in dry fields from the New England States westward to Illinois, and southward as far as Brazil. It is a viscidly-hairy annual, about 20 inches (50 Cm.) high, with opposite petiolate ovate-lanceolate leaves; the flowers have a somewhat inflated tubular six-toothed calyx, six unequal bluish-purple petals, and twelve included stamens.

The genus is mostly confined to tropical America, and several species are cultivated for ornament, among which the so-called *cigar-plant* (C. platycentra), with its scarlet-red tubular calyx, is best known. The leaves and branches of C. antisyphilitica, *Kunth,* and C. microphylla, *Kunth,* are used in South America in syphilitic complaints.

Medical Action and Uses.—Loosestrife unites in itself demulcent and astringent qualities. It has been much used in Europe in *chronic diarrhœa* and *dysentery, leucorrhœa, blenorrhœa,* and passive *hæmorrhages,* and for various local cutaneous irritations. It is generally given in a decoction prepared by boiling an ounce of the root in a pint (Gm. 32 in Gm. 500) of water, and in doses of 1 or 2 fluidounces (Gm. 32–64).

An infusion is, however, preferable to the decoction, and may be made with half an ounce of the leaves and stems to a pint of hot water (Gm. 15 to Gm. 500) (Campardon, *Bull. de thérap.,* cv. 337).

MACIS, *U. S.*—MACE.

Arillus myristicæ.—Macis, Fr., G.; *Fleur de muscade,* Fr.; *Muskatblüthe,* G.

The arillus of the fruit of Myristica fragrans, *Houttuyn.*

Nat. Ord.—Myristicaceæ.

Origin.—(See MYRISTICA.) When the nutmeg is gathered, the arillus, which envelops the seed, is cut off and dried in the sun, whereby its bright-red color is changed to brownish-orange. With the view of its better preservation it is often sprinkled with sea-water. It is principally obtained from the Banda Islands.

Description.—Mace is about $1\frac{1}{2}$ inches (38 Mm.) long, smooth, flat, about $\frac{1}{12}$ inch (2 Mm.) thick at the base, thinner above, longitudinally slit into irregular, narrow, and somewhat branching bands of a brownish-orange and nearly dull color, somewhat translucent, and fatty when pressed or scratched. It breaks readily with a short fracture, but cannot be triturated to powder on account of the oil. It has a very agreeable aromatic odor, closely analogous to that of nutmeg, and a warm aromatic taste. The United States consume annually about 80,000 pounds of mace.

Constituents.—The most important constituent is the volatile oil (Oleum macidis, *P. G.*), which is present to the amount of about 8 per cent., but occasionally as much as 17 per cent. may be obtained (*Pharmacographia*). Schacht (1862) found it to consist mainly of a hydrocarbon, $C_{10}H_{16}$, called *macene,* which yields a crystallizable compound with hydrochloric acid gas, and appears to be related to, and by Koller (1865) considered identical with, the myristicene of oil of nutmeg. The oxygenated portion of the volatile oil is still less known than the hydrocarbon. Henry (1824) found red fat soluble, and yellow fat insoluble, in alcohol, but the 24.5 per cent. residue obtained by Flückiger (*Pharmacographia*) with boiling ether and drying at 100° C. (212° F.) appeared to have consisted solely of resin and semi-resinified volatile oil. The same author obtained with alcohol 1.04 per cent. of uncrystallizable sugar, and with hot water 1.8 per cent. of a body which turned blue, and after drying reddish-violet, with iodine, and is probably intermediate between starch and mucilage.

Adulterations are not likely to be met with, at least not of the unpowdered mace. The mace of the wild nutmeg (M. fatua) is of a darker red color, less divided at the base, with more slender bands, and destitute of the grateful fragrance and taste of true mace.

Pharmaceutical Preparation.—Tinctura macidis. Digest 1 part of mace with 5 parts of alcohol, and filter.

Medical Action and Uses.—The operation of mace appears to be the same as that of nutmeg, and there is reason to believe that an excessive dose of it may induce dangerous narcotism. It is used to impart an aromatic taste to medicines, but more commonly as a condiment for flavoring food and promoting its digestion.

MAGNESIA, *U. S., Br.*—Magnesia.

Magnesia usta, P. G.; *Magnesia calcinata.—Calcined magnesia*, E.: *Magnésie*, *Magnésie calcinée*, Fr.; *Gebrannte Magnesia*, G.

Formula MgO. Molecular weight 40.

Preparation.—Take of Carbonate of Magnesium 4 ounces. Put it into a Cornish or Hessian crucible closed loosely by a lid, and expose it to a low red heat until a small quantity, taken from the centre of the crucible when it has cooled and dropped into diluted sulphuric acid, causes no effervescence.—*Br.*

The Br. Ph. recognizes two varieties of magnesia, the heavy as *Magnesia ponderosa*, made from the heavy magnesium carbonate by the process just given, and *Magnesia levis* or *light magnesia*, which is made in precisely the same manner from the light magnesium carbonate. In the United States both kinds are extensively used, but when the heavy variety is desired it is usually designated in prescriptions as *Magnesia ponderosa*, under which title it has been admitted into the present Pharmacopœia, while the light magnesia is designated as *Magnesia*. Nearly 9000 pounds of calcined magnesia were imported into the United States in 1876, and afterward about 20,000 pounds annually.

The officinal carbonate of magnesium consists of magnesium carbonate and hydrate. On heating it, water and carbonic acid are given off and magnesium oxide remains behind; $4(MgCO_3).Mg2HO.5H_2O$ yields $5MgO + 4CO_2 + 6H_2O$. The carbonate of magnesium is pressed somewhat firmly into a crucible, and this is placed in a suitable furnace, loosely covered with a lid to prevent the product from becoming contaminated with ashes and other impurities, and then heated to dull redness. The expulsion of the water and carbonic acid gas keeps the surface of the powder continually in motion, and there is no necessity of testing it as long as that motion is kept up; when the motion ceases a small quantity of the powder is taken from beneath the surface and near the centre, mixed with sufficient water to displace the air, and then poured into an excess of dilute sulphuric acid. If no evolution of carbonic acid gas takes place, the product is finished, and may be dipped out with a ladle, and the crucible filled with a fresh portion of magnesium carbonate without removing it from the furnace. Made by the process formerly recommended in the U. S. Pharmacopœia, a large and rather flat earthen vessel is used, to allow of the magnesia being stirred continuously, in which case the heat may be raised to full redness; but it should never be raised to that degree if the stirring is omitted, because the magnesia would become dense and granular, and with difficulty soluble in dilute acids. The yield is between 40 and 43 per cent. of the weight of the magnesium carbonate.

Properties.—The two varieties of magnesia have the same composition and chemical properties, and differ from each other only in the degree of aggregation of their molecules. Heavy magnesia is more readily miscible with water than the light kind, and, like the latter, should remain suspended in the water for some time, and settle gradually. Should it subside very rapidly, the probability is that it was exposed to too high a degree of heat. It may be obtained from the light variety by triturating the latter for some time in the presence of strong alcohol, drying, and rubbing to powder. Magnesia is a white, very fine powder, without odor, and of an earthy, but destitute of a saline, taste. Exposed to a high heat, it becomes more compact, but does not fuse except before the oxyhydrogen blowpipe. According to Fresenius, it requires 55,000 parts of water for solution, but the liquid, like the moistened magnesia, has a distinct alkaline reaction. Its specific gravity varies between 2.3 and 3.3. When mixed with water it unites with it, forming a hydrate having the composition Mg2HO, and when heated losing 31 per cent.

of its weight. Exposed to the atmosphere, a similar change takes place, but carbonic acid is also absorbed and a corresponding quantity of oxycarbonate is formed. It should therefore be preserved in well-stoppered bottles. "On stirring 1 part of magnesia with 15 parts of water in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient firmness to prevent it from falling out when the glass is inverted."—*U. S.*

Tests.—The degree of hydration allowable is not given by the pharmacopœias, but when well kept the loss by heating to redness should not exceed 5 or 6 per cent. It should dissolve in dilute acids without any or with but very slight effervescence. The absence of even traces of carbonate are demanded by the U. S. and British Pharmacopœias—a requirement far too stringent; the German Pharmacopœia has very properly adopted the test recommended by Biltz, and directs that if 0.2 Gm. (3 grains) of magnesia be heated to boiling with 5 Ccm. (80 minims) of water, for the purpose of expelling adherent air, and after cooling the mixture be poured into 5 Ccm. of diluted sulphuric acid, the whole of the magnesia should be dissolved, and only a small number of distinct gas-bubbles should be observed. Tested in this manner, magnesia containing 1 per cent. of carbonic acid will evolve the gas in numerous distinct bubbles, however, without foaming, and if more than traces of lime are present the liquid will be turbid and deposit calcium sulphate. When treated with dilute nitric acid, magnesia should dissolve without leaving any residue, and the solution should yield at most a faint cloudiness, but no precipitates with barium nitrate (sulphates) or silver nitrate (chlorides), and potassium ferrocyanide should impart only a bluish tint, but not a deep-blue precipitate (iron). On adding ammonium chloride and an excess of ammonia the solution should remain clear on the further addition of ammonium oxalate (absence of calcium) and on the addition of sulphydrate of ammonium (zinc, etc.); but it yields with phosphate of sodium a copious white precipitate of ammonio-magnesium phosphate.

Several proprietary articles consisting of heavy magnesia are occasionally met with; this magnesia is generally characterized by freedom from grittiness and ready miscibility with water, but is not superior to a dense magnesia obtainable by careful manipulation from a properly-prepared magnesium carbonate.

Magnesium.—The metal magnesium is widely distributed, but is less abundant than calcium; it is found as silicate in *meerschaum*, *olivine*, *mica*, *serpentine*, and other minerals; as chloride in sea-water and the waters of saline springs; and as carbonate in most spring and mineral waters, in *magnesite*, and in *dolomite* or magnesian limestone. Black (1755) first proved magnesia to be distinct from lime, and Davy (1808) isolated the metal, which is now generally prepared by modifications of the process elaborated by St. Claire-Deville and Caron (1856), by heating sodium with anhydrous magnesium chloride; the resulting sodium chloride is dissolved by water, and the magnesium left behind in the form of a gray powder, which is fused and moulded as desired. It is a silver-white metal, of a strong metallic lustre, malleable, fusing at a red and volatilizing at a white heat, but burning with a bright white light when held in the flame of a gas-jet. Its density is only 1.78; it is not altered in dry air and but slightly tarnished in a damp atmosphere. *Soapstone* or *French chalk* is a double silicate of magnesium and aluminium.

Off. Prep.—Massa copaibæ, *U. S.*; Pulvis rhei comp., *Br.*; Trochisci magnesiæ, *U. S.*

Medical Action and Uses.—The action of magnesia and of its carbonates consists partly in neutralizing the acid in the alimentary canal, and partly in rendering acid secretions, as the urine, either neutral or alkaline. If a sufficient quantity of acid exists in the stomach or is attracted thither by the magnesia, a neutral purgative salt is formed; but in default of such a combination the magnesia may pass into the intestine unchanged in part, and if it be taken habitually may accumulate there and form concretions large enough to obstruct the bowel (*Bull. et Mém. de la Soc. de thérap.*, 1879, p. 77).

Magnesia has the advantage over other laxatives in being almost tasteless and in rarely causing nausea or colic. It produces feculent rather than watery stools, which are remarkable for their slight degree of fetor. It is slower than salines in its operation, but nearly as thorough. Its use is distinctly indicated in whatever condition is attended with gastro-intestinal acidity, with *heartburn*, *sour eructations*, and *flatulence*. It has even arrested the *vomiting of pregnancy* when the liquid rejected was acid. Although it corrects gastric acidity, it does not remove the cause of that symptom, for which purpose aromatics and bitter tonics are usually required. It is ordinarily associated with rhubarb in the treatment of dyspeptic *diarrhœa*, especially in children, and is a very appropriate laxative in *hæmorrhoidal* cases attended with constipation. It is useful in the *aphthous* affections of the mouth which attend infantile diarrhœa. In *gout* and its allied disorders its antacid qualities render it appropriate; the following formula is commonly employed: R. Magnesii sulph. ℥j–ij; Aquæ menthæ virid. f℥x; Vin. colchici seminis, Syrup. simpl. āā fʒj; Magnesiæ ʒij.—M. S.—From 1 to 3 tablespoonfuls every 2 hours until from four to six stools are produced in the 24 hours. In infantile *colic* the following carminative mixture is used: R. Magnesiæ gr. xxx; Tinct. asafœtidæ gtt. xl; Tinct. opii gtt. xx; Sacch. alb. gr. lx; Aquæ f℥j.—M. S.—20 drops and upward every hour until relief occurs. Magnesia is appropriate, as already stated, in cases of *uric acid gravel*, but is probably less so than the carbonates of sodium and potassium; but in such cases, when marked by gastric acidity, it should not be neglected. Like its carbonate, magnesia taken internally will sometimes entirely remove *warts*. Dujardin-Beaumetz has reported a striking example of the efficacy of this treatment (*Bull. de thérap.*, civ. 232).

As an antidote to *arsenious acid* freshly-precipitated magnesia ranks next in value to freshly-prepared sesquioxide of iron. It is also antidotal to *acids*, including oxalic acid, and to *phosphorus*. In all cases of poisoning for which it is appropriate magnesia should be very largely administered, diffused in water.

As a purgative the *dose* of magnesia is about 40 grains (Gm. 3), and 5 grains (Gm. 0.30) for infants. As an antacid it may be taken in doses of 10 grains (Gm. 0.60) after meals, suspended in water. Mixture with milk, which is usual to disguise its taste, renders its operation slower.

The medicinal action and uses of Magnesia ponderosa are identical with those of magnesia.

MAGNESII CARBONAS, *U. S.*—CARBONATE OF MAGNESIUM.

Magnesiæ carbonas, Magnesium carbonicum, P. G.; *Magnesia alba, Magnesia hydrico-carbonica, Carbonas magnesicus.—Carbonate of magnesia*, E.; *Carbonate de magnésie, Magnésie blanche*, Fr.; *Magnesiumkarbonat, Weisse Magnesia*, G.

Formula $(MgCO_3)_4.Mg(HO)_2.5H_2O$. Molecular weight 484.

Preparation.—Take of Sulphate of Magnesia 10 ounces; Carbonate of Soda 12 ounces; Boiling Distilled Water a sufficiency. Dissolve the sulphate of magnesia and the carbonate of soda each in a pint of the water, mix the two solutions, and evaporate the whole to perfect dryness by means of a sand-bath. Digest the residue for half an hour with 2 pints of the water, and, having collected the insoluble matter on a calico filter, wash it repeatedly with distilled water until the washings cease to give a precipitate with chloride of barium. Finally, dry the product at a temperature not exceeding 212° F.—*Br.*

This process yields *Magnesii carbonas ponderosa*, Br.; if the two solutions are mixed and then boiled for 10 or 15 minutes, but not evaporated, the precipitate will be more bulky, and after washing and drying constitutes the *Magnesii carbonas levis* or *light carbonate of magnesium* of the British Pharmacopœia.

On mixing cold solutions of magnesium sulphate and sodium carbonate a white voluminous precipitate results, which in the course of several days is gradually converted into the compound $MgCO_3.3H_2O$, identical with that which often crystallizes from the effervescing solution of magnesia (see p. 911); but when heat is applied carbonic acid gas is given off, and the insoluble portion remaining is a hydrocarbonate, the composition of which varies somewhat, a larger amount of carbonic acid being given off if the heat be continued; and the heavy magnesium carbonate obtained as described above has probably the formula determined by Berzelius, $3MgCO_3.MgH_2O_2.3H_2O$; which compound on ignition would yield nearly 44 per cent. of magnesia, MgO, as required by the British Pharmacopœia. Light magnesium carbonate yields less (between 40.3 and 41.7 per cent.) magnesia, according to Otto and Laake. The formula $3MgOCO_2.MgH_2O_2.4H_2O$ requires 41.9 per cent. MgO. A compound of the composition $4MgOCO_2.MgH_2O_2.5H_2O$ would yield 41.3, and with an additional H_2O only 40, per cent. MgO. Magnesium carbonate may be obtained from the mother-liquors or bittern of salt-works, and is prepared on an extensive scale in England from magnesian limestone by treating it in the state of powder with cold water and carbonic acid under a pressure of five or six atmospheres; magnesium bicarbonate is first dissolved, removed from the calcium salt, and by boiling converted into the officinal carbonate. The importation of magnesium carbonate into the United States increased from 134,000 pounds in 1867 to 355,447 in 1878, but since that time has been less.

Properties.—Besides the slight difference in composition just referred to, the heavy and light magnesium carbonates differ only in the degree of aggregation of their molecules, the former being slightly granular, the latter a smooth and less dense powder, both being inodorous and of a slight earthy taste. It is almost insoluble in water, requiring, according to Fyfe, 2500 parts of cold and 9000 parts of boiling water for solution, and when it is moistened with water and applied to turmeric-paper a brown color is gradually produced. When heated to dull redness water and carbonic acid gas are given off and magnesia remains. It dissolves with copious effervescence in dilute sulphuric, hydrochloric, and other acids, and the solutions have the chemical behavior of magnesium salts.

Tests.—Magnesium carbonate may be contaminated with calcium compound, and from incomplete washing also with the acidulous radicals contained in the mother-liquors, more particularly with chlorides, bromides, and sulphates. These impurities are detected by dissolving the carbonate in dilute nitric acid, and this solution should not be precipitated by nitrate of silver (chloride and bromide) or barium nitrate (sulphate); neutralized with ammonia, it should not be precipitated by ammonium oxalate (calcium). On the addition of ammonia or ammonium carbonate a white precipitate is produced, which should be completely soluble in an excess of the precipitant and in ammonium chloride (an insoluble portion would indicate alumina), and the ammoniacal solution should not yield a white precipitate with hydrogen sulphide (zinc).

The following tests have been adopted by the German and United States Pharmacopœias: Distilled water, boiled with the salt, and after filtration evaporated to dryness, should not leave more than a trace of a fixed residue. The salt should be soluble in diluted hydrochloric acid to a colorless liquid. A 2 per cent. solution of the salt prepared with the aid of acetic acid should not be affected with hydrosulphuric (not hydrochloric, as stated by the U. S. P.) acid, nor, after addition of test solution of carbonate (chloride, *P. G.*) of ammonium with an excess of water of ammonia, by solution of sulphide of ammonium (absence of metals). Another portion of the 2 per cent. solution should not at once (within two minutes, *P. G.*) be rendered more than faintly opalescent by test solution of nitrate of barium (limit of sulphate) or of nitrate of silver (chloride). The cold solution in hydrochloric acid, on being supersaturated with test solution of ammonium carbonate, should not be rendered more than faintly opalescent (absence of more than traces of aluminium or calcium).—*U. S.* If 0.2 Gm. of magnesium carbonate with 2 Ccm. of water and 8 or 9 drops of hydrochloric acid be heated to boiling, and the solution then mixed with 10 Ccm. of test solution of ammonium chloride, 20 Ccm. of distilled water, 5 Ccm. of ammonia, and 6 Ccm. of test solution of ammonium oxalate, the liquid should not at once become turbid (calcium).—*P. G.* Iron, if present, is removed either by precipitating it from the solution with lime, or by calcining the salt, when insoluble ferric oxide is formed.

Off. Prep.—Liquor magnes. carbon., *Br.;* Liq. magnes. citrat., *U. S.*, *Br.;* Magnesia, *Br.;* Magnes. citras granulatus, Mistura magnesiæ et asafœtidæ, *U. S.;* Trochisci bismuthi, *Br.*

Medical Uses.—The carbonate is less efficient than magnesia itself, but its action and uses are the same. It is said to remove *warts* from the skin when taken night and morning in teaspoonful doses and continued for several weeks.

Carbonate of magnesium may be given as a laxative in doses of from 30 to 120 grains (Gm. 2–8); as an antacid from 5 to 20 grains (Gm. 0.30–1.30) may be taken after meals. It may be agreeably administered in carbonic acid water.

MAGNESII CITRAS GRANULATUS, *U. S.*—GRANULATED CITRATE OF MAGNESIUM.

Magnesium citricum effervescens, P. G.—*Effervescing magnesium citrate*, E.; *Limonade séche au citrate de magnésie*, Fr.; *Brausemagnesia*, *Magnesiumcitrat in Körnern*, G.

Preparation.—Carbonate of Magnesium 11 parts (2¾ oz. av.); Citric Acid 48 parts (12 oz. av.); Bicarbonate of Sodium 37 parts (9¼ oz. av.); Sugar, in No 60 powder, 8 parts (2 oz. av.); Alcohol, Distilled Water, each a sufficient quantity; to make 100 parts (25 oz. av.). Mix the carbonate of magnesium intimately with 33 parts (8¼ oz. av.) of citric acid, and enough distilled water (about 5 parts or 1¼ fluidounces) to make a thick paste; dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine powder. Then mix it intimately with the sugar, the bicarbonate of sodium, and the remainder of the citric acid (15 parts or 3¾ oz. av.), previously reduced to a very fine powder. Dampen the mass with a sufficient quantity of alcohol, and rub it through a No. 20 tinned-iron sieve, to form a coarse granular powder. Lastly, dry it in a moderately warm place. Granulated citrate of magnesium should be kept in well-closed bottles —*U. S.*

The formula of the German Pharmacopœia is like the preceding except in the second part, where, calculated for the above proportion of magnesium carbonate, 37.4 parts of sodium bicarbonate, 17.4 parts of citric acid, and 8.7 parts of sugar are directed. The French Codex uses calcined magnesia 65, magnesium carbonate 60, citric acid 300, and sugar 600, parts.

The first step is the preparation at as low a temperature as possible of an acid magnesium citrate, a little over one-half the citric acid ordered for this manipulation being sufficient for the formation of the normal salt. The remaining operation has for its object the incorporation with this salt of sodium bicarbonate and citric acid in such a manner as to avoid mutual decomposition, which is designed to take place only when the mixture is to be used and is stirred with water. Sieves of different degrees of fineness are usually used, so as to obtain granules nearly uniform in size.

Properties.—This preparation forms white granules or a white granular inodorous powder having an acid reaction and a pleasantly saline and mildly acidulous refreshing taste. On exposure to the air it attracts moisture, resulting in the decomposition of the bicarbonate and the evolution of carbonic acid gas, and afterward becomes damp, without, however, completely deliquescing. It is nearly insoluble, or rather only partly soluble, in alcohol, but dissolves slowly and with copious, long-continued but not vehement effervescence in 2 parts of water at 15° C. (59° F.); this solution is rarely perfectly clear, but usually is more or less opalescent from traces of impurities contained in the magnesium carbonate, and in the course of several days deposits crystals of magnesium citrate. Boiling water dissolves more rapidly a larger amount of the granules, and this solution separates on cooling a portion of the magnesium citrate in crystals. The total amount of citric acid ordered by the U. S. Pharmacopœia is only slightly in excess of that required for the production of normal salts; an increase from 48 to 49 or 50 parts would render the taste more acidulous and the solution more permanent. The aqueous solution shows the reactions of citric acid and of magnesium salts; on boiling with test solution of calcium chloride a white precipitate is produced, and the cold solution, on being rendered alkaline with ammonia-water, yields with test solution of sodium or ammonium phosphate a white precipitate which is readily soluble in acetic acid.

Tests.—"The saturated aqueous solution of the salt, when mixed with a saturated solution of acetate of potassium and some acetic acid, should not yield a white crystalline precipitate (absence of tartrate)."—*U. S.* A solution of 1 Gm. of the granules, on being treated with ammonia-water and ammonium phosphate, should yield a precipitate, which, after having been throughly washed with diluted ammonia-water, then dried, and ignited in a porcelain crucible, should leave a white residue of magnesium pyrophosphate weighing not less than 1.22 Gm., showing the presence of at least 4.4 per cent. of MgO.

Uses.—In the *dose* of from 120 grains to an ounce (Gm. 8–30) this compound forms an agreeable laxative in mild febrile disorders.

MAGNESII SULPHAS, *U. S., Br.*—SULPHATE OF MAGNESIUM.

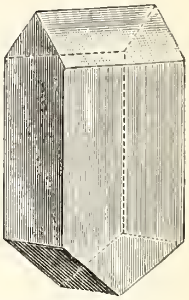
Magnesiæ sulphas, Magnesium sulfuricum, P. G.; *Sal amarum, Sal Epsomense, Sal anglicum, Sal Sedlicense, Sulfas magnesicus.—Sulphate of magnesia, Epsom salt,* E.; *Sulfate de magnésie, Sel d'Epsom, Sel de Sedlitz, Sel amer,* Fr.; *Magnesiumsulfat, Bittersalz, Schwefelsaures Magnesium,* G.

Formula $MgSO_4.7H_2O$. Molecular weight 246.

Origin and Preparation.—Sulphate of magnesium is contained in sea-water and in the waters of many mineral springs, which thereby acquire a bitter taste. The *Crab Orchard salt* of Kentucky is the same salt in an impure state, and, as analyzed by J. T. Viley (1871), contains about 65 per cent. of magnesium sulphate after having been dried at 120° C. It probably results from the mutual decomposition of gypsum and magnesian limestone, and is obtained by evaporating the water which collects in wells dug in the ground. The pure salt is made on the large scale from *magnesite*, which is principally $MgCO_3$, by dissolving it in dilute sulphuric acid and crystallizing; large quantities of the salt are made by various processes from magnesian limestone, and more recently it is extensively obtained at the Stassfurt salt-works, principally from the mineral *kieserite*, which is $MgSO_4$ combined with varying quantities of water, and in its natural state as insoluble as gypsum. 37,542 pounds of this salt were imported in 1878, and 9422 pounds in 1882.

Properties.—As found in the market, magnesium sulphate has generally been purified by re-solution in water and rapid crystallization, and forms small rhombic prisms or needles, which resemble those of oxalic acid and sulphate of zinc, are perfectly transparent, without odor, and have a cooling and bitter saline taste and a neutral reaction. It dissolves at the ordinary temperature in from one to one and a half times its weight, and in two-thirds its own weight of boiling water; it is also soluble in diluted alcohol, but insoluble in strong alcohol. Both the German and U. S. Pharmacopœias give the solubility of crystallized magnesium sulphate as 1 part in 0.8 parts of water at 15° C., and in 0.15 parts of boiling water; but a solution saturated at 15° C. contains for 100 parts of water, according to Mulder (1864), 69.29 parts; according to Gerlach (1859), 107.1 parts; and according to Michel and Krafft (1854), 108.44 parts; and at 100° C., according to Mulder, 151.29 parts of the crystallized salt. Exposed to air, the crystals slowly effloresce, becoming superficially opaque; when heated the salt melts, gives off $6H_2O = 43.9$ per cent., and at a red heat parts with the last molecule of water, fuses, and on cooling congeals into a white mass weighing 48.78 per cent. of the crystallized salt; the total weight of water amounts to 51.22 per cent. The aqueous solution on the addition of barium chloride yields a white precipitate of barium sulphate insoluble in hydrochloric acid. It is not precipitated in the cold by potassium bicarbonate or ammonium carbonate, but gives white precipitates with the carbonates and the hydrates of sodium and potassium, which are redissolved by ammonium chloride. Ammonia added to its solution likewise causes a white precipitate soluble in ammonium chloride, and this solution, on the addition of ammonium phosphate, deposits all magnesium in the form of a crystalline powder, which is phosphate of magnesium and ammonium, $MgNH_4PO_4.6H_2O$, and is insoluble in diluted ammonia, sparingly soluble in water, and freely soluble in diluted acetic and other acids; the precipitate, after having been well washed with diluted ammonia, then dried, and ignited in a porcelain crucible, is converted into magnesium pyrophosphate, $Mg_2P_2O_7$ (mol. weight 222), which represents 21.62 per cent. Mg or 36.03 per cent. of MgO.

Fig. 180.



Crystal of Magnesium Sulphate.

Tests.—Impurities are detected in precisely the same manner as in the nitric acid solution of magnesium carbonate (see above). The following tests have been adopted by the U. S. P.: "The aqueous solution should not be colored nor be precipitated by test solution of ferrocyanide of potassium, hydrosulphuric acid, or sulphide of ammonium (absence of metals). A 5 per cent. solution, after addition of chloride of ammonium, should not be precipitated nor rendered turbid by test solution of carbonate of ammonium and water of ammonia (absence of other alkaline earths). A 1 per cent. solution should not yield more than a slight opalescence with test solution of nitrate of silver (limit of chloride). If an aqueous solution of 1 Gm. of the salt, mixed with chloride of ammonium, be completely precipitated by solution of phosphate of ammonium and water of ammonia, the filtrate evaporated to dryness, the residue gently ignited and then dissolved in 5 Ccm. of water, this solution, acidulated with a few drops of hydrochloric acid, should not become more than faintly opalescent on mixing 1 volume of it with 2 volumes of alcohol nor on adding test solution of chloride of barium to another portion (absence of more than about 1 per cent. of sulphates of alkalies)."

The test for alkaline earths in magnesium sulphate is superfluous, their sulphates being insoluble, or sparingly soluble, in water. The simpler tests of the German Pharmacopœia are as follows: "A 5 per cent. solution should have a neutral reaction; it should not be affected by hydrogen sulphide after having been acidulated with acetic acid, nor by ammonium chloride and ammonia and the subsequent addition of ammonium sulphide; tested with silver nitrate, it should at most become opalescent within 5 minutes. The salt while being held in a flame should not persistently color it yellow."

Pharmaceutical Uses.—Sulphate of magnesium is used for preparing Magnes. carbonas and Liquor magnes. carbon., and forms a constituent of Infusum sennæ comp., *U. S.;* Enema magnes. sulphat. and Mistura sennæ comp., *Br.*

MAGNESII SULPHAS EXSICCATUS, Magnesium sulfuricum siccum, *P. G.* The crystallized sulphate is exposed in a warm place until it has lost from 35 to 37 per cent. of its weight, and is then passed through a sieve. It is a white powder having the properties of the crystallized salt, except that it contains less water; on exposure to air it gradually attracts moisture, and should therefore be kept in well-stopped bottles. The

German Pharmacopœia directs it to be dispensed when powdered magnesium sulphate is prescribed.

MAGNESII LACTAS, Lactate of magnesium, $Mg2C_3H_5O_3.3H_2O$; mol. weight 256. 6 parts of calcium lactate (see page 71) and 5 parts of magnesium sulphate are separately dissolved in hot water, the solutions mixed and filtered from the precipitated calcium sulphate, the last traces of which are removed by digesting with a little magnesium carbonate; the filtrate is then evaporated and crystallized. The salt forms white granular crystals or needles, is insoluble in alcohol, soluble in about 30 parts of cold and 6 parts of boiling water, and when heated is decomposed without melting. Its solution in water is not precipitated by nitrate of barium, carbonate of ammonium, or sulphydrate of ammonium.

Medical Action and Uses.—Sulphate of magnesium, dissolved in a large quantity of water and taken on an empty stomach, is very prompt in its operation, producing copious watery dejections and generally diuresis. Indeed, if the skin be kept cool the latter mode of operation may exceed the purgative effect, particularly if the dose be not large. Delicate persons, especially in cool weather, are apt to feel chilly and weak during its operation. This refrigerant influence renders it appropriate in warm weather and in febrile affections. If the dose be excessive and largely diluted, hypercatharsis may occur. On the other hand, large doses not thus diluted have sometimes occasioned an alarming sedation, with pallor, debility, coldness, and even syncope, although no purgation whatever occurred. In at least one case, that of a boy ten years old, death resulted. These effects, according to the dose and degree of dilution with water, are more or less produced by all saline cathartics. According to Rutherford, magnesium sulphate has no cholagogue action. Iaworski finds that a solution of sulphate of sodium is much more rapidly absorbed from the stomach than one of magnesium sulphate (*Bull. de thérap.*, cvi. 228).

When properly administered it is nearly always a safe and harmless purgative; indeed, it is generally used without medical advice by persons affected with *constipation*, slight *febrile attacks*, etc. It is highly objectionable when habitually employed for the former purpose in a full purgative dose, for it soon ceases to act purgatively and confirms the evil it was used to cure. It is also one of the least eligible cathartics in cold weather. On the other hand, if used in small doses largely diluted, as 1 drachm in ½ pint of water, it may be continued for a long time without sensibly diminishing in activity. As an antiphlogistic purgative at the commencement of *fevers*, especially of malarial fevers, it is justly esteemed, whether or not it is preceded by a dose of 8 or 10 grains of calomel, which many think essential to the result. In *typhoid fever* there is much reason to believe that a gentle purgative action maintained during the first week of the attack by this medicine tends to moderate the fever, mitigate the special typhoid phenomena of the disease, and lessen the danger of intestinal perforation. In acute *dysentery* of a sthenic type saline laxatives, and this one among the number, have a decided influence in lessening the tormina, tenesmus, and bloody and mucous stools, and reducing the febrile action. But to be efficient its administration ought to commence as early as possible in the attack and before ulcers form in the rectum. In both of the last-mentioned affections an ounce of the salt may be dissolved in a pint of water, and a wine-glassful of the solution administered every two or three hours. When this treatment has been pursued for 24 or 48 hours it should be suspended for about 12 hours, and then resumed. In various *inflammations*, serous and parenchymatous, it was formerly the custom to administer Epsom salt in small doses, largely diluted, with the addition of half a grain of tartar emetic to each pint of the solution, which was given in wine-glassful doses at intervals of 3 hours. The method is temporarily supplanted by the use of medicines which reduce the pulse-rate and temperature without providing any outlet for the effete products of morbid action.

In all cases of *intestinal obstruction* not clearly due to organic causes the use of this or some similar medicine should have a fair trial, care being taken to employ a weak solution and to administer it in moderate doses at proper intervals. In *painter's colic* sulphate of magnesium with the addition of sulphuric acid has been regarded as a specific for the disease, but erroneously.

Administration.—From half an ounce to an ounce (Gm. 16–32) of Epsom salt dissolved in half a pint (Gm. 250) of water is a full purgative dose, but even a less proportion of the salt and a larger proportion of water will produce nearly an equal effect. Its taste may be partially disguised by aromatic sulphuric acid in the proportion of half a fluidrachm to the half pint of liquid. The addition to the saline solution of a little strong coffee helps to mask its nauseous flavor. It is frequently given in an infusion of senna when a prompt and vigorous operation is required. This mixture forms the basis of the so-called "black draught."

MAGNESII SULPHIS, *U. S.*—SULPHITE OF MAGNESIUM.

Magnesium sulfurosum, Sulfis magnesicus.—Sulfite de magnésie, Fr.; *Magnesiumsulfit, Schwefligsaures Magnesium*, G.

Formula $MgSO_3.6H_2O$. Molecular weight 212.

Preparation.—G. Arehbold (1872) recommended its preparation by passing sulphurous acid gas in excess through a mixture of magnesium carbonate and water and carefully concentrating the solution. Prof. Remington (1878) suspends 1 part of magnesia in 2 parts of water, and adds an excess of officinal sulphurous acid. Hager's process is as follows: Mix 1 part of magnesium carbonate with 8 parts of water, and pass into the mixture, stirring it occasionally, a current of sulphurous acid gas as long as carbonic acid gas is evolved and until the liquid rapidly bleaches litmus; the delivery-tube should terminate about an inch (25 Mm.) beneath the surface of the liquid. The mixture, containing an excess of sulphurous acid, is set aside for several hours, the clear liquid decanted, the crystalline magma washed with water, drained, and dried in a moderately warm place. The yield is 2 parts. According to R. H. Davies (1872), an acid sulphite is not formed.

Magnesium sulphite should be kept in well-stopped small bottles; in contact with air it is converted into sulphate.

Properties.—The salt is a white crystalline, inodorous powder, having an earthy, somewhat bitter, and sulphurous taste and a neutral or slightly alkaline reaction; it may be obtained in colorless tetrahedrons (Fourcroy and Vauquelin), or in hexagonal rhombohedrons (Rammelsberg), which on exposure to air become opaque from the formation of sulphate. The salt is insoluble in alcohol. Fourcroy and Vauquelin state that it dissolves in 20 parts of water at 15° C. (59° F.) and in less (19 parts *U. S. P.*) of boiling water; according to Hager, 80 parts of cold and 120 parts of boiling water are necessary for solution. At about 200° C. (392° F.) the salt becomes soft and parts with its water of crystallization, and at a higher heat is converted into magnesia and anhydrous magnesium sulphate. The aqueous solution shows with alkali carbonates or phosphates the same behavior as the sulphate.

Tests.—"When treated with four times its weight of diluted hydrochloric acid the salt dissolves completely and emits the odor of burning sulphur, without becoming cloudy (difference from hyposulphite). A 1 per cent. aqueous solution, strongly acidulated with hydrochloric acid, should not afford more than a slight cloudiness with test solution of chloride of barium (limit of sulphate)."—*U. S.* Hager suggests the following: A solution of 1 Gm. of the salt in 100 Gm. of water on being mixed with a solution of 1 Gm. of iodine in test solution of potassium iodide, and afterward with 5 Gm. of diluted sulphuric acid, should form a clear and colorless liquid; 1 part of pure magnesium sulphite will decolorize 1.19 parts of iodine.

Uses.—This compound appears to be identical in its action with sulphite of sodium. It tends to check fermentation, and hence to arrest the formation of gases in the alimentary canal during digestion. It appears to be a superfluous addition to the Pharmacopœia. It may be given in *doses* of from 10 to 60 grains (Gm. 0.60–2).

MAGNOLIA, *U. S.*—MAGNOLIA.

Magnolia-bark, E.; *Écorce de magnolier*, Fr.; *Magnolienrinde*, G.

The bark of Magnolia glauca, Magnolia acuminata, and Magnolia tripetala, *Linné* (M. Umbrella, *Lamarck*).

Nat. Ord.—Magnoliaceæ.

Origin.—M. glauca, *sweet bay*, *white bay*, *beaver tree*, or *swamp sassafras*, is indigenous to swampy localities near the coast of the United States from Massachusetts to Louisiana; in the northern part of the country it is shrubby; farther south it is a small tree 15 to 25 feet (4.5–7.5 M.) high. It has oval-oblong leaves, which are shining above and white beneath, and bears fragrant white flowers about 2 inches (5 Cm.) in diameter, with about ten ovate or obovate-obtuse petals. The leaves may be used for marking by placing the white surface upon the fabric and writing with some pressure upon the upper surface: the roots yield a yellow dye.

M. acuminata, called *cucumber tree* from the appearance of the young fruit, is found in groves and rich woods from Western New York to Ohio and southward, chiefly along the Alleghanies to Georgia, and westward to Tennessee. It grows to the height of 60 to 90 feet (18–27 M.), and has oblong-acuminate, underneath pubescent, leaves, and light bluish-green flowers tinged with yellow, about 4 or 5 inches (10–13 Cm.) in diameter.

M. Umbrella, *umbrella tree*, so called from the large leaves appearing whorled at the ends of the branches, is found in rich soil from Pennsylvania and Ohio southward along the Alleghanies to Georgia and Tennessee, and attains a height of about 40 feet (12 M.). Its leaves are over a foot, sometimes 3 feet (30–90 Cm.), long, obovate-lanceolate, pointed at both ends, silky when young, and its white flowers are about 7 inches (18 Cm.) in diameter.

The magnolias produce their flowers in May and June; they have a white or greenish calyx of three sepals, many stamens with short filaments, and many ovaries collected on an elongated receptacle, forming a cone-like aggregation of fruits which open at maturity, the berry-like seeds being suspended by a thread-like funiculus.

Description.—The bark necessarily varies as obtained from the different species. The young bark of M. glauca is light orange-brown, glossy, with some gray spots, and underneath the thin corky layer of a green color. The bark of the larger branches is nearly smooth, externally of a light-gray or whitish color, marked with scattered warts and some longitudinal cracks. Older bark has the warts somewhat confluent and the cracks deepened into fissures. The inner surface is whitish, or, after drying, yellowish or pale-brownish, smooth, and very finely and closely striate. The bark of M. tripetala is thicker, is of a pale-brown underneath the ash-gray outer layer, and has a thick liber with rather tough bast-fibres. Magnolia-bark breaks in the outer layer with a smooth fracture, and with a more or less fibrous fracture in the bast-layer, and exhibits upon the light-brownish transverse section rather broad wedges of the bast and medullary rays. The dried bark has scarcely any odor, but its taste is warm, spicy, somewhat astringent, and bitter, particularly in the young bark.

Constituents.—The bark of Magnolia grandiflora was examined by Stephen Procter (1842), who found in it a little volatile oil, resin, and a crystalline principle resembling liriodendrin. The root- and stem-bark of M. glauca were investigated by W. D. Harrison (1862), the former yielding a little volatile oil and nearly tasteless and colorless crystals; the latter contained tannin, producing a dark-green precipitate with ferric salts, but did not yield the crystalline principle nor could the bitter principle be isolated. By treating the alcoholic extract of the fruit of M. Umbrella with hot petroleum benzin, Wallace Procter (1872) obtained colorless crystals of *magnolin*, which are soluble in alkalies, alcohol, ether, chloroform, carbon bisulphide, and fixed oils, but sparingly so in boiling water, in which they fuse; the solutions have an irritating taste. The crystals are colored red by sulphuric acid and brown by nitric acid. The pungent taste of the fruit is due to a soft resin and the odor to a little volatile oil.

Medical Uses.—The bark of the several medicinal species of magnolia is bitter and aromatic without astringency. Like numerous other plants of similar qualities, it has been used in hot decoction to produce diaphoresis in *fevers*, bronchial *catarrhs*, *rheumatism*, and *gout*, and in cold decoction or tincture as a tonic. The tree is said to render clear the waters near which it grows, and to prevent malarial affections. The preparations of the bark spoken of above are used in the cure of intermittent fevers. The *dose* of the recently-dried bark in powder is stated to be from 20 to 60 grains (Gm. 2–4), frequently repeated. The infusion or decoction is less eligible than the tincture, which is not, however, officinal.

MALTUM, *U. S.*—MALT.

Maltum hordei.—*Barley malt*, E.; *Malt d'orge*, *Drêche*, Fr.; *Malz*, *Gerstenmalz*, G.

The seed of Hordeum distichum, *Linné* (Nat. Ord. Graminaceæ), caused to enter the incipient stage of germination by artificial means, and dried.

Preparation and Properties.—Different kinds of grain may be employed for the preparation of malt, but the kind most generally used is barley. The grain is soaked in water, and then placed in heaps; heat is spontaneously generated, and by occasional turning prevented from rising too high. Under these conditions germination takes place, and when the germ has acquired the desired length the grain is rapidly dried, and constitutes *malt*. According to the degree of heat employed in drying the color of the malt varies somewhat, and is known as either *pale*, *pale amber*, *amber*, or *amber-brown*. For some purposes malt is made to undergo a roasting process in revolving cylinders, to obtain *roasted* or *black* malt if the integuments are of a dark-brown color, or *crystallized* malt if the interior of the grain has become dark-brown. Malt has an agreeable odor and a sweet taste, and yields with water a more or less deep yellowish-brown or brown infusion. Only pale or pale amber-colored malt is employed medicinally.

Constituents.—The chemical changes taking place in germinating grain and sprouting potatoes were explained by Payen and Persoz (1833), who discovered a peculiar ferment, *diastase*, which exists in the vicinity of the embryo, but not in the radicle of the germ; on making an infusion of fresh malt, precipitating salts and some proteids with a little alcohol, and then adding more alcohol, diastase in an approximately pure condition is precipitated, but, according to Dubrunfaut (1868), is a mixture which contains the true fermentative principle, *maltin*. The remaining constituents of malt are those of barley, with the exception of *dextrin* (see pp. 199 and 768) and *sugar*, which have been formed from a portion of the starch, the remainder of which, still present in the malt, is likewise converted into the same compounds by the process of *mashing*, which consists in preparing an infusion of ground malt, called *wort*, and keeping it at a temperature of about 70° C. (158° F.).

During the process of malting good barley increases about 9 per cent. in volume, but loses about 20 per cent. in weight, and good malt should yield to water soluble principles amounting to two-thirds of its weight. Diastase has the property of converting starch into dextrin and sugar, and in this respect resembles *ptyalin*, a ferment met with in the salivary glands of animals. Coutaret (1870) regards the two ferments as being identical.

Off. Prep.—Extractum malti, *U. S.*

Medical Action and Uses.—Liquid and semi-fluid extracts of malt were much used a few years ago in Germany, where they were first introduced, as tonic and nutritious substitutes for malt liquors. Thence they were diffused to every part of the world, until their local manufacture displaced the imported preparations, and both were superseded by some later fashionable medicine. In many cases they were found quite beneficial in states of chronic debility and *dyspepsia* due to organic disease or infirmity or to mere nervous exhaustion, but seldom more, and often less so, than good malt liquors into the composition of which hops enter. Malt appears to be especially adapted to promote the digestion of amylaceous food by promoting its conversion into dextrin and glucose. The semi-liquid preparation, which is the only true extract of malt, is very difficult to take, owing to its tenacious and adhesive qualities, and is generally prescribed in teaspoonful doses mixed with soup, wine, beer, or milk. It should be taken at the beginning of a meal or while it is being eaten. Malt preparations are of use in tubercular *phthisis* and other wasting diseases only because they enable the digestive organs to assimilate more food than it would otherwise be possible to digest.

An infusion of malt made with cold water is an energetic diastatic agent. The following directions may be followed in its preparation: "3 ounces (or piled-up tablespoonfuls) of crushed malt are thoroughly well mixed in a suitable vessel with ½ pint of cold water. The mixture is allowed to stand over night—that is to say, for 12 or 15 hours. It is then filtered through until it becomes perfectly bright. The above quantities yield about 7 ounces of product of a sherry-brown color and a faint sweetish taste. It is nearly neutral, and its sp. gr. about 1025. Its chief solid constituent is maltose, and is rich in diastase. . . . . It is very prone to fermentation, and ought to be prepared fresh every day" (Roberts, *Practitioner*, xxiii. 405). A tablespoonful of this liquid, added to ½ pint of gruel prepared from wheat or other flour, or from oatmeal, groats, pearl-barley, arrowroot, or another farina, and at a temperature not too high for being eaten, will immediately transform the starchy ingredients of the mixture into sugar and dextrin. In this manner a food may be formed which will save or prolong the life of patients affected with tubercle, marasmus, or any *wasting disease* in which all other forms of nutriment are either vomited or passed by stool. Above all, it is valuable in the treatment of two of the most fatal diseases of infancy, *cholera infantum* and *summer diarrhœa.*

It appears that in Japan malt (*midzu ame*) has long been used for similar purposes (Eldridge, *Med. News*, xliv. 114).

MANGANI OXIDUM NIGRUM, *U. S.*—BLACK OXIDE OF MANGANESE.

Manganesii oxidum nigrum, Br., U. S. 1870; *Manganum hyperoxydatum*, *Oxydum manganicum*, *Magnesia vitriariorum.*—*Dioxide* (*Peroxide*) *of manganese*, *Pyrolusite*, E.; *Oxyde* (*Peroxyde*) *de manganèse*, Fr.; *Braunstein*, *Mangansuperoxyd*, G.

Native, crude binoxide of manganese, containing at least 66 per cent. of the pure oxide. (Formula MnO_2. Molecular weight 86.)

Origin.—Pyrolusite—or, as it is commercially called, *black manganese* or *manganese*—is found in different parts of Germany, France, Spain, and Great Britain, and also in Nova Scotia, Vermont, Pennsylvania, and other parts of North America. Sometimes it is found nearly pure, but it is generally associated with other manganic ores, particularly with the inferior brown *manganite*, and often with iron, lime, baryta, silica, etc. It may also be obtained artificially by carefully fusing manganous carbonate with potassium chlorate and washing the mass, or, according to Walter Weldon (1867), by exposing a mixture of manganous hydroxide and lime to the air at a temperature of about 55° C. (131° F.). The average importation of ore and oxide of manganese into the United States for the eight years ending 1880 was nearly 1,700,000 pounds annually.

Properties.—It is amorphous, and is then of a dull gray-black color, or in masses composed of tabular, fibrous, or radiating crystals having a bright metallic lustre and yielding a black or grayish-black, somewhat gritty, tasteless powder. Its specific gravity is 4.7 to 4.94. It is insoluble in water and in all simple solvents, as well as in weak acids; it dissolves in hot hydrochloric acid to manganous chloride, while chlorine is given off; $MnO_2 + 4HCl$ yields $MnCl_2 + 2H_2O + Cl_2$. When it is treated with diluted sulphuric acid in the presence of oxalic acid, the latter is oxidized to carbonic acid, manganous sulphate being dissolved; $MnO_2 + H_2SO_4 + H_2C_2O_4$ yields $2CO_2 + MnSO_4 + 2H_2O$. When heated to redness the black oxide parts with a portion of its oxygen, leaving brown manganic oxide, Mn_2O_3, or at a bright-red heat red manganoso-manganic oxide, $MnO.Mn_2O_3$; and when mixed with potassa and potassium chlorate and heated to dull redness, a black-green mass of potassium manganate is obtained, which yields with cold water a deep-green solution, the color changing to purple on the addition of an acid or on boiling, potassium permanganate being produced.

Valuation.—The value of black oxide of manganese for the production of chlorine may be determined in various ways, either by ascertaining directly the loss in weight occasioned by the evolution of carbonic acid gas in the reaction just described, when the weight of $2CO_2$ (88) will indicate 1 molecule of MnO_2 (86), or after the reaction has been completed the excess of the oxalic acid added is estimated by a standardized solution of potassium permanganate, which is added until it ceases to be decolorized. The generation of chlorine and its oxidizing effect upon ferrous salts are utilized for the same purpose in the following manner: 5 Gm. (or 50 grains) of the finely-powdered oxide are mixed in a flask with about 15 Gm. of water and 35 Gm. (or 1 ounce) of strong hydrochloric acid; 32.3 Gm. (or 323 grains) of pure granular ferrous sulphate are likewise weighed out and added, at first in larger, afterward in smaller, portions, until, after some digestion, the odor of chlorine has entirely disappeared and a drop of the liquid is colored blue by ferricyanide of potassium from the excess of ferrous salt. If the oxide was pure MnO_2 (accepting the molecular weight 86), it would require 32.3 Gm. (or 323 grains) of the ferrous sulphate; from the exact quantity of the latter used the percentage of the former is easily calculated. The Pharmacopœia requires black manganese to contain at least 66 per cent. of MnO_2, and if of this strength the above quantity, after the addition of 21.3 Gm. (or 213 grains), will give no blue reaction with the ferricyanide. This is the process of assay adopted by the Pharmacopœia, the quantities directed being black oxide of manganese 5 Gm., water 15 Gm., hydrochloric acid 20 Gm., and ferrous sulphate 21 Gm., which indicate only 65 (not 66) per cent. of pure manganese dioxide. The 32.3 Gm. (or 323 grains) of the ferrous sulphate may also be added at once, and after the completion of the reaction its excess ascertained by standardized permanganate of potassium.

Impurities.—The presence of carbonates is detected by the effervescence occurring with *cold* dilute hydrochloric acid, and the presence of iron is ascertained in the solution obtained with strong or with hot dilute hydrochloric acid by the blue precipitate with ferrocyanide of potassium.

Composition.—Black oxide of manganese consists of 62.8 parts (1 atom) of manganum and 37.2 parts (2 atoms) of oxygen.

The metal *manganum*, *manganium*, or *manganesium* was first isolated by Gahn (1774), after Pott, Scheele, Bergmann, and others had shown black manganese to be free from iron; it may be obtained by reducing one of its oxides with carbon at a very high temperature. It resembles iron, but is harder, more brittle, and has a lighter or darker, sometimes a reddish, tint; its specific gravity is 7.13–7.21 (Brunner), and it melts at a white heat. Besides the oxygen compounds mentioned above it unites with this element also in several other proportions. *Manganous oxide*, MnO, is a grayish-green powder which readily oxidizes in contact with the air. *Manganic acid*, H_2MnO_4, is not known in the free state, but only in the form of salts, which have a green color. *Manganic heptoxide*, Mn_2O_7, is a heavy, dark red-brown, oily liquid which detonates violently when heated to between 30° and 40° C. (86° and 104° C.). *Permanganic acid*, $H_2Mn_2O_8$, is a deep violet-colored liquid which is a powerful oxidizing agent. (See POTASSIUM PERMANGANATE.)

Uses.—Black oxide of manganese is used for the preparation of oxygen and largely in the manufacture of chlorine, and the solution obtained in this process may be employed for preparing other compounds of manganium. It is employed in preparing Aqua (liquor) chlori, *U. S.*, *Br.;* Hydrarg. perchloridum, Liq. sodæ chloratæ, Potass. chloras, Potass. permanganas, *Br.*

Medical Action and Uses.—Black oxide of manganese was introduced into medicine when its chemical affinities were found to be nearly analogous to those of iron. But the chemical ground of judgment proved, as it usually does in therapeutics, a fallacious one, and none of the curative effects anticipated were secured. On a different ground, probably, it was employed in the treatment of morbid sensibility of the stomach —an affection which was doubtless, in some cases, *gastralgia*, and in others *simple ulcer.* When it was of service in such cases it probably acted as bismuth subcarbonate or subnitrate acts, by furnishing an inert and insoluble coating to the part. It was given in the *dose* of from 5 to 40 grains (Gm. 0.30–3).

MANGANI SULPHAS, *U. S.*—SULPHATE OF MANGANESE.

Manganesii sulphas, U. S. 1870; *Manganum sulfuricum*, P. G.; *Sulfas manganosus.*—*Manganous sulphate*, E.; *Sulfate de manganèse*, *Sulfate manganeux*, Fr.; *Manganosulfat*, *Schwefelsaures Manganoxydul*, G.

Formula $MnSO_4.4H_2O$. Molecular weight 222.

Description.—Black oxide of manganese is mixed with sufficient strong sulphuric acid to obtain a thin magma, which is heated to boiling and evaporated to dryness; the mass is now heated in a crucible to dull redness for some time for the purpose of decomposing the iron sulphate. When cool it is treated with water, and the solution, if iron be still present, digested with manganous carbonate, then filtered, and evaporated to crystallize.

Properties.—When crystallized below 6° C. (43° F.) the salt contains $7H_2O$, and is isomorphous with ferrous sulphate; above that temperature and below 20° C. (68° F.) it contains only $5H_2O$ and has the form of copper sulphate. But the salt usually met with is crystallized between 20° and 30° C. (86° F.), and forms right rhombic—or, according to Marignac, monoclinic—prisms, containing $4H_2O$, three of which are given off at a temperature of 115° C. (239° F.). A salt of the same composition as this residue is also obtained by adding sulphuric acid to solution of manganous sulphate and evaporating; it forms a granular powder. The crystals of the officinal salt are transparent and colorless, or more frequently of a pale rose-red color, slightly efflorescent in a dry atmosphere, insoluble in strong alcohol, but dissolve at 15° C. (59° F.) in 150 parts of 60 per cent., in 50 parts of 50 per cent., and in 2 parts of 10 per cent., alcohol. The salt requires at 15° C. (59° F.) 0.8 (Brandes), 1.06 parts (Mulder) of water, and 1.08 (Brandes), 1.28 (Mulder) parts of boiling water; at 55° C. (131° F.) 0.9 part of water is required. The solution has a styptic and slightly bitter taste, a neutral or faintly acid reaction, and yields with ammonium sulphide a flesh-colored precipitate, with ferrocyanide a white one, and with ferricyanide a grayish-brown one, but is not disturbed by tannic acid. The fixed alkalies and alkaline carbonates produce white precipitates, which on exposure to air are rapidly oxidized, turning brown. Barium chloride yields an insoluble white precipitate.

Tests.—The most common impurity likely to be met with is sulphate of iron, the presence of which would be indicated by the blue-black color produced with solution of tannin or by the more or less deep-blue color of the precipitate with potassium ferrocyanide. Sulphate of copper would in the slightly acidulated solution produce a black precipitate with sulphuretted hydrogen. The precipitate with ammonium sulphide should be completely soluble in acetic acid, proving the absence of zinc salt. The sulphates of magnesium and the fixed alkalies are indicated by the residue left after precipitating the solution completely with ammonium sulphydrate or carbonate, evaporating the filtrate to dryness, and igniting; the Pharmacopœia permits a trace of these last impurities. When heated to dull redness the salt should lose 32.4 per cent. of its weight (water of crystallization).

Other Compounds.—Mangani carbonas. Carbonate of manganum is prepared by precipitating in the presence of a little syrup a solution of manganous sulphate with carbonate of sodium, washing the precipitate well, and drying it rapidly with a moderate heat. It is a white powder having a brownish tinge and dissolving in carbonic acid water, leaving only a slight residue of brown manganic oxide.

Mangani chloridum. Chloride of manganum is most economically obtained when preparing chlorine from black oxide of manganese and hydrochloric acid; the resulting liquid is digested with manganous carbonate until the iron has been completely precipitated; the filtrate is evaporated, crystallized, and by recrystallization purified from calcium chloride if present. The salt is in granular, or when slowly evaporated in tabular, crystals of a pale rose-red color, and has the composition $MnCl_2.4H_2O$ (mol. weight 196.8). It is soluble in alcohol, and requires at ordinary temperature about 2½ parts of water for solution.

Mangani iodidum. Manganous iodide is a very deliquescent salt, and is best administered in the form of *syrup*, which may be prepared by dissolving manganous carbonate in hydriodic acid, or by the following formula proposed by Prof. Procter (1850): Take of sulphate of manganese 16 drachms; iodide of potassium 19 drachms; sugar, water, each sufficient. Dissolve each of the salts in 3 fluidounces of water containing 2 drachms of syrup; mix, and after precipitation filter the solution into a bottle containing 12 ounces of sugar; add water to make a pint, and shake the bottle till the sugar is dissolved. Each fluidounce contains 1 drachm of iodide of manganium; it may be given in doses of 10 drops to ½ fluidrachm.

The same author has also proposed a *syrup of the iodides of iron and manganese*, to be prepared as follows: Take of iodide of potassium 1000 grains; ferrous sulphate 630 grains; sulphate of manganese 210 grains; clean iron filings 100 grains; powdered sugar 4800 grains; distilled water sufficient. Rub the sulphates and iodide separately to powder, mix with the iron filings, add ½ fluidounce of water, and rub to a uniform paste; add the same quantity of water a second and a third time at intervals of 15 minutes, and rub. Place the sugar in a bottle, and drain the dense solution into it through a filter, adding water slowly to the magma, until the solution of the iodides is displaced and the water measures 12 fluidounces. Lastly, agitate the bottle till the sugar is dissolved. Each fluidounce contains 50 grains of the iodides in the proportion of 3 parts of iodide of iron to 1 of iodide of manganium. The dose is the same as the preceding. Both syrups contain some potassium sulphate.

Mangani lactas. Lactate of manganum is formed by adding manganous carbonate to hot lactic acid; on evaporating the filtrate the salt is obtained in pale rose-red shining crystals, which contain 19 per cent. of water of crystallization, are soluble in 12 parts of cold water, and dissolve likewise in hot alcohol, crystallizing again on cooling.

Mangani phosphas. Manganous phosphate is obtained by precipitating 10 parts of manganous sulphate with 11 parts or sufficient of phosphate of sodium, each separately dissolved in about 80 parts of water, washing the precipitate well to remove the sodium sulphate, and drying. It is a white crystalline powder, sometimes with a reddish tint, having the composition $Mn_32PO_4.4H_2O$ (mol. weight 424) and dissolving readily in dilute acids. A syrup has been recommended by T. S. Wiegand (1854); the salt may be dissolved in dilute hydrochloric, or, better still, in phosphoric acid, and sufficient sugar dissolved in the cold solution.

Mangani tannas. Tannate of manganium was recommended by Marletta (1865). It is obtained by adding recently-precipitated manganous carbonate to a hot solution of tannic acid in distilled water until it ceases to dissolve, filtering, and evaporating to dryness. The carbonate must be absolutely free from iron, and the solution must be protected from contact with iron, otherwise it will acquire an inky color. The salt is soluble in water, and when prescribed in solution syrup or glycerin should be added for preservation.

Mangani tartras, Tartrate of manganum. On dissolving 10 parts of Rochelle salt and 8 parts of manganous sulphate, each in its own weight of hot water, and mixing the solutions, small white or pale-reddish crystals of manganous tartrate are obtained on cooling which must be washed with cold water, since hot water decomposes them into a soluble acid and an insoluble basic salt.

Physiological Action.—Sulphate of manganese is as energetic as the black oxide is inert. In experiments upon animals, when given internally in large doses, it occasions vomiting and gastro-intestinal inflammation; injected into the veins, it causes vomiting and purging, dyspnœa, rapid exhaustion, paralysis, and death, and after this traces of gastro-intestinal inflammation, and even ulceration, with congestion of the liver and spleen, while liquid or coagulated blood is found on both sides of the heart. In some experiments it occasioned a profuse secretion of bile, and in others it was found to diminish the blood-pressure and paralyze the muscles of animal life. It is generally stated that sulphate of manganese possesses the qualities of caustic potassa or soda, dissolving the tissues, and in no wise the astringent action of iron salts.

More than half a century ago Gmelin performed the experiments with sulphate of manganese which are summarized in the preceding paragraph.

More recent experiments have shown that the salts formed by manganese with organic acids weaken the heart's action, prolong its diastole, diminish the arterial blood-pressure, tend to paralyze the muscular system, and increase the excretion of nitrogenous compounds. (Compare Robert, *Practitioner*, xxxi. 454.) Apparently ignorant of these experiments or of their bearing, a non-medical scientist on the one hand, and on the other a pharmacist and a surgeon, drew the conclusion that because manganese had been detected in the blood, and because in its chemical habitudes it closely resembles iron, therefore it must possess therapeutical virtues analogous to those of iron, and might be used at least to reinforce the latter metal. The folly of some of these theorists went even so far as to suggest the idea that, inasmuch as in nearly all martial preparations there is some manganese, they may possibly derive their virtues from it and not from the iron they contain. The above statement of the physiological action of manganese exhibits the absolute antagonism of its action to that of iron in every point.

Medical Uses.—Sulphate of manganese has been employed as a *cholagogue* purgative in *jaundice* and other affections associated with hepatic engorgement, but its irritating qualities render it an unsafe remedy. The *dose* of sulphate of manganese is from 2 to 5 grains (Gm. 0.10–0.30). Its advantages as a substitute for iron are quite illusory. An ointment made with this salt which acts as an irritant upon the skin has been applied by friction to *glandular indurations* and swellings of the *joints*. The chloride has occasionally been used to stimulate indolent *ulcers*, especially those of a syphilitic origin, but it possesses no superiority over the usual topical applications made for this purpose. Of the other manganic compounds above described it need only be said that they possess no recognized therapeutical value. (A further consideration of manganic compounds will be found under Permanganate of Potassium.)

MANNA, *U. S., Br., P. G.*—Manna.

Manne, Fr.; *Manna*, G.

The concrete saccharine exudation, in flakes, of Fraxinus Ornus, *Linné*, s. Ornus europæa, *Persoon*. Steph. and Church, *Med. Bot.*, plate 53; Bentley and Trimen, *Med. Plants*, 170. *Nat. Ord.*—Oleaceæ.

Origin.—The manna ash, or flowering ash, is a slender tree about 12 to 20 feet (3.6–6 M.) high, with opposite pinnate leaves and small white diandrous flowers grouped together on a terminal, drooping, very elegant panicle. It is indigenous to the countries bordering the Mediterranean on the north from Asia Minor west to Spain, and has been introduced into Central Europe and England as an ornamental tree. The foliage, even on the same tree, is frequently very variable, and Fraxinus rotundifolia, *Lamarck*, cannot be regarded as a distinct species nor even as a well-marked variety.

Collection.—Manna is at present collected for commercial purposes solely in Sicily, as was ascertained by Hanbury, the plantations or *frassinetti* being cheifly on the northern shore of that island. When the tree is about eight years old and its trunk at least 3 inches (75 Mm.) in diameter, it will yield manna and remain productive for from 12 to 20 years, when the stem is cut down and replaced by a shoot from the stump. The incisions are made in dry weather with a hooked knife, one each day, commencing near the root and directly above each other; they are transverse, 2 inches (5 Cm.) or less in length, and penetrate through the bark to the wood. In the following year the same operation is repeated on the untouched side, and this is continued from year to year until the tree ceases to be productive. The juice flowing from the lower incisions is collected on tiles or in receptacles made from the stem of an Opuntia; that from the upper incisions hardens on the stem, or, for producing a superior variety called *manna a cannolo* which is rarely seen in commerce, is allowed to harden on sticks or straws inserted into the cuts. When sufficiently hard the large pieces are gathered, and completely dried before being packed, while the smaller ones are afterward scraped from the stem and sold separately. The annual exportation averages about 3000 cwt., about one-tenth of which is sent to the United States.

Description.—The varieties of manna generally distinguished in our commerce are *large flake*, *small flake*, and *sorts*. Flake manna (*Manna cannulata*, P. G.) consists of three-edged pieces varying in length from ½ inch to 6 or 8 inches (1 to 15 or 20 Cm.), ½ to 1 or 2 inches (1 to 5 Cm.) wide, and somewhat less in thickness, flat or curved on one side where it adhered to the tree, and uneven from roundish projections on the others, showing the marks of different layers. It is externally of a yellowish-white, in some places pale-brownish, color, friable, internally porous, and the cavities filled with white glistening crystals of mannit. Its odor is saccharine, somewhat nauseous, and its taste sweet and honey-like, but combined with a very slight bitterness and acridity. Large and small flake manna differ only in size, the latter, however, being often of a darker shade. Manna in sorts (*Manna communis*, P. G., s. *geracina*) consists of the scrapings, and is met with in fragments of the size of a pin's head to about ½ inch (12 Mm.) in diameter, with a rather adhesive surface and of a brownish color outside, but internally nearly white and crystalline; not unfrequently the fragments are united by a viscid brownish matter, which, without the flakes, constitutes *fat manna* (*Manna pinguis*, s. *crassa*, s. *de Puglia*) a variety rarely seen in this country, and rejected by the pharmacopœias. It flows from the incisions late in autumn, and is more particularly yielded by old trees; it is soft and glutinous, entirely devoid of crystals, and less agreeable in odor and taste than flake manna, from which it differs in containing much less mannit and more gum, sugar, and coloring matter. The U. S. P. gives 0.834 as the specific gravity of manna, which is an error, manna being heavier than water; it probably intended to state that manna should dissolve in 15 parts of alcohol of the spec. grav. .834.

Manna dissolves in about 6 parts of cold water, yielding a nearly clear solution, and is less soluble in alcohol, leaving little residue.

Sophistication.—Manna has occasionally been sophisticated by mixtures made of bread-crumb, starch, glucose, etc., which are very readily discovered if practised with flake manna; starchy substances can also be readily detected in manna sorts by the iodine tests.

Tests.—On boiling 5 parts of manna with 100 parts of alcohol a solution should be obtained which does not affect the color of litmus, and while cooling deposits many crystals of mannit; the undissolved residue, about 1 per cent., should be solid, not viscid. Manna dried in the water-bath should lose not over 10 per cent. of moisture.—*P. G.*

Constituents.—The best dry flake manna contains about 90 per cent. of *mannit*, the remainder being fermentable *sugar*, *resin*, and *mucilage*. Mannit, $C_6H_8(OH)_6 = C_6H_{14}O_6$, was discovered by Proust (1806), and may be obtained by treating manna with boiling alcohol and recrystallizing several times from hot alcohol. Charles T. Bonsall (1853) recommends the dissolving of manna in three times its weight of boiling water, precipitating gum and coloring matter by a little subacetate of lead, removing excess of lead by sulphuretted hydrogen or a little sulphuric acid, concentrating the filtrate and pouring the hot syrupy liquid into twice its bulk of cold alcohol; the mannit will crystallize on cooling. It crystallizes in colorless needles or glossy rhombic prisms which fuse at 165° C. (329° F.) and boil near 200° C. (392° F.), when a portion sublimes unaltered, but most of it is converted into *mannitan*, $C_6H_{12}O_5$, a sweetish, syrupy liquid. Mannit dissolves in about 6 parts of cold and in much less hot water, in 90 parts of cold 67 per cent. alcohol, and is insoluble in ether and nearly so in absolute alcohol. The solutions scarcely affect polarized light, are not altered by boiling with dilute acids, and do not reduce Fehling's solution. It unites with bases, forming compounds which are insoluble in alcohol. Nitric acid converts it into racemic acid and sugar, and ultimately into saccharic and oxalic acids. Gorup-Besanez (1861) observed that moist platinum-black converts it into *mannitic acid*, $C_6H_{12}O_7$, and *mannitose*, $C_6H_{12}O_6$, which is fermentable, but optically inactive. Berthelot (1856) has shown that under certain circumstances mannit will undergo alcoholic fermentation. Mannit has been found in a large number of plants, is formed in small quantity during the alcoholic fermentation of sugar, and may be obtained artificially by acting upon glucose with sodium amalgam.

The fermentable sugar present in manna reduces Fehling's solution very readily, and the mucilaginous matter is partly precipitated by acetate of lead, partly by subacetate. The resin is soluble in ether, and has a brown-red color and an acrid taste. The green color observed in some pieces of manna is due to *fraxin*, $C_{32}H_{36}O_{20}$, which was discovered by Salm-Horstmar (1857) in the bark of Fraxinus excelsior, the European ash (see pp. 713 and 765), and splits with dilute acids into glucose and *fraxetin*, $C_{10}H_8O_5$.

Pharmaceutical Preparation.—SYRUPUS MANNÆ. Syrup of manna. Dissolve 10 parts of manna in 40 parts of distilled water, filter, and add 50 parts of sugar.—*P. G.*

Other Mannas.—The sweet exudations of various trees have received the name of manna: that sometimes obtained in Southern Europe from incisions into the trunk of Fraxinus excelsior, *Linné*, is identical with the foregoing. The young shoots of the European larch, Pinus Larix, *Linné*, yield in the middle of summer a white exudation known as *Briançon manna* and containing the sugar *melezitose*, $C_{12}H_{22}O_{11}.3H_2O$. The leaves of Eucalyptus viminalis, *Labillardière*, and other species of Australia, yield *Australian manna*, containing *melitose*, $C_{12}H_{28}O_{14}$. *Persian manna* comes from Alhagi Camelorum, *Fischer* (Leguminosæ), and contains spines and leaflets of the plant; other varieties are produced by Salix fragilis, *Linné*, and different species of Astragalus. *Tamarisk manna* exudes from Tamarix mannifera, *Ehrenberg*, in consequence of the puncture made by an insect, Coccus manniparus, *Ehrenberg*, and is collected near Mount Sinai, and sold by the monks of the convent of St. Catharine; it contains cane-sugar, glucose, and dextrin.

Armenian (oak) manna results from the puncture of a Coccus upon the leaves of Quercus Vallonea, *Kotschy*, and Q. persica, *Jaubert et Spach;* it is either dissolved from the leaves by water, which is evaporated, or else scraped off, and then is mixed with numerous small fragments of the leaves: it consists chiefly of grape-sugar. *Lebanon manna* is in small sweet grains obtained from Cedrus libanotica, *Link*. Saccharine exudations have been observed upon a number of other plants, and the saccharine products of some insects, like the *trehala* (*tigala*) of Syria, containing the peculiar sugar *trehalose*, and the *lerp* of Australia, have sometimes been classed with the mannas: they are not entirely soluble in water.

Medical Uses.—Manna is a *laxative* peculiarly adapted to children and pregnant women; it is also a gentle *cholagogue*, and at the same time a suitable *expectorant* in febrile affections of the lungs. Some writers have held it to be peculiarly fitted, owing to the mildness of its action, to be employed in cases of *piles* and of *genito-urinary irritation.* It is slow in its operation, and is not apt to leave the bowels confined, but it tends to occasion flatulence and colic. It may be given in doses of from half an ounce to an ounce (Gm. 16–32), dissolved in hot water. Formerly, as at the present day, it was often associated with rhubarb, tamarinds, or senna, and it forms one of the ingredients of *the black draught:* ℞. Sennæ ℥ss; Magnesiæ sulph, Mannæ āā ℥ss; Sem. fœniculi ʒj; Aquæ bull. Oss.—M. Macerate in a covered vessel until the liquid cools. One-third of it may be given every four or five hours until it operates. The same infusion may be made with cold water by percolation. It is less nauseous and has a slighter tendency to gripe.

MARMOR ALBUM, *Br.*—WHITE MARBLE.

Marmor, U. S. 1870.—*Marble*, E; *Marbre*, Fr.; *Marmor*, G.
Formula $CaCO_3$. Molecular weight 100.

Native white granular carbonate of calcium.

Properties.—Marble is found in various parts of the globe, the white kind being nearly pure carbonate of calcium, while the colored varieties are more or less tinged or variegated by the presence of oxides of iron and maganium or by bituminous matter. It is met with in masses which are an aggregation of minute crystals, imparting a granular and glistening appearance. It has the specific gravity 2.7, is brittle, hard, insoluble in the ordinary solvents, but entirely soluble in dilute hydrochloric acid, carbonic acid gas being given off. It is used in pharmacy for generating the gas mentioned, for which purpose black marble containing bituminous compounds is inadmissible, but other varieties may be used. In case the solution in hydrochloric acid is to be used for the preparation of other calcium compounds, it must be completely freed from iron by digesting it with milk of lime, and after filtration should not be precipitated by a solution of sulphate of calcium (absence of barium and strontium), nor by ammonium phosphate after the previous addition of excess of ammonium chloride and ammonium carbonate and filtration (absence of magnesium).

Marble has the same composition as chalk, and when heated to redness parts with carbonic acid gas, leaving lime or oxide of calcium, CaO.

Pharmaceutical Uses.—In producing carbonic acid gas and for preparing Liquor calcii chloridi.

MARRUBIUM, *U. S.*—HOREHOUND.

Herba marrubii.—*Hoarhound*, E.; *Herbe de marrube blanc*, Fr.; *Andornkraut*, *Weisser Andorn*, G.

The leaves and tops of Marrubium vulgare, *Linné.* Bentley and Trimen, *Med. Plants*, 210.

Nat. Ord.—Labiatæ, Stachydeæ.

Origin.—Horehound is a perennial herb, and is found in waste places in Asia from Northern India westward to the Mediterranean, and throughout Europe except the extreme north; it has been naturalized in Canada and in many parts of the United States westward to California, also in some parts of South America. It is not unfrequently met with in gardens, and it flowers from June to September.

Description.—The branching stem is about a foot (30 Cm.) high, quadrangular, much-branched, and covered with a white felt. The leaves are opposite, petiolate, about an inch (25 Mm.) long, roundish-ovate, somewhat heart-shaped or rounded at the base, obtuse, serrate or coarsely crenate, wrinkled by the prominent veins below, pale-green and downy above and white-hairy beneath. The flowers are in dense axillary whorls, with woolly, linear, and hooked bracts, a tubular ten-ribbed calyx divided into ten short, spreading, stiff, and hooked teeth, and a white bilabiate corolla enclosing four stamens. The four akenes are dark-brown.

Horehound has a strong, peculiar, and aromatic odor and an aromatic and persistent bitter taste.

Constituents.—Horehound contains, besides some resin, tannin, and other common principles, a small quantity of volatile oil, and *marrubiin*, a bitter principle discovered by Mein (1855). Harms obtained 30 grains from 25 pounds of the dry herb by treating the aqueous extract with alcohol, distilling the latter, and agitating the residue with ether, which dissolves the marrubiin. Kromer (1861) agitated the infusion with charcoal and exhausted the latter with hot alcohol, which dissolves the bitter principle and tannin; the latter is removed by oxide of lead. Marrubiin is slightly soluble in cold water, crystallizes from alcohol in prismatic and from ether in tabular crystals, is not precipitated by tannin, and has a very bitter and somewhat acrid taste.

Medical Uses.—Anciently regarded as a general stimulant, expectorant, deobstruent, carminative, and local anodyne, horehound continues to be employed as a stomachic tonic in *dyspepsia*, and in *chronic bronchitis* to restrain secretion. It has also been used in chronic rheumatism, hepatic and uterine disorders, and, like other bitter herbs, in intermittent fever. It has some reputation as an *anthelmintic*, and is said to diminish salivation. The *dose* of the powder is stated to be from 30 to 60 grains (Gm. 2–4). An infusion made with an ounce of horehound in a pint (Gm. 32 to Gm. 500) of hot water may be given in doses of a wine-glassful. The expressed juice should be administered with honey or milk in the dose of a teaspoonful or two (Gm. 4) several times a day. An extract is prepared in Europe.

MASSÆ PILULARUM.—Pill Masses.

Masses pilulaires, Fr.; *Pillenmassen*, G.

The U. S. Pharmacopœia of 1880, in accordance with general custom, orders three pill masses to be kept in bulk, instead of one (Pilula ferri carbonatis) as heretofore, and designates such a pill mass as *Massa*, which is equivalent to *Pilula* adopted by the British Pharmacopœia. (For general remarks on the preparation of pill masses see Pilulæ.)

MASSA COPAIBÆ, *U. S.*—Mass of Copaiba.

Pilulæ copaibæ, U. S. 1870.—*Masse pilulaire de copahu*, Fr.; *Copaiva-Pillenmasse*, G.

Preparation.—Copaiba 94 parts (1 oz. av.); Magnesia, recently prepared, 6 parts (28½ grains); to make 100 parts (about 1 oz.). Mix them intimately, and set the mixture aside until it concretes into a pilular mass.

Should the mixture not concrete in 8 or 10 hours a deficiency of water in the copaiba may be inferred; and this difficulty may be obviated in subsequent operations by shaking the copaiba with one-twentieth of its weight of water, allowing it to stand until all the uncombined water has subsided, and then decanting and keeping it in closed bottles for use.—*U. S.*

The proportion of copaiba has been slightly decreased, 94 parts being now directed instead of 96 parts for 6 parts of magnesia. The variety of copaiba best adapted for these pills is Maracaibo copaiba (p. 504), since it contains a larger proportion of resin; this enters into combination with the magnesia, forming a resin soap, which gradually becomes dry and hard. If thin Para copaiba is to be used for making these pills, it is advisable to evaporate sufficient of the volatile oil until the residue, after cooling, forms a viscid liquid, when it may be mixed with the magnesia. Recently-prepared magnesia is anhydrous, and does not easily combine with the copaivic acid until after it has become hydrated. In making the mixture it is, therefore, better to supply at once any deficiency in the water of hydration. The combination will also be hastened by the application to the mixture of a moderate heat for about 10 minutes. The *pilules de copahu* (F. Cod.) are made in the same manner, and contain 3.86 grains (0.25 Gm.) of copaiba; those of the U. S. P. 1870 contain 4.8 grains.

In Europe pills of copaiba and powdered cubebs are sometimes used, and made into a mass by means of wax. The quantities necessary are 1 part of each of the ingredients named, or 3 parts of copaiba, 5 of cubebs, and 1 of wax. This mass retains its plasticity for a long time.

Medical Uses.—The efficiency of copaiba must necessarily be very much impaired by being given in so insoluble a combination. Each pill should contain about 5 grains of copaiba, and the average *dose* would be two or three pills.

MASSA FERRI CARBONATIS, *U. S.*—Mass of Carbonate of Iron.

Pilula ferri carbonatis, U. S. 1870, Br.—*Vallet's mass, Vallet's pill mass*, E.; *Masse pilulaire de Vallet, de carbonate ferreux*, Fr.; *Vallet'sche Pillenmasse*, G.

Preparation.—Sulphate of Iron 100 parts (10 oz. av.); Carbonate of Sodium 110 parts (11 oz. av.); Clarified Honey 38 parts (3 oz. av. and 350 grains); Sugar, in coarse powder, 25 parts (2½ oz. av.); Syrup, Distilled Water, each a sufficient quantity; to make 100 parts (10 oz. av.). Dissolve the sulphate of iron and the carbonate of sodium separately, each in 200 parts (20 oz. av. or 19¼ fluidounces) of boiling distilled water, and, having added 25 parts (2½ oz. av. or 15 fluidrachms) of syrup to the solution of the iron salt, filter both solutions. Mix them, when cold, in a bottle just large enough to hold them or add enough distilled water to fill it; close the bottle accurately with a stopper and set it aside, so that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed syrup and distilled water in the proportion of 1 part (½ fluidounce) of syrup to 16 parts (10 fluidounces) of water, wash the precipitate with the mixture until the washings no longer have a saline taste. Drain the precipitate on a flannel cloth, and express as much of the water as possible. Lastly, mix the precipitate immediately with the honey and sugar, and by means of a water-bath evaporate the mixture, constantly stirring, until it is reduced to 100 parts (10 oz. av.).—*U. S.*

Take of saccharated carbonate of iron 1 ounce; confection of roses ¼ ounce. Beat them into a uniform mass.—*Br.*

The first process differs from that of the last Pharmacopœia only in the honey, of which now 38 parts (formerly 37½ parts) are ordered.

On mixing solutions of ferrous sulphate and sodium carbonate, ferrous carbonate and sodium sulphate are formed by mutual decomposition (see p. 689). In contact with air the white iron precipitate rapidly oxidizes. The change is prevented by washing the precipitate in bottles by decantation with water recently boiled, and excluding the air; an additional protection is afforded by dissolving some sugar in the water. The pill mass, when recently made, is of a greenish-gray color, but on exposure becomes superficially greenish-black. If properly made it contains nearly 42 per cent., and the mass of the Br. P. 34 per cent., of ferrous carbonate.

Pilulæ ferri carbonici, *P. G.;* Pil. ferratæ Valleti.—Pills of ferrous carbonate, *E.;* Pilules de Vallet, Pilules ferrugineuses, *Fr.;* Eisenpillen, Vallet'sche Pillen, *G.*—Ferrous sulphate 100 parts is converted into carbonate with sodium bicarbonate by the process described on page 674; the washed precipitate is mixed with sugar 16 parts, honey 52 parts, and the mixture evaporated to 80 parts. 10 Gm. of this mass, with the requisite quantity of powdered marshmallow-root, are made into 100 pills, which are rolled in powdered cinnamon, and each of which represents .025 Gm. iron.—*P. G.*

The formula of the French Codex is almost identical with that of the United States Pharmacopœia, except that milk-sugar is used in place of sugar; 6 parts of the mass are mixed with 1 part each of powdered marshmallow- and liquorice-root, and divided into pills, each weighing 0.25 Gm., which are to be silvered.

Medical Uses.—Mass of carbonate of iron is one of the most efficient forms in which iron can be exhibited. It is especially indicated in pure *anæmia* and in *anæmic chlorosis*, and in all affections in which the red corpuscles of the blood are deficient, particularly when the digestive function is not greatly impaired. When dyspeptic disorders attend, the soluble preparations of iron are usually more efficient. The *dose* of mass of carbonate of iron is from 3 to 5 grains (Gm. 0.15–0.30), and should usually be taken at meal-time.

MASSA HYDRARGYRI, *U. S.*—Mass of Mercury.

Pilula hydrargyri, Br.; *Massa cœrulea.—Blue mass, Blue pill*, E.; *Masse pilulaire bleue*, Fr.; *Mercurial-Pillenmasse*, G.

Preparation.—Mercury 33 parts (3 oz. av.); Glycyrrhiza, in No. 60 powder, 5 parts (199 grains); Althæa, in No. 60 powder, 25 parts (2 oz. av. and 119 grains); Glycerin 3 parts (120 grains); Honey of Rose 34 parts (3 oz. av. and 40 grains); to make 100 parts (9 oz. av. and 40 grains). Triturate the mercury with the honey of rose and glycerin until it is extinguished. Then gradually add the glycyrrhiza and althæa, and continue the trituration until globules of mercury cease to be visible under a lens magnifying 10 diameters.—*U. S.*

Mercury 2 parts; confection of roses 3 parts; liquorice-root, in fine powder, 1 part.—*Br.*, *F. Cod.*

The British Pharmacopœia still directs the mercury to be extinguished by trituration with confection of roses, and the U. S. Pharmacopœia recommends trituration with a saccharine liquid (honey) containing a little glycerin, which facilitates the division of the metal. W. W. Stoddart (1855) has shown that the globules of mercury rapidly disappear on being triturated with powdered liquorice-root kept moist by a liquid; the directions above given may be conveniently modified in accordance with this suggestion, so that the mercury is first completely extinguished with the powdered glycyrrhiza and sufficient of the mixed liquids before the remaining powder and liquid are incorporated. The use of a considerable proportion of powdered althæa is an improvement, the mass being of a lighter color and of a purer blue tint; but the large amount of mucilage present in marshmallow-root favors the production of mould in a damp atmosphere; which tendency is in a measure counteracted by the glycerin.

When properly prepared, blue mass contains metallic mercury in the state of very fine division. It is not impossible that when kept on hand for a long time a change, due to the partial oxidation of mercury, may gradually take place, as has been repeatedly observed. Such a change, however, could only be very superficial, since the metal is well protected by the other ingredients of the pill mass.

PULVIS MASSÆ HYDRARGYRI, ÆTHIOPS SACCHARATUS.—Powdered blue mass, *E.*; Poudre de mercure saccharin, Mercure (Ethiops) saccharin, *Fr.*; Wurmzucker, *G.*

Blue mass or blue pill is not unfrequently ordered in powders, but is unsuited for the purpose unless mixed with other absorbent powders. It may, however, be readily obtained in the state of a permanent powder having the same relative composition as the pill mass by substituting in the above directions for the glycerin and honey of rose an equal weight of milk-sugar, using a drop of oil of roses to impart the requisite flavor, and keeping the mixture moist by the addition of alcohol; after a uniform mass has been obtained it is spread out to allow the alcohol to evaporate spontaneously, after which it may be reduced to a permanent powder. W. E. Bibby (1876) recommended 1 part of mercury to be triturated with 2 parts of sugar of milk, without adding any liquid, the metal being rapidly extinguished.

PILULÆ HYDRARGYRI; PILULÆ CŒRULEÆ, *F. Cod.*—Blue pills, *E.*; Pilules de mercure, Pilules bleues, *Fr.*; Mercurialpillen, *G.*—Each pill contains 0.05 Gm. (¾ grain) of mercury, *F. Cod.* The pills of U. S. P. 1870 contained 1 grain of mercury.

Medical Action and Uses.—Mass of mercury, or blue mass, differs from other mercurials in irritating the stomach and the bowels less, and, therefore, in being less apt to act as a cathartic. For this reason, probably, it is more apt than they are to form combinations in the primæ viæ, which are readily absorbed and produce constitutional effects. Such effects are commonly sought from mercury in this form when it is given in *doses* of 3 grains (Gm. 0.20) or less, repeated several times a day until the characteristic soreness of the gums is observed. To prevent its acting as a laxative it is usually associated with ¼ grain (Gm. 0.01) or less of opium in each *dose*, or the mercurial is repeated at intervals of an hour or two in doses of ¼ or ⅓ grain (Gm. 0.01–0.02). When it is desired to increase the secretions of the *liver* and *pancreas*, a dose of from 3 to 6 grains (Gm. 0.20–0.40) is usually administered at night, and is followed the next morning by a saline, or, still better, a senna, draught, or some other suitable cathartic. Whether the mercury does or does not specifically promote the secretion of the glands referred to is a question discussed elsewhere. (See HYDRARGYRUM.)

MASTICHE, *U. S.*, *Br.*—MASTIC.

Mastix, *Resina mastiche.*—*Mastich*, E.; *Mastic*, Fr.; *Mastix*, G.

The concrete resinous exudation from Pistacia Lentiscus, *Linné.* Woodville, *Med. Bot.*, t. 11; Bentley and Trimen, *Med. Plants*, 68.

Nat. Ord.—Terebinthaceæ, Anacardieæ.

Origin.—A small tree or shrub which is indigenous to the basin of the Mediterranean, has pinnate leaves with leathery sessile leaflets varying in form between linear and ovate, short-stalked, reddish-yellow pistillate, and larger greenish staminate, flowers, and small blackish drupes. Mastic is obtained in a few islands of the Grecian Archipelago, principally in Scio, from the var. γ Chia, which is tree-like and has broad leaves.

Collection.—The resin is contained in the bast-layer of the bark in elongated ducts having a large elliptic cavity and surrounded by one or more layers of small cells, in which the resin is secreted. To obtain it vertical incisions are made in June and July in the bark of the trunk and larger branches, and in July and August, after the exuding resin has hardened, it is carefully removed from the tree and collected in baskets; this is the finest quality. An inferior quality consists of the tears which have dropped from the incisions upon tiles or flat stones kept under the tree. A vigorous tree may yield 10 pounds of mastic; the total harvest is very variable, and occasionally reaches 50,000 cwt., but is generally considerably less. About 2000 pounds of mastic are annually consumed in the United States.

Description.—The best quality of mastic is in globular or more or less elongated brittle tears of the size of a pea, which are externally covered with a whitish dust or have been freed from it by washing, and are then of a pale-yellow color, perfectly transparent, of a glass-like lustre, and break readily with a conchoidal fracture. Placed between the teeth, it is easily crushed, and then softens into a plastic mass. Its specific gravity is about 1.07; it becomes soft below the boiling-point of water, but fuses at some degrees above it. It has a balsamic odor, more apparent on being heated, and a slight terebinthinous taste. It dissolves partly in alcohol, and is also soluble in benzol, acetone, volatile oils, cold creosote, and warm petroleum, leaving a whitish residue. The alcoholic solution reddens litmus.

The inferior kinds of mastic consist of similar tears, to which sand and fragments of bark adhere, mixed with gray- or brown-colored pieces.

Constituents.—Mastic contains a minute quantity of *volatile oil* and about 90 per cent. of *alpha-resin* or *mastichic acid*, which is soluble in cold alcohol, combines with bases, and, according to Johnston, has the composition $C_{20}H_{32}O_2$. The portion insoluble in alcohol is white, tenacious, soluble in ether and oil of turpentine, and has been named *beta-resin* or *masticin*; its composition is $C_{20}H_{31}O_2$. Hot water dissolves the bitter principle, acquires an acid reaction, and the solution gives a precipitate with tannin.

Varieties and Adulterations.—BOMBAY MASTIC. Under this name a drug has appeared in the market which, when well selected and clean, closely resembles the Scio mastic, but is usually in less clean and more opaque tears. It is obtained from Pistacia cabulica and Khinjuk, *Stocks*, which are indigenous to North-western India and Beloochistan. Pist. atlantica, *Desfontaines*, a variety of Pist. Terebinthus, *Linné*, growing in Algeria and other parts of Northern Africa, yields likewise a mastic-like resin.

SANDARACA.—Sandarac, *E.*; Sandaraque, *Fr.*; Sandarak, *G.*—It is the exudation of Callitris quadrivalvis, *Ventenat*, s. Thuja articulata, *Vahl* (Nat. Ord. Coniferæ, Cupressineæ), a small tree of North-western Africa. It forms brittle elongated tears of a pale-yellowish color, with a dusty surface, the fracture glass-like and transparent, almost wholly soluble in alcohol, and becoming pulverulent when masticated.

The tears of *olibanum* are generally larger, translucent, and destitute of glassy lustre. The exudation of Atractylis gummifera is sold in Greece as *pseudo-mastich* or *acanthomastich*, and consists of agglutinated tears which are oblong in shape and about 2 inches (5 Cm.) long by 1 inch (25 Mm.) in thickness.

Off. Prep.—Pilulæ aloes et mastiches, *U. S.*

Medical Uses.—Formerly employed internally for purposes similar to those for which other terebinthinates are prescribed, as catarrh of the bronchia and urinary passages, its medicinal use is now almost entirely restricted to forming a solution in ether with which cotton may be saturated for the purpose of filling *carious teeth* and protecting their tender surface from the influence of cold and the contact of food during mastication. Sandarac may be employed in a similar manner. A solution of mastic in alcohol may be applied to arrest *bleeding* from leech-bites and other slight wounds. Mastic is an ingredient of the "dinner pill" (Pil. aloes et masticbes). At a time when Chian turpentine was supposed to be a remedy for uterine cancer, mastic was substituted for it with equally negative results (*Med. Record*, xviii. 518).

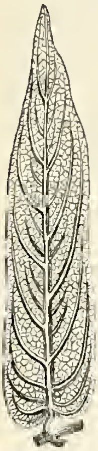
MATICO, *U. S.*—Matico.

Maticæ folia, Br.—*Feuilles de matico*, Fr.; *Maticoblätter*, G.

The leaves of Artanthe elongata, *Miquel*, s. Piper elongatum, *Vahl*, s. P. angustifolium, *Ruiz et Pavon*, s. Steffensia elongata, *Kunth*. Bentley and Trimen, *Med. Plants*, 242.

Nat. Ord.—Piperaceæ.

Fig. 181.



Matico-leaf.

Origin.—A shrubby plant about 8 feet (2.4 M.) high, sometimes cultivated, and found in moist woods of tropical America from Mexico southward to Venezuela, Brazil, and Peru. The minute yellowish flowers are very numerous, aggregated into a solid, cylindrical, slender spike about 6 inches (15 Cm.) long, and produce blackish fruits of the size of a poppy-seed.

Description.—The leaves, which are very frequently mixed with branches and spikes of flowers or fruits, are rather thick, about 6 inches (15 Cm.) long, oblong-lanceolate, very finely serrulate, narrowed at the apex to a blunt point, heart-shaped, and somewhat unequal at the base, having a very short petiole. The upper surface is nearly glabrous, of a green color, and very uneven or tessellated in appearance from the depressed veins, which are prominent beneath, making the downy lower surface reticulate, the meshes being small, and the veins densely covered with brownish hairs. The leaves, particularly when rubbed between the fingers, have an aromatic odor and a warm, aromatic, bitterish taste.

Constituents.—Matico contains about $1\frac{1}{2}$ per cent. of a thickish, pale-yellow, volatile oil, consisting of two oils, one of which is sometimes heavier than water. Wiegand (1846) proved the non-existence of Hodge's maticin, which is a potassium salt. Stell (1858) showed the absence of piperine and cubebin, and obtained a ruby-colored resin of a very acrid and pungent taste. Subsequently, Marcotte isolated a crystallizable acid named *artanthic* acid. Matico contains also some tannin and other principles common to vegetables.

Substitutions.—In different parts of South and Central America the Spanish names *matico* and *yerba* or *palo del soldado* (soldier's herb or tree) are given to other plants besides the one described above—namely, to Eupatorium glutinosum, *Kunth* (Compositæ), and Waltheria glomerata, *Presl* (Sterculiaceæ), the leaves of which are likewise used for arresting hæmorrhage. The first-named species has opposite petiolate, ovate-lanceolate leaves, which are more or less heart-shaped at the base, acuminate, crenately serrate, roughish above and tomentose beneath. The leaves of the second species are ovate, serrate, rounded or subcordate at the base and soft-hairy on both sides. Artanthe (s. Piper) lanceæfolia, *Miquel*, is similarly used in New Granada. Bentley (1864) met with the leaves of Artanthe adunca, *Miquel*, Piper aduncum, *Linné*, which were offered as matico. They are similar in shape, and the upper surface is marked by some sunken, ascending, and parallel nerves, and the lower surface by corresponding reticulations, but they have not the tessellated appearance nor the roughness and hairiness on the lower surface observed on the officinal matico-leaves; their properties appear to be the same.

Off. Prep.—Infusum maticæ, *Br.*; Extract. matico fluid., Tinct. matico, *U. S.*

Allied Products.—Piper Betle, *Linné*—Betel, *E.*, *G.*: Bétel, *Fr.*—It is a climbing shrub, indigenous to India and cultivated in various tropical countries. The leaves are about 5 inches (12 Cm.) long, broadly ovate, acuminate, obliquely cordate at the base, five- to seven-nerved, coriaceous, and above glossy. They have a burning aromatic and bitter taste, and are largely employed by the Malays for chewing with slaked lime and scrapings of the areca-nut (p. 256).

Piper Carpunya, *Ruiz et Pavon.* A small tree indigenous to Chili and Peru, the leaves of which are used. They are about 4 inches (10 Cm.) long, cordate-ovate, acute, coriaceous and glossy, and when dry have an agreeable odor, and are used in affections of the digestive organs.

Piper peltatum and P. umbellatum, *Linné.* Both plants are known in some parts of tropical America as *caapeba*, in others as *periparabo*; the roots are used as diuretics and the leaves in skin diseases and tumors. The rhizome is tuberous, about $\frac{4}{5}$ inch (2 Cm.) thick, with dark-brown woody rootlets about $\frac{1}{5}$ inch (5 Mm.) thick and containing reddish oil-glands.

Piper methysticum, *Forster.* It is a shrub, with cordate, acuminate, and many-nerved leaves, indigenous to the Sandwich and other islands of the Pacific Ocean. The root is the part employed, and is known as *ava* and *kava-kava.* It is large, woody, but spongy and light, has a thin grayish-brown bark, and a meditullium consisting of a yellowish or yellow, occasionally pale-reddish, cellular tissue, and of numerous radiating linear wood-bundles. It has an agreeable odor, recalling that of lilac and of meadow-sweet, and a faintly pungent and slightly bitter taste. Cuzent (1860) found in the root some volatile oil of a lemon-yellow color, a large amount of starch, an acrid resin, and a principle called *kavahen* or *methysticin*, which crystallizes in needles on concentrating the tincture of kava-root, and is purified by treatment with animal charcoal and recrystallization from alcohol. It is colorless, tasteless, fusible above 120° C. (248° F.), sparingly soluble in cold water, and readily soluble in alcohol and ether. The masticated root, subjected to fermentation, yields an intoxicating beverage called *kava*.

Medical Action and Uses.—In its nature and operation matico closely resembles the terebinthinate medicines, while its odorous and special stimulant qualities rank it with cubeb and copaiva. Like these substances, it is absorbed into the blood, and appears to produce a constriction of the capillary vessels, whereby it controls mucous fluxes and hæmorrhages, while it occasions more or less diuresis. It has been employed, like copaiva, in the treatment of *bronchitis*, *gonorrhœa*, *leucorrhœa*, *vesical catarrh*, *incontinence of urine*, and *chronic diarrhœa* and *dysentery*, and in *hæmorrhage* from the *lungs*, *stomach*, *bowels*, *rectum*, and *kidneys*. Like oil of turpentine, it has been used as a topical hæmostatic. The *dose* of the powder is from ½ drachm to 2 or 3 drachms (Gm. 2–12) several times a day. An extract has been made, of which the dose is from 60 to 75 grains (Gm. 4–5). The fluid extract and tincture are officinal.

Betel-leaves are chewed in Malabar, as above stated, and it is said that in Java their juice is used to cure obstinate and dry coughs. The inhabitants of the Fiji Islands employ *Piper methysticum* to prepare a drink which has several of the qualties of tea and coffee, being refreshing and stimulating, but not intoxicating. It augments the secretion of saliva, and hence is much prized for relieving the thirst incident to a hot climate. It, however, impairs the muscular power, so that they who indulge in it are apt to walk with a staggering gait, although the mind remains perfectly clear. It does not raise the temperature, and only influences the pulse by steadying it. It constipates the bowels, and its long-continued and excessive use is said to impair the eyesight and to produce leprous ulcers all over the body. Mr. Kesteven, from whom these statements are derived, mentions that the chief medical use of kava is to cure chronic *cystitis* and *gleet* (*Practitioner*, xxviii. 199). A similar account of its medicinal properties is furnished by Dupuy, who also states that it is a diuretic and a stomachic tonic (*Med. Record*, xvi. 106). Its stimulating and diaphoretic action caused it to be used by the South Sea Islanders in the treatment of *syphilis* (Strumpf).

MATRICARIA, *U. S.*—German Chamomile.

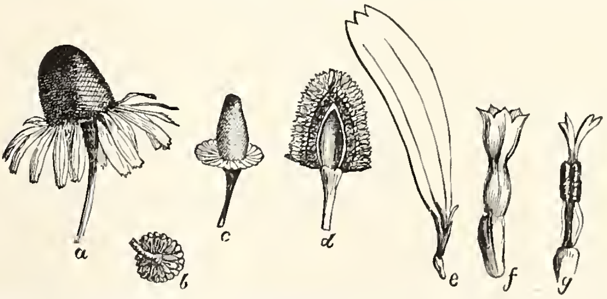
Flores chamomillæ, P. G.; *Flores chamomillæ vulgaris.*—*Fleurs de camomille commune* (*d'Allemagne*), Fr.; *Kamille*, *Kamillenblumen*, G.

The flowers of Matricaria (Chrysanthemum, *Bernhardi*) Chamomilla, *Linné*, s. Chamomilla officinalis, *Koch*. Bentley and Trimen, *Med. Plants*, 155.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—An annual herb, with a branching stem about a foot (30 Cm.) high, smooth, twice- or thrice-pinnatifid leaves, with spreading setaceous segments and numerous flower-heads terminating the slender branches. The plant is common in fields and waste places throughout Europe as far north as Finland, and in the temperate parts of Asia; it has been completely naturalized in Australia, and is occasionally cultivated in German settlements in the United States. The flowers appear from May till August; on drying, from 20 to 25 per cent. of the drug is obtained. About 140,000 pounds of chamomile-(Anthemis) and German chamomile-flowers were imported in 1882.

Fig. 182.



Matricaria: *a*, flower-head; *b*, involucre; *c*, receptacle and involucre; *d*, longitudinal section of receptacle, with disk-florets; *e*, ray-floret; *f*, disk-floret; *g*, stamens and style of disk-floret.

Description.—The flower-heads are ½ to ¾ inch (12–18 Mm.) broad, and have a flattish involucre, with two or three rows of small, oblong-linear, obtuse scales having the margin membranous. The receptacle is at first convex, but becomes strongly conical and hollow, and is free from chaff. The ray-florets are about fifteen in number, soon reflexed, white, ligulate-oblong, with two notches at the apex and enclosing the bifid style, but no stamens. The numerous yellow disk-florets are tubular, five-toothed, somewhat glandular, hermaphrodite, and have the anthers united into a tube through which the bifid style projects. The akenes are small, curved, finely five-ribbed on the inner surface, brownish, without pappus, but with a slightly elevated margin at the apex. German chamomile-flowers have a peculiar aromatic odor and a bitterish aromatic taste. They are easily distinguished from allied composite plants by their smooth, conical, and hollow disks, which shrink very considerably on drying.

Constituents.—German chamomile-flowers contain about ¼ per cent. of volatile oil, some bitter extractive, malates, tannates, and a little tannin, besides the principles common to vegetables. Pattone's *anthemic acid*, isolated (1859) from Anthemis arvensis, *Linné*, was obtained by Werner (1867) from the officinal flowers by exhausting them with hot water acidulated with acetic acid, concentrating, precipitating with alcohol, evaporating the filtrate, and treating with chloroform. It is described as colorless silky needles having an agreeable odor of chamomile, a strongly bitter taste, and dissolving in water, alcohol, ether, and chloroform. The precipitate obtained with alcohol is stated to contain a tasteless crystalline principle, *anthemidin*, which is insoluble in alcohol, ether, and chloroform, but soluble in acetic acid.

The volatile oil, OLEUM CHAMOMILLÆ ÆTHEREUM, is a dark-blue, in thin layers transparent, thickish liquid, which gradually turns green and brown when exposed to light and air, and more rapidly if obtained from dried flowers; it has a strong odor of the flowers and a warm, aromatic taste; dissolves in about 8 parts of 80 per cent. alcohol, has the specific gravity 0.93, and seems to consist of a terpene, $C_{10}H_{16}$, associated with $C_{10}H_{18}O$. The volatile oil becomes dark-brown or green with strong or diluted nitric acid, and deep red-brown with sulphuric acid. The blue color is due to the presence of a volatile principle which was named *azulene* by Piesse and *cœrulein* by Gladstone (1863), and which, according to both investigators, is present in all other volatile oils having a blue or green color—in the latter associated with a yellow principle.

An oil of German chamomile, containing oil of lemon, is still sometimes met with in our market; it was formerly officinal in Europe as *Oleum chamomillæ citratum*, and, according to the late Prussian Pharmacopœia, prepared by adding to 480 parts of recently-collected flowers 1 part of oil of lemon, and then distilling with water; it has a deep-blue color, but is more limpid than the pure oil and more prone to change in color.

Pharmaceutical Preparations.—OLEUM CHAMOMILLÆ INFUSUM is employed externally, and made like oleol of anthemis (p. 209); it has a yellowish-green color.

SYRUPUS CHAMOMILLÆ. Prepare an infusion from 3 parts of German chamomile with sufficient hot water to obtain 10 parts of filtered liquid, and dissolve in this 18 parts of sugar.—*P. G.* 1872.

Medical Uses.—German chamomile has less agreeable qualities than English chamomile (Anthemis), but medicinally may be substituted for it.

MEDEOLA.—MEDEOLA.

The rhizome of Medeola (Gyromia, *Nuttall*) virginica, *Linné*. Meehan, *Native Flowers*, ii. 157.

Nat. Ord.—Liliaceæ.

Origin.—The medeola or *Indian cucumber* grows in damp soil in woods and shady places of the United States east of the Mississippi, and flowers in May and June. It has a slender stem, about 18 inches (45 Cm.) high, beset with a deciduous fine wool, and bearing above its middle a whorl of six or eight spreading oblong-lanceolate leaves, which are about 3 inches (75 Mm.) long, and acute at both ends. Near the top is a whorl of three or four smaller ovate pointed leaves, and above them three or four greenish-yellow recurved flowers having six sepals and stamens, and producing a purplish-blue three-celled berry, each cell containing about five triangular seeds.

Description.—The rhizome is horizontal, 1 or 1½ inches (25–38 Mm.) long, about ¼ inch (6 Mm.) thick, pointed at the lower end, beset with hair-like simple rootlets, pale brown-yellowish externally, white internally, and with few small wood-bundles. It is without odor, and has a sweetish, in the fresh state somewhat cucumber-like, taste. Its constituents, among which is starch, have not been investigated.

Medical Action and Uses.—Nothing appears to have been added for many years to the scanty knowledge originally possessed of this root—viz. that it was reputed to be hydragogue and diuretic, and therefore useful in *dropsies.*

MEL, *U. S., Br.*—HONEY.

Miel, Fr.; *Honig*, G.

A saccharine secretion deposited in the honey-comb by Apis mellifica, *Linné*, the hive bee.

Class Insecta; Order Hymenoptera.

MEL DESPUMATUM, *U. S.*—CLARIFIED HONEY.

Mel depuratum, Br., P. G.—*Miel despumé, Mellite simple, Sirop de miel*, Fr.; *Gereinigter Honig*, G.

Origin.—A saccharine liquid is secreted by the nectaries of flowers and collected by the working bees in their so-called honey-bags, where it probably undergoes some changes before it is disgorged again in the hive. Evidently, the source from which it has been collected by the bees must exert considerable influence on its flavor, and it may even contain injurious principles when the flowers of poisonous plants have been frequented by the bees; to this cause at least have been referred cases of poisoning which occurred after partaking of honey. It has been stated that honey-bees introduced into Australia ceased to produce honey after the first year, probably because in that climate they could collect the necessary food during the entire year. Honey is largely produced in Europe and North America; much that is used in the United States is imported from the West Indian Islands, and recently a well-flavored honey from California has been introduced in the Atlantic States. The importation amounted in 1878 to 24,515 gallons, and in 1882 to 69,932 gallons.

Preparation.—The finest honey, called virgin honey, is obtained simply by draining the comb; when pressure or heat is used a darker-colored product is obtained. The yield of a hive is about 15 to 20 pounds. (See paper by B. F. Creighton in *Amer. Jour. Phar.*, 1875, p. 487.)

Clarification.—Honey a convenient quantity; heat it by means of a water-bath, remove the scum, and strain.—*U. S.*

The object of clarification is to remove the wax and other impurities of honey, which rise to the surface when the honey is kept for a while in the condition of a thin fluid by exposing it to the heat of a water-bath. The British Pharmacopœia directs it then to be strained through flannel previously moistened with water. The French Codex dissolves 4 parts of honey in 1 part of water, heats the mixture, removes the scum, clarifies with paper pulp, strains, and evaporates to the proper density; all preparations of honey are directed to be clarified merely by the use of paper pulp. The German Pharmacopœia of 1872 ordered honey to be diluted with twice its weight of water, heated to 100° C. (212° F.) for 1 hour, filtered, and evaporated. Various other methods have been suggested, among which may be mentioned the following: To dilute the honey with some water, add white of egg, heat gradually up to near boiling, strain and concentrate; or, to add to 28 pounds of honey, diluted with water, a little (3 drachms) gelatin, heat, and exactly precipitate the gelatin by (1 drachm) of tannin; or to treat the diluted honey with prepared chalk, or with animal charcoal, or with both, or with aluminium hydrate, or with Irish moss, or to interrupt the boiling repeatedly for about a minute by the addition of sufficient cold water, and after filtration to concentrate to the proper consistence. The long-continued heat necessary for concentrating diluted honey impairs its aroma and imparts to it a darker color; the use of tannin is objectionable, since traces of it are likely to remain behind and render the honey unfit for use with salts of iron. In our experience the first two processes give quite satisfactory results, though the product is never absolutely transparent—a result aimed at by the other processes.

Properties.—When recently prepared, honey is a translucent or nearly transparent, pale-yellowish or brownish, thick, syrupy liquid, which, on keeping, separates a granular deposit, and is ultimately changed into a crystalline mass intermixed with some liquid. It is stated that California honey gathered in May becomes granular in a few days, but if taken later in the season remains liquid for a long time. It has a slight acid reaction, an agreeable odor, varying more or less from causes mentioned above, and a sweet taste, followed by a slight acridity. E. Dietrich (1877) ascertained that, by dialyzing honey into water the dialyzed portion, on concentration, had a golden-yellow color and a remarkably fine floral odor, while the residue upon the dialyzer was destitute of honey odor and had a sweet but insipid taste. In some parts of Africa a brown, and even greenish, honey has been observed, which may be produced by different species of Apis. Clarified honey has the same properties, except that it is more transparent, and has the specific gravity 1.30 *P. G.*, 1.27 *F. Cod.*; neither the U. S. nor the Br. Pharmacopœia indicates the density, which for our climate ought not to be below 1.38.

Honey dissolves readily in water, also in diluted alcohol, yielding in both cases slightly turbid solutions which have a faint acid reaction. A mixture of honey with 2 parts of water should have a specific gravity between 1.101 and 1.115 (*U. S.*), which permits the density of the honey to vary between 1.38 and 1.44.

Constituents.—The odor of honey is doubtless due to a minute quantity of volatile oil, which, according to Calloud, is intimately associated with a yellow coloring matter, *melichroin*, separated by the nectaries and bleached on exposure to sunlight. Small quantities of wax and gummy matter are usually present, and A. Vogel (1882) found in crude honey about .1 per cent. of formic acid, which appears to preserve it from decomposition; but the main constituents are *grape-sugar* or *dextrose* and *fruit-sugar* or *lævulose*, of each of which from 32 to 42 per cent., or a total of about 72 to 78 or 80 per cent., is present. The honey of an American wasp, Polybia apicipennis, according to Karsten, contains a little cane-sugar, and the same may be the case with honey from other sources; this constituent, however, is gradually changed to *invert-sugar*, which is a mixture of grape- and fruit-sugars. It is the grape-sugar which renders honey granular, while the fruit-sugar remains liquid; the former turns polarized light to the right, the latter to the left. The albuminates, mucilaginous matter, pollen, and wax present in honey vary between about 0.5 and 1 or 2 per cent.; the ash left on incineration is generally between .12 and .16 per cent., and, according to Hager, should not exceed .5 per cent.

Adulterations.—The coarse adulteration with starchy substances is easily recognized in the soluble matter left on treating with alcohol, and by the blue color produced on the addition of solution of iodine. Adulterations with artificial grape-sugar prepared from starch by boiling with sulphuric acid are difficult to establish; aside from the physical properties, the presence of soluble sulphate (of calcium) affords the best criterion. Beet-root molasses contains chlorides, and if used for adulterating honey causes a white precipitate with silver nitrate. Starch-paste, added with the view of rendering honey thick, is deposited as a jelly-like, stringy mass on dilution with water. Neither crude honey nor honey clarified by the process of the U. S. P. yields with water an absolutely clear solution. The tests given by the pharmacopœias are as follows: "If 1 part of honey be dissolved in 4 parts of water, a clear solution should result, which should not be rendered more than faintly opalescent by a few drops of test solution of nitrate of silver (chloride) or of nitrate of barium (sulphate). If a small portion of honey be diluted with 1 volume of water and then gradually mixed with 5 volumes of absolute alcohol, it should not become more than faintly opalescent, and should neither become opaque nor deposit a slimy substance at the bottom and along the sides of the test-tube (starch, dextrin). When incinerated in small portions at a time in a platinum crucible, it should not leave more than 0.2 per cent. of ash (any larger percentage of ash and failure to respond to the preceding tests indicating the presence of glucose or other foreign admixtures). Water boiled with honey and allowed to cool should not be rendered blue or green on the addition of test solution of iodine (absence of starch)."—*U. S.* "If mixed with an equal bulk of ammonia-water, the color of honey should not be altered (absence of turmeric, aniline colors, etc.)."—*P. G.*

Pharmaceutical Uses.—Clarified honey is used as an excipient for some *pill masses* and *confections*, as the basis of *mellita* and *oxymellita*, and as an ingredient in Massa ferri carbon., *U. S.*

MELLITA.—Medicated honeys, *E.*; Mellites, *Fr.*; Honige, *G.*—These are simply mixtures of honey with certain medicinal substances. Owing to their proneness to change, the number of these officinal mixtures has been considerably diminished, and with but few exceptions none are kept on hand, but are prepared extemporaneously when required by the physician.

OXYMELLITA—Oxymels, *E.*, *Fr.*; Sauerhonige, *G.*—are medicated honeys containing acetic acid. (See OXYMEL.)

Medical Action and Uses.—Honey is one of the most ancient of medicines, and its nutritious qualities were always well known. Medical history shows that the Greeks and Arabians were well acquainted with its uses and the noxious qualities of certain kinds of it. Honey may be used with other food without any unpleasant effects in most instances, but there are persons who cannot take even a small quantity of it without feeling the head heavy or confused, while in others it causes flatulence or diarrhœa. Among the plants which are frequented by bees producing poisonous honey are Nerium oleander, Azalea pontica, Daphne mezereum, Aconitum, and Kalmia latifolia. The last, or mountain-laurel, is the chief source of poisonous honey in this country. The symptoms it produces are dimness of sight, vertigo, a mild or furious delirium, abdominal pain, vomiting and purging, perspiration, convulsions, foaming at the mouth, and, in a few instances, death. In some cases an eruption also appears upon the skin, and there is soreness of the throat with hoarseness of the voice.

Anciently, honey was employed for most of the medicinal purposes for which sugar is now used, and especially with barley-water for bronchial affections and sore throats. Its present use is almost exclusively local and for the same purposes as of old, and particularly to stimulate mucous surfaces, and even cutaneous sores, when their condition denotes impaired vitality. It is habitually employed in gargles to cure *aphthæ*, *thrush*, and *pseudo-membranous deposits*, but its efficacy is increased by the addition of muriatic acid, borate of sodium, chlorate of potassium, etc. Honey of rose is officinal. Borate of sodium, in the proportion of 60 grains to an ounce of honey, is a very convenient application to aphthæ, etc. of the female genital organs. Honey is sometimes used as an ingredient of poultices for *boils* and *carbuncles*, as an application to *fissures of the nipple*, etc., and is applied in plasters to the mammæ for *drying up the milk*.

In this connection it may be mentioned that *propolis*, a resinous exudation with which bees cover the bottom of their hive, is reported to be beneficial in the treatment of acute and chronic *diarrhœa*.

MEL BORACIS, *Br.*—Borax Honey.

Mel sodii boratis, U. S. 1870.—*Honey of borate of sodium*, E.; *Mellite de borax*, *Miel boraté*, Fr.; *Boraxhonig*, G.

Preparation.—Take of Borax, in fine powder, 60 grains (2 parts); Glycerin 30 grains (1 part); Clarified Honey 480 grains (16 parts). Mix.—*Br.*

Uses.—It is made extemporaneously, and is applied to most of the local affections enumerated in the last article.

MEL ROSÆ, *U. S.*—Honey of Rose.

Mel rosatum, P. G.; *Mellitum rosatum.*—*Mellite de roses rouges*, *Miel rosat*, Fr.; *Rosenhonig*, G.

Preparation.—Red Rose, in No. 40 powder, 8 parts (2 oz. av.); Clarified Honey 92 parts (23 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (25 oz. av. or 17½ fluidounces). Moisten the powder with 2 parts (½ oz.) of diluted alcohol, pack it firmly in a conical glass percolator, and gradually pour diluted alcohol upon it until 33 parts (8¼ oz. av. or 8 fluidounces) of percolate are obtained. Reserve the first 3 parts (¾ oz. av. or 5½ fluidrachms) of the percolate, evaporate the remainder, by means of a water-bath, to 5 parts (1¼ oz. av. or 9 fluidrachms), add the reserved portion, and mix the whole with the clarified honey.

This process is essentially the one recommended by I. J. Grahame (1859), and aims to preserve in the reserved portion the main quantity of the little volatile oil present in the rose-petals. The French Codex directs the rose to be infused in 6 parts of water, the infusion to be strained, mixed with 6 parts of honey, and the mixture to be evaporated by means of a water-bath to the density 1.27. The German Pharmacopœia requires the infusion from 1 part of pale rose to be evaporated to a syrupy consistence, this to be mixed with five times its weight of alcohol, and the filtrate with 10 parts of clarified honey, the whole to be evaporated to 10 parts.

Medical Uses.—Its agreeable flavor and slight astringent and stimulant virtues render it a very pleasant and useful addition to water as a mouth-wash and gargle in cases of *sore mouth* and *sore throat*, or it may be applied undiluted to the affected part. It is a convenient vehicle for the administration of aromatic sulphuric acid and other acids.

MELILOTUS.—Melilot.

Herba (*Summitates*) *meliloti*, P. G.—*Sweet clover*, E.; *Mélilot*, Fr.; *Steinklee*, *Melilotenklee*, G.

Nat. Ord.—Leguminosæ, Papilionaceæ.

The leaves and flowering branches of Melilotus officinalis, *Desrousseaux* (Mel. arvensis, *Wallroth*, Mel. diffusa, *Koch*), and of Mel. altissimus, *Thuilliers* (Mel. officinalis, *Willdenow*, Mel. macrorrhizus, *Persoon*).

Origin.—Both plants are indigenous to Europe, the first species having an ascending stem 20 to 40 inches (0.5–1 M.) long, and growing in dry fields and along roadsides; its pale-yellow flowers have a short carina and produce obovate, transversely-wrinkled, mostly one-seeded legumes. The second species has been naturalized in the United States, grows in meadows and damp places, has an erect stem 3 to 5 feet (0.9–1.5 M.) high, the flowers bright yellow, with the carina as long as the standard and wings, and the legume obliquely oval, pointed, pubescent, reticulately wrinkled, and two-seeded. Both plants flower from July to September, and on drying acquire an agreeable odor of coumarin.

Description.—The stipules are entire, awl-shaped; the petiolate trifoliate leaves have oval or obovate-oblong leaflets, the lower ones notched, the upper ones truncate at the apex, entire near the base, and somewhat sharply serrate above, about $\frac{4}{5}$ to $1\frac{1}{4}$ inches (2 to 3 Cm) long; the flowers are in spreading or ascending racemes, and the reflexed legumes are brown or blackish. The drug has a strong agreeable odor and a bitterish, aromatic, and somewhat pungent taste.

Allied Plant.—Melilotus albus, *Desrousseaux* (M. vulgaris, *Willdenow*). White melilot is indigenous to Europe and naturalized in the United States; it resembles the preceding species, but has white flowers, the petals of which are unequal, the standard being longest.

Constituents.—The odorous principle was observed by Vogel (1820), and supposed to be benzoic acid. Guillemette (1835) proved it to be identical with Guibourt's *coumarin*, obtained from tonka beans, and which exists also in some rubiaceous plants. (See Galium.) It may be prepared by exhausting the herb with strong alcohol, distilling off most of the solvent, separating the fat, crystallizing, and purifying by recrystallization from alcohol. Coumarin, $C_9H_6O_2$, which has since been isolated from many odorous plants (see pp. 721 and 880), crystallizes in colorless shining prisms, which fuse at 67° C. (152.6° F.) and are readily soluble in fixed and volatile oils, alcohol, and hot water. It was obtained artificially by W. H. Perkin (1867) by treating salicyl aldehyd with sodium, and decomposing the compound with acetic anhydride. When treated with sodium amalgam it is converted into *melilotic* and *coumaric acids*, which are also present in the herb, sometimes in combination with coumarin. Both acids are crystallizable, and have a bitter taste. Melilotic acid, $C_9H_{10}O_3$, fuses at 82° C. (179.6° F.), and its salts, when strongly heated, yield phenol. Coumaric acid, $C_9H_8O_3$, is also obtained from coumarin by boiling it with concentrated potassa solution; it fuses at 195° C. (383° F.), and the solutions of its salts are fluorescent.

Tonka Beans, *E.*, Fève tonka, *Fr.*, Tonkabohnen, *G.*, are the seeds of a papilionaceous tree of Guiana, Dipteryx (Coumarouna, *Aublet*) odorata, *Willdenow*. They are nearly 2 inches (5 Cm.) long, somewhat two-edged, deeply wrinkled, blackish-brown, of a fatty lustre, and usually covered with a crystalline efflorescence of coumarin. The so-called English tonka beans, from Dip. oppositifolia, *Willdenow*, are smaller, about an inch (25 Mm.) long, smoother, and contain less coumarin.

Pharmaceutical Preparation.—Emplastrum meliloti. Melt together 4 parts of yellow wax and 1 part each of turpentine and olive oil, and while cooling add 2 parts of powdered melilot.—*P. G.* 1872.

Medical Action and Uses.—The peculiar odor of melilot, which is closely analogous to that of tonka bean, of vanilla-grass, etc., as well as its active properties, are attributed to a proximate principle, coumarin. Given to dogs in the dose of from 7 to 10 grains, this substance produced great and even fatal depression, and in man in the dose of from 30 to 60 grains it occasioned nausea, giddiness, depression, vomiting, and drowsiness. In Europe melilot is sometimes mingled with hay to stimulate the appetite of cattle; it is strewn among clothing and furs to protect them from moths, and is mixed with snuff to scent it. Formerly it was used in a variety of disorders, including colic, diarrhœa, dysury, dysmenorrhœa, and rheumatism, but at present it is only applied externally, in decoction or infusion or in plasters or ointments, to allay *local pains*, especially in the abdomen and joints. The liquid preparations named are made with from half an ounce to an ounce of the flowering-tops in a pint of water (Gm. 16–32 to Gm. 500).

MELISSA, *U. S.*—MELISSA.

Folia (Herba) melissæ, P. G.—*Balm, Lemon balm*, E.; *Mélisse, Céline, Herbe au citron*, Fr.; *Melissenblätter, Citronenkraut*, G.

The leaves and tops of Melissa officinalis, *Linné.*

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Balm is a perennial herb, from the woody root-stock of which a number of branching, pubescent stems, 2 to 4 feet (0.6–1.2 M.) high, are produced. The plant is indigenous to Western Asia and Southern Europe, has become naturalized to some extent in the United States, and is not unfrequently cultivated. The variety *α* citrata, *Bischoff*, or lemon balm, is generally preferred, and is alone recognized by some of the European pharmacopœias. On drying, the fresh leaves lose about 75 per cent. of their weight.

Description.—The leaves are 1¼ to 2 inches (3–5 Cm.) long, petiolate, ovate, with a rounded or somewhat heart-shaped base, coarsely crenate-serrate at the margin, obtusely pointed at the apex, the upper surface with scattered hairs, the lower surface glandular in the axils of the nerves. The upper leaves are smaller, often softly pubescent on both sides, and at the base rather wedge-shaped. The axillary cymules are about four-flowered; the calyx is hairy, tubular-bell-shaped, with the upper lip three-toothed and the lower two-cleft. The milk-white or pale-purplish corolla has the tube curved upward, the upper lip notched and the lower lip three-lobed, with the lowest lobe largest; the stamens are four in number, the lower pair longer, all converging toward the upper lip. The dried herb has a mild agreeable odor, in the variety mentioned above somewhat like that of lemon; the taste is slightly bitter.

Melissa cordifolia, *Persoon*, is indigenous to Southern Europe, where it is sometimes medicinally employed; the leaves are larger and more woolly, and have a rather disagreeable odor; the plant is now regarded as a mere variety of M. officinalis.

Adulterations are not likely to be met with. The leaves of Nepeta cataria, *Linné*, var. *β* citriodora, have an odor resembling that of lemon balm, but they are cordate-ovate, of a gray-green color, soft-downy above and tomentose beneath, and by these characters are easily distinguished from melissa.

Constituents.—The leaves contain, besides the common constituents of plants, a small quantity of tannin and bitter principle and about ⅛ to ¼ per cent. of volatile oil, which is colorless or yellowish, has a spec. grav. of about 0.89, dissolves in about 5 parts of alcohol spec. grav. 0.85, and contains a stearopten.

Pharmaceutical Preparations.—AQUA MELISSÆ, *P. G.* Take 1 part of balm-leaves and sufficient water; distil 10 parts.

SPIRITUS MELISSÆ COMPOSITUS.—Compound spirit of balm, *E.;* Eau des Carmes, *Fr.;* Karmelitergeist, *G.*—Take of balm 14 parts; lemon-peel 12 parts; nutmeg, 6 parts; cinnamon and cloves, each 3 parts; alcohol 150 parts; and water 250 parts; distil 200 parts. —*P. G.* The French Codex gives a similar formula, and directs for the above quantity of spirit nearly 2 parts each of coriander and angelica in addition to the other ingredients.

Medical Uses.—Balm tea is a popular and refreshing drink when made with the fresh plant and taken cold. A hot infusion of the dried plant (Gm. 5–10 in Gm. 100) is one of the mildest that can be used to favor the operation of diaphoretic medicines.

MENISPERMUM, *U. S.*—MENISPERMUM.

Canadian moonseed, Yellow parilla, E.; *Ménisperme du Canada*, Fr.; *Canadisches Mondkorn*, G.

The rhizome of Menispermum canadense, *Linné.*

Nat. Ord.—Menispermaceæ.

Origin.—This is a North American climber, with peltate, roundish-cordate, and angular leaves, small clusters of greenish-yellow flowers, and black, glaucous, roundish kidney-shaped drupes. The rhizome was formerly brought into commerce as *Texas sarsaparilla*, and its botanical source was established by R. P. Thomas (1855).

Description.—The rhizome is several feet long, about ¼ inch (6 Mm.) thick, of a yellowish-brown color, cylindrical when dry, with numerous fine longitudinal wrinkles, and beset with thin branching rather brittle rootlets. Internally it is yellowish, breaks with a tough fibrous fracture, and exhibits on tranverse section a bark of about one-tenth the diameter of the rhizome and composed of two distinct layers, a woody zone consisting of about fourteen rather broad porous wood-wedges separated by medullary rays of nearly the same width, and a large central pith. The rhizome has a slight odor and a bitter taste.

Constituents.—We found (1863) the rhizome to contain a small quantity of berberine and a larger proportion of a white alkaloid, which has a bitter taste, neutralizes acids completely, and yields precipitates with the group reagents for alkaloids. H. L. Barber (1884) found this alkaloid to differ from oxyacanthine and menispermine, and to be insoluble in benzol and alkaline liquids; it dissolves in 75 parts of water, in 6 parts of alcohol, in 40 parts of ether, and in 20 parts of chloroform, and gives with sulphuric acid a brown color, gradually fading; with nitric acid, a yellow color; and with fused zinc chloride, a brownish-yellow color. We propose for this alkaloid the name *menispine*. The rhizome also contains starch, gum, resin, tannin, and other common constituents of plants.

Medical Action and Uses.—It has been reputed for many years that menispermum is tonic, alterative, and diuretic, and that its medicinal qualities are similar to those of sarsaparilla. It much more probably resembles calumba, not so much because, like that medicine, it yields berberine, as because it is bitter. We read that it is used in *scrofulous* affections as a substitute for sarsaparilla, but without the assurance that the latter medicine is itself of demonstrable utility in their treatment. Whatever virtues it may possess await discovery by intelligent investigation.

MENTHA PIPERITA, *U. S.*—Peppermint.

Folia (Herba) menthæ piperitæ, P. G.; *Menthe poivrée*, Fr.; *Pfefferminze*, G.

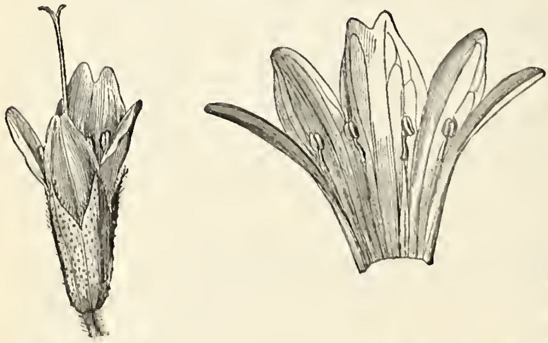
The leaves and tops of Mentha piperita, *Linné*. Bentley and Trimen, *Med. Plants*, 203.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Peppermint is a perennial plant, readily multiplying by runners, and with a square frequently purplish stem, about 3 feet (90 Cm.) high. Its native country is unknown; it is regarded as a mere variety of M. hirsuta, *Linné*, with which it is connected by many intermediate forms, and from which it was probably produced by cultivation. It is now found wild in wet places in England, in other countries of Europe, and in North America; it is largely cultivated. It flowers in August and September. The moisture of the fresh herb amounts to about 80 per cent.

Description.—The leaves are 2 to 3 inches (50–75 Mm.) long, and all petiolate, the petioles being about ½ inch (12 Mm.) long; they vary in shape between lanceolate and ovate-lanceolate, have a rounded base, an acute apex, and a sharply serrate margin; the upper surface is dark-green and smooth, the lower surface paler with numerous glands, and upon the nerves sparingly pubescent. The inflorescence is terminal, and consists of twelve to sixteen whorls, the lowest of which are somewhat distant; it is conical in shape, rounded or somewhat acute above, and 2 inches (5 Cm.) long; the cymules of each whorl contain about twenty or thirty flowers. The calyx is often purplish, tubular, five-toothed, ten-ribbed, glabrous, but dotted with yellowish glands. The corolla is pale purplish-red and smooth, with the tube about as long as the calyx, and the limb nearly equally four-lobed, and the upper lobe emarginate. The four short stamens are equal in length, and included in the tube. The fruit consists of four brownish smooth or rugose akenes. The herb has a strong peculiar aromatic odor and a pungent and cooling taste.

Fig. 183.



Mentha piperita, *Linné*: flower and corolla cut open, magnified 8 diameters.

Several varieties are known, differing in the width of the leaves, the amount of pubescence, and the compactness of the flowering spikes.

Constituents.—The most important constituent is the volatile oil, to which the drug owes its odor and taste, and of which the dried herb yields in the neighborhood of 1 per cent. (See Ol. Menthæ Piperitæ.) A little tannin and the other constituents are of no medicinal importance. (For Menthol, see pp. 1067 and 1663.)

Pharmaceutical Preparations.—SPECIES AROMATICÆ, *P. G.*—Aromatic herbs, *E.;* Espèces (Herbes) aromatique, *Fr.;* Aromatische Kräuter, *G.*—Peppermint, wild thyme, garden thyme, and lavender-flowers, of each 2 parts; cloves and cubebs, of each 1 part. Cut and bruise separately, separate the fine powder, and mix.—*P. G.* Peppermint, sage, wild thyme, garden thyme, rosemary, hyssop, origanum, and wormwood, of each 1 part.—*F. P.*

SYRUPUS MENTHÆ (PIPERITÆ).—Syrup of peppermint, *E.;* Sirop de menthe poivrée, *Fr.;* Pfefferminzsyrup, *G.*—Dissolve 60 parts of sugar in 40 parts of infusion prepared from 10 parts of peppermint, 50 parts of water and 5 parts of alcohol.—*P. G.*

Off. Prep.—Spiritus menthæ piperitæ, Vinum aromaticum, *U. S.*

Medical Action and Uses.—The name, "peppermint," describes the sharp, biting taste of this plant, whose odor when fresh is likewise very powerful, but refreshing. In the mouth it produces a pungent sensation, followed by a sense of coolness and numbness, increased by inhaling strongly. The essential oil occasions this feeling more sensibly, as well as a diffusive warmth in the abdomen, when it is swallowed. The action of peppermint is mainly that of a carminative stimulant, with a certain degree of anodyne power, which last is especially recognized by the popular use of the bruised fresh leaves to allay *colic*, *headache*, and other local pains. A hot infusion is commonly employed to relieve *colic*, *flatulence*, *diarrhœa*, *vomiting*, *cholera morbus*, *dysmenorrhœa*, and the associated abdominal pains. Nervous *headache*, *palpitation of the heart*, *hiccup*, and other phenomena of difficult digestion are palliated by this medicine. The hot or warm infusion, especially when made with from half an ounce to an ounce of the fresh herb to a pint of water (Gm. 15–32 to Gm. 500), is a very excellent preparation. It may be given in tablespoonful *doses.* Usually the water or the spirit is more convenient, given in sweetened hot water. The special virtues of the oil are described elsewhere.

MENTHA VIRIDIS, *U. S.*—SPEARMINT.

Herba menthæ acutæ (vel romanæ).—*Menthe verte*, *Menthe romaine*, *Baume vert*, Fr.; *Grüne Minze*, *Römische Minze*, G.

The leaves and tops of Mentha viridis, *Linné*, s. M. sylvestris, var. glabra, *Koch.* Bentley and Trimen, *Med. Plants*, 202.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Spearmint is a perennial herb with a square green or sometimes purplish stem about 3 feet (90 Cm.) high, and multiplying extensively by long runners. It is probably a cultivated variety of M. sylvestris, *Linné*, the typical form of which has broader woolly leaves and a cylindrical or subconical inflorescence, and is frequently found in moist and swampy localities throughout the greater portion of Europe. Spearmint appears to be indigenous to England, but it is cultivated and has been naturalized in the United States and most civilized countries. It flowers from July to September; on drying, its weight diminishes from 80 to 85 per cent.

Description.—The leaves are sessile, or only the lowest with a very short petiole, 2 to 3 inches (5–7 Cm.) long, lanceolate to ovate-lanceolate, acute, serrate, smooth or sparingly hairy, and densely glandular beneath. The inflorescence is in terminal, narrow, acute spikes, with distant whorls of about fifteen to twenty flowers in each. The glandular calyx is tubular-bell-shaped, with five sharp and ciliate teeth; the corolla is light-purplish, naked, four-lobed, and bears upon its tube four long and nearly equal stamens. Spearmint has a strong aromatic odor and a warm aromatic taste, which resembles that of peppermint, but is less pungent, and scarcely cooling.

FOLIA (HERBA) MENTHÆ CRISPÆ.—Crisped (curled) mint, *E.;* Menthe crépue, *Fr.;* Krauseminze, *G.*

The German and other pharmacopœias recognize, instead of spearmint, this cultivated variety, known as Mentha crispa, *Linné*, which is by different botanists referred to M. aquatica, M. sylvestris, or M. piperita, *Linné*. The leaves are sessile or short-petiolate, smooth or somewhat pubescent, heart-shaped or roundish-ovate, acute or pointed, and sharply toothed and crisped on the margin. Other species of mint, like M. viridis, sativa, arvensis, and rotundifolia, *Linné*, frequently produce in cultivation forms with crisped leaves, and the crisped mints cultivated in different parts of continental Europe probably belong to several of these species.

Constituents.—The principal constituent of spearmint is volatile oil (see OL. MENTHÆ VIRIDIS); the others, like a little tannin, are of no medicinal or pharmaceutical importance.

Off. Prep.—Spiritus menthæ viridis, *U. S.*

Medical Uses.—The action of spearmint is generally described as identical in its action with that of peppermint, but it is really much less intense. Its uses are the same as those of peppermint, but its milder action has led to its being preferred for infantile cases. An infusion of spearmint may be made with the proportions mentioned under Peppermint.

MENYANTHES.—Buckbean.

Folia (*Herba*) *trifolii fibrini*, P. G.; *Bogbean. Marsh trefoil*, *Water shamrock*, E.; *Ményanthe*, *Trèfle d'eau* (*de marais*), Fr.; *Fieberklee*, *Bitterklee*, *Dreiblatt*, G.

The leaves of Menyanthes trifoliata, *Linné.* Bentley and Trimen, *Med. Plants*, 184.
Nat. Ord.—Gentianaceæ.

Origin.—The buckbean is a perennial indigenous to North America from Pennsylvania northward and to Europe and Northern Asia. It grows in boggy places, has a fleshy rhizome of the thickness of a finger and sheathed by the remnants of the leaf-stalks, and bears a naked scape with about fifteen rose-colored or whitish flowers. It blooms in May and June. The leaves are collected in spring, and on drying lose about 80 per cent. in weight.

Description.—The leaves are on petioles 4 or 6 inches (10–15 Cm.) long, ternate, the leaflets sessile, 2 to 3 inches (5–8 Cm.) long, obtuse, oblong or obovate, entire or slightly crenate, smooth, and pale-green. They are inodorous, and have a very bitter taste, free from astringency.

Constituents.—Trommsdorff found in the leaves the principles usually present in herbaceous parts of plants, and obtained the bitter principle in the form of an extract-like mass. Brandes (1830 and 1842) succeeded in gaining it partly as a thick amorphous mass, partly in yellowish-white granules. Landerer (1839) found an ethereal extract of buckbean to contain white bitter needles, which were soluble in water and alcohol and precipitated by alkalies from their acid solution (?). Kromayer and Ludwig (1861) obtained *menyanthin*, which has probably the composition $C_{33}H_{54}O_{16}$. The following is an outline of one of the processes: The concentrated infusion is precipitated with tannin; the precipitate mixed with litharge, dried, and exhausted with alcohol. The mass left on evaporating the alcohol is washed with cold water and ether, again treated as before with tannin and litharge, the alcoholic solution passed through animal charcoal, mixed with water, and evaporated. It dries over sulphuric acid to an amorphous whitish mass, which on the application of heat softens, and at 115° C. (239 F.) is limpid and transparent. It is sparingly soluble in cold water, soluble in alkalies and alcohol, but insoluble in ether. It has a very bitter taste, and when boiled with dilute acids is resolved into sugar, a brown resin, and *menyanthol*, the latter being oily, volatile, heavier than water, and of an agreeable odor resembling that of bitter almonds. The leaves contain a pectin compound, which causes the infusion, sweetened with sugar, to gelatinize in a few days; this compound is insoluble in diluted alcohol.

Pharmaceutical Uses.—EXTRACTUM MENYANTHIS, S. TRIFOLII FIBRINI. The French preparation is the inspissated juice. In Germany it is made by hot infusion of the dry leaves with water.

Medical Action and Uses.—Water shamrock or marsh trefoil is a bitter tonic which is reputed to be also antiscorbutic, emmenagogue, and vermifuge. In large doses, like other bitters, it acts as an emetic, and some observers have attributed to it narcotic qualities. It is chiefly used in atonic *dyspepsia* and those hepatic and digestive derangements which are apt to prevail in damp malarial localities. It is a popular remedy in chronic *cutaneous eruptions*, both internally and externally. The most efficient form of the medicine is the expressed juice, which is administered in the dose of 2 or 3 ounces (Gm. 64–96) daily, in whey or thin broth. An infusion is made with half an ounce of the herb in a pint of hot water (Gm. 16 to Gm. 500) both for internal and external use.

MESEMBRYANTHEMUM.—Ice-Plant.

Diamond fig, E.; *Glaciale*, *Cristalline*, Fr.; *Eiskraut*, G.

Mesembryanthemum crystallinum, *Linné.*
Nat. Ord.—Mesembryanthemeæ.

Description.—The ice-plant is an annual or biennial growing near the sea-coast of Southern Europe and Southern Africa, and is much cultivated for ornament. It is smooth, but covered with glittering vesicles resembling hoar-frost. The stem is about a foot (30 Cm.) long, decumbent, and has the lower leaves opposite, the upper ones alternate, varying between roundish-ovate or obovate to oblong, wavy, amplexicaul, and frequently purplish on the margin and apex. The flowers are nearly sessile, white or reddish, have numerous linear petals and stamens, and produce a five-celled many-seeded capsule. The plant is inodorous and has an unpleasant saline taste.

Constituents.—John found the expressed juice to contain 3 per cent. of solid matter, consisting of various salts and the ordinary principles of the herb. The liquid of the vesicles, according to Voelcker, contains albumen, oxalic acid, and various salts. The dry plant yielded to Brandenburg 42 per cent. of ash, of which 31 per cent. was sodium salts, the remainder being salts of earths and traces of potassium. H. Mangon (1882), on the contrary, found the ash to contain such a proportion of potassium salts that ice-plants raised on a hectare of ground would yield 863 kilos of potassium carbonate.

Medical Action and Uses.—This is an obsolete medicine which once had a certain vogue in Europe, especially for the relief of disorders of the bladder attended with *dysury* or *incontinence* of urine. The expressed juice was used in the *dose* of a tablespoonful (Gm. 16) daily.

MESENNA.—MUSENNA.

Muséna, Moucéna, Fr.; *Musennarinde*, G.

Origin.—Musenna-bark has been referred by Brogniart to a tree, Albizzia anthelmintica, *Courdon* (Nat. Ord. Leguminosæ), and by Martius and others to Rottlera Schimperi, *Hochstetter* (Nat. Ord. Euphorbiaceæ). The bark comes from Abyssinia, and was sent to Europe about the year 1838.

Description.—Musenna-bark comes in flat or bent pieces, which are 1 or 2 inches (2–5 Cm.) broad, and sometimes 12 inches (30 Cm.) long. The outer surface is either smooth and brown-gray or uneven, fissured, and yellowish-brown, followed by a thick pale brownish-yellow granular layer, which covers the very tough and fibrous pale-yellow bast-layer. The bark is inodorous, and has, particularly in the liber, a nauseous, sweet, bitterish, and afterward persistently acrid taste.

Constituents.—Thiel (1862) isolated *musennin*, which is an amorphous acrid principle resembling saponin, but more soluble than this in alcohol; the bitter principle has not yet been obtained pure. Tannin appears to be absent, the infusion being colored yellow by ferric chloride. The bark yields 5½ per cent. of ash, containing much silica.

Medical Action and Uses.—It is alleged that the Abysssinians, to expel *tæniæ*, use 3 or 4 ounces (Gm. 90–120) of the powdered bark of musenna made into an electuary with honey, after fasting for 24 hours. The parasite is discharged, neither whole nor in fragments. but reduced to a sort of pulp. The medicine thus administered is apt to occasion nausea, but neither colic nor diarrhœa, and its use is followed after several hours by a purgative, usually of castor oil. When musenna has been employed in Europe it has generally failed to produce the results as a tænicide which are attributed to it in its native country.

METHYLENI BICHLORIDUM.—BICHLORIDE OF METHYLENE.

Dichlormethane, Chloro-methyl, E.; *Chlorure de méthyle monochloré, Ether chlorhydrique monochloruré de l'esprit de bois*, Fr.; *Methylenchlorid, Chlormethylchlorür*, G.

Formula CH_2Cl_2. Molecular weight 84.8.

Preparation.—Methyl chloride (CH_3Cl), which is a colorless gas of an agreeable odor and sweet taste, is prepared by heating a mixture of 1 part of methylic alcohol, 2 parts of common salt, and 3 parts of sulphuric acid, and passing the gas through water into a glass globe. Chlorine gas is conducted at the same time into this globe, which is drawn out below so as to form a thin tube, passing into one tubulure of a Woulfe's bottle, the second tubulure being connected, by means of a bent glass tube, with a second Woulfe's bottle placed in ice, and this with a flask cooled by means of a freezing mixture; the liquid condensed in the Woulfe's bottles is chiefly chloroform, while that condensing in the flask will be pure methylene bichloride. This is Regnault's process, by whom the compound was discovered (1840); methyl chloride was discovered by Dumas and Peligot (1835).

Properties.—Methylene bichloride is a colorless liquid, having at 18° C. (64.4° F.)

the spec. grav. 1.344, and boiling at 30.5° C. (87° F.). The same compound, obtained by Butlerow (1859) by heating biniodide of methylene in a current of chlorine gas, boiled at 40.5° C. (105° F.). Its odor resembles that of chloroform. It has no action upon test-paper, is soluble in alcohol and ether, and scarcely affected by alcoholic solution of potassa. It is decomposed when exposed to light and air, the change being prevented by the addition of a little alcohol. Its vapor has the density 3.012 and burns with a bright flame.

In composition it may be regarded as the chloride of methylene (CH_2) or as a derivative of methyl, CH_3; the following shows its relation to allied compounds:

	Methyl, CH_3.	Methylene, CH_2.
Marsh gas	$CH_3.H$	———
Methyl chloride	$CH_3.Cl$	———
Methylene bichloride	$CH_2Cl.Cl$	CH_2Cl_2
Chloroform	$CHCl_2.Cl$	$CHCl.Cl_2$
Chlorocarbon	$CCl_3.Cl$	$CCl_2.Cl_2$

Physiological Action.—*On Animals:* Dr. Richardson found that chloride of methylene produced, though in a less intense degree, the same effects as the bichloride, which has the great advantage of being a more stable compound. When pigeons are exposed to the vapor of the latter preparation it is longer in producing anæsthesia than chloroform, the pulse and respiration are more accelerated, the insensibility more prolonged, and the recovery more sudden. In a rabbit killed by it the heart-beat and the breathing ceased simultaneously; the lungs were not congested, and both sides of the heart contained blood. Blood saturated with this bichloride is of a bright-red color, and even when defibrinated forms a clot of albumen and corpuscles.

On Man: The inhalation of the vapor is described as being very pleasant and but slightly irritating, drowsiness and unconsciousness coming on without any noise in the head or oppression, and recovery taking place at once and completely, without any sense of depression. Like chloroform, it is very apt to occasion vomiting, and like ether it sometimes causes a stage of excitement and struggling which may be difficult to subdue. Although it does not produce fatal effects as frequently as chloroform, it is not exempt from that danger. Up to 1874 at least four cases had been reported in which death was directly traceable to this anæsthetic, and in the following year a fifth occurred in London. In the last case the breathing became suddenly loud and stertorous, deep, full, and exaggerated; the lips and cheeks retained their color; the pulse at the wrist failed rapidly, and then ceased almost abruptly. A sixth case occured at Ipswich, England, in which the stertor was preceded by rather violent struggling. Up to 1881 nine deaths were attributed to this anæsthetic, in some of which the abrupt occurrence of death seems to prove that it was due to syncope. In several, also, it followed doses of ½ drachm (Reichert, *Amer. Jour. of Med. Sci.*, July, 1881, p. 52). A further, although a subordinate, objection to this compound is its volatility, which renders its use difficult in a hot atmosphere.

Surgical Uses.—In 1877, Mr. Spencer Wells made the following statement, which, in relation to the particular class of cases referred to, appears conclusive as to the superiority of this anæsthetic: "In 1872, I made known my opinion that all the advantages of complete anæsthesia, with fewer drawbacks, could be obtained better by the use of bichloride of methylene than by any other known anæsthetic. This was the result of the experience of five years and of three hundred and fifty serious operations. The experience of the five succeeding years, with more than six hundred additional cases of ovariotomy and many other cases of surgical operations, has fully confirmed me in this belief Given properly diluted with air, it has, in my experience of ten years, with more than one thousand operations of a nature unusually severe as tests of an anæsthetic, proved to be, without a single exception, applicable to every patient, perfectly certain to produce complete anæsthesia, relieving the surgeon from all alarm and even anxiety, and its use has never been followed by any dangerous symptoms which could be fairly attributed to it." Other surgeons have testified to its efficiency in a great variety of surgical operations, both capital and trivial, yet, from whatever cause, it does not seem to have supplanted to any great extent either chloroform or ether. Perhaps it may be, as Mr. Wells remarks, that the fluid sold as bichloride of methylene may have been only chloroform mixed with some spirit or ether; perhaps the reason may be found in the opinions expressed by Dr. Richardson himself, that "he was not favorably impressed with the application of the bichloride to *quick* general anæsthesia," and that "it belongs to a dangerous family of chemical substances, and cannot therefore be played with without risk."

The deaths above referred to have been attributed to asphyxia, but the symptoms of some of them distinctly refute that opinion; yet it is none the less imperative that in administering the vapor a sufficient proportion of atmospheric air should be admitted along with it. For this purpose a hollow cone made of pasteboard, pierced with holes, should contain the cloth or sponge upon which the liquid has been poured. The quantity used should not exceed, for a first inhalation, 30 or 40 minims; half as much may be used each time that signs of returning consciousness appear.

METHYLI IODIDUM.—Iodide of Methyl.

Iodure de methyle, Fr.; *Jodmethyl*, G.
Formula CH_3I. Molecular weight 141.6.

Preparation.—This compound was first obtained by Dumas and Peligot (1835) by adding very gradually 1 part of phosphorus to a solution of 8 parts of iodine in 12 or 15 parts of methylic alcohol, agitating the distillate with water, and rectifying. According to Wanklyn (1867), iodide of potassium and anhydrous methylic alcohol are mixed in a retort in equivalent proportions; dry hydrochloric acid gas is passed into the mixture, which is then distilled, and the distillate purified as before.

Properties.—Iodide of methyl is a colorless liquid of an ethereal odor and the spec. grav. 2.199 at 0° C. (32° F.). It boils at 43.8° C. (111° F.), and by the aid of a wick burns with difficulty, giving off violet vapors.

Allied Compound.—Methyleni iodidum, s. biniodidum, CH_2I_2 (mol. weight, 267.2), was prepared by Butlerow (1859) by acting upon iodoform with sodium ethylate. It is readily formed by heating chloroform with very concentrated hydriodic acid for several hours to near 130° C. (266° F.). It is a yellow liquid having the spec. grav. 3.34, congealing to glossy scales near the freezing-point, and boiling at 180° C. (356° F.), at the same time suffering partial decomposition.

Medical Action and Uses.—Proposed in 1868 by Dr. B. W. Richardson, iodide of methyl was stated to be respirable and anæsthetic when pure, but giving rise to great excitement of the heart and circulation, and when decomposed, as it was apt to become, it produced the irritating effects of iodine, including lachrymation, salivation, and bronchial secretion. In experiments upon animals inhalation of the vapor produced fatal engorgement of the bronchia. Of it Sir James Y. Simpson wrote: "I found it very powerfully anæsthetic, but dangerously so. After inhaling a very small quantity for 2 or 3 minutes I remained for some seconds without feeling much effect, but objects immediately began to multiply before my eyes, and I fell down in a state of insensibility, which continued for upward of an hour. I did not completely recover from the effects of it for some days." It was used as a local anæsthetic in cancerous and other cases, but it appears at present to have become obsolete.

MEZEREUM, *U. S.*—Mezereon.

Mezerei cortex, Br.; *Cortex mezerei*, *Cortex thymeleæ (vel coccognidii)*.—*Mezereon-bark*, E.; *Écorce de mézéréon, de garou, de lauréole, de thymelee*, Fr.; *Seidelbastrinde*, *Kellerhalsrinde*, G.

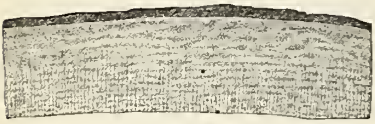
The bark of Daphne Mezereum, *Linné*, Daphne Gnidium, *Linné*, and Daphne Laureola, *Linné*. Steph. and Church, *Med. Bot.*, plate 65; *Eng. Bot.*, vol. ii. plate 119; Bentley and Trimen, *Med. Plants*, 225, 226, 227.

Nat. Ord.—Thymelaceæ.

Origin.—The three plants named above are small shrubs about 2 to 4 feet (0.6.–1.2 M.) high. The mezereon has rose-red, sessile, fragrant flowers in small clusters preceding the deciduous leaves, and is indigenous to hilly and mountainous regions of Europe, extending to the Arctic Circle, and eastward to Siberia. The other two species are found in Southern Europe; D. Laureola, or *spurge laurel*, is also met with eastward to Asia Minor. This species has large evergreen leaves and yellowish-green flowers in axillary clusters, while the *spurge flax* (D. Gnidium) has narrow annual leaves and small white flowers in terminal, corymbose racemes. The bark is usually collected during the winter.

Description.—Mezereon-bark is in long bands about ½ inch (12 Mm.) wide, $\frac{1}{24}$th of an inch (1 Mm.) thick, either folded and tied together in bundles or rolled up into flat disks with the inner surface outward. The outer surface varies in color from pale-yellowish or brownish to brown-yellow, with a coppery lustre, and is marked with numerous minute blackish warts and transversely elongated leaf-scars, in the axils of which is found a cluster of blackish spots. Older bark shows some transverse fissures. The corky layer is easily separated from the pale-greenish outer bark, and with this from the bast-layer. The inner surface is whitish, of a silky lustre, and from loosened bast-fibres has a hairy appearance. The bark tears somewhat irregularly in a longitudinal direction, but with difficulty transversely. The fine and tough bast-fibres are in tangential rows and alternate with layers of parenchyma, this tissue being radially striate by narrow one-rowed medullary rays. The dried bark is inodorous and has a persistently acrid and burning taste.

FIG. 184.



Mezereon-bark: transverse section, magnified.

The bark of the spurge flax is of a darker brown color, and has numerous spirally arranged leaf-scars; that of the spurge laurel is more of a gray or brown-gray color, not prominently marked with leaf-scars, and has a greenish bast; both agree with mezereon-bark in acridity. The root-bark of the three species is regarded as the strongest, but the stem-bark is most generally met with.

Constituents.—Landerer observed (1836) that mezereon-bark contains a neutral acrid principle which volatilizes with the vapors of water; a similar observation was made by Squire (1842) with mezereon-root, and by Vauquelin (1808) with the distillate from water which had been used for washing the resin. The acrimony is, however, mainly due to a soft resin or oil, which, according to C. G. Gmelin (1822), is not precipitated by lead acetate from its alcoholic solution. This acrid principle deserves further investigation. Vauquelin (1808) discovered *daphnin* in the bark of spurge flax, and the same principle was isolated by Gmelin and Bär (1822) from mezereon-bark. Rochleder (1864) obtained it from the aqueous decoction of the alcoholic extract, after precipitating with sugar of lead, by precipitating it with subacetate of lead, decomposing with hydrogen sulphide, washing with ether, and crystallizing from water. It has a persistently bitter, not acrid, taste, and an acid reaction, dissolves readily in hot water and alcohol, is insoluble in ether, yields with alkalies yellow solutions, and colors ferric chloride blue. Zwenger (1860) ascertained it to be a glucoside of the composition $C_{31}H_{34}O_{19}.4H_2O$, yielding *daphnetin*, $C_{19}H_{14}O_9$, which has a coumarin-like odor. On the dry distillation of the alcoholic extract *umbelliferon* is obtained.

Pharmaceutical Uses.—The comminution of the bark requires some precaution to avoid the injurious effects of the dust. The bark may be readily cut into small pieces, and should then be moistened with a little water, which should also be added on bruising the bark in a mortar.

Off. Prep.—Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.*; Extr. mezerei æthereum, *Br.*; Extr. mezerei, Extr. mezerei fluid., Extr. sarsaparillæ compos. fluid., *U. S.*

Allied Drug.—FRUCTUS (GRANA) MEZEREI, S. GNIDII, S. COCCOGNIDII.—Mezereon-fruit, *E.*: Grains de garou, *Fr.*: Kellerhalskörner, *G.*—The berry-like fruit of the above species is in the fresh state red or of the spurge laurel blackish, globular-ovate or oval, about ⅕ inch (5 Mm.) thick; after drying, brown or black, wrinkled; contains a black glossy seed, is inodorous, and has a strongly acrid and burning taste. Besides gum, vegetable acids, protein compounds, and other medicinally unimportant principles, Casselmann obtained from the fruit 31 per cent. of drying oil, 0.22 per cent. of acrid resin, and 0.38 per cent. of *coccognin*, which differs from daphnin in having a neutral reaction, in being very sparingly soluble in hot water, and in not being a glucoside; when heated it melts, and sublimes apparently unchanged, giving off a coumarin-like odor.

Physiological Action.—Ancient and modern authorities agree in describing various diseases which mezereon is fitted to cure. They all imply the possession by the medicine of acrid qualities; thus we learn that it irritated the fauces, and was capable of reddening, and even of blistering, the skin—that it was used as a gargle in sore throat and as an emetic, purgative, cholagogue, emmenagogue, and sudorific. Experiments on animals have proved it to be a violent irritant of the gastro-intestinal mucous membrane, and observations upon man lead to the same conclusion. In some of the latter there was narcotism or convulsion, and in one at least acrid and blood-red urine. Death has sometimes ensued. When the bark is chewed it in a little while excites a burning heat in the mouth, which lasts for many hours. In medicinal doses the decoction causes salivation and increased cutaneous and mucous secretions, which are said to acquire a peculiar odor. Excessive doses give rise to symptoms of gastro-intestinal irritation, with violent pain and sometimes very severe urinary irritation. When the bark is fresh or has been soaked in water or in vinegar, it reddens the skin, and at length occasions vesicles, followed by moist and painful ulcers which are difficult to heal. A case is recorded of a girl upon whose cheek the fresh juice of mezereon had been rubbed. Extreme swelling, pain, and a vesicular eruption were followed by fever and internal disorders, which are said, after the lapse of nine months, to have ended fatally.

We have elsewhere furnished illustrations of the narcotico-acrid action of mezereon-berries and of their use in medicine (*Therapeutics*, 4th ed., i. 407). Not long ago (1882) a case of poisoning by them occurred in England. A girl two and a half years old, having eaten a number of the berries, vomited, became dull and stupid, and then unconscious. The eyes were wide open, the pupils dilated, the face blue, the pulse and breathing very faint and slow. The lips and inside of the mouth looked swollen and as if burnt. After the evacuation of a large number of mezeoreon-seeds from the bowels recovery took place (Shaw, *Brit. Med. Jour.* and *Phila. Med. Times*, xiii. 101).

Medical Uses.—At one time mezereon was much in vogue as a remedy for *syphilis*, and to this day it is an ingredient of the compound decoction of sarsaparilla. But the evidence in its favor is not adapted to convince. In chronic non-syphilitic *cutaneous diseases* its reputation was equally ill-founded. In *chronic rheumatism* it seems to have been more useful, but here also its real value in a complex system of treatment is difficult to determine. It is seldom used alone, except as a *local irritant* in the form of the recent or moistened bark above referred to. In this respect it may more or less take the place of cantharides. It has been applied to improve the condition of foul or indolent *ulcers* and to maintain the discharge from *issues* and *setons*. For these purposes mezereon ointment is convenient. To excite vesication the bark, prepared as already described and bound firmly to the skin with a roller, should be freshly applied twice every day until vesication begins. Mezereon ointment may be used to prolong and renew the suppuration originally produced by cantharides.

When poisoning by mezereon occurs the stomach should be evacuated by lukewarm albuminous or mucilaginous liquids. Milk and fatty oils may also be administered.

MICA PANIS, *Br.*—BREAD-CRUMB.

Mie du pain, Fr.; *Brodkrumen*, G.

The soft part of bread made with wheat flour.

It is employed as an excipient in the preparation of certain pills, like those of corrosive sublimate, etc., and externally for emollient poultices. It is a constituent of *Cataplasma carbonis*.

Medical Uses.—It may be presumed that this article was made officinal in order that only wheaten bread should be used. But in the only article for which it is directed, charcoal poultice, any other form of bread would answer equally well. In this country Indian corn meal is generally employed.

MISTURÆ VEL MIXTURÆ.

Mixtures, E.; *Potions*, *Mixtures*, Fr.; *Mixturen*, G.

Liquid medicines which contain insoluble substances in suspension, or which are composed of two or more liquids, with or without the addition of saline or other material, are termed "mixtures," and in its more limited application the term is restricted to mixtures intended for internal use. They are most frequently prepared extemporaneously and upon the prescriptions of physicians, since even among the officinal ones but few possess sufficient stability to permit them to be kept on hand for a longer period than a few days. Insoluble substances, when light and readily diffusible in water, do not generally require the addition of gum-arabic or other mucilaginous body to ensure their uniform suspension and the equalization of the dose; such an addition is desirable in all cases where the insoluble bodies are much heavier than water. However, some judicious restrictions are necessary, lest the insoluble compound form a compact deposit which cannot be readily suspended again by agitation. This difficulty may be avoided by reducing the gum to a very small proportion, and increasing the suspending power of the vehicle by the addition of sugar or glycerin. When fats, volatile oils, or resinous substances are to be given in watery liquids, gum or the yelk of egg is requisite as a medium for uniform, and within certain limits permanent, suspension; such mixtures are opaque, and are called Emulsiones (Emulsion, *E.*, *Fr.*, *G.*). Certain drugs, like the gum-resins and some seeds, naturally contain a principle (gum, emulsin, etc.) which is capable of keeping the oil or resin suspended in water, and when triturated with water yield emulsions; in all cases the drug should be rubbed or beaten into a uniform pasty mass, if necessary, with small quantities of water, the trituration being afterward continued with the gradual addition of water, after which the emulsion may be strained. Unglazed wedgewood or porcelain mortars having a rather flat bottom are very serviceable for this purpose. Under no circumstances should powdered gum-resins be employed, unless they have been powdered and sifted in cold weather, without having been previously dried by heat.

Fixed oils, to be emulsified, require as a rule one-half their weight of powdered gum-arabic, and the mixture may then be diluted with water to eight or ten times the quantity of oil employed. We have been informed by Mr. Boring that the employment of the infusion or syrup of wild cherry materially facilitates the perfect suspension of oils; infusion of malt, saponin-like bodies, and the soluble proteids more or less possess the same property. To prepare emulsions the powdered gum is triturated with not over one and a half times its weight of water; the oil is gradually added, each portion being completely emulsified before more is added, or the oil and gum are well mixed together; 1½ parts of water for 1 of gum are added at once and well triturated; when uniform, the remaining water may be incorporated. Dilg (1878) succeeded in making permanent emulsions by using gum-arabic equal to one-eighth the weight of the oil; the powdered gum, 1 part, is at once made into a thin mucilage with 4 parts of water; the oil is then mixed with it gradually, and when these are well combined 4 parts of water are added in small portions and with constant trituration, after which the mixture will bear copious dilution with water. If properly made, the oil will not separate, and if, after several days, a cream-like layer should rise to the surface, it may be readily incorporated with the aqueous liquid by agitation. For the proper emulsion of solid fats, and if not inadmissible also of camphor and resins, the addition of almond or similar fixed oil is advisable, but not indispensable. A yolk will readily emulsionize an ounce of fixed oil and facilitate the suspension of resins and volatile oils; the latter require a larger amount of gum than the fats, unless the process of J. W. Forbes (1872) be followed, who directs for 1 ounce of volatile oil, ether, or chloroform only 20 grains of gum-arabic. The liquid to be emulsionized is first introduced into a dry vial, and then the gum; the two are well mixed by agitation; ½ ounce of water is added and thoroughly incorporated by agitation, after which the mixture is diluted with the remaining water or mucilage. On standing, a denser emulsion separates like cream, which is again readily mixed on slight agitation. In applying this process to fixed oils, E. Gregory (1876) found it necessary to increase the powdered acacia to three-eighths the weight of the oil.

Emulsio oleosa of European pharmacy is prepared with 2 parts of expressed oil of almonds, 1 part of powdered acacia, and 17 parts of water.

The term Saturations is applied in Europe to effervescing draughts made from lemon-juice, vinegar, tartaric or citric acid, to which is added a sufficient quantity of a carbonate to afford a nearly neutral salt, the solution remaining charged with as much carbonic acid gas as it will retain without being filtered. The weight of carbonates required for the neutralization of a given weight of acid will be seen from the following table:

100 parts of—	Potass. carb.	Potass. bicarb.	Sod. carb. exsicc.	Sod. carb. crystal.	Sod. bicarb.	Ammon. carb.	Magnes. carb.
Acidum citricum require....................	98	145	75	200	120	84	65
Limonis succus "	7	10	5	14	8.5	6	4.6
Acidum tartaricum "	92	133	70	190	112	78	60
Acetum (4.5 per ct. ac.) require.........	5	7.5	3.9	10.5	6.3	4.3	3.4

Mixtures are usually taken by the teaspoonful or tablespoonful; occasionally they are made of such a strength that they require to be taken by drops, and are then often distinguished as Guttæ (Drops, *E.*; Gouttes, *Fr.*; Tropfen, *G.*). If intended to be taken at once or in a few divided doses, the mixture is designated as Haustus s. Potio (Draught, *E.*; Tisane, Potion, *Fr.*; Tränkchen, *G.*). Julapium (Julep, *E.*, *Fr.*, *G.*) is a sweet mixture rendered aromatic by the addition of volatile oil or medicated water, and occasionally colored by the use of a fruit syrup or a little cochineal, etc. A sweet mixture prepared so as to have a thick syrupy consistence is still occasionally distinguished as LINCTUS (*vel* Looch, Lohoch, Eclegma).

It should be remembered that lemon-juice varies in strength, the above quantities being sufficient when containing from 7 to 7.5 per cent. of citric acid. The figures under Potass. carb. relate to the anhydrous pure salt. As a rule, a slight excess of acid is used in these extemporaneous preparations, which thereby become more agreeable to the taste.

MISTURA AMMONIACI, *U. S., Br.*—AMMONIAC MIXTURE.

Emulsio ammoniaci, Lac ammoniaci.—Ammoniacum mixture, Milk of ammoniac, E.; *Emulsion (Mixture) de gomme ammoniaque, Lait ammoniacal,* Fr.; *Ammoniak-Emulsion,* G.

Preparation.—Ammoniac 4 parts (164 grains); Water 100 parts (4100 grains or 9 fluidounces). Rub the ammoniac with the water, gradually added, until they are thoroughly mixed, and strain.—*U. S.*

For 1 part of ammoniac the water ordered is 25 parts *U. S.*, 32 parts *Br.;* or for 1 fluidounce of water (wine measure) 18.22 grains *U. S.*, and (Imperial measure) 13.7 grains *Br.*, of ammoniac.

Medical Uses.—Mixture of ammoniac is employed chiefly in the treatment of *chronic bronchitis* and *bronchorrhœa.* The *dose* is 1 or 2 tablespoonfuls (Gm. 16–32).

MISTURA AMYGDALÆ, *U. S., Br.*—ALMOND MIXTURE.

Emulsio amygdalæ, s. amygdalarum; Emulsio simplex.—Milk of almonds, E.; *Emulsion simple, Lait d'amandes,* Fr.; *Mandelemulsion, Mandelmilch,* G.

Preparation.—Sweet Almond 6 parts (246 grains); Acacia, in fine powder, 1 part (41 grains); Sugar 3 parts (123 grains); Distilled Water 100 parts (4100 grains or 9 fluidounces). Having blanched the almond, add the acacia and sugar, and beat them in a mortar until they are thoroughly mixed; then rub the mixture with the distilled water, gradually added, and strain.—*U. S.*

Take of compound powder of almonds 2½ ounces; distilled water 1 pint. Rub the powder with a little of the water into a thin paste, then add the remainder of the water, and strain through muslin.—*Br.*

The presence of gum-arabic in both preparations does not increase the stability of either or the amount of oil suspended. Without using gum, 10 parts of sweet almonds are ordered for 100 parts (*P. G.*), 200 parts (*F. Cod.*), of water. European physicians sometimes prescribe the following *compound emulsion of almonds:*

EMULSIO AMYGDALARUM COMPOSITA. Take of sweet almonds 4 parts; hyoscyamus-seed 1 part; diluted bitter-almond water 64 parts. Make an emulsion, and add of white sugar 6 parts, calcined magnesia 1 part.—*P. G.* 1872.

LOOCH ALBUM.—White linctus, *E.;* Looch blanc, *Fr.*—30 parts of sweet and 2 parts of bitter almonds are blanched, triturated with 20 parts of sugar and 120 parts of water, and the emulsion strained and gradually added, with continued trituration, to a mixture of 10 parts of sugar and 0.5 part of powdered tragacanth. Finally, add 10 parts of orange-flower water. The finished preparation weighs 150 parts.—*F. Cod.*

Medical Uses.—Almond mixture is an excellent demulcent in *acute laryngeal* and *bronchial* inflammations, *dysentery*, and irritations of the *urinary passages.* It should be administered freely. The white linctus of the French Codex is an excellent palliative of pharyngeal, laryngeal, and bronchial irritation.

MISTURA ASAFŒTIDÆ, *U. S.*—ASAFETIDA MIXTURE.

Lac asafœtidæ.—Milk of asafœtida, E.; *Mixture (Lait) d'asafœtida,* Fr.; *Asafœtida-Emulsion, Stinkasantmilch,* G.

Preparation.—Asafetida 4 parts (164 grains); Water 100 parts (4100 grains or 9 fluidounces). Rub the asafetida with the water, gradually added, until they are thoroughly mixed.—*U. S.*

The asafetida has been increased from 15 to 18.22 grains per fluidounce.

A *syrup of asafetida*, of the same strength by volume as the mixture, may be prepared by triturating 150 grains of selected tears with small quantities of water, decanting the concentrated emulsion until 4 fluidounces are obtained, in which 6 troyounces of sugar are dissolved by agitation. While at first milk-white, it acquires after exposure a pinkish color; the resin, which partially separates on standing, is easily incorporated by agitation. If desired, the asafetida odor may be covered by the addition of a little oil of bitter almonds, or, as suggested by J. J. Rambo (1871), by substituting infusion of wild-cherry bark for the water, which changes the white to a brownish color.

A *wine of asafetida* was recommended by H. N. Rittenhouse (1855) to be made by triturating ½ troyounce of the gum-resin with sufficient white wine to obtain 2 fluidounces, 1 drachm of which, mixed with 5½ fluidrachms of water, represents approximately the officinal mixture.

Medical Uses.—Asafetida mixture is the most prompt and decided in its action of all the forms of administering asafetida by the mouth. It is frequently given as an enema, but for the latter purpose a mixture of an ounce of tincture of asafetida with half a pint of water is more convenient and efficient. The *dose* of mixture of asafetida is 1 or 2 tablespoonfuls (Gm. 16–32).

MISTURA CHLOROFORMI, *U. S.*—CHLOROFORM MIXTURE.

Emulsio chloroformi.—Emulsion de chloroforme, Fr.; *Chloroform-Emulsion*, G.

Preparation.—Purified Chloroform 8 parts (320 grains); Camphor 2 parts (80 grains); Fresh Yelk of Egg 10 parts (400 grains); Water 80 parts (3200 grains or 7 fluidounces); to make 100 parts (4000 grains or about 8 fluidounces). Rub the yelk of egg in a mortar, first by itself, then with the camphor previously dissolved in the chloroform, and lastly with the water, gradually added, so as to make a uniform mixture.—*U. S.*

Medical Uses.—This mixture forms a stable preparation which may sometimes be convenient for the administration of chloroform in cases of *gastralgia*, *flatulent*, *biliary*, *renal*, and *uterine colic*, and in *nervous* or *hysterical* paroxysms. The *dose* is 1 or 2 tablespoonfuls (Gm. 16–32).

MISTURA CREASOTI, *Br.*—CREASOTE MIXTURE.

Mixture de créosote, Fr.; *Kreosot-Mixtur*, G.

Preparation.—Take of Creasote, Glacial Acetic Acid, each 15 minims; Spirit of Juniper ½ fluidrachm; Syrup 1 fluidounce; Distilled Water 15 fluidounces. Mix the creasote with the acetic acid, gradually add the water, and lastly the syrup and spirit of juniper.—*Br.*

Medical Uses.—Creasote mixture, it is stated, is intended to allay *vomiting*, but the bulk of its dose and the spirit of juniper and syrup contained in it render it peculiarly unfit to relieve the cases of vomiting in which creasote is most useful. The purpose of the glacial acetic acid in this mixture is not evident. The *dose* is stated to be from 1 to 2 ounces (Gm. 32–64).

MISTURA CRETÆ, *U. S., Br.*—CHALK MIXTURE.

Mixture avec la craie, Fr.; *Kreidemixtur*, G.

Preparation.—Compound Chalk Powder 20 parts (400 grains); Cinnamon-Water 40 parts (800 grains or 14 fluidrachms); Water 40 parts (800 grains or 14 fluidrachms); to make 100 parts (2000 grains or about 4 fluidounces). Rub the powder with the cinnamon-water and water, gradually added until they are thoroughly mixed. This preparation should be freshly made when wanted for use.—*U. S.*

Take of prepared chalk ¼ ounce; gum-acacia, in powder, ¼ ounce; syrup ½ fluidounce; cinnamon-water 7½ fluidounces. Triturate the chalk and gum-acacia with the cinnamon-water, then add the syrup, and mix.—*Br.*

This mixture spoils readily during warm weather; the addition of a little glycerin or the substitution of glycerin for the sugar, as recommended by G. W. Kennedy (1872), would tend to preserve it for several days while in the hands of the patient, but it should be dispensed only freshly made.

Medical Uses.—Chalk mixture is one of the most convenient forms in which chalk can be administered in the *diarrhœas* both of adults and children, especially when the discharges are yeasty or greenish and there is flatulent distension of the abdomen with sour eructations. If there is reason to suspect the presence of undigested food in the bowels, a dose of magnesia should first be given. For the watery diarrhœa which often precedes the attack of *epidemic cholera* there is no better medicine than this. In most cases laudanum should be added to the mixture or given along with it, and ordinarily its efficiency is much increased by the addition of kino, krameria, or catechu. The *dose* is a tablespoonful (Gm. 16).

MISTURA FERRI AROMATICA, *Br.*—AROMATIC MIXTURE OF IRON.

Potion (Mixture) de fer aromatique, Fr.; *Aromatische Eisenmixtur*, G.

Preparation.—Take of Pale Cinchona-Bark, in powder, 1 ounce; Calumba-Root, in coarse powder, ½ ounce; Cloves, bruised, ¼ ounce; Fine Iron Wire ½ ounce; Compound Tincture of Cardamoms 3 fluidounces; Tincture of Orange-Peel ½ fluidounce; Peppermint-Water a sufficiency. Macerate the cinchona-bark, calumba-root, cloves, and iron with 12 fluidounces of the peppermint-water in a closed vessel for 3 days, agitating occasionally; then filter the liquid, adding as much peppermint-water to the filter as will make the product measure 12½ fluidounces; to this add the tinctures, and preserve the mixture in a well-stopped bottle.—*Br.*

This has been introduced into the British from the old Dublin Pharmacopœia. During the maceration a portion of the iron is dissolved by the organic acids contained in the drugs.

Medical Uses.—This is a mixture of bitter tonics and aromatic stimulants with a modicum of iron. Many years ago it was appropriately described by Neligan, who said; "In consequence of its black color it is commonly known as *Heberden's ink.*" Notwithstanding its being an unchemical compound, it is a most excellent tonic; it is very generally used in Dublin in the various states of debility attended with anæmia. *Dose*, from 1 to 2 fluidounces (Gm. 32–64).

MISTURA FERRI COMPOSITA, *U. S., Br.*—COMPOUND IRON MIXTURE.

Griffith's mixture, E.; *Mixture de Griffith*, Fr.; *Griffith's Eisenmixtur*, G.

Preparation.—Sulphate of Iron, in coarse powder, 6 parts (18 grains); Myrrh, in small pieces, 18 parts (54 grains); Sugar 18 parts (54 grains); Carbonate of Potassium 8 parts (24 grains); Spirit of Lavender 50 parts (150 grains or 190 minims); Rose-Water 900 parts (2700 grains or 5 fluidounces and 7½ fluidrachms); to make 1000 parts (3000 grains or about 6½ fluidounces). Rub the myrrh, sugar, and carbonate of potassium with the rose-water, gradually added, then with the spirit of lavender, and lastly with the sulphate of iron. Pour the mixture immediately into a bottle, which should be well stopped. This preparation should be freshly made when wanted for use.—*U. S.*

The manipulation directed by the British Pharmacopœia differs only in dissolving the ferrous sulphate in a small portion of the rose-water previous to adding it to the remaining mixture. The ingredients are sulphate of iron 25 grains; carbonate of potassium 30 grains; myrrh and refined sugar, each 60 grains; spirit of nutmeg 4 fluidrachms; and rose-water 9½ fluidounces (Imperial).

The preparation of this mixture presents no difficulty if good tears of myrrh are selected and the directions are strictly followed. The reaction between the iron and potassium salts, resulting in the formation of ferrous carbonate and potassium sulphate, takes place in the myrrh emulsion, by which the insoluble ferrous carbonate is kept in suspension. Unless in full and well-corked bottles, the mixture, at first of a dirty-greenish color, is hardly protected against oxidation by the small quantity of sugar present, and should be freshly made when needed.

Medical Uses.—This preparation has special advantages over other ferruginous medicines in several chronic affections, and especially in *chlorotic anæmia*, *chronic bronchitis*, *albuminuria*, and certain chronic *diseases of the skin* (eczema, psoriasis). These disorders have in common a deteriorated condition of the blood and a debility of the nervous system, which the iron of the mixture is adapted to correct, and several among them present in addition a relaxed state of the secretory organs, which the myrrh and the sulphuric acid tend to counteract. The first-named two are those which usually exhibit the most favorable results of its use. The mixture was originally called *antihectic* from the utility it manifested in hectical conditions of pulmonary disease—not those, however, as is sometimes erroneously supposed, which belong to tubercular consumption, but those of chronic bronchitis attended with purulent expectoration, and usually associated with dilatation of the bronchia. The *dose* is from ½ ounce to 1½ ounces (Gm. 16–40) two or three times a day.

MISTURA FERRI ET AMMONII ACETATIS, *U. S.*—MIXTURE OF ACETATE OF IRON AND AMMONIUM.

Mixtura martiata Basham.—Basham's mixture, E.; *Potion (Mixture) de Basham*, Fr.; *Basham's Eisenmixtur*, G.

Preparation.—Tincture of Chloride of Iron 2 parts (100 grains or 93 minims); Diluted Acetic Acid 3 parts (150 grains or 160 minims); Solution of Acetate of Ammonium 20 parts (1000 grains or 2⅛ fluidounces); Elixir of Orange 10 parts (500 grains or 7 fluidrachms); Syrup 15 parts (750 grains or 70 fluidrachms); Water 50 parts (2500 grains or 5½ fluidounces); to make 100 parts (5000 grains, or nearly 11½ oz. av., or 9¼ fluidounces). To the solution of acetate of ammonium, previously mixed with the diluted acetic acid, add the tincture of chloride of iron, and then the elixir of orange, syrup, and water, and mix the whole thoroughly.—*U. S.*

Ferric chloride and ammonium acetate mutually decompose each other, forming ferric acetate and ammonium chloride, only about 10 per cent. of ammonium acetate remaining undecomposed. "Mistura ferri acetatis composita" would therefore seem to be a more appropriate title for this new officinal preparation.

Uses.—This preparation has long been used in the treatment of various forms of *albuminuria*, but chiefly in that which attends tubular nephritis. Its recommendations are its agreeable appearance, its not unpleasant taste, its acceptability by the stomach, and its diuretic action derived from its acid and ammonia. *Dose*, from ½ fluidounce to 1 fluidounce (Gm. 15–30).

MISTURA GENTIANÆ, *Br. 1867.*—GENTIAN MIXTURE.

Potion de gentiane, Fr.; *Enzianmixtur*, G.

Preparation.—Take of Gentian-Root, sliced, ¼ ounce; Bitter Orange-Peel, cut small, Coriander-Fruit, bruised, each 30 grains; Proof Spirit 2 fluidounces; Distilled Water 8 fluidounces. Macerate the gentian, orange-peel, and coriander in the proof spirit for 2 hours; then add the water, macerate again for 2 hours, and strain through calico.

This is nearly identical with the compound infusion of gentian, *U. S.* 1870 (see page 819). *Dose*, from ½ fluidounce to 1 fluidounce (Gm. 15–30).

MISTURA GLYCYRRHIZÆ COMPOSITA, *U. S.*—COMPOUND MIXTURE OF LIQUORICE.

Brown mixture, E.; *Mixture de réglisse*, Fr.; *Lakritzen-Mixtur*, G.

Preparation.—Pure Extract of Glycyrrhiza 3 parts (300 grains); Sugar, in coarse powder, 3 parts (300 grains); Acacia, in fine powder, 3 parts (300 grains); Camphorated Tincture of Opium 12 parts (1200 grains or 2¾ fluidounces); Wine of Antimony 6 parts (600 grains or 11 fluidrachms); Spirit of Nitrous Ether 3 parts (300 grains or 6⅛ fluidrachms); Water 70 parts (7000 grains = 16 oz. av. or 15⅜ fluidounces); to make 100 parts (10,000 grains = 22⅞ oz. av. or about 21½ fluidounces). Rub the extract of glycyrrhiza, sugar, and acacia with the water, gradually added; then add the other ingredients, and mix the whole thoroughly.—*U. S.*

This formula is nearly identical with that of 1870; a slight increase in spirit of nitrous ether has been made, and the commercial powdered extract of liquorice has been replaced by the extract prepared by cold infusion from the root. The mixture has now a somewhat lighter color than formerly, and is not turbid and unsightly in appearance from the presence of the insoluble matters contained in powdered extract of liquorice. An equally efficient mixture is obtained by using *purified* extract of liquorice (see page 637).

Medical Uses.—Compound liquorice mixture, or *brown mixture*, as it is frequently called, is an agreeable and efficient remedy in the early stages of *acute bronchitis* and catarrhal *laryngitis*. It hastens and promotes expectoration, chiefly by reducing the febrile tension of the vascular system. The average *dose* for an adult is a tablespoonful (Gm. 16).

MISTURA GUAIACI, *Br.*—GUAIACUM MIXTURE.

Emulsio resinæ guaiaci.—Emulsion de résine de gaïac, Lait de gaïac, Fr.; *Guajak-Emulsion*, G.

Preparation.—Take of Guaiacum Resin, in powder, Refined Sugar, each half an ounce; Gum-Acacia, powdered, ¼ ounce; Cinnamon-Water 1 pint. Triturate the guaiacum with the sugar and the gum, adding gradually the cinnamon-water.—*Br.*

This is a partial emulsion of guaiac resin, which, on exposure, soon changes in color (see page 750).

Medical Uses.—Although unpleasant to the taste, it is perhaps less repulsive than the tinctures of guaiac. Very probably also the guaiacum in it, being thoroughly divided by sugar and gum, is more readily acted upon and absorbed by the stomach than the solid mass precipitated from a tincture would be. *Dose,* from 1 to 4 tablespoonfuls (Gm. 16–64) several times a day.

MISTURA MAGNESIÆ ET ASAFŒTIDÆ, *U. S.*—MIXTURE OF MAGNESIA AND ASAFETIDA.

Mistura carminativa Dewees.—Dewees' carminative, E.; *Mixture carminative de Dewees,* Fr.; *Dewees' Carminativ,* G.

Preparation.—Carbonate of Magnesium 5 parts (350 grains); Tincture of Asafetida 7 parts (490 grains or 8½ fluidrachms); Tincture of Opium 1 part (70 grains or 75 minims); Sugar 10 parts (700 grains or 1⅝ oz. av.); Distilled Water a sufficient quantity; to make 100 parts (7000 grains). Rub the carbonate of magnesium and sugar in a mortar with the tincture of asafetida and tincture of opium. Then gradually add enough distilled water to make the mixture weigh 100 parts (7000 grains = 16 oz. av. or about 15 fluidounces).—*U. S.*

Medical Uses.—It is to be regretted that this mixture was made officinal. An intelligent physician would desire to vary the proportions of its several constituents, and especially of its narcotic ingredient, for almost every case of infantile colic under his care. Such mixtures do not tend to promote rational medicine. It will be observed that the laudanum in this mixture forms one-hundredth of the whole. The average *dose* is about 20 drops (Gm. 1.25).

MISTURA POTASSII CITRATIS, *U. S.*—MIXTURE OF CITRATE OF POTASSIUM.

Mistura neutralis.—Neutral mixture, E.; *Potion gazeuse (effervescente),* Fr.

Preparation.—Fresh Lemon-Juice, strained, 100 parts (1 fluidounce); Bicarbonate of Potassium about 10 parts (45 grains) or a sufficient quantity. Add the bicarbonate of potassium gradually to the lemon-juice until it is neutralized.

In composition this mixture is identical with LIQUOR POTASSII CITRATIS (page 921), but, being prepared with fresh lemon-juice, is aromatic and more agreeable. The juice should be strained before the bicarbonate is added, to avoid the expulsion of the carbonic acid gas by subsequent straining. Owing to the variable acid strength of lemon-juice, the amount of potassium bicarbonate necessary for neutralization may vary considerably; it is usually between 45 and 50 grains for each fluidounce, but may be 60 grains or more. Since as much carbonic acid gas as possible is to be retained in the mixture, litmus-paper is useless for determining the neutralization. A pleasantly acidulous mixture well charged with carbonic acid gas is obtained by first using for each fluidounce of juice 40 grains of the bicarbonate, and after this has been dissolved introducing from 10 to 15 grains of the same salt in large crystals; as soon as, after moderate stirring, carbonic acid gas is seen to arise from the crystals slowly and in distinct bubbles, the liquid should be poured off from the crystals and dispensed. A few drops of the solution heated to boiling should show a faintly acid or neutral, but not an alkaline, reaction to test-paper.

Medical Uses.—Neutral mixture is diaphoretic and diuretic. It is very generally employed as a *febrifuge,* either alone or with the addition of antimonial wine, of spirit of nitrous ether, of morphine, or of all united. It should be administered diluted with water, or, where no contraindication exists, with lemonade. The *dose* is a tablespoonful (Gm. 16).

MISTURA RHEI ET SODÆ, *U. S.*—MIXTURE OF RHUBARB AND SODA.

Potion à la rhubarbe alcaline, Fr.; *Alkalische Rhabarbermixtur,* G.

Preparation.—Bicarbonate of Sodium 30 parts (60 grains); Fluid Extract of Rhubarb 30 parts (60 grains); Spirit of Peppermint 30 parts (60 grains or 77 minims);

Water a sufficient quantity (about 1820 grains or 4 fluidounces); to make 1000 parts (2000 grains or 4⅝ oz. av.). Dissolve the bicarbonate of sodium in 500 parts (1000 grains or 2¼ fluidounces) of water. Add the fluid extract of rhubarb and the spirit of peppermint, and lastly enough water to make the mixture weigh 1000 parts.—*U. S.*

The mixture has a deep brown-red color.

Medical Uses.—Like the mixture of magnesia and asafetida, this preparation is much more appropriate for magistral than officinal for prescription. The Pharmacopœia already possesses the aromatic syrup of rhubarb, which is purgative and carminative, and to it bicarbonate of sodium is commonly added when required. The *dose* of this mixture is variously stated at from ½ drachm (*U. S. D.*) to 3 ounces (Ede's *Handbook*). For infantile dyspeptic *colic* and *diarrhœa* about ½ fluidrachm (Gm. 2) may be given, and repeated, if necessary, at hourly intervals.

MISTURA SCAMMONII, *Br.*—Scammony Mixture.

Emulsio purgans cum scammonia, Lac scammonii.—Emulsion purgative avec la scammonée, Mixture de scammonée, Fr.; *Scammonium-Emulsion*, G.

Preparation.—Take of Scammony, in powder, 6 grains; Milk 2 fluidounces. Triturate the resin of scammony with a little of the milk, and continue the trituration, gradually adding the remainder of the milk, until a uniform emulsion is obtained.—*Br.*

Scammony resin is readily emulsionized with milk. The French Codex directs 1 part of the resin to be first triturated with 15 parts of sugar, afterward with 120 parts of milk, and the emulsion to be flavored with five parts of cherry-laurel water.

Medical Uses.—Scammony forms with unskimmed milk a fine uniform emulsion which perfectly suspends the drug and conceals its acrid and nauseous taste. The mixture is intended to be a *dose* for an adult; for a child of five years one-third of the quantity will suffice.

MISTURA SENNÆ COMPOSITA, *Br.*

(See Compound Mixture of Senna, under Infusum Sennæ, page 822.)

MISTURA SPIRITUS VINI GALLICI, *Br.*

Mixture of spirit of French wine, Brandy mixture, E.; *Mixture de cognac*, Fr.; *Branntwein-Mixtur*, G.

Preparation.—Take of Spirit of French Wine, Cinnamon-Water, each 4 fluidounces; the Yelks of 2 Eggs; Refined Sugar ½ an ounce. Rub the yelks and sugar together, then add the cinnamon-water and spirit.—*Br.*

In our opinion this preparation scarcely deserves a place in a pharmacopœia.

Medical Uses.—As a nutritious and stimulant draught this preparation is often useful in *typhoid states* of fever and in exhaustion from nervous excitement, hæmorrhage, and other conditions which do not contraindicate the use of alcohol. "Eggnog" made with milk is much more efficient than this preparation.

MITCHELLA.—Mitchella.

Partridgeberry, Checkerberry, Squaw-vine, Winter-clover, E.

Mitchella repens, *Linné*.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Description.—This pretty North American evergreen, which is found in woods, has a creeping and branching stem 10 to 12 inches (25–30 Cm.) long, and opposite petiolate, roundish-ovate, entire leaves, which are about ½ inch (12 Mm.) long, and often marked with white lines. The flowers are in pairs, often diœcious, have a white or pale-purplish funnel-shaped corolla, and four exserted or included stamens, and produce a rather dry berry-like scarlet-red fruit, which is composed of two united ovaries and contains four bony nutlets. The flowers are fragrant; the leaves are inodorous, somewhat astringent, and bitter.

We have no knowledge of any analysis of this plant.

Medical Action and Uses.—The virtues of this plant are exceedingly indefinite, for it is reputed to be diuretic, tonic, and astringent, and capable of facilitating childbirth if taken for several weeks before the close of pregnancy. It very probably may be useful in chronic disorders of the urinary passages when given in decoction.

MONARDA.—Horsemint.

American horsemint, E.; *Menthe de cheval*, Fr.; *Pferdeminze*, G.

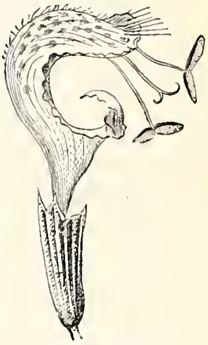
The leaves and tops of Monarda punctata, *Linné*. Bentley and Trimen, *Med. Plants*, 208.

Nat. Ord.—Labiatæ, Monardeæ.

Origin.—Horsemint is a perennial herb 1 to 2 feet (30–60 Cm.) high, which is indigenous to the United States, where it grows in dry sandy fields from New York westward to Illinois, and southward to near the Gulf of Mexico. It flowers in the latter part of summer until September, and should be collected with the flowering-tops.

Description.—The leaves are about 2 inches (5 Cm.) long, lanceolate, somewhat toothed, acute, narrowed at the base into a petiole, smooth above, and glandular dotted beneath. The whorls of cymules are about ten-flowered, situated in the axils of the upper leaves, and surrounded by about eight leafy, sessile, and entire bracts, which are pale-yellow and purple in color. The tubular, downy calyx is divided into five short and rigid teeth. The corolla is prominent, yellowish, with the large arched upper lip spotted with purple, and a small, three-lobed, somewhat crisped lower lip. The two slender exserted stamens are inserted in the throat above the narrow corolla-tube. Horsemint has a strong aromatic odor and a warm, pungent, somewhat bitterish taste.

Fig. 185.



Flower of Monarda punctata, *Linné*.

Other Species of Monarda.—M. didyma, *Linné*, or *Oswego tea*, is found in the Alleghanies and northward to Canada and Wisconsin. It has the larger bracts and floral leaves tinged with red, and showy bright-red corollas, with the stamens exserted beyond the narrow upper lip.

M. fistulosa, *Linné*, or *wild bergamot*, has the larger bracts and floral leaves of a grayish tint, and whitish or pale-purplish flowers with exserted stamens; it grows in woodlands from New England to Wisconsin southward.

Substitutions.—In some counties of Pennsylvania Pycnanthemum incanum, *Michaux*, or *wild basil*, is known and popularly used as horsemint; the plant is downy to hoary, has acute, ovate, or oblong leaves, the upper ones whitened, and the flowers in dense heads with narrow linear bracts and awned calyx-lobes. In Great Britain, Mentha sylvestris, *Linné*, is known as horsemint.

Constituents.—The important constituent is the volatile oil, which is contained in the leaves and flowers; nothing is known about the other principles, among which are doubtless those commonly met with in herbaceous plants.

Oleum monardæ, *U. S.* 1870.—Oil of horsemint, *E.;* Essence de menthe de cheval, *Fr.;* Pferdeminzöl, *G.*—This volatile oil is obtained in the United States from fresh horsemint by distillation with water or steam. It is yellowish or usually of a reddish or brownish-red color, lighter than water, readily soluble in alcohol, crystallizing below 5° C. (39° F.), and of a peculiar fragrant odor and pungent taste. Boiled with nitro-prusside of copper, it becomes colorless, greenish, brown, and finally nearly black. Iodine dissolves quietly, turning the oil bright red, afterward blackish and pitchy. The elæopten is probably a hydrocarbon, but has not been examined. The stearopten is *thymol*, $C_{10}H_{14}O$, identical with that obtained from oil of thyme. (See Thymol.)

Medical Uses.—Horsemint is regarded as being diaphoretic, diuretic, carminative, and emmenagogue, like most other plants of its class containing an acrid essential oil. It may be used in hot infusion to prevent the formation of *catarrhal*, *rheumatic*, and *diarrhœal* affections occasioned by cold. The infusion is usually made with half an ounce of the herb in a pint (Gm. 16 to Gm. 500) of hot water, and may be given in wine-glassful doses. The smallest drop of the oil of horsemint diffuses a pungent, aromatic, and persistent heat over the tongue and fauces; when applied to the skin it excites redness and heat, and, if the application is continued, pain and vesication also. It may be used for the same purposes as oil of peppermint, etc., but is more frequently employed with soap liniment or camphorated oil as an embrocation to relieve the pain of *muscular rheumatism*, *chronic articular rheumatism*, and *neuralgia*. It is also applied in liniments in local *paralysis*, *flatulent colic*, *cholera infantum*, and even in *low forms of fever*. For these purposes 1 part of the oil to 3 or 4 of the excipient may be prescribed. In neuralgia it may be applied pure. Internally, the oil may be given in doses of 2 or 3 drops (Gm. 0.06–0.20), properly diluted with sweetened water.

MONESIA.—Monesia-Bark.

The bark of Chrysophyllum glyciphlœum, *Casaretti.*
Nat. Ord.—Sapotaceæ.

Origin.—The tree yielding monesia-bark is indigenous to the forests of Brazil, and has alternate, coriaceous, and entire leaves. The berry-like fruits of several species of Chrysophyllum are edible, Ch. Cainito, *Linné*, being known as *star-apple.*

Description.—The bark is in flat or curved pieces ⅛ to nearly ¼ inch (3 to 6 Mm.) thick, often 2 or 3 inches (5 or 7 Cm.) broad, externally marked with confluent ridges, forming large irregularly quadrangular or hexagonal meshes, which are covered with a thin, smooth, whitish tissue while the bark is young. The inner surface is cinnamon-colored and longitudinally striate, otherwise smooth. The bark is very hard, breaks with a granular fracture, and shows in the interior alternate layers of brown and pale-reddish tissue. It is inodorous and has a peculiar taste, which is at first sweet like liquorice, afterward bitterish, somewhat acrid and astringent.

Constituents.—Monesia-bark was examined by Derosne, Henry, and Payen (1840), who announced the presence of *glycyrrhizin*, *monesin*, which appears to be identical with saponin, *tannin*, red coloring matter resembling kinic red, trace of volatile oil, pectin, 3 per cent. of ash, etc. Heydenreich (1839) separated from the aqueous extract 52 per cent. of tannin and 36 per cent. of a sweet principle, which was not precipitated by sulphuric acid or lead acetate, and was not fermentable.

Extractum moncsiæ, *Monesia*, comes from Brazil in irregular dark-brown friable angular pieces, destitute of any red hue. It is soluble in water, and has a sweet afterward astringent taste, followed by slight but persistent acridity.

Allied Trees.—Achras Sapota, *Linné*, s. Sapota Achras, *Miller.* The tree is known in the West Indies and South America as *sapota;* it is 40 or 50 feet (12–15 M.) high, with large whitish flowers and globular-oval somewhat angular fruits, which are externally rust-brown and rough, internally whitish, and soft-pulpy, and contain several glossy black seeds. The tree contains a bitter milk-juice.

The bark has a bitter and strongly astringent taste, and is employed as a substitute for cinchona. Bernou (1882) found in it two resins, one of which is soluble in ether, 11.8 per cent. of tannin, and the alkaloid *sapotine*, which is soluble in alcohol, ether, and chloroform, and is precipitated from its salts by ammonia.

The fruit, after it has become fully ripe, has a quince-like flavor, and is known as *sapodilla plum.* The very bitter seeds possess diuretic and aperient properties.

Mimusops Elengi, *Linné.* The bark and root are used in India as a tonic and astringent; the flowers yield by distillation with water a very fragrant perfume; the fruit is sweet and edible; the seeds yield a fixed drying oil, and the timber is durable and heavy.

Bassia longifolia, *Linné.* The East Indian *elloopa tree* yields valuable timber, and from the flowers and fruits a nourishing jelly; the leaves and bark, like the fixed oil of the seed, are used in rheumatic and cutaneous diseases. A similar use is made of *fulwa-butter*, a butyraceous fat prepared from the pale-brown glossy seeds of Bassia butyracea, *Roxburgh.*

Medical Action and Uses.—Internally and in small doses, as from 4 to 8 grains, monesia gives tone to the stomach and increases the appetite, but in doses of 20 or 30 grains it occasions gastric oppression and constipation. Upon recent sores it causes a burning and stinging pain of brief duration, lessening their secretions and promoting granulation and cicatrization. Monesin acts upon such sores as a more active irritant, inducing rapidly a plastic exudation.

The medicinal uses of monesia denote its possession of a stimulant as well as an astringent property. It has been found useful in atonic *dyspepsia*, in *vomiting* produced by atony rather than by active irritation of the stomach, and in all forms of *diarrhœa* unattended with fever. It has been employed with profit in chronic *bronchitis*, in various forms of hæmorrhage, especially *hæmoptysis* and *menorrhagia*, and locally by injection in *epistaxis.* In various ecchymoses depending upon *scurvy* its internal administration is said to have been advantageous. As a topical application it has been recommended in *ulcers* and *pseudo-membranous* exudations of the mouth and fauces and of many other parts, also in *leucorrhœa*, *gleet*, and *diarrhœa*, and especially in *fissures* of the *mouth* and *anus.* Although these virtues of monesia appear to have been demonstrated by clinical observation, the medicine seems to have been neglected and almost fallen into disuse.

The *dose* of monesia may be stated at from 3 to 20 grains (Gm. 0.15–1.30) or from 10 to 60 grains (0.60–4) a day. Monesin has been recommended in the dose of ½ grain. For local applications the tincture diluted with from 10 to 20 parts of water has been used; also an ointment made with 1 part of the extract to 7 of lard, and a glycerole of similar proportions.

MORI SUCCUS, *Br.*—Mulberry-Juice.

Succus mororum.—Suc de mûres, Fr.; *Maulbeersaft*, G.

The juice of the ripe fruit of Morus nigra, *Linné*. Steph. and Church, *Med. Bot.*, plate 39; Bentley and Trimen, *Med. Plants*, 229.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The black like the white mulberry, Morus alba, *Linné*, is indigenous to the Levant; both are rather small trees, about 30 feet (9 M.) high, and are cultivated and partly naturalized in Europe, where the leaves of both, more generally of the white, are employed for feeding the silkworm. Both species are also occasionally seen in cultivation in the United States; M. alba, however, is alone naturalized. The mulberry is usually monœcious; the staminate flowers are in loose catkins, the pistillate flowers in short dense spikes; the latter flowers contain a two-celled ovary with two thread-like styles, one of the cells disappearing after fructification, while the four-lobed calyx becomes fleshy.

Description.—Through the coalescence of the fleshy calyces the pistillate spikes of the mulberry ripen into what appears to be a compound berry or drupe having some resemblance to the blackberry. The mulberry is of an oblong or ovate form, about 1 inch (25 Mm.) long, fleshy and juicy, purplish-black, each fruit crowned with the filiform styles. The fruit proper is a lenticular akene enclosed in the fleshy calyx. Mulberries contain a dark reddish-purple juice, and have scarcely any odor, but possess a very agreeable acidulous taste.

Morus rubra, *Linné*, is common in rich woods in the United States from Western New England southward to Florida and westward to Dakota and New Mexico. It is usually about 20 feet (6 M.), but occasionally 60 feet (18 M.), high, and has a durable hard, yellowish wood. The fruit is dark-purple, 1 to 1½ inches (25–38 Mm.) long, and otherwise resembles the preceding.

Constituents.—From comparative experiments made in the laboratory of Fresenius (1857), it appears that mulberries contain more sugar than gooseberries, currants, strawberries, raspberries, blackberries, and huckleberries, while in the free acid they are about intermediate between wild and cultivated raspberries. The analytical results, as obtained by Van Hees, were as follows, calculated for 100 parts of the fruit: sugar 9.192, free acid (estimated as malic acid) 1.860, albuminous compounds 0.394, pectin, gum, and other organic compounds 2.031, ashes 0.566, and water 84.707 parts, the remaining 1.250 parts consisting of the akenes and other tissues, with the insoluble organic compounds and ash.

C. R. A. Wright and G. Patterson (1878) examined the juice expressed from mulberries not quite ripe, and obtained from the liter 26.83 Gm. of citric acid, 7.82 malic acid, 2.74 glucose, 23.37 other organic constiuents, and 9.40 ash—a total of 70.16 Gm. of solids. This juice had slightly fermented, and contained a trace of volatile, probably acetic, acid.

Off. Prep.—Syrupus mori, *Br.*

Medical Uses.—Mulberries are refreshing to the taste like all subacid fruits, and slightly laxative. Their fresh juice, or a syrup prepared with it, is frequently employed in Europe for the same purposes to which in this country the juice and jelly of currants are applied—viz. in *inflammations* with *fever*, and especially in *sore throat*. The bark of the root of Morus nigra has been found an efficient substitute for pomegranate-root in the treatment of *tænia*.

MORPHINA, *U. S.*—Morphine.

Morphia, U. S. 1870; *Morphinum, Morphium.—Morphia*, E.; *Morphine*, Fr.; *Morphin*, G.
Formula $C_{17}H_{19}NO_3.H_2O$. Molecular weight 303.

Origin.—Morphine is an alkaloid which has thus far only been found in opium, in the capsules of the different varieties of Papaver somniferum, *Linné*, and in the milk-juice of the red-flowering Pap. orientale, *Linné;* according to Charbonnier (1868), it is also present in Argemone mexicana, *Linné*. Although obtained by Derosne (1803) in an impure condition by precipitating a concentrated infusion of opium with ammonia, it was confounded by him with narcotine. Sertürner (1816), however, not only established its difference from that body, but also proved its basic nature and its poisonous effects. Morphine was the first organic alkaloid known.

Preparation.—Take of Opium, sliced, 12 troyounces; Water of Ammonia 6 fluidounces; Animal Charcoal, in fine powder, Alcohol, Distilled Water, each a sufficient quantity. Macerate the opium with 4 pints of distilled water for 24 hours, and, having worked it with the hands, again macerate for 24 hours and strain. In like manner, macerate the residue twice successively with the same quantity of distilled water, and strain. Mix the infusions, evaporate to 6 pints, and filter; then add 5 pints of alcohol, and afterward 3 fluidounces of the water of ammonia, previously mixed with ½ pint of alcohol. After 24 hours pour in the remainder of the water of ammonia, mixed, as before, with ½ pint of alcohol, and set the liquid aside for 24 hours that crystals may form. To purify these, boil them with 2 pints of alcohol until they are dissolved, filter the solution, while hot, through animal charcoal, and set it aside to crystallize.—*U. S.* 1870.

This process is essentially that of Dr. E. Staples (1829). On maceration with water, the morphine, minute traces excepted, is readily dissolved, together with other constituents. To decompose the morphine salt ammonia is added; by this process the morphine is rapidly deposited, together with narcotine and some of the other alkaloids, and mixed with considerable coloring matter, from which it may be freed by repeatedly recrystallizing from dilute hydrochloric acid and expressing. Most of the coloring matter and narcotine remains in solution, and at the same time not an inconsiderable amount of hydrochlorate of morphine enters the mother-liquors, from which it may be subsequently recovered. If, however, the concentrated infusion of opium is mixed with not more than an equal bulk of alcohol, and a sufficient amount of ammonia-water is added, the morphine will be more slowly precipitated in a crystalline condition, while the great bulk of the coloring matter remains in solution. The slower the separation of the alkaloid, the larger and purer will be its crystals; hence the advantage of adding the ammonia in separate portions. Since morphine is soluble in ammonia, only sufficient of the latter should be added to unite with the acids, and if in slight excess it should be allowed to evaporate by exposure. The mother-liquid from this evaporation contains a small amount of morphine, which, when working on a larger scale, it is important to recover. The alcohol may be distilled off, and if not otherwise purified may be reserved for a similar purpose. If the process has been well conducted, the crude morphine has a light-brownish color, which is removed by dissolving in hot alcohol and treating with animal charcoal. The mother-liquor from this crystallization retains a portion of the morphine, together with the narcotine first precipitated. On distilling off the alcohol the alkaloids are obtained, and may be preserved until sufficiently accumulated for further purification. Narcotine may be separated from morphine by treatment with ether, in which the former is readily soluble, the latter entirely insoluble.

Many other processes have been proposed. As a rule, the treatment of opium with acidulated water or alcohol offers no advantages, since more narcotine and other organic compounds are thereby dissolved. Wittstock proposed to separate the narcotine from the infusion of opium by chloride of sodium, in which the narcotine is insoluble, but a little morphine is likewise liable to be deposited. The first precipitation with ammonia is sometimes effected at a boiling temperature; after cooling the morphine will be granular, and may be more advantageously washed with cold water and expressed. Precipitation with carbonate of sodium does not appear to ensure a larger yield. Pelletier observed that when acetic acid is added to crude powdered morphine until the liquid begins to retain an acid reaction, all the morphine will be dissolved, while the narcotine remains behind; and this behavior may be used for separating the two alkaloids; or the impure morphine may be completely dissolved in dilute acetic acid, the solution evaporated to dryness, and the residue treated with water, which leaves narcotine. Gregory has proposed a process which has been adopted by the British Pharmacopœia for preparing hydrochlorate of morphine from opium, and which has the advantage of dispensing with alcohol in the purification of the alkaloid. To obtain this in a pure state, the following directions are given: Take of opium, sliced, 1 pound; chloride of calcium ¾ ounce; purified animal charcoal ¼ ounce; solution of ammonia, distilled water, each a sufficiency. Macerate the opium for 24 hours with 2 pints of the water, and decant. Macerate the residue for 12 hours with 2 pints of the water, decant, and repeat the process with the same quantity of the water, subjecting the insoluble residue to strong pressure. Unite the liquors, evaporate in a water-bath to the bulk of 1 pint, and strain through calico. Pour in now the chloride of calcium, previously dissolved in 4 fluidounces of distilled water, and evaporate until the solution is so far concentrated that upon cooling it becomes solid. Envelop the mass in a double fold of strong calico and subject it to powerful pressure, preserving the dark fluid which exudes. Triturate the squeezed cake with about ½ pint of boiling distilled water, and, the whole being thrown upon a paper filter, wash the residue well with boiling distilled water. The filtered fluids having been evaporated as before, cooled, and solidified, again subject the mass to pressure; and, if it be still much colored, repeat this process a third time, the expressed liquids being always preserved. Dissolve the pressed cake in 6 fluidounces of boiling distilled water; add the animal charcoal and digest for 20 minutes; wash the filter and charcoal with boiling distilled water, and to the solution thus obtained add the solution of ammonia in slight excess. Let the pure crystalline morphia, which separates as the liquids cools, be collected on a paper filter and washed with cold distilled water until the washings cease to give a precipitate with solution of nitrate of silver acidulated by nitric acid. From the dark liquids expressed in the above process an additional product may be obtained by diluting them with distilled water, precipitating with solution of potash added in considerable excess, filtering, and supersaturating the filtrate with hydrochloric acid. This acid liquid, digested with a little animal charcoal and again filtered, gives, upon the addition of ammonia, a small quantity of pure morphia.—*Br.*

In this process the morphine salts, as naturally contained in the opium, are decomposed by an excess of calcium chloride, with the formation of hydrochlorate of morphine, which, crystallizing on cooling from the sufficiently concentrated solution, produces with the calcium meconate a solid mass, from which the mother-liquor is removed by strong pressure. The pressed cake, on being treated with boiling water, yields up the morphine (and codeine) hydrochlorate, while the calcium meconate remains upon the filter. The evaporation, expression, and resolution are repeated until most of the coloring matter has entered the mother-liquors and nearly the whole of the calcium meconate remains upon the filter. The removal of the last traces of color is then effected by animal charcoal, and the morphine precipitated in a granular condition by adding a slight excess of ammonia to the boiling solution. The dark-colored mother-liquors contain, besides coloring matter and calcium salts, narcotine and morphine, which are precipitated by potassa, an excess of which dissolves the latter readily and completely, but narcotine sparingly and slowly, as observed by Robiquet, Wittstock, and others. The filtration of the strongly alkaline liquid must, therefore, not be long delayed; and when the clear liquid is acidulated with hydrochloric acid it contains morphine hydrochlorate, potassium chloride, and some coloring matter, from the last of which it is freed by animal charcoal; ammonia then precipitates the nearly pure alkaloid. The decoloration of the morphine salt by means of animal charcoal is more readily effected when in aqueous solution, as here directed, than when dissolved in alcohol.

Lime has an action upon morphine and narcotine similar to that of potassa. Couërbe has founded upon this behavior a method for preparing morphine which was somewhat modified by Mohr (1840), who directs 4 parts of opium to be exhausted by repeated boiling with water; the strained and expressed decoction is gradually added to boiling milk of lime, made of 1 part of burned lime and 8 parts of water; and after boiling for a few minutes the mixture is strained, pressed, and the undissolved portion twice boiled with a fresh portion of water. The liquid, containing mainly morphine, lime, and coloring matter, is concentrated to 8 parts, filtered, and the filtrate, while boiling, mixed with sufficient powdered sal ammoniac to convert all the lime into calcium chloride, while ammonia is given off, and the morphine on cooling separated as a granular mass; this is washed with cold water, dissolved in hydrochloric acid, purified with animal charcoal, and crystallized as hydrochlorate of morphine, or the alkaloid precipitated by ammonia. The morphine precipitated from the lime solution is darker in color than the first morphine precipitate obtained by Staples' process, but much lighter than the corresponding precipitate by Gregory's process. A modification of Mohr's process, by which the morphine is at once obtained almost free from coloring matter, has been adopted as the pharmacopœial process for assaying opium. (See OPIUM.)

Properties.—Morphine crystallizes in short, transparent, and colorless or white prisms or needles, which require for solution 10,000 parts of cold and 460 parts of boiling water. Chastaing (1882) ascertained that 1 liter of water dissolves at 10° C. (50° F.) 0.1 Gm., at 20° C. (68° F.) 0.2 Gm., at 30° C. (86° F.) 0.3 Gm., and at 100° C. (212° F.) 2.17 Gm., of morphine. At or near 15° C. (59° F.) the alkaloid is stated to be soluble in 100 parts (*U. S.*), 90 parts (Merck), 42 parts (Choulant) of alcohol, and at the boiling temperature in 36 parts (*U. S.*, Choulant), 24 parts, of alcohol (Bucholz).

Duflos found it soluble in 20 parts of cold and 13.3 parts of boiling absolute alcohol; Pettenkofer, in 40 and 30 parts respectively. Prof. Prescott (1875) determined morphine to be soluble in the following quantities of hot liquids: in 6148 parts of ether sp. gr. .729, in 4379 parts of chloroform sp. gr. 1.4953, in 8930 parts of benzol sp. gr. .8766, and in 91 parts of amylic alcohol sp. gr. .8316; all except the last liquid dissolved from four to five times more of the nascent alkaloid. Chloroform containing 7 per cent. of alcohol dissolves $\frac{1}{150}$ of morphine (Vander Burg, 1879). Reveil (1863) found morphine to be soluble in 220 parts of glycerin. It is soluble in about 400 parts of cold amylic alcohol and 500 parts of acetic ether, in fixed alkalies and alkaline earths, less so in ammonia (117 parts), and still less in ammoniacal salts, but nearly insoluble in fixed oils. The alkaloid is not altered by exposure to air, and is indorous, and at first tasteless, developing, however, a bitter taste. Its solutions have an alkaline reaction upon test-paper, and with acids it yields salts, most of which are crystallizable. Heated to 120° C. (248° F.), it loses 5.95 per cent. of water of crystallization and fuses to an oily liquid, which crystallizes on cooling; at a higher heat it is decomposed, and burns without leaving any residue.

Reactions.—Commercial concentrated sulphuric acid dissolves morphine with a yellowish afterward gray color. Pure morphine yields with pure sulphuric acid a colorless solution, and when heated to 100° C. (212° F.) for half an hour is colored pink-red (Prescott, 1877). Mixed with six or eight times its weight of sugar, morphine acquires with sulphuric acid a bright purple-red color, gradually changing to violet-blue, blue-green, and dingy-yellow (Schneider, 1872). The delicacy of this test is increased by the addition of a little bromine-water, so that .00001 Gm. of morphine will still show a rose-red color (Weppen, 1874). Concentrated nitric acid imparts a blood-red color, changing to orange and yellow. Dissolved in sulphuric acid and the solution heated to near 150° C. (302° F.), the addition of a little nitric acid colors violet-blue, changing quickly to blood-red, and afterward to deep orange (Husemann, 1863). *Fröhde's reagent* (1866) (0.001 to 0.005 sodium molybdate in 1 Ccm. H_2SO_4) acquires a beautiful violet color, changing to blue, olive-green, yellow, and in 24 hours to purplish-blue. In the reaction of this reagent upon many alkaloids and other organic substances a light- or dark-blue or more or less green color is produced; the changes in color must, therefore, be noticed, and a larger amount of the molybdate in the test carefully avoided. (See papers by Buckingham, Wellcome, and Prescott in *Amer. Jour. Phar.*, 1873, p. 150; 1876, pp. 21, 59.) Chlorine-water added to morphine causes a yellow or orange color, which is deepened by alkalies; chlorinated alkalies or lime at once produce the orange color. Morphine decomposes iodic (Serullus) and periodic (Boedeker) acids, liberating iodine; in dilute solutions the addition of sulphuric acid is advisable; ammonia deepens the yellow color of the solution. Solutions of silver nitrate, gold chloride, potassium ferricyanide, cuprammonium, and chromic acid are reduced by morphine and its salts. Ferric chloride colors morphine and its salts deep-blue, the color being destroyed by free acids and alcohol, but not by alkalies (Robinet). Pellagri (1877) recommended a test which depends upon the production of apomorphine (see p. 220), and is applied as follows: The suspected substance is dissolved in concentrated hydrochloric acid, a little sulphuric acid is added, and the solution evaporated at 100° C.; a purple color will be produced. To the residue is added a little hydrochloric acid, then bicarbonate of sodium, and finally a strong solution of iodine in hydriodic acid, when a green compound is produced, dissolving in ether with a purple color.

The *salts of morphine* are precipitated from their solutions by the alkalies and alkaline earths, the precipitates being soluble in an excess of the precipitant. Similar precipitates are produced by the alkaline carbonates and cyanides, but the alkaline bicarbonates fail to precipitate acid solutions in the cold. Tannin causes a white precipitate soluble in acetic acid, in mineral acids, and in alcohol. Auric or platinic, but not mercuric, chloride occasions a yellow precipitate. The acidulated solutions of morphine are precipitated by potassio-mercuric iodide, potassio-cadmium iodide, and other general reagents for alkaloids; the precipitate with phosphomolybdic acid turns blue with cold sulphuric acid and brown on warming. 1 Ccm. of Mayer's test solution precipitates 0.020 Gm. morphine. When a salt of morphine is heated with an excess of sulphuric or hydrochloric acid to near 150° C. (302° F.), the alkaloid parts with H_2O and is converted into apomorphine, $C_{17}H_{17}NO_2$ (see page 220).

Beckett and Wright (1875) ascertained that morphine treated with acetic, benzoic, or butyric anhydride is converted into derivatives containing acetyl, benzoyl, or butyryl in the place of 1 or 2H. Hesse (1883) obtained similar compounds with propionic anhydride at 85° C. (185° F.). *Diacetyl-morphine* and the analogous derivatives are not colored by ferric chloride, and are decomposed into morphine and the corresponding acids on being warmed with alcoholic solution of potassa.

Tests.—When heated upon platinum-foil, no fixed residue should be left (lime, magnesia, etc.). On dissolving 1 part of morphine in 20 parts of solution of soda or potassa, no insoluble residue should be left (narcotine and other alkaloids); and the liquid should remain colorless (glucose, etc.), and should not give off ammoniacal vapors (ammonium salts). "Morphine should yield a colorless solution with cold concentrated sulphuric acid, which should not acquire more than a reddish tint by standing for some time (narceine, thebaine, etc.), and which should not assume a purple or violet, but merely a greenish, color on the addition of a small crystal of chromate of potassium (absence of and difference from strychnine, brucine, etc.)."—*U. S.*

Pharmaceutical Uses.—The alkaloid is used in preparing morphine salts.

Physiological Action.—*On Animals:* As the effects of the several salts of morphine are nearly identical, it will be convenient to study them in connection with the alkaloid itself. The first remark is that birds, in many instances, tolerate the action of morphine, when taken into the stomach, to an almost incredible degree; thus it has been found that of two pigeons one might survive a dose of 12 grains, while it would prove fatal to the other bird. Even hypodermically 3 grains were required to destroy life. In these animals morphine appears to act upon the spinal marrow rather than upon the brain, causing unsteady movements, partial paralysis, and general convulsions. Analogous results have followed experiments upon rabbits, dogs, and horses. Thus, 6 grains of acetate of morphine administered to a dog caused paralysis of the hind legs, salivation, somnolency, and *dilated* pupils, but the animal recovered. A like result followed the administration of 12 grains of morphine to a horse. It should, however, be stated that in exceptional cases morphine has appeared to produce true, and even fatal, narcotism in birds. So, too, in certain experiments upon dogs a true narcotic operation has been observed; on awaking, the animals looked terrified and haggard, dragged their hind legs, failed to recognize their masters, and slunk into a dark corner, where they remained for many hours and until the intoxication had entirely passed away. The rationale of its action upon animals may, according to Witkowski, be expressed in the following propositions: 1, Morphine paralyzes the cerebral centres of sensation and motion in the brain; 2, the paralysis of these centres is preceded by their excitement; 3, this paralysis precedes that of the respiratory centres; 4, the centres of the inhibitory vagus fibres, the vascular nerves, and those which contract the pupil are neither depressed nor stimulated by morphine; 5, spinal reflex excitability is heightened by it; and 6, the peripheral nerves are in no manner affected by morphine. According to Curci (*Centralbl. f. d. ges. Thérapie*, ii. 72), morphine slows the pulse, especially in the first stage of its operation—in moderate doses rapidly, but slightly diminishing the blood-pressure at first, then increasing it, and finally lessening it during full narcosis.

On Man: The general effects of morphine on the system are almost identical with those of opium, but there are some points of difference which call for notice, and some peculiarities depending upon the manner in which morphine is administered. It does not appear to stimulate the nervous system or the circulation as much as opium, nor display so decided a narcotic influence. It has been remarked that although 2 or even 3 grains of opium certainly contain less than a grain of morphine, yet their action is more intense, rapidly occasioning a degree of narcotism bordering upon coma, but soon subsiding without leaving decided secondary effects behind; while morphine does not so readily produce narcotism, but its after-effects are of longer duration. Opium also increases the temperature as well as the sense of heat, but morphine, while agreeing in the latter effect, lowers the temperature. So, too, opium primarily increases the frequency of the pulse, but morphine diminishes it. Opium is less apt to excite nausea and vomiting than morphine. Of this operation it has been remarked that women are much more liable to it than men, and especially to vomiting. When morphine is used hypodermically such effects usually take place immediately, but when given by the stomach they may not appear for several days. A corresponding contrast is presented by its action on the bowels: by the hypodermic method morphine continues to constipate, but by the mouth it tends to occasion diarrhœa after a few days. Under like circumstances opium does not cause looseness of the bowels, but ceases to confine them. Contrary to the general opinion, morphine does not, according to Rutherford's experiments, affect the secretion of bile. The experiments of Filhene (*Archiv f. Pathol. u. Pharmakol.*, xi. 60) led him to a conclusion in harmony with general clinical experience—viz.

that when respiration is interfered with by anæmia of the medulla oblongata, without previous pulmonary obstruction, the use of morphine in doses capable of restoring the act of respiration to its normal type is thoroughly indicated. But when, on the other hand, an obstacle to the arterialization of the blood exists in the lungs themselves, then morphine must be circumspectly used. Berkart, in like manner, teaches that when the pulmonary obstruction originates in the heart itself, it may often be overcome by stimulation of the heart; and no better agent can be resorted to for that purpose than morphine in small doses, administered hypodermically. Morphine is very apt to occasion ardor urinæ, with vesical irritation and diminished secretion of urine. The last symptoms may be accounted for, in part, by the profuse sweating that often follows the administration of morphine in full doses. It is said to be more marked in females than in males. Although itching of the skin sometimes attends the action of opium, it is usually insignificant compared with that which morphine frequently causes. It generally begins in the eyes and nose, and often extends to the whole surface of the body, causing great restlessness and distress. Along with this symptom, or independently of it, various fugitive eruptions appear of a papular or erythematous description, and especially urticaria. They probably depend upon the same immediate cause that provokes diaphoresis, and they have been oftener noticed after the hypodermic use of morphine than otherwise. Among many instances the following may be cited in illustration: In a case of sciatica Comanos used a hypodermic injection of ⅓ grain (Gm. 0.02) of morphine. The next day the whole skin was covered with a scarlet rash, the temperature was 102° F., and at the end of 4 days desquamation took place. Some time afterward the same dose was given by the mouth, and produced a similar febrile eruption; and later an ointment containing morphine was rubbed into the skin over the painful nerve, and after several days an eruption broke out as before, and then a large carbuncle formed (*Berlin klin. Wochensch.*, No. 42, 1882). As with all narcotics, so with morphine: if it is left off abruptly, wakefulness and restlessness, with nervous depression, are apt to ensue. The fatal dose of morphine cannot be determined; it may not exceed a single grain, and, on the other hand, a case is recorded in which 7 grains of morphine were taken in the form of Magendie's solution, and yet by dint of powerful excitation, chiefly electrical, the patient recovered (Schweig). An infant fourteen days old recovered after taking ⅙ grain of morphine, and another three weeks old after taking a teaspoonful of wine of opium (*Boston Med. and Surg. Jour.*, July, 1880, p. 57). In another case it is said that 10 grains were taken, but the patient recovered after the hypodermic injection of atropine (*Med. News*, xli. 592).

The influence of morphine used habitually by hypodermic injection is most pernicious. Even in dogs, after a time emaciation sets in and ultimately reaches an extreme degree; the animal is habitually torpid, the skin of the feet grows morbidly sensitive, and the temperature is very low. After death the brain and spinal marrow are anæmic and the lungs and liver engorged. In man the effects are similar, but those of the intellectual sphere are predominant. They include nervousness, tremor, hyperæsthesia, spasms, neuralgia, insomnia, anxiety, hypochondria alternating with excitement, hallucinations, a suicidal tendency, dryness of the tongue, constipation, and scanty urine, with vesical irritation, and sometimes albuminous urine. It also blunts the perception of duty, gratitude, and even delicacy, and perverts the sense of truth. No doubt those effects are due in part to the efforts made by the slave of the morphine habit to conceal his illicit indulgence or its degree, but they are chiefly attributable to the obtuseness which it creates in the moral faculties as well as the senses. If the drug is abruptly withdrawn, the patients suffer a collapse, with indescribable distress from nervousness and loss of self-control, profuse sweats, or diarrhœa and a dusky discoloration of the face. The tolerance of morphine in some cases of its habitual use is extremely remarkable, as the following summary will prove: A man gradually increased his daily dose until at the end of 2 years it reached 40 grains (Siredey). A woman who used morphine hypodermically at last took 14 grains every day. Except habitual lassitude of mind and body no bad effect of any kind was produced (Braithwaite). But the most singular instance of this nature is one reported by Dr. Lyman of Boston: A woman forty-seven years of age had been addicted to the morphine habit since the age of eighteen. She was in good flesh, though a small eater and with an indifferent appetite; she experienced no disorder of the heart or kidneys, her bowels were moved by the help of injections, and her catamenia were always regular. Yet throughout this long period of 28 or 29 years her daily dose of morphine averaged about 16 grains. A woman aged sixty-six years often had three hypodermic injections daily, each of 6 grains of morphine (*Practitioner*, xxv. 66). Another habitually took this amount internally, and occasionally doubled it. During one period of 3 weeks she took a drachm of morphine daily, and on several days 80 grains (*Boston Med. and Surg. Jour.*, Feb. 1882, p. 128). In some persons almost every hypodermic injection is followed by an abscess. We are familiar with the case of a lady who for several years was subject to violent attacks of neuralgia of the face and head, for which she was treated by hypodermic injections of morphine. Almost all the punctures were followed by abscesses, and both of her arms from the shoulders almost to the wrists are deformed by the scars they left behind them. According to Obersteiner, about 74 per cent. of the victims of the morphine habit are males, and of these nearly 47 per cent. are medical men.

Many cases occur in which idiosyncrasies modify the usual effects of morphine. In some it causes violent mental excitement, hallucinations, and a total inability to sleep; in others it occasions nervous depression, syncope, pallor of the skin, feebleness of the pulse, dyspnœa, insensibility, urgent vomiting, etc.; in others, again, spasmodic movements or a fully-formed tetanoid paroxysm (*British Med. Jour.*, Oct. 18, 1879). No doubt some of the most alarming examples of this nature have followed the hypodermic injection of morphine, either because of the swift absorption of the narcotic or from its having been thrown into a vein. Hence the wisdom of the rule to introduce morphine hypodermically with great deliberation, and of the advice that has been given to associate with each injection $\frac{1}{96}$ grain of atropine to counteract the depressing and nauseating effects of the morphine. This dose should never be repeated while the effects of a previous dose appear to be increasing. In all cases the condition of the pulse and the heart should be considered. Not a few examples are recorded of death by syncope immediately after the administration of morphine hypodermically, and many also in which death seemed imminent. In one case, among others, a case of lumbago, this effect resulted from the hypodermic injection of $\frac{1}{6}$ grain of morphine at a spot midway between the spine and the crest of the ilium. In about 10 minutes collapse with syncope occurred, and the patient was with difficulty saved (*Boston Med. and Surg. Jour.*, Oct. 1879, p. 619). The administration of chloroform to a person under the *full* influence of morphine is peculiarly dangerous. Even ether should be cautiously employed, especially if severe pain is suffered (*Med. Record*, xxii, 274). The immediate and remote effects of the hypodermic use of morphine and of the "morphine habit" have been fully depicted by numerous writers. To their works the reader is referred (Burkart, *Die chron. Morphia Vergiftung*, 1877–78; Pétit, *Bull. de thérap.*, vol. xcvi.; Levinstein, *Die Morphiumsucht*, 1880; Obersteiner, *Med. News and Abst.*, July, 1880, p. 438, and *Wiener klinik*, Marz, 1883; Kane, *Morphia Hypodermically*, 1880).

Medical Uses.—Although morphine may, in general terms, be used for the same purposes as opium, which are fully treated of elsewhere (see Opium), and especially as an internal medicine, it is true, nevertheless, that the introduction of the hypodermic method of employing it has shown its fitness for certain special conditions. This method is superior to any other when the prompt action of the medicine is necessary to save life or lessen pain, when the patient is unable or unwilling to swallow, and when a local rather than a general influence is sought. The use of morphine, and especially its hypodermic use, in the treatment of *insanity*, while it is unquestionably preferable to allowing the insane to become exhausted by excessive mental and physical exertion, is just as certainly abused to save trouble for physicians and attendants. Very often the disease, whether it have a physical basis or not, is fostered and prolonged by this method, which is really but little better than the strait-jacket, the tranquillizing-chair, and other instruments of torture which are now seldom used in asylums which are managed by a sound intelligence. And hardly less mournful is it to know that in these institutions the baleful habit of morphine-intoxication has often been formed. Undoubtedly, a wise and prudent use of this remedy is most advantageous, especially in cases of transient or of periodical mania, or when it is attended by severe bodily pain, provided that the administration be absolutely controlled by a responsible physician and not trusted to inexperienced assistants or ignorant or unfaithful nurses. (Compare Voisin, *Bull. de thérap.*, c. 385, 443.) In *sunstroke* attended with convulsions, jactitation, delirium, and general excitement the hypodermic injection of a salt of morphine, in the dose of $\frac{1}{4}$ grain, affords prompt relief. In *epileptiform convulsions* due to mental excitement, in pregnancy and the *puerperal state*, in *hysteria* and aggravated *chorea*, in various *local spasms*, as of the face, glottis, diaphragm, etc., this remedy should always be borne in mind. Morphine hypodermically employed is perhaps the best remedy in *tetanus*, even of the traumatic form, and a like statement is true of the analogous condition caused by *strychnia*-poisoning. It is the proper antidote in *poisoning by belladonna* or atropine. Of all the remedies for *spasmodic asthma* this one procures incomparably the most speedy relief. Nor is it only in spasmodic dyspnœa that the treatment is efficient. Huchard, among others, contends that, with rare exceptions, this symptom is by itself an indication for the use of hypodermic injections of morphine (*Bull. de thérap.* xcvi. 477). The attacks of dyspnœa due to mitral obstruction are less amenable to this medicine than any other, whether cardiac, pulmonary, or nervous (*Ibid.*, c. 173). The pain of *neuralgia*, especially in its severer forms, such as affect the fifth nerve, the sciatic, and the gastric nerves, is promptly palliated by it. In neuralgia of the superficial nerves rapid vesication of the skin over the painful points, and the application to the cutis of a strong solution or ointment containing a morphine salt, may also be employed, but its effect is less prompt and sure than the hypodermic plan. Of all palliatives employed in that most terrible of pains, *angina pectoris*, none affords more prompt and sure relief, not only subduing the neuralgic anguish, but calming the tumultuous and disordered movements of the heart. It has the advantage over other methods of being almost free from danger. One of the best occasional remedies for *nervous headache* which females are apt to experience during the menstrual periods is a cup of strong coffee with $\frac{1}{5}$ grain of a morphia salt, but it is a remedy which is not to be recommended for general or frequent use. The hypodermic injection of morphine is the promptest of all palliatives for *muscular rheumatism*, and especially for *lumbago*. The use of morphine as an antidote to poisoning by Belladonna, Atropina, and Calabar Bean is considered under those several titles. It may, however, be mentioned in this place that the antagonism in question may sometimes be usefully employed to meet special indications. Thus, morphine, which is so essential to moderate cough in phthisis, and which is at the same time contraindicated by its tendency to produce sweating, may, if associated with a minute proportion of atropine, fulfil its important object without inducing profuse diaphoresis. In like manner, the depressing influence of morphine, which renders it dangerous in certain cases of extreme exhaustion accompanied with severe pain, may be counteracted by giving atropine along with it (Fothergill).

Like all new methods, the hypodermic use of morphine has been greatly perverted; the prompt alleviation of pain and the pleasing intoxication which follows form too strong a temptation to its use for all persons to resist successfully. Like alcohol, its intoxication leaves behind it a sense of debility and depression which nothing but a fresh resort to the medicine relieves. If continuously employed, it creates an artificial necessity for resorting to its powerful and genial support, and the longer it is used the larger is the dose of it required. A peculiar allurement of the habit as compared with that of taking opiates by the mouth is that in many cases it does not so readily derange the stomach, impair the appetite, or produce constipation. These effects should be borne in mind, but it is equally important to remember that in cases of hopeless disease the duty of the physician is, above everything else, to relieve his patient's suffering.

The average *dose* of morphine or of its salts is about $\frac{1}{5}$ grain (Gm. 0.013), but morphine uncombined is seldom prescribed. For hypodermic uses an officinal solution of acetate of morphine has been provided by the British Pharmacopœia. (See Injectio Morphiæ Hypodermica.) It is said that if the morphine solution is heated in a spoon before being injected, organic growths that may have formed in it will be destroyed, and the solution will then become less irritating. The tartrate has been proposed as superior to any other salt of morphine for hypodermic injection. It is said to be entirely bland and unirritating, and that its solution can be kept fresh for any length of time (Stuart).

MORPHINÆ ACETAS, *U. S., Br.*—Acetate of Morphine.

Morphiæ acetas, Morphinum (s. Morphium) aceticum, Acetas morphinæ, Acetas morphicus.—Acetate of morphia, E.; *Acétate de morphine*, Fr.; *Morphinacetat, Essigsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3.C_2H_4O_2.3H_2O$. Molecular weight 399.

Preparation.—The British Pharmacopœia, not recognizing morphine as officinal, directs that alkaloid to be prepared from 2 ounces of the hydrochlorate by precipitating its solution with ammonia and washing the precipitate with distilled water; the moist morphine is diffused in 4 ounces of water, dissolved by neutralizing with acetic acid, the solution evaporated on a water-bath until it concretes on cooling, and the mass dried with a gentle heat and reduced to powder. The salt should be kept in small well-stopped vials. A very slight excess of acetic acid is rather of advantage, since the salt begins to decompose during the evaporation by the liberation of a little acid; it is therefore advisable to facilitate evaporation at a rather low temperature by means of a current of air. The salt may be crystallized with some difficulty in the form of white silky needles, but is very generally obtained in powder as directed above.

For obtaining the salt of very handsome appearance Hager gives the following directions: Rub 10 parts of pure morphine to powder, keeping it moist by the addition of a little alcohol, and add 25 parts of glacial acetic acid, triturating constantly; then drop alcohol into the mixture until it has become of a syrupy consistence, and afterward ether until the color of the mixture has changed to milk-white; after two or three days the solidified mass is loosened in the mortar and turned, and when completely dry is rubbed to powder and preserved.

Properties.—Acetate of morphine forms a white mostly amorphous powder which has a slight acetous odor and very bitter taste. Belohoubek (1880) found in the crystallized salt two forms of needles—the first transparent and distinct, the other white, opaque, and aggregated to tufts. When freshly prepared, the salt dissolves at 15° C. (59° F.) in 12 parts of water and 68 parts of alcohol (*U. S. P.*), in 45 parts of alcohol (Hager), and at the boiling-point requires 1.5 parts of water and 14 parts of alcohol (*U. S. P.*), 2 parts of alcohol (Hager). The salt is soluble in 2.44 parts of water (Dott, 1881–82), in 60 parts of chloroform, and is insoluble in ether. The alcoholic solution, mixed with an excess of ether, deposits crystals of morphine, free acetic acid remaining in solution. Cold strong sulphuric acid dissolves the salt without color only when recently made. When kept on hand it slowly loses acetic acid; its reaction to test-paper changes from neutral to alkaline, and the salt becomes incompletely soluble in water unless a little acetic acid be added; it gradually acquires a yellowish-gray, and finally brownish, color, and should then be redissolved in acetic acid and evaporated or converted into another salt of morphine. Its aqueous solution undergoes similar changes, the acetic acid being slowly decomposed, with the separation of brown flocculent compounds, while the morphine crystallizes out, forming long prisms if the solution is not disturbed. The formula given by the Pharmacopœia is that of Oudemanns (1873), and requires 71.4 per cent. of anhydrous or 75.94 per cent. of crystallized morphine. Kieffer (1857) found the salt to contain 79.8 per cent. of morphine.

Tests.—The salt responds to the morphine tests described above, and leaves no residue when ignited. If its solution is precipitated by tannin, the addition of dilute hydrochloric acid redissolves the precipitate; solution of potassa or soda gives a white precipitate soluble in excess of the alkali; a remaining turbidity would indicate the presence of narcotine. Sulphuric acid added to the salt liberates acetous vapors.

Off. Prep.—Liquor morphiæ acetatis, *Br.*

Medical Uses.—The action and uses of the acetate are the same that have been described in the article on Morphina. The *dose* of the acetate is about $\frac{1}{5}$ grain (Gm. 0.01).

MORPHINÆ HYDROCHLORAS, *U. S.*, *Br.*—Hydrochlorate of Morphine.

Morphiæ hydrochloras, Br. 1867; *Morphiæ murias*, U. S. 1870; *Morphinum hydrochloricum*, P. G.; *Murias* (*Hydrochloras*) *morphicus.—Muriate of morphia*, E.; *Chlorhydrate de morphine*, Fr.; *Morphinhydrochlorat*, *Salzsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3.HCl.3H_2O$. Molecular weight 375.4.

Preparation.—The British Pharmacopœia has a process for preparing this salt from opium, which was given under Morphina, as far as the precipitation of pure morphine. The remaining steps are as follows: "Diffuse the pure morphia (obtained from 1 pound of opium) through 2 fluidounces of boiling distilled water placed in a porcelain capsule kept hot, and add, constantly stirring, the diluted hydrochloric acid, proceeding with caution, so that the morphia may be entirely dissolved and a neutral solution obtained. Set aside to cool and crystallize. Drain the crystals, and dry them on filtering-paper. By further evaporating the mother-liquor and again cooling additional crystals are obtained." If pure morphine has been used and an excess of hydrochloric acid avoided, the salt may be wholly obtained in crystals by judicious evaporation of the mother-liquor. On account of the greater stability of this salt and of its solution, the German Pharmacopœia directs it to be dispensed whenever acetate of morphine is prescribed.

Properties.—Hydrochlorate of morphine crystallizes in white silky, flexible, and inodorous needles or transparent prisms having a bitter taste and neutral reaction. It is soluble in 20 parts of cold (24 parts at 15° C. *U. S. P.*; 25 parts *P. G.*; 23.9 parts, Dott, 1882) and in less than its own weight (about 0.5 parts *U. S. P.*) of boiling water; in 60 parts of cold and in 10 parts of boiling 80 per cent. alcohol (Wittstein); in 63 parts (48 parts, Candidus, 1882) of alcohol at 15° C., and in 31 parts of boiling alcohol (*U. S. P.*); in 50 parts of alcohol sp. gr. .832 (*P. G.*); in 19 parts of glycerin and in 800 parts of olive oil; it is insoluble in ether. Heated to 100° C. (212° F.), it loses 14.38 per cent. of water of crystallization (Tausch, 1880). It yields 75.9 per cent. of anhydrous and 80.7 per cent. of crystallized morphine. On triturating the salt with sulphuric acid and sprinkling bismuth subnitrate upon the mixture, a dark-brown color is produced (*P. G.*).

Tests.—The salt should not have an acid reaction, and should answer to all the morphine tests described before; its aqueous solution yields with nitrate of silver a white precipitate, which is insoluble in nitric acid, but dissolves in ammonia. When heated to 130° C. (266° F.) the pure salt remains white, while the commercial salt generally turns brown or black from the decomposition of resinous substances present (Tausch, 1880). When ignited, the salt should leave no fixed residue.

Off. Prep.—Injectio morphiæ hypodermica, Liquor morphiæ hydrochlor., Supposit. morphiæ, Suppos. morphiæ cum sapone, Trochisci morphiæ, Troch. morphiæ et ipecacuanhæ, *Br.*

Medical Uses.—The operation of the hydrochlorate of morphine is identical with that of the acetate, and its *dose* is the same, or about $\frac{1}{5}$ grain (Gm. 0.01).

MORPHINÆ SULPHAS, *U. S., Br.*—SULPHATE OF MORPHINE.

Morphiæ sulphas, U. S. 1870; *Morphinum sulfuricum*, P. G.; *Sulfas morphicus.*—*Sulphate of morphia*, E.; *Sulfate de morphine*, Fr.; *Morphinsulfat, Schwefelsaures Morphin*, G.

Formula $(C_{17}H_{19}NO_3)_2H_2SO_4.5H_2O$. Molecular weight 758.

Preparation.—This salt may be prepared in the same manner as the hydrochlorate. 1 ounce of pure morphine is diffused in 2 ounces of boiling distilled water, and diluted sulphuric acid is cautiously added until the alkaloid is dissolved and the liquid has a neutral reaction to test-paper; it is then allowed to cool and crystallize; the crystals are drained and dried, and the mother-liquor concentrated to obtain an additional crop of crystals.

The importation of morphine and its salts into the United States amounted to somewhat over 3000 ounces annually in 1879 and for some years previous, but has been much larger since, and was 23,239 ounces in 1882.

Properties.—Sulphate of morphine crystallizes in white fascicles of transparent silky, inodorous, and bitter needles, which are neutral to test-paper, and are not altered on exposure to air. At 120° C. (248° F.) it parts with 4 molecules of water (Liebig), but on being heated to 130° C. (266° F.) it loses 11.87 per cent. of water of crystallization, becoming anhydrous (Regnault); the exsiccated salt absorbs water on exposure (Liebig). The crystallized salt dissolves in 23.01 parts of water at 15° C. (59° F.), as was determined by Dott (1881–82). The somewhat greater solubility of some samples of morphine sulphate (Von Coblentz in 1882 found some to be soluble in 18 and 19 parts of water) may be due to the presence of other alkaloidal salt or of an excess of acid. Choulant's statement (1818), that morphine sulphate dissolves in 2 parts of water, refers to a salt which was said to contain 40 morphine, 22 sulphuric acid, and 38 water of crystallization. The officinal salt dissolves in 0.75 parts of boiling water, in 702 parts of alcohol at 15° C., and in 144 parts of boiling alcohol (*U. S. P.*); Hager states it is readily soluble, and P. C. Candidus (1882) found it to dissolve in 40 parts of alcohol. It dissolves in 5 parts of glycerin (Reveil, 1863), but is insoluble in ether. The salt represents 75.2 per cent. of anhydrous and 79.94 per cent. of crystallized morphine. Its aqueous solution yields a white precipitate with chloride of barium, insoluble in nitric acid. Dott (1877) noticed an article sold in England which was adulterated with 34.63 per cent. of anhydrous sodium sulphate.

Tests.—Sulphate of morphine should have a neutral reaction to test-paper, should show the behavior of morphine salts described in the article on MORPHINA, and should leave no fixed residue when ignited.

Off. Prep.—Pulvis morphinæ compositus, Trochisci morphinæ et ipecacuanhæ, *U. S.*

Other Salts of Morphine.—MORPHINÆ HYDROBROMAS, $C_{17}H_{19}NO_3HBr.2H_2O$; mol. weight, 401.8. This salt is prepared by dissolving the alkaloid in warm hydrobromic acid or by double decomposition between alcoholic solutions of 6 parts of potassium bromide and 19 parts of sulphate of morphine, and by evaporating the filtrate from the precipitated potassium sulphate. E. Schmidt (1877) found it to crystallize in long white needles, which are more soluble in water than the hydriodate, and become anhydrous at 100° C. According to Latour, it contains $3H_2O$, and requires 25 parts of water at 15° C. for solution.

Morphinæ hydriodas, $C_{17}H_{19}NO_3.HI.2H_2O$; mol. weight, 448.6. It is prepared, like the preceding, from morphine and hydriodic acid, or from 4 parts of potassium iodide and 9 parts of sulphate of morphine. A concentrated solution of potassium iodide, added to a solution of acetate or hydrochlorate of morphine, separates the same salt. It crystallizes in long silky needles, parts with its water at 100° C., and recombines with it on exposure to air. Prepared by either process, Schmidt found it to have the above formula and to be sparingly soluble in cold water.

Morphinæ tartras $(C_{17}H_{19}NO_3)_2C_4H_6O_6.3H_2O$; mol. weight, 774. On dissolving 4 parts of morphine with 1 part of tartaric acid in 20 parts of hot water, the greater portion of the salt crystallizes on cooling in small needles. It is somewhat efflorescent in dry air, loses at 130° C. 6.76 per cent. of water, is soluble in alcohol, and dissolves in 9.7 parts of water at 15° C. (Dott, 1882); the aqueous solution is not precipitated by alkalies, alkali carbonates, or calcium chloride (Arppe). The salt represents 78.3 per cent. of crystallized morphine.

Morphinæ meconas $(C_{17}H_{19}NO_3)_2C_7H_4O_7.5H_2O$; mol. weight, 860. This salt is present in opium, and may be prepared by neutralizing morphine with meconic acid. According to Robiquet, it is uncrystallizable and is readily soluble in alcohol, and, according to Dott (1882), dissolves in 33.9 parts of water at 15.5° C. (60° F.).

Medical Uses.—Sulphate of morphine is more generally used than any of the other salts of this alkaloid. Its *dose* is about ⅕ grain (Gm. 0.01).

MOSCHUS, *U. S., Br.*—Musk.

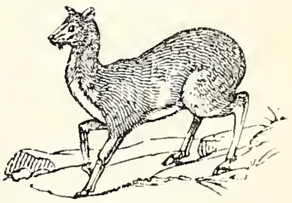
Musc, Fr.; *Moschus*, G.

The dried secretion from the preputial follicles of Moschus moschiferus, *Linné*.

Class Mammalia. Ord. Ruminantia.

Origin.—The musk deer resembles the deer (Cervus), but differs from it in the want of horns, and in the canines, which are long and project considerably downward from the lips of the male. It inhabits chiefly the mountainous regions and elevated table-lands of Central Asia, and is met with from Anam, in Farther India, north-westward to Thibet, and northward in China and Tartary to Mantchooria and Southern Siberia. It lives in pine forests in the Himalayas, frequently at an altitude of 10,000 to 14,000 feet (3000–4260 M.). The musk-sac is found in the male only, and is located on the abdomen, immediately before the preputial orifice and to the rear of the umbilicus. The animal has nocturnal habits, and is taken by snares and pitfalls, or sometimes by shooting; the sac is cut off as soon as possible, and rapidly dried by pressing it against heated stones. 6883 ounces of musk and civet have been annually imported during the past eight years.

Fig. 186.



Musk Deer.

Description.—The musk-bag (called sac, pod, or pouch) is oval in shape, about 2 inches (5 Cm.) long and 1½ inches (38 Mm.) wide, with a thickness of about half an inch (13 Mm.). The upper surface is smooth and flat, the lower surface convex and hairy. The hairs are grayish and brown, rather stiff and appressed, and arranged in a circle toward the aperture near the centre of the bag, and in the form of a pencil toward the preputial orifice, which is about ¼ inch (6 Mm.) in the rear of the former. From this orifice, underneath the hairy skin between the strata of the muscular coat and toward the posterior end of the sac, is a canal containing the front portion of the thin penis. Following the muscular coat is the musk-pouch proper, with an external fibrous coat, having on the inner surface numerous depressions resembling meshes and surrounded by folds, and covered by two coats—the one soft and pearly, and the other very delicate, silvery-white on the outside, and yellowish or brownish on the inside. The musk is supposed to be separated by a number of glands, of which two or more are situated in each depression. In the young animal the secretion is slight and of a milky appearance, but after it has passed its third year the musk is of better quality; in the fresh state it is of an unctuous consistence.

Fig. 187.

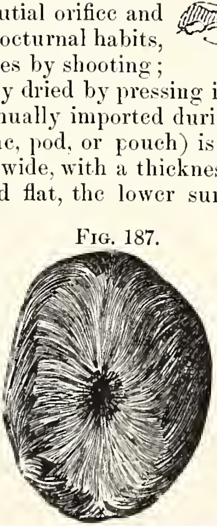
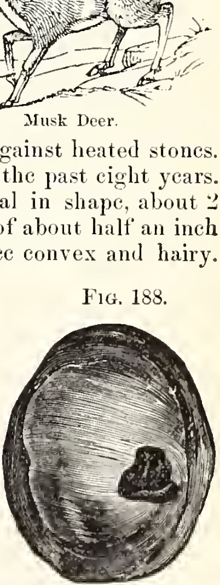


Fig. 188.



Chinese musk-sac.

Lower surface. Upper surface.

From a record kept by Messrs. Cramer and Small (*Amer. Jour. Phar.*, 1872, p. 565) the average weight of Chinese musk-bags was found to be 394 grains, and of the musk in each 157 grains.

Musk is of a crummy appearance, near the musk-orifice mixed with grayish hairs of a reddish-brown color or darker brown, and irregularly granular, somewhat unctuous to the touch, of a strong, diffusible, and persistent odor, and of a bitterish taste. When entirely exsiccated it is almost inodorous, but the odor reappears on moistening, and is increased by the addition of a little alkali. Musk should be kept in not too warm a place, where the air has some access to it. The German Pharmacopœia now requires it, for medicinal use, to be dried over sulphuric acid until it ceases to lose weight. Its odor disappears or is more or less modified on triturating the musk with camphor, oil of bitter almond, fennel, ergot, mustard, sulphur, acids, various salts, etc.

Varieties.—Several varieties are known in commerce, the best being the *Chinese*, *Thibet*, or *Tonquin* musk. It is usually imported in small boxes, internally lined with sheet lead and containing about twenty-five sacs, each wrapped in paper. The outer hairs are trimmed short, and are of a yellowish or grayish color. Musk enters commerce through the Chinese ports. *Siberian musk* comes by way of St. Petersburg, hence the name *Russian musk;* it often resembles and has the same quality as the preceding; when in flatter ovate sacs with thinner and paler hairs, and of fainter, less aromatic, and more urinous odor, it is called *Cabardine musk.* The small and inferior *Bucharian* and *Assam musk-sacs* rarely, if ever, reach this country. Chinese musk only should be employed in medicine, and should always be purchased in sacs.

Substitutions and Adulterations.—The substitution of artificial musk-bags, made from a piece of the hide stitched to a membrane, is readily recognized by the absence of the circular arrangement of the hairs and of the central aperture. Genuine sacs are sometimes slit open, the musk partly removed, and other substances introduced in place thereof. This may usually be detected by being stitched together on the edge of the hide and inside membrane. There is no means of detecting the fraudulent introduction through the orifice of pieces of lead, etc. until after the bags have been opened.

Tests.—Musk should not have an ammoniacal odor. Cold water dissolves about one-half the weight of the musk; the solution should be deep-brown, faintly acid, and scarcely disturbed by solution of corrosive sublimate (ammonium carbonate). Weak alcohol yields a similar solution. Strong alcohol dissolves about 10 per cent., yielding a slightly colored tincture, which should scarcely become turbid on the addition of water (resins, etc.). Carefully freed from fragments of skin and hairs and heated upon platinum-foil, musk should give off a slightly urinous odor, but very distinct from the odor of burning blood, and should leave about 6 to 8 per cent. of a gray (not red) ash. The German Pharmacopœia has adopted the examination of musk by the method suggested by Bernatzik: A small quantity of musk, kept in a thin layer under oil of turpentine (or warmed with a little glycerin), and examined under the microscope, is seen to consist of diaphanous brown amorphous splinters and lumps, without being mixed with other foreign substances.

Constituents.—Musk, treated with potassa, gives off ammonia; it contains cholesterin, various fatty and waxy substances, gelatinous and albuminous compounds, and salts. The odorous principle volatilizes partly with the vapors of water, but is not a volatile oil; it is most probably formed in the presence of moisture by the slow and continuous decomposition of one of the constituents.

Off. Prep.—Tinctura moschi, *U. S.*

Allied Drugs.—ANTILOPE DORCAS, *Linné.* This is a deer-like ruminant inhabiting Northern Africa. Its small globular excrements have a strong musk-like odor, and have been recommended as a substitute for musk, more especially in perfumery. Jacqueme obtained from them 7 per cent. of alcoholic extract, consisting of biliary substances, of a crystallizable acid, and of an odorous resin, which is also soluble in carbon disulphide. Water dissolves ammonium and sodium salts, and the insoluble portion contains calcium phosphate.

HYRACEUM is supposed to be the dry excrements of the *klipdas* or *badger* (Hyrax capensis, *Cuvier*), a mammal of the order Hyracoidea, inhabiting Southern Africa and attaining a length of about 18 inches (45 Cm.). Hyraceum is in irregular tough but plastic pieces of a black-brown color; when warmed of a castor-like odor and having a bitter nauseous taste. It is partly soluble in water, less soluble in alcohol and ether, and when heated becomes soft, and afterward burns, giving off acrid vapors. It contains a volatile oily matter, resin, fat, various acids, biliary constituents, etc.

CIVETTA, ZIBETHUM.—Civet, *E.;* Civette, *Fr.;* Zibeth, *G.*—This is an unctuous secretion contained in a pouch located between the anus and genitals of both the males and females of Viverra

Civetta, *Schreber*, and V. Zibetha, *Schreber* (class Mammalia, ord. Carnivora). The former animal inhabits Africa, the latter Southern Asia, and they are occasionally kept captive for collecting the secretion, which is removed by means of a small ladle. It is at first yellowish, but becomes dark-brown, is fusible, nearly insoluble in water, partly soluble in ether and in hot alcohol, and has a strong musk-like odor and a bitterish, acrid, nauseous taste. It contains volatile oil, different fats, resin, coloring matters, and salts.

The above substances are sometimes, though rarely, employed as stimulants and anti-spasmodics, but are more or less used in perfumery.

Physiological Action.—Injected into the veins of animals, musk has produced a degree of narcotism with muscular spasms, followed by bloody stools, exhaustion, and death, after which cadaveric rigidity and mucous injection were found. In man it produces an effect comparable to that of alcohol, since, after stimulating the brain and heart and raising the temperature, it occasions, according to some, drowsiness and thoracic oppression, but, according to others, leaves no reactionary effects behind. Its odor continues for several days to impregnate the breath and all the secretions.

Medical Uses.—The scarcity, high price, and falsification of musk have caused its use to be comparatively restricted, and explain the varying and often contradictory estimates of its value as a medicine. Yet, on the whole, the conditions it is adapted to remedy are pretty well defined. They include all those nervous phenomena which are represented by the term *ataxia*, and among them subsultus tendinum, mild muttering delirium, floccitation, muscæ volitantes, and hiccough, with a small, frequent, tremulous or irregular pulse, without coma and without collapse. Under these circumstances musk tends to produce refreshing sleep, while it calms muscular spasm and favors perspiration, while the pulse grows fuller, more regular, and less frequent. These are phenomena which may occur in all febrile diseases originally of a typhoid type or tending to assume it, and notably in *typhus*, *typhoid fever*, the *eruptive fevers*, and certain inflammations also, but particularly *pneumonia*. In proportion as ataxic prevail over adynamic phenomena is musk advantageous. The former are often met with in the advanced stages of *cholera infantum*, besides others that indicate serous effusion upon the brain; and they are sometimes dissipated by the administration of musk.

Its fitness to combat the special phenomena above indicated is illustrated by its efficacy in purely nervous and non-febrile affections. There can be no doubt of its having repeatedly effected a cure in cases of *hiccough*, *pharyngeal spasm*, *laryngismus stridulus*, *spasmodic croup* (spasmodic laryngitis), *spasmodic cough*, *whooping cough*, *vomiting*, and *colic*. Even *chorea*, *hysterical convulsions*, and *tetanus* have occasionally been cured by its means. Its power as a nervine is also shown by its relieving *wakefulness* resulting from combined mental and bodily fatigue—such cases, in fact, as are benefited by valerian, camphor, asafetida, and ammonia.

Musk is usually administered in pill or emulsion and in *doses* of 10 grains (Gm. 0.60) or upward, every two or three hours. It may also be employed in suppositories. To children it may be given in doses of 1 or more grains (Gm. 0.06) in the above-mentioned forms or in a small enema.

MOXA.—Moxa.

Moxa, Fr.; *Brenncylinder*, G

Moxas are vegetable substances, either cut or formed into short cylinders, and which when ignited will burn without fusing. In China and Japan moxas are made of the felt-like down covering the leaves of Artemisia chinensis, *Linné*, and perhaps of other plants. In other countries paper, cotton, or hemp impregnated with a weak solution of nitrate of potassium has been employed for the purpose, or the pith of some plants containing sufficient nitrates to sustain an even combustion, like that of the sunflower (see page 759). Occasionally mixtures have been made of potassium nitrate with substances like lycopodium, beaten together with some adhesive material and rolled into cylinders of convenient size. Instead of nitrate, chlorate or chromate of potassium has been employed. Cylinders made of saltpetre-paper (see page 421) have been used for the same purpose.

Medical Action and Uses.—The moxa is said to have been employed as a form of cautery from time immemorial by Oriental nations, and particularly by the Chinese and Japanese, from whom it was introduced into Europe by the Portuguese; but it was also used by the Egyptians, the Persians, and the Laplanders. The moxa cylinder should be about an inch long and from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. One end of it is applied to the skin and held in its place by a pair of forceps or a *porte-moxa*, while the opposite end is lighted and the surrounding skin protected by a damp rag, a piece of adhesive plaster, or of paper saturated with a solution of alum and dried and having an aperture in its centre. Combustion is maintained by the breath or by a pair of bellows until the whole cylinder is consumed. To prevent deep cauterization liquor ammoniæ is applied immediately after the burning. Sometimes the cylinder is moved about within a small area, without permitting any one spot to become deeply involved; or it may be held very near, but without touching the skin; or, finally, it may be removed when the combustion of the moxa has reached to within a line or two of the skin. It should not usually be applied where the skin is the only covering of bone, tendon, ligament, or cartilage, nor to the mammæ, genital organs, or abdomen. The first sensation of heat is apt to be considered agreeable rather than painful, but it increases and grows tolerably severe. Yet we are assured that it causes less pain than either blisters or caustic issues.

In regard to the *modus operandi* of the moxa those who have most employed it consider that its action differs from that of the hot iron. Some have suggested that a very volatile (anæsthetic) principle is given off by the burning fibres, and in point of fact an empyreumatic oil must in this way be formed upon or near the skin; others consider that the operation is most efficient when there is really no burning of the integument or any serous or purulent discharge.

The remedial uses of moxa are those of counter-irritant agents in general. It seems to have been most efficient in affections of the superficial joints, as the *knee* and the *wrist;* in *white swelling* and *coxalgia;* in diseases of the *vertebræ* and their ligaments and in *lumbar abscess;* in *neuralgia*, and especially in *sciatica;* in *lumbago*, *rheumatic gout*, and *paralysis;* and finally in *hypertrophy of the spleen* and in *chronic bronchitis.* Of late years most of the applications of the moxa have been superseded by those of the galvanic cautery. This cautery has the advantage of being under the control of the surgeon more completely than any other, and also of being applicable to deep-seated lesions even of the bones.

MUCILAGINES.—Mucilages.

Mucilages, Fr.; *Schleime*, G.

These preparations consist of viscid, more or less tenacious, and adhesive liquids, or of opaque semi-liquid jellies; in all cases the solvent vehicle is water. All mucilages as directed by the pharmacopœias are prone to change, and gradually acquire an acid reaction and offensive odor, at the same time becoming more liquid. If not intended for medicinal use the change may be retarded or prevented by the addition of alum, creasote, or glycerin.

MUCILAGO ACACIÆ, *U. S., Br.*—Mucilage of Acacia.

Mucilago gummi arabici, P. G.—*Mucilage of gum-arabic*, E.; *Mucilage de gomme arabique*, *Mucilage arabique*, Fr.; *Gummischleim*, G.

Preparation.—Acacia, in small fragments, 34 parts (8½ oz. av.); Water a sufficient quantity; to make 100 parts (25 oz. av. or about 19 fluidounces). Wash the acacia with cold water, then add to it 66 parts (16½ oz. av. or 15⅞ fluidounces) of water; agitate occasionally until it is dissolved, and strain.—*U. S.*

Gum-arabic 4 oz. av.; distilled water 6 fluidounces (Imperial).—*Br.* Gum-arabic 1 part; distilled water 2 parts.—*P. G.* Powdered gum-arabic 1 part; cold water 1 part; dissolve in a mortar.—*F. Cod.*

White and clear pieces of gum-arabic should be selected for preparing this mucilage. The impurities which necessitate the subsequent straining are generally accidental admixtures of the gum, and may mostly be removed by rapid washing with cold water before dissolving it. The solution may be effected in a corked bottle by placing it on its side, whereby a more extended surface of the gum is exposed to the solvent action of water, and by agitating it occasionally so as to mix the heavy solution with the lighter liquid. It is a nearly transparent, colorless, or scarcely yellowish, viscid liquid, having a faint rather agreeable odor and an insipid taste. To prevent its decomposition, Archer & Co. (1874) employed *tolu-water* instead of distilled water, using 1 fluidrachm of tincture of tolu, rubbed up with carbonate of magnesium, to 1 pint of water.

Pharmaceutical Uses.—This mucilage serves for the suspension of insoluble substances in mixtures and to impart adhesiveness to pill masses. The British Pharmacopœia directs it to be used as an excipient in the preparation of troches

MISTURA GUMMOSA.—Gum mixture, *E.;* Potion gommeuse, Julep gommeux, *Fr.;* Gummimixtur, *G.*—Powdered gum 10 parts, syrup of gum 30 parts, water 100 parts, and orange-flower water 10 parts.—*F. Cod.*

Off. Prep.—Syrupus acaciæ, *U. S.*

Medical Uses.—This mucilage, diluted according to the taste or the condition of the patient, and sweetened and flavored, forms a customary drink in *fevers* and in inflammatory affections of the *respiratory* and *digestive* organs. It is probably not directly nutritive, but it possibly retards tissue-waste.

MUCILAGO AMYLI, *Br.*—MUCILAGE OF STARCH.

Mucilage d'amidon, Fr.; *Stärkeschleim*, G.

Preparation.—Take of Starch 120 grains; Distilled Water 10 fluidounces. Triturate the starch with the water gradually added, then boil for a few minutes, constantly stirring.—*Br.*

It should always be made fresh when needed.

Off. Prep.—Enema aloes, Enema magnes. sulphat., Enema opii, Enema terebinthinæ, *Br.*

Medical Uses.—Mucilage of starch is generally entrusted to domestic manufacture, but it may be worth while for physicians to know that 120 grains of starch should be mixed with about ½ pint of water (Gm. 4 to Gm. 250) to procure a liquid of the proper density for an enema, such as may be used in *dysentery.* But in that disease, if opiates or any other medicines intended to be retained are to be added to the mucilage, the quantity of it injected should not exceed 3 ounces.

MUCILAGO CYDONII, *U. S.*—MUCILAGE OF CYDONIUM.

Mucilago cydoniæ.—Mucilage of quince-seed, E.; *Mucilage de coing*, Fr.; *Quittenschleim*, G.

Preparation.—Cydonium 2 parts (18 grains or 1.2 Gm.); Distilled Water 100 parts (900 grains or 60 Gm. or 2 fluidounces). Macerate the cydonium for 30 minutes in a covered vessel with the distilled water, frequently agitating. Then strain the liquid through muslin, without pressure. This preparation should be freshly made when required for use.—*U. S.*

The P. G. 1872 recognized the same formula, but employed rose-water. The French Codex directs quince-seed 1 part and tepid water 50 parts, to be left in contact for 6 hours, after which the mucilage is strained with pressure.

Bandolin is a mucilage of quince-seeds used for dressing the hair, and is made by macerating 2 drachms of unbroken quince-seeds in a pint of water, and adding about an ounce of cologne-water, with some other scent to suit.

Action and Uses.—Quince-seed mucilage is lenitive and protective, and, like other mucilages, may be applied to the *inflamed skin* or *conjunctivæ*, and may be administered internally in *gastro-intestinal* and *urinary inflammations*, and to allay *cough*, irritation of the air-passages, etc.

MUCILAGO SASSAFRAS MEDULLÆ, *U. S.*—MUCILAGE OF SASSAFRAS-PITH.

Mucilage de moëlle de sassafras, Fr.; *Sassafrasmark-Schleim*, G.

Preparation.—Take of Sassafras-Pith 2 parts (9 grains); Water 100 parts (450 grains or 1 fluidounce). Macerate for 3 hours, and strain.—*U. S.*

It is a colorless, thickish, transparent liquid of a bland taste.

Medical Uses.—The mucilage of sassafras-pith is a refreshing and useful application to the eye in *acute conjunctivitis*, and may serve as a vehicle for more active agents. It is equally appropriate as a soothing lotion in erythematous and other *inflammations of the skin.* Internally, it may be freely used as a drink in *dysentery* and other bowel complaints, and in *febrile affections* generally.

MUCILAGO TRAGACANTHÆ, *U. S., Br.*—Mucilage of Tragacanth.

Mucilage de gomme adragante, Mucilage adragant, Fr.; *Traganthschleim*, G.

Preparation.—Tragacanth 6 parts (144 grains); Glycerin 18 parts (432 grains = 6 fluidrachms); Water a sufficient quantity; to make 100 parts (2400 grains or 5½ oz. av.). Mix the glycerin with 76 parts (1824 grains or 4 fluidounces) of water; heat the mixture to boiling, add the tragacanth, and let it macerate for 24 hours, stirring occasionally. Then add enough water to make the mixture weigh 100 parts (5½ oz. av.), beat it so as to render it of uniform consistence, and strain forcibly through muslin.—*U. S.*

Take of tragacanth, in powder, 60 grains (or 12 parts); distilled water 10 fluidounces (or 875 fluid parts); rectified spirit 2 fluidrachms (or 22 fluid parts). Mix the tragacanth with the spirit; then pour in the water with constant agitation.—*Br.*

The first formula yields a thick jelly-like mass, the second a more fluid preparation. The former is better adapted as an excipient for troches (*U. S.*) and many pill masses. If made without glycerin, as directed by the U. S. P. 1870 and by the French Codex (tragacanth 1 part, water 9 parts), it has the disadvantage of drying out and rendering the pills very slowly soluble—a fault which has been corrected by substituting glycerin for a portion of the water. Thus prepared, it may be readily mixed with aqueous liquids, and serves also a good purpose for suspending insoluble substances.

Medical Uses.—Tragacanth mucilage has scarcely any medicinal qualities peculiar to itself. It is seldom used unless as an excipient in lenitive mixtures, and in troches and lozenges which are intended to dissolve slowly in the mouth. Its tenacity has led to its occasional use as a protective for *burns and ulcers.*

MUCILAGO ULMI, *U. S.*—Mucilage of Slippery-Elm Bark.

Mucilage d'écorce d'orme fauve, Fr.; *Ulmenrinden-Schleim*, G.

Preparation.—Elm, sliced and dried, 6 parts (108 grains); Boiling Water 100 parts (1800 grains or 4 fluidounces). Macerate for 2 hours in a covered vessel, and strain.—*U. S.*

There is no obvious reason for specially drying slippery-elm bark; perhaps *bruised* was intended, as heretofore directed. The mucilage, becoming cold during the protracted maceration, cannot be strained without pressure, whereby a portion of the powder resulting from the ruptured tissues would be forced through the strainer. By substituting digestion for maceration the process could be materially shortened and the warm liquid more readily strained. The mucilage contains at least a portion of the starch of the bark; if intended to be free from starch, cold water should be used. (See also page 544).

Medical Uses.—As a demulcent, mucilage of slippery elm is employed in *acute* affections of the respiratory, digestive, and urinary organs. As a lenitive for external use it is frequently applied to *erysipelatous* and other acute *cutaneous eruptions, abscesses, rheumatic joints*, etc. It is very apt to grow sour, and, if allowed to get dry, renders the skin painfully hard and stiff.

MUCUNA.—Cowage.

Setæ siliquæ hirsutæ.—Cowhage, E; *Pois velus, Pois à gratter*, Fr.; *Kratzbohnen, Kuhkrätze*, G.

The hairs of the pods of Mucuna (Dolichos, *Linné*, Stizolobium, *Persoon*, Carpopagon, *Roxburgh*) pruriens, *De Candolle*, s. Mucuna prurita, *Hooker*. Woodville, *Med. Bot.*, t. 153; Bentley and Trimen, *Med. Plants*, 78.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a long, slender, twining plant, with large trifoliate, nearly smooth leaves, and showy dark-purple and greenish flowers in pendulous axillary racemes, producing flattish, hairy, S-shaped legumes, with about four brownish seeds mottled with black. It is cultivated and wild both in the East and West Indies.

Description.—The hairs covering the legumes are about ⅛ inch (3 Mm.) long, of a glossy-brown color, straight, quadrangular prismatic, sharply pointed at the apex, somewhat retrorsely serrate on the upper half, and partly empty, partly filled with a brown granular matter. They easily penetrate the skin, and occasion an intolerable itching, which is greatly increased by washing and rubbing.

The fruits of Stizolobium (Mucuna, *De Candolle*, Dolichos, *Linné*) urens, *Persoon*, are shorter, less bent, and covered with shorter and darker hairs, which are used like the preceding. An emulsion of the seeds is used in the West Indies in dysuria, and an infusion of the root of the first species is considered to possess diuretic properties, and in India is employed as a remedy in cholera.

Constituents.—Nothing is known of the composition of cowhage, except that it contains a little tannin and resin (Martius, 1827).

Medical Action and Uses.—Cowhage was originally employed as a *vermifuge* under the idea that its prickly setæ, which irritate the skin so severely and are so difficult to detach, would wound and injure the worms, and either kill them or promote their expulsion. Observation showed, however, that when the spiculæ are moistened they are quite innocuous, and there is much reason for believing that the supposed vermicide virtues of this substance are imaginary. It is difficult to imagine that an agent which has actually been employed to produce a painful irritation and eruption upon *paralyzed limbs* for the purpose of arousing their dormant functions should cripple or destroy intestinal worms and leave the intestine itself uninjured. As a vermifuge the setæ are mixed with honey or molasses by dipping the pods in the liquid, and when it has reached the consistence of an electuary it may be given, fasting, in doses of 1 or more teaspoonfuls for several successive days. Subsequently a purge of calomel and jalap may be prescribed; and this is, doubtless, the most efficient part of the treatment. When formerly used to relieve paralysis, it was applied in a layer upon the affected part, supported by thin paper or a similar substance, or else incorporated in simple ointment or lard.

MYRICA.—WAX-MYRTLE.

Bayberry, *Candleberry*, E.; *Arbre à suif*, Fr.; *Wachsbaum*, *Wachsgagel*, G.

Myrica cerifera, *Linné*.

Nat. Ord.—Myricaceæ.

Origin.—The wax-myrtle is shrubby or sometimes arborescent, usually from 4 to 8 feet (1.2–2.4 M.) high, and grows near Lake Erie, but chiefly along the Atlantic coast of North America. It has alternate, oblong-lanceolate, entire or near the apex sparingly toothed leaves, which are nearly smooth, about 2 inches (5 Cm.) long, on both sides covered with resinous dots, and fragrant when bruised. The flowers are diœcious, the staminate ones in nearly cylindrical catkins about $\frac{3}{4}$ inch (18 Mm.) long, the pistillate ones shorter, and producing globular one-seeded nuts, which are of the size of a pea, blackish, and covered with a white waxy incrustation.

The bark and waxy incrustation of the fruit have been employed.

Description.—1. The bark is in quills or curved pieces about $\frac{1}{16}$ inch (1.5 Mm.) thick, externally covered with a whitish, slightly wrinkled, thin, corky layer, which separates in small fragments, underneath which the bark is dark reddish-brown and nearly smooth, resembling the inner surface, except that the latter is slightly striate. The fracture is granular, of a pale-reddish color, and scarcely fibrous in the inner layer. The bark yields a light reddish-brown irritating powder, which has a peculiar aromatic odor and an astringent somewhat bitter and pungently acrid taste.

2. Myrtle-wax, or *bayberry tallow*, is prepared by boiling the fruit with water until the fat collects on the surface. It has a balsamic odor, is harder and more brittle than beeswax, varies in color between green, yellowish, and gray, and breaks with a shallow conchoidal fracture. G. E. Moore (1862) found its specific gravity to range from 1.004 to 1.006, its fusing-point from 47° to 49° C. (116.6° to 120.2° F.), and four-fifths of it to be soluble in hot alcohol.

Constituents.—The constituents of bayberry-bark, as determined by G. M. Hambright (1863), are, besides those more generally met with, a trace of volatile oil, tannin, an acrid resin soluble in alcohol and ether, an astringent resin insoluble in ether, and *myricinic acid*, the latter obtained from the alcoholic extract, after having been treated with ether, by exhausting it with hot absolute alcohol. It forms small granules, which produce a thick froth on being agitated with water, and on the addition of ammonia a deep-green color, rapidly changing to red and yellow. It has a lastingly acrid taste. Dana obtained from the fruit 32 per cent. of solid fat, 5 of resin, and 45 of starch. The myrtle-wax consists, according to G. E. Moore, of about one-fifth palmitin, the remainder being palmitic acid, with a small quantity of lauric acid.

Allied Plants.—Myrica Gale, *Linné*.—Sweet gale, Dutch myrtle, *E.;* Piment royal, Galé odorant, *Fr.;* Gagel, Brabanter Myrte, *G.*—This is a smaller shrub than the preceding, growing in swampy places from the mountains of North Carolina northward to Canada, and in the northern parts of Europe and Asia. The leaves are on short petioles 1½ inches (38 Mm.) long, obovate-lanceolate, wedge-shaped at the base, serrate near the apex, subcoriaceous, softly pubescent beneath, and on both sides with yellow resinous dots. The fruit is likewise resinous-dotted. The leaves and brown branches have a strong balsamic odor and an aromatic, astringent, and bitterish taste. Rabenhorst (1836) obtained from 3000 parts of fresh leaves 1 part of a thickish volatile oil containing 70 per cent. of stearopten.

A solid fat very similar to myrtle-wax is obtained from the fruit of other species of Myrica indigenous to different countries.

Medical Action and Uses.—The bark of the root is acrid and stimulant, and in doses of a drachm causes a sensation of heat in the stomach, followed by vomiting, and sometimes by diuresis. When chewed it acts as a sialagogue, and has proved useful in *toothache.* The powder is an active errhine. The leaves have some celebrity in domestic practice as an anti-spasmodic, anti-scorbutic, and astringent medicine. They have been used to check *hæmoptysis.* The other native species are very similar in their properties. The "myrtle-wax" which covers the berries appears to have astringent and slightly narcotic properties, and was used with alleged success in an epidemic of typhoid *dysentery* when it was administered in the dose of 1 or 2 drachms (Griffith).

MYRISTICA, *U. S., Br.*—Nutmeg.

Semen myristicæ, P. G.; *Nux moschata.—Muscade, Noix de muscade*, Fr.; *Muskatnuss*, G.

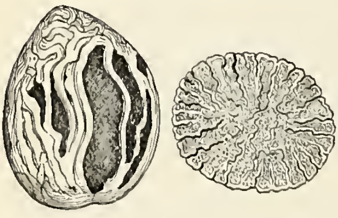
The kernel of the seed of Myristica fragrans, *Houttuyn*, s. M. moschata, *Thunberg*, M. aromatica, *Lamarck*, M. officinalis, *Linné filius.* Suppl. Steph. and Church, *Med. Bot.*, plate 104; Bentley and Trimen, *Med. Plants*, 218.

Nat. Ord.—Myristicaceæ.

Origin.—The nutmeg tree is indigenous to the Molucca Islands, but is at present cultivated in various parts of India, in the Philippines, West Indies, and South America. It attains a height of 30 to 60 feet (9–18 M.), and has alternate, smooth, entire, and prominently veined, leathery leaves, and small, yellowish, diœcious flowers, with the stamens united into a fleshy column, and a superior ovary, ripening into a dehiscent, pear-shaped, tough, one-seeded berry. The tree commences to yield fruit when about nine years old, and continues productive for sixty or seventy years.

Collection.—The fruit is gathered, when split on one side, by means of a long hook fastened to a long stick; the pericarp is removed, and the arillus (see Macis, p. 943) detached from the nut-like seed, which on the Banda Islands is carefully dried first by solar heat for a few days, or in Bencoolen at once on frames over a slow wood-fire at a temperature of about 140° F. This requires about 2 months, during which time the seeds are frequently turned, and when the kernels rattle in the shell they are packed for the Chinese market. The entire seeds do not enter the European and American commerce, but only the kernels, which are removed from the shell by cracking the latter with a wooden mallet, carefully garbled and packed (*unlimed nutmegs*), sometimes mixed with cloves, in casks which have been smoked and whitewashed on the inside. In the Dutch colonies the kernels are dipped in a thick milk of lime (*limed nutmegs*)—a custom which originated in the desire to destroy the vitality of the embryo, and thus limit this culture to their own possessions. Small and worm-eaten nutmegs are usually used for obtaining the fixed oil. About 1,000,000 pounds of nutmegs are now annually consumed in the United States.

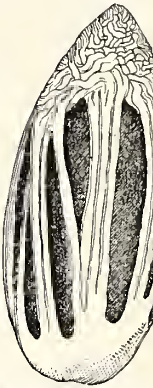
Fig. 189.



Nutmeg with mace, and transverse section.

Description.—Nutmeg in the shell is an oval or elliptical seed about an inch (25 Mm.) or more in length, with a brown, somewhat glossy, woody but brittle testa, light-brown raphe, and bearing the shallow impression of the mace. The nutmegs of our commerce are deprived of the testa or shell, oval or ovate in shape, an inch (25 Mm.) or a little less in length, and marked on the broad end with a circular scar, from which proceeds a shallow furrow to a deeper depression near the upper end. The entire surface is reticulately furrowed and of a light-brown color, or covered, particularly in the furrows, with a white powder (lime). The embryo is located near the broad end in a small conical cavity of the albumen or endosperm, which constitutes the remainder of the commercial article, is of a pale brownish-yellow color, has a fatty lustre, and is dissected by numerous curved channels filled with brown tissue and penetrated by the inner seed-coat (tegmen). Nutmegs have a strong and pleasant aromatic odor and a warm, aromatic, somewhat bitter taste.

Fig. 190.



Wild Nutmeg, with mace.

The Penang and Singapore nutmegs are unlimed; the Dutch are limed.

False Nutmegs.—The *long*, *wild*, or *male* nutmeg resembles the foregoing, but is oblong, about 1½ to 2 inches (4–5 Cm.) long; the mace inodorous, less deeply lobed, the kernel of a paler color than nutmeg, and scarcely aromatic. It is obtained from Myristica fatua, *Houttuyn*, and is rarely seen in our commerce.

The so-called *California nutmeg* is the seed of Torreya californica, *Torrey*, s. T. Myristica. *Hooker;* nat. ord. Coniferæ, sub-ord. Taxineæ. It is oblong, with a smooth, brownish, thin testa, enclosing a kernel of the same shape, which has upon cross-section a marbled appearance similar to that of the nutmeg, but has a terebinthinate odor and taste. The tree grows to the height of 70 feet (21 M.), and has an odorous light-colored and close-grained wood.

Constituents.—Nutmegs contain between 2 and 8 per cent. of volatile oil (see Oleum Myristicæ), between 25 and 30 per cent. of fat (see Oleum Myristicæ Expressum), some starch, protein compounds, and other principles of no medicinal importance.

Off. Prep.—Acetum opii, Pulv. aromaticus, *U. S.;* Pulv. catechu comp., Pulv. cretæ aromaticus, Spiritus armoraciæ comp., *Br.;* Tinctura lavandulæ comp., *U. S.*, *Br.;* Tinct. rhei aromat., Trochisi cretæ, Troch. magnesiæ, Troch. sodii bicarbonatis, *U. S.*

Medical Action and Uses.—Observations and experiments upon man and animals agree in showing that nutmeg has a narcotic and intoxicating power. A woman took ½ pint of whisky in which an ounce of finely-powdered nutmeg was mixed. She suffered various symptoms, probably due to the alcohol in the draught. It is stated that after these subsided she had pain in the ovaries, a leucorrhœal discharge, and sexual excitement (*Phila. Med. Times*, x. 438). It is but little used as a medicine, except for flavoring purposes, but extensively as a condiment to qualify the action of oleraceous vegetables, soups, and pastry. It may be given in cases of simple debility of the stomach in *doses* of from 5 to 20 grains (Gm. 0.30–1.30).

MYROBALANUS.—Myrobalan.

Myrobalans, E., Fr.; *Myrobalanen*, G.

The fruit of several species of Terminalia, *Linné* (Myrobalanus, *Gaertner*).

Nat. Ord.—Combretaceæ.

Origin.—The following species yield myrobalans: Terminalia Chebula, *Retzius*, T. bellerica, *Roxburgh*, T. citrina, *Roxburgh*, and perhaps others. They are large trees, indigenous to India, with coriaceous entire and alternate or nearly opposite leaves, decandrous whitish or yellowish racemose flowers, and one-seeded drupaceous fruits.

Description.—The following varieties have been distinguished:

1. Myrobalani chebulæ. They are 1¼ to 2 inches (3–5 Cm.) long and ½ to 1 inch (12–25 Mm.) thick, oblong or pyriform in shape, obtusely five-angled and five-ribbed, blackish-brown, the endocarp pale-brown and resinous-dotted, and contain a white seed.

2. M. bellericæ. They are roundish-oval, of about the size of a nutmeg, narrowed below, and indistinctly five-angled, reddish-brown, covered with a soft brownish tomentum, and contain a pale-brown endocarp enclosing the ovate and obtusely triangular seed.

3. M. citrinæ. These are 1½ inches (38 Mm.) long, oblong, obtusely five-angled, ribbed, orange- or ochrey-yellow, smooth, with a pale-brown acutely angular endocarp and a cylindrical seed.

4. M. nigræ, s. indicæ. These are unripe fruits, varying in size and shape, blackish-gray, and with an undeveloped seed.

5. M. emblicæ. These are obtained from Emblica officinalis, *Gaertner*, s. Phyllanthus Emblica, *Linné*, a euphorbiaceous tree of India, and consist of subglobular drupaceous six-grooved capsules, which contain in each of the three cells two triangular red-brown seeds.

Constituents.—The astringent taste of myrobalans is due to tannin; Stenhouse (1843) found in the first variety also gallic acid, mucilage, and brown-yellow color. The last variety contains notable quantitities of sugar. According to Hennig (1869), myrobalans yield about 45 per cent. of tannin, which is obtainable in the same manner as from nutgalls, and at a lower price, owing to the cheapness of the drug. The seeds contain fixed oil.

Allied Species.—TERMINALIA CATAPPA, *Linné*. The bark is very astringent. The seeds resemble almonds, are edible, and yield about 30 per cent. of a bland fixed oil, which does not readily turn rancid, and at 5° C. (41° F.) commences to separate stearin.

TERM. BENZOIN, *Linné filius*, s. T. augustifolia, *Jacquin*. The resinous exudation is fragrant and resembles benzoin in properties.

Medical Action and Uses.—These fruits are now wholly disused in medicine, although they were once held in high esteem. Pliny speaks of one species as an astringent in diarrhœa and menorrhagia and as a vulnerary. The Arabian physicians abound in their praise. Some species appear to have been cholagogue and others astringent. Rhazes declares that they act as emetics and cathartics, purge away the excrement, remove humidity, strengthen the senses and the understanding, and are useful in cutaneous eruptions, colic, mental debility, obstinate fevers, headache, dropsy, and splenic disorders. Mesue embellishes this statement by adding, among other things, "that they restore youth, improve the complexion, the breath, and the perspiration, impart joy and hilarity," etc. They continued to be used by European physicians as late as the last century.

MYRRHA, *U. S., Br., P. G.*—MYRRH.

Gummi-resina myrrha.—Myrrhe, Fr., G.

A gum-resinous exudation from Balsamodendron (Balsamea, *Engler*) Myrrha, *Nees. Plant. Med.*, plate 357; Berg and Schmidt, *Off. Gew.*, t. 29; Bentley and Trimen, *Med. Plants*, 59.

Nat. Ord.—Burseraceæ.

Origin.—Myrrh exudes spontaneously from large shrubs or small trees, about 10 feet (3 M.) high, growing in the Somali country and in South-western Arabia, and is collected by the Somalis, who cross the Gulf of Aden for the purpose; but the principal supply of myrrh comes from Eastern Africa, from the country of the Somalis. The plant was collected by Ehrenberg (1820–26) in Arabia, and a second species found in Africa was subsequently named Bals. Ehrenbergianum, *Berg*, but is by Oliver and Bentley considered identical with B. Opobalsamum, *Kunth*, which grows northward into Abyssinia, and is the source of balm of Gilead (see below). Formerly, myrrh entered commerce through Egypt and the ports of the Levant, hence the term *Turkey myrrh*; at present it is mostly taken from Aden and Berbera to Bombay, where it is assorted before being shipped to Europe and America. From the observations of Marchand (1866), it seems to be chiefly produced in the bark and to a small extent in the pith. About 20,000 pounds of myrrh are imported into the United States.

Description.—Myrrh is in roundish or irregular tears, or in larger masses having an uneven surface of a lighter or darker reddish-brown color and dull dusty appearance. These break readily with an uneven somewhat splintery fracture, which is of a waxy lustre, apparently fatty to the touch, often marked with semicircular whitish lines of a brownish-yellow or reddish color, and translucent, at least when in thin layers. In cold weather myrrh may be readily powdered, but in warm weather it cannot be reduced to a fine powder until after it has been well dried and deprived of some volatile oil. When triturated with water it yields a brown-yellow emulsion. Alcohol dissolves it partly, leaving the gum behind and yielding a brownish orange-colored tincture. The alcoholic extract dissolved in ether acquires a red or violet color in the presence of bromine vapor. Myrrh has a peculiar rather agreeable odor and an aromatic, acrid, and bitter taste.

Other Varieties of Myrrh.—According to Vaughan (1853), there are two other varieties of myrrh found in the Arabian commerce at Aden—one called by the Arabs *mur*, or by the Somalis *mulmul*, also known as *heera bôl*, by which names African myrrh is likewise known; it resembles the latter in all sensible properties, and is considered identical with it, although it is usually upon the fractured surface destitute of the whitish lines and dissolves in alcohol, sometimes to the extent of 25 per cent. The other variety is known as *bissa bôl*, or by the Somalis as *hebbakhade*. Hanbury (1853) states that it is the *Myrrha indica* of Martiny, and was formerly, but is not now, distinguished in commerce as *Indian myrrh*; it has the appearance of an inferior dark-colored myrrh, and is chiefly distinguishable by its different odor, which is likened to that of mushrooms.

Admixtures.—Myrrh is not unfrequently mixed with dark-colored pieces of various gums, some of which merely swell with water, and with *East India bdellium*. The latter is referred to Balsamodendron (Balsamea, *Engler*) Mukul, *Hooker*, and, according to Dymock (1876), a similar exudation is yielded by B. Roxburghii, both species indigenous to India, but perhaps also growing in Southern Arabia. It is in large pieces, rounded and dusty on the surface, breaks with a flat conchoidal fracture, has a dark sometimes blackish-brown color, is translucent in thin layers, and has an odor somewhat resembling myrrh; its tincture does not acquire a purplish color on the addition of nitric acid.

Constituents and Tests.—Myrrh contains a small quantity of volatile oil which may reach 2 or 2½ per cent., from 25 to 40 per cent. of resin, 40 to 65 (or in Arabian myrrh 75) per cent. of gum, and yields about 3½ per cent. of ash, mostly $CaCO_3$. *Oil of myrrh* is a pale-yellow, thick liquid, of specific gravity 0.98, but, according to Brandes (1819), sometimes heavier than water. The variable yield is explained by Bley and Diesel (1845) by oxidation, whereby, among other products, formic acid is formed. From the same cause, probably, the composition may vary: Ruickholdt (1845) obtained results leading to the formula $C_{10}H_{14}O$, which would make it isomeric with thymol and carvol; Heldt (1847) found $C_{22}H_{32}O_2$; Buri (*Pharmacographia*) obtained $C_{22}H_{32}O$. Dissolved in bisulphide of carbon, the oil gradually assumes a permanent violet or blue color after the addition of nitric acid or bromine. The *resin* is entirely soluble in alcohol, ether, and choloform. Hager (1865) found it only partly soluble in bisulphide of carbon, the soluble portion acquiring a violet color with nitric acid and with bromine. Hydrochloric acid produces the same color with the resin, after previously moistening it with alcohol. The bitter principle, according to Flückiger, is sparingly soluble in water, partly soluble in carbon disulphide, soluble in ether and in alcohol, and from the latter solution precipitated by lead acetate; its alkaline solution reduces Fehling's test liquid and precipitates floccules on the addition of acids. The *gum* consists, according to Hekemeijer (1858), of two kinds—one being precipitated by neutral, the other by basic acetate of lead. Shuttleworth (1871) recommends it as making a good paste of unlimited keeping qualities; its adhesiveness is increased by the addition of a little molasses. Myrrh melts together with caustic potassa with some difficulty; Hlasiwetz and Barth (1866) found among the products protocatechuic acid and a little pyrocatechin.

Allied Drugs.—BALSAMUM GILEADENSE, *Balm of Gilead*, *Mecca balsam*, or *Opobalsamum*, though differing greatly from myrrh, is referred to Balsamodendron Opobalsamum, *Kunth*. It is said to exude spontaneously, and is an opaque yellowish or whitish, fragrant, viscid liquid, in which Trommsdorff found 30 per cent. of volatile oil and 64 per cent. of hard resin, while Bonastre obtained only 10 per cent. of volatile oil, 70 per cent. of adhesive, and 12 of hard resin. It is at present rarely, if ever, met with in our commerce.

BDELLIUM. Indian bdellium is described above. African bdellium is the exudation of Balsamodendron (Balsamea, *Engler;* Heudelotia, *Richard*) africanum, *Arnott*, a shrub indigenous to West Africa, and is used in France chiefly as an addition to some plasters. It is met with in irregular roundish or oval tears about an inch (25 Mm.) in diameter, and varying in color from pale-yellowish to brown-red. It is translucent, breaks with a waxy fracture, and resembles myrrh in odor and taste, but its tincture does not become purple on the addition of nitric acid.

Pharmaceutical Preparation.—EXTRACTUM MYRRHÆ, Extract of myrrh, made with cold distilled water, contains chiefly gummy matter and the bitter principle.

Off. Prep.—Decoct. aloes comp., *Br.;* Mistura ferri comp., Pilulæ aloes et myrrhæ, *U. S.*, *Br.;* Pil. ferri comp., *U. S.;* Pil. galbani (assafœtidæ) comp., Pil. rhei comp., Tinct. myrrhæ, *U. S.*, *Br.;* Tinct. aloes et myrrhæ, *U. S.*

Medical Action and Uses.—Myrrh is both stimulant and tonic. In small doses it appears to quicken the appetite and digestion; in larger doses it irritates the stomach, occasioning nausea, and even vomiting and diarrhœa, quickening the pulse, stimulating the bronchial mucous membrane, and probably exerting a special influence of the same sort upon the uterine system. It has been found useful in *atonic dyspepsia* with flatulence, mucous evacuations, constipation, and associated nervous disorders of an hysterical or hypochondriacal description. In such affections it is profitably combined with vegetable bitters and iron. The compound iron mixture is a valuable preparation of this nature which is extensively employed in *amenorrhœa* connected with anæmia and general torpor of the functions. In like manner it may be employed in chronic uterine and vaginal *leucorrhœa*. Myrrh is especially useful in *chronic bronchitis* with profuse expectoration, but if fever is present its dose should at first be small. In ancient times it was much used as a vulnerary to promote the healing of *wounds*, *ulcers*, etc. of an indolent type. Its stimulant and astringent qualities are manifested in cases of *spongy* and *ulcer-*

ated gums. Its *dose* is from 5 to 30 grains (Gm. 0.30–2), but it is seldom used in substance. It may be prescribed in emulsion as an enema.

MYRTUS.—Myrtle.

Myrte, Fr., G.

Myrtus communis, *Linné.*
Nat. Ord.—Myrtaceæ.

Origin and Description.—The myrtle is a shrub or small tree inhabiting the countries near the Mediterranean, and frequently cultivated. It has a dark grayish-brown, fissured, astringent bark, and opposite, smooth and glossy, entire leaves, varying in length from $\frac{1}{2}$ inch to 2 inches (12–50 Mm.), and in shape from ovate to linear-lanceolate and mucronate; they are on very short petioles, are densely pellucid-punctate, and bear in their axils a white or light-pinkish flower with numerous stamens. The fruit is a roundish-oval or subglobular, fleshy, bluish-black berry of the size of a pea, with two cells, each containing four or five whitish kidney-shaped seeds. The leaves, flowers, and fruit have a very agreeable odor.

Constituents.—Riegel (1849) obtained from the ripe berries volatile oil, resin, tannin, citric acid, malic acid, sugar, etc. Raybaud (1834) found the volatile oil, as distilled from the leaves, flowers, and fruit, to have a yellowish or greenish-yellow color, and to be lighter than water. Gladstone (1863) ascertained it to have the specific gravity .891, to be dextrogyre, and to consist mostly of a hydrocarbon, $C_{10}H_{16}$, boiling between 160° and 170° C. The bitter principle has not been investigated.

The fragrant water distilled from the flowers and leaves is known in France as *eau d'ange.*

Allied Plants.—Myrtus Chekan, *Sprengel*, s. Eugenia Cheken, *Molina*, is a shrub about 5 feet (1.5 M.) high, with a rough brown astringent bark, and indigenous to Chili, where it is known as *cheken*, *chekan*, or *chequen.* The leaves are collected with the brown-gray branches, and are nearly sessile, about $\frac{4}{5}$ inch (2 Cm.) long, oval-lanceolate or elliptic, somewhat revolute on the margin, rather light-green, smooth, delicately feather-veined, and dotted with minute oil-glands; they have a slight aromatic odor and an aromatic, pungent, and slightly bitter taste. C. H. Hutchinson (1879) found tannin and volatile oil, but no alkaloid. J. Höhn (1882) obtained 4.2 per cent. of tannin and indications of the presence of a glucoside. J. W. England (1883) isolated from the distillate with potassa small white crystals, which he believes to be the acetate of a volatile alkaloid, *chekenine:* this supposed salt is insoluble in ether, soluble in alcohol and water, not precipitated by iodine or by Mayer's solution, has a feeble bitter taste, and with nitric acid and potassium ferrocyanide gives a green color. The leaves yield from 2 to 4 per cent. of volatile oil and from 8 to 10 per cent. of ash. Mr. England proposed for the *fluid extract of cheken* a menstruum composed of 3 parts of alcohol and 1 part of water.

Psidium pyriferum, *Linné*, and Ps. pomiferum, *Linné*, are small trees of the West Indies and other tropical countries, having an astringent bark, aromatic and astringent leaves, and fragrant flowers. The acidulous fruit is known as *guava*, and is used in the form of jelly, marmalade, etc.

Jambosa vulgaris, *De Candolle* (Eugenia Jambos, *Linné*), and J. malaccensis, *De Candolle*, are larger East Indian trees, of which the flowers, leaves, and bark are employed. The fruit, known as *rose-apple*, has an acidulous rose-like flavor.

Medical History and Uses.—The myrtle, so renowned in history and poetry, was hardly less distinguished for its medicinal virtues. It occupies a prominent place in the writings of Hippocrates, Pliny, Dioscorides, Galen, and the Arabian writers. Pliny furnishes an account of it of which the following is a summary: The berries arrest hæmoptöe; they are used in dysentery and as an application to indolent ulcers and inflamed eyes; and in wine are an antidote to the poison of mushrooms; they also cure the bites of scorpions, inflammation of the bladder, headaches, abscesses, aphthæ, leucorrhœa, and other mucous discharges. The juice is diuretic, but constipates. An ointment made with it cures eruptions of the skin and darkens the hair. The dried leaves in powder arrest sweats; in fomentations check the white flux, correct prolapsus of the womb and rectum, and are employed to cure ulcers, burns, erysipelas, otorrhœa, alopecia, and eruptions of the skin, to arrest hæmorrhage, and as an application to lentigo, pterygion, panaris, condylomata, and swelled testicles. A wine made from the berries was used for most of these purposes, and was regarded as tonic. This catalogue of virtues is repeated, but hardly enlarged, by subsequent ancient writers, who, however, following Galen, ascribe to myrtle the opposite qualities of cold and hot or astringent and stimulant, the former residing chiefly in the leaves, the latter in the berries.

It is remarkable that a plant which was formerly used for so many medicinal purposes should have become almost obsolete as a medicine. In 1876 attention was directed toward it by Delioux de Savignac, from whose essay the following particulars are taken: He used the infusion of the leaves or a dilution of the tincture as an injection in *leucorrhœa* and *prolapsus of the uterus.* Its agreeable odor renders it more acceptable than other analogous preparations to delicate women, and, besides arresting the discharge, it renders firm the parts to which it is applied. A fine powder prepared with the dried leaves was applied on tampons of cotton wadding with excellent results in cases of *ulcers* of the *uterus*, especially when the cotton was previously moistened with glycerin. The same powder was used with striking advantage as a dressing for recent and suppurating *wounds* and *ulcers*, for *eczema* and *intertrigo*, and was confined by carded cotton and a bandage. The infusion of the fruit or of the leaves was found equally efficacious in similar cases, and as a lotion for sinuses and other ulcers not readily accessible to the powder. Where fetid discharges or a tendency to *gangrene* existed, myrtle wine was used to destroy the fetor and promote granulation and the cure. It was also injected with excellent results into deep, suppurating sinuses. The essential oil and its alcoholic solution appear not to possess to an equal degree the anæsthetic properties of oil of peppermint, etc., but they nevertheless are somewhat anodyne.

In catarrhal affections of the *kidneys* and *bladder* powder of myrtle-leaves is recommended in doses of from 15 to 60 grains a day (Gm. 1–4); and the same prescription is stated to lessen the colliquative *sweats* of phthisis. The infusion would be more suitable in such cases, but its taste is repugnant to most patients. It is more applicable to the treatment of *dysentery* by enema. The powder, given to the extent of from 15 to 30 grains (Gm. 1–2) a day, was used with great benefit in *menorrhagia.* The author whom we cite recommends the infusion as a collyrium in *conjunctivitis*, as a gargle in various forms of *pharyngitis*, and to be used like rhatany in the treatment of *hæmorrhoids.* For the last-mentioned purpose he also found it remarkably useful when given internally with Venice turpentine in a bolus. Finally, the infusion was of service in *chronic bronchitis.* The essential oil is, however, more efficient.

An infusion of myrtle for topical use may be prepared with from 2 to 4 drachms of the leaves (Gm. 8–16) to a pint of water; for internal administration it should be diluted. An infusion of the berries may be made with similar proportions for internal as well as external administration. The finely-powdered and sifted leaves may be prescribed in doses of from 15 to 30 grains a day (Gm. 1–2). An infusion of the bark may be prepared with from 1 to 2 ounces (Gm. 32–64) in half a pint (Gm. 250) of water. The essential oil has also been used in the catarrhal affections above mentioned.. It is best administered in capsules containing 4 or 5 drops of the oil.

Cheken, or *chequen*, is represented by Murrell (*Practitioner*, xxiv. 321) to be an efficacious remedy for mucous profluvia of the *air-passages* and the *urinary tract.* A fluid extract of it was given in *doses* of a teaspoonful three or four times a day. These statements have failed of confirmation by Gottheil (*Med. Record*, xxiv. 258).

NAPHTHALINUM.—Naphthalin.

Naphthalene, E.; *Naphthaline*, *Napthalène*, Fr.; *Naphtalen*, G.
Formula $C_{10}H_8$. Molecular weight 128.

Origin.—Naphthalin was discovered by Garden (1820) in coal-tar oil, and recognized by Reichenbach as resulting from the decomposition of the products of distillation of coal. It has since been obtained from a large number of organic bodies, particularly if the distillation-products are conducted through a red-hot tube, and is a constituent of the petroleum of Burmah.

Preparation.—Coal-tar oil is distilled, and that portion collected by itself which passes over between 170° and 200° C. (338° and 392° F.), or the distillation is continued until the contents of the retort begin to char. The dark-colored product is purified by resubliming it two or three times.

Properties.—Naphthalin forms colorless and transparent, glossy scales or large laminæ, which have a faint and peculiar odor; from its solution in ether it crystallizes in rhombic plates or prisms. Its specific gravity is 1.15. According to Kopp (1855), it fuses at 79.2° C. (174.6° F.), forming a colorless liquid, and crystallizes again on cooling. It volatilizes slowly at the ordinary temperature, and boils at 218° C. (424.4° F.). When heated in the air its vapors are ignited with difficulty, and burn rapidly with a red and sooty flame. It is insoluble in water and alkaline liquors, freely soluble in hot alcohol, in ether, disulphide of carbon, chloroform, and in warm fixed and volatile oils. On dissolving together with picric acid in hot alcohol the two compounds unite, forming on cooling golden-yellow needles having the composition $C_{10}H_8.C_6H_3(NO_2)_3O$, and yielding all the picric acid to ammonia. Naphthalin yields with chlorine and bromine numerous products of addition and substitution. When treated with strong nitric acid, *nitronaphthalins* are generated, which by the action of reducing agents are converted into *naphthylamine*, $C_{10}H_7.NH_2$, which is crystallizable, turns red in the air, and the salts of which yield blue, and finally purple-colored, precipitates with ferric chloride, chromic acid, and other oxidizing agents. Commercial naphthalin usually contains a small proportion of empyreumatic oil, which causes it to assume a yellow color on exposure and to dissolve in sulphuric acid with a brown color; the impurity may be removed by recrystallization.

Medical Action and Uses.—Applied to the tongue, it gradually develops a strong, acrid, burning taste in the mouth and throat and the expectoration of ropy or frothy sputa (Dupasquier, 1842–43). It has been employed with reputed advantage in *chronic bronchitis* and *bronchorrhœa*, particularly as they occur in advanced life. In other words, its operation in these affections is the same as that of terebinthinate and balsamic medicines. Fischer (*Times and Gazette*, Dec. 1881, p. 718) was one of the first to state that naphthalin is a powerful antiseptic, preventing putrefaction and correcting the putrid exhalations from *wounds*, *ulcers*, and mucous canals, while it does not irritate the exposed tissues or excite eczema in the surrounding skin. It stains neither the skin nor the linen, and is said to have no unpleasant smell of its own, but after remaining for a while upon the skin it exhales a peculiar, but not a very strong, odor. Continued application of it to raw surfaces or to mucous membranes, or to the skin by friction, is sometimes followed by irritation in the urinary passages, and even by hæmaturia (Fürbringer, *Bull. de thérap.*, ciii. 47). Djankonow states that a solution of 1 part of naphthalin in 4 parts each of alcohol and ether, when applied to foul and indolent ulcers and wounds, causes them to granulate and cicatrize rapidly (*Amer. Jour. of Med. Sci.*, Jan. 1883, p. 247). The disease in which naphthalin has been found most useful is *scabies*. Its use was first suggested by the fact that furriers employed it to protect their goods from insects. Kaposi recommends for this affection the following ointment: ℞. Naphthalin 15 parts; lard 100; green soap 50; powdered chalk 10. Except in aggravated cases, a single thorough friction is declared to be sufficient for the cure. In severer cases two frictions suffice. After them the patient is made to lie between blankets for several hours (*Centralblatt f. d. gesammte Ther.*, i. 69). The same dermatologist strongly commends the use of a 5 per cent. ointment of napthalin in *prurigo* as the most efficient remedy for that distressing affection. It certainly does not cure the disease radically, for prurigo is an outward expression of a constitutional state. In eczema, psoriasis (Emery, 1842), tinea tonsurans, and various other cutaneous diseases in which it has been employed this preparation is of very subordinate efficiency. Dissolved in alcohol, it has been applied as a substitute for tincture of camphor in *sprains*, *contusions*, etc. It is a valuable agent in preventing the ravages of moths, book-worms, etc., and has been administered internally for *intestinal worms*. The *dose* is from 8 to 30 grains (Gm. 0.50–2), given in some aromatic and alcoholic vehicle. An ointment is made with 25 grains of naphthalin to an ounce of lard (Gm. 1.60 to Gm. 32).

Naphthol, which bears the same relation to naphthalin as phenol does to benzol, has also been used in the treatment of *scabies* and other diseases of the skin, including *psoriasis* and chronic *eczema*. It also prevents putrescence (Van Harlingen, *Am. Jour. Med. Sci.*, Oct. 1883, p. 479; Shoemaker, *Boston Med. and Surg. Jour.*, Oct. 1883, p. 440).

NARCISSUS.—Daffodil.

Narcisse des prés, *Porrillon*, Fr.; *Gelbe Narcisse*, G.

Narcissus Pseudonarcissus, *Linné*.
Nat. Ord.—Amaryllidaceæ.

Description.—Daffodil is found wild in moist and shady places in Southern Europe, and is frequently cultivated in gardens. It has an ovate, tunicated, whitish *bulb*, which is covered by brown leaf-scales and has a mucilaginous and bitter taste. The *leaves* are flat, linear, erect, a foot (30 Cm.) long, and ⅓ inch (8 Mm.) broad. The *flowers* are single on the scape, nodding, large, yellow, with a top-shaped tube and a large bell-shaped cup, wavy or crisped at the margin, and equal to the six spreading divisions of the perianth; they have an unpleasant odor and a nauseous, bitter, and acrid taste.

Constituents.—The acrid and bitter principles of daffodil have not been investigated. Caventou obtained from the flowers by ether a yellow, and by alcohol a brown-yellow, coloring matter. Jourdain (1840) gave the name *narcitin* to an emetic, probably extractive, substance, of which he obtained 37 per cent. from the bulb and 25 per cent. from the flowers; it is described as white, translucent, of a slight odor and taste, deliquescent and soluble in water, alcohol, and vinegar. He also found 6 per cent. of gum and 24 per cent. of tannin. Gerrard obtained a crystalline neutral principle and *pseudonarcissine*, an amorphous alkaloid.

Narcissus jonquilla, *Linné*, *Jonquil.* The scape bears two to five small, yellow, fragrant flowers, from which ether takes up a yellow, butyraceous, volatile oil of a very agreeable odor; afterward alcohol dissolves a brown, viscid oil of an unpleasant odor (Robiquet, 1835).

Medical Action and Uses.—The several species of Narcissus appear to possess almost identical qualities. Pliny describes their emetic, purgative, maturative, and cicatrizing powers, and refers also to their soporific virtue, saying that the plant was called narcissus because it was narcotic, and not after the fabled boy: "et a narce narcissum dictum, non a fabuloso puero." The Arabian writers dwell especially upon its emetic properties, and its stimulant virtues exhibited in curing alopecia, producing abortion, and exciting genital erections by its local irritation. According to Orfila's experiments upon dogs, the flowers and the bulb are local irritants, internally causing vomiting, purging, and inflammatory gastro-intestinal lesions. Applied to wounds, the extract inflames them and produces all of the above effects, besides affecting the brain and the whole nervous system, causing staggering, anæsthesia, paralysis, and death by paralysis of the lungs and heart. M. Gerrard extracted from the flowering bulbs an alkaloid which in many respects resembles atropine. It dries the mouth; checks the cutaneous circulation; dilates the pupil, especially in topical application to the eye, the dilatation being preceded for a short time by contraction; quickens the pulse; in a great measure antagonizes the effects of muscarine and pilocarpine on the heart of frogs, and, directly applied to the frog's heart, slows and weakens its contractions. The alkaloid extracted from the bulb after flowering causes copious salivation, and probably increases cutaneous secretion; given internally, contracts the pupils; topically applied, dilates the pupils, but less so than the alkaloid of the flowering plant; slightly relaxes the bowels; and causes some faintness and nausea. An extract of the flowered bulbs exhibits emetic and purgative properties not possessed by the alkaloids. In man the most noticeable effect of narcissus is vomiting. From 15 to 30 grains of wild narcissus-flowers are said to act as an emetic, especially if given in a decoction prepared from the flowers dried slowly in the sun. In 1876 the infusion was strongly recommended for children when prepared in the following manner: From 30 to 50 grains (Gm. 2–3.30) of narcissus-flowers are infused for 15 or 20 minutes in 5 or 6 ounces (Gm. 160–190) of hot water, and strained. When slightly sweetened, children take it without repugnance and vomit within 10 or 12 minutes. The emetic action of narcissus has been used to break up *intermittent fever* and relieve *bronchial catarrh* with congestion or obstruction of the air-tubes. Like ipecacuanha, it has also been prescribed in *dysentery*, especially of the epidemic form. Its influence on the nervous system is attested by the vogue it has enjoyed in *hysteria*, *chorea*, *whooping cough*, and even *epilepsy*. The *dose* of the powdered flowers is from 15 to 30 grains (Gm. 1–2); of the powdered bulb from 30 grains to 2 drachms (Gm. 2–8) may be given as an emetic.

NASTURTIUM.—Water-Cress.

Cresson de fontaine, Fr.; *Brunnenkresse*, G.

Nasturtium officinale, *R. Brown*, s. Sisymbrium Nasturtium, *Linné*, s. Cardamine fontana, *Lamarck*.

Nat. Ord.—Cruciferæ, Siliquosæ.

Description.—The true water-cress is a perennial herb growing in springs, brooks, ponds, and ditches in Europe, Asia, Africa, and North America. The ascending and spreading stem is 1 or 2 feet (30–60 Cm.) long, angular and hollow. The leaves are petiolate, 2 or 3 inches (50–75 Mm.) long, dark-green, pinnate, with from five to fifteen obliquely ovate or roundish oblong leaflets, about ¾ inch (18 Mm.) long, or sometimes much smaller, the terminal one being largest, ovate-cordate or oblong, and rather wedge-shaped at the base. The flowers are in loose corymbose racemes, white, and produce linear ascending pods about ½ inch (12 Mm.) long. The fresh plant, bruised, has a pungent odor and a bitterish somewhat biting taste.

Constituents.—On distilling the fresh plant with water a volatile oil is obtained which contains sulphur and is probably identical with oil of mustard.

NASTURTIUM SYLVESTRE, *R. Brown*, with narrow linear pods, and

NAST. PALUSTRE, *De Candolle*, with oblong or ovoid pods, have similar properties. Both species grow in North America (the former one as an introduced plant), and have pinnatifid toothed leaves and small yellow flowers.

The name *cress* is used for a number of more or less pungent plants, like *garden-cress*, Lepidium sativum, *Linné; winter-cress*, Barbarea vulgaris, *R. Brown; bitter-cress*, Cardamine amara, *Linné; penny-cress*, Thlaspi arvense, *Linné; wart-cress* or *swine-cress*, Senebiera didyma, *Persoon; wall-cress* or *rock-cress*, Arabis lyrata, *Linné*. All these plants belong to the natural order Cruciferae. The *Para cress*, Spilanthes oleracea, *Jacquin*, is a composite plant. The well-known garden-plants of the order Tropæolaceæ, Tropæolum majus, and Tr. minus, *Linné*, are indigenous to Peru and known as Indian cress or garden nasturtium, *E.;* Cresson des Indes, Capucine, *Fr.;* Kapuzinerkresse, *G.;* the buds and unripe fruits are sometimes used like capers.

Medical Action and Uses.—Like several other plants that have a pungent taste, as scurvy-grass (Cochlearia officinalis) and horse-radish (C. armoracia), water-cress has long been celebrated as a purifier of the blood, and was and is used in the spring to eliminate the crude humors accumulated during the winter. That it increases the appetite, renders the bowels freer, and the urine more abundant is familiarly known. It is a favorite and efficient domestic remedy in many cases of glandular *scrofula* in children, and applied in a poultice to *eczematous* eruptions it sometimes effects a cure. It is also reputed to do good in chronic *bronchitis*. It is best eaten fresh as a salad, but it may be given in decoction or infusion or its expresed juice may be taken in milk.

NECTANDRÆ CORTEX, *Br.*—BEBEERU-BARK.

Nectandra, U. S. 1870; *Cortex beberu, s. bibiru.—Greenheart-bark*, E.; *Écorce de bébéeru*, Fr.; *Bibirurinde*, G.

The bark of Nectandra Rodiæi, *Schomburgk*. Hooker's *Jour. Bot.*, 2d ser.; Bentley and Trimen, *Med. Plants*, 219.

Nat. Ord.—Lauraceæ.

Origin.—The greenheart is a tree from 60 to 100 feet (18–30 M.) high, growing in British Guiana on hillsides a short distance from the sea, and disappearing farther inland. The small compound racemes of white flowers are situated in the axils of the coriaceous oblong elliptical and acuminate leaves, and produce a subglobular berry about 2 inches (5 Cm.) in diameter, supported by the enlarged cup-shaped tube of the calyx, and containing a single seed nearly the size of the fruit. The wood is very durable and useful in shipbuilding.

Description.—The bark is in flat or somewhat curved pieces, sometimes 1 or 2 feet (30–60 Cm.) long and 4 or 6 inches (10–15 Cm.) wide by ¼ inch (6 Mm.) thick, is heavy, hard, and brittle, and consists of liber only. The outer surface is gray-brown, with numerous irregular conchoidal depressions, the ridges between consisting of soft cork, sometimes with light reddish-gray patches containing small suberous warts. The inner surface is cinnamon-brown and rather coarsely striate. The bark breaks with a short and rough granular fracture, which is somewhat fibrous in the inner layer. It has no odor; its taste is astringent and persistently bitter.

Constituents.—Besides tannin, producing green precipitates with iron salts, some starch, and other common constituents, the bark contains an alkaloid, *beberine*, $C_{18}H_{21}NO_3$, discovered by Rodie (1834). In its pure state it is a white bitter fusible powder, soluble in alcohol and ether, according to Walz (1860) identical with *buxine*, the alkaloid of Buxus sempervirens, *Linné*, and, according to Flückiger (1869), also with *pelosine* and paricine. (See PAREIRA BRAVA.) The commercial sulphate of beberine (see page 302) was found by Maclagan (1843) to contain another alkaloid, *sipirine*, which is red-brown, resin-like, and insoluble in ether. Maclagan obtained the alkaloid also from the fruit. It is combined with *bebiric acid*, which forms white deliquescent crystals, fuses at 150° C., and sublimes at 200° C. Together with Gamgee (1870), he examined the wood and obtained several alkaloids, one of which, *nectandrine*, $C_{20}H_{23}NO_4$, fuses in boiling water, is very soluble in chloroform, little so in ether; sulphuric acid and manganese dioxide produce a green color, changing to violet. The others have not been further examined. It has not been determined whether any one of these alkaloids is identical with *parabuxine*, $C_{24}H_{48}N_2O$, which was found by Pavia in box-bark; according to Pavesi and Rotondi

(1874), its sulphate is insoluble in alcohol, its nitrate crystallizes in pearly scales, and its hydrochlorate in minute needles.

Pharmaceutical Uses.—For the preparation of Beberiæ sulphas, *Br.*

Allied Drugs.—Coto-bark was sent from Bolivia to Europe in 1875. Its origin has not been determined, but it is probably derived from a lauraceous tree. It is met with in flat or curved pieces ¼ inch (6 Mm.) or more thick, of a cinnamon-brown color, externally smooth, the inner surface usually darker, and upon the transverse section showing numerous yellow dots of groups of stone-cells and bast-fibres; the bark breaks with a short, granular, and in the inner layer irregular and coarsely splintery, fracture, and has an aromatic odor resembling a mixture of cardamom, cajuput, and camphor, and a bitterish aromatic and pungent taste.

By extracting the bark with ether Jobst and Hesse (1876, 1877) isolated a number of new proximate principles. *Cotoin*, $C_{22}H_{18}O_6$, crystallizes in white fusible prisms, has a biting taste, is readily soluble in alcohol, ether, chloroform, and carbon bisulphide, and with difficulty soluble in benzol, petroleum benzin, and cold water. Nitric acid dissolves it with a blood-red, sulphuric acid with a brown-yellow, and hydrochloric acid with a yellow, color. Ferric salts precipitate its concentrated solutions blackish-brown; subacetate of lead causes a yellow precipitate. Wittstein found in coto-bark also pale-yellow *volatile oil* of a peppery taste, a volatile alkaloid, probably propylamine, resin, starch, etc., and 1.8 per cent. of ash.

Paracoto-bark resembles the bark described above in color and appearance, except that the outer layer consists of whitish deeply-fissured cork, and that it is weaker in odor and taste, the odor resembling that of nutmeg.

Paracotoin, $C_{19}H_{12}O_6$, crystallizes in yellowish-white scales, is tasteless, slightly soluble in cold alcohol, is not affected by ferric chloride, and dissolves in sulphuric and nitric acids with a yellow color; solution of potassa converts it into paracotoic acid, paracumarhydrin, and other products.

Leucotin, $C_{21}H_{20}O_6$, and *oxyleucotin*, $C_{21}H_{20}O_7$, are tasteless, and dissolve in sulphuric acid with a dark-yellow, in nitric acid with a blue-green, color; the two compounds are separated by cold alcohol, in which oxyleucotin is sparingly soluble.

Hydrocotoin, $C_{22}H_{20}O_6$, crystallizes in pale-yellow or white prisms or needles, is tasteless, and dissolves in warm nitric acid with a purple-red color.

Cotonetin, $C_{20}H_{16}O_5$, forms delicate white scales which resemble cotoin in behavior.

Both barks contain *piperonylic acid*, $C_8H_6O_4$, which has been obtained by Mielck (1869) among the products of oxidation of piperic acid, and was shown by Fittig and Remsen (1871) to be methylene-protocatechuic acid; it is sublimable, and crystallizes in needles melting at 228° C. (442.4° F.).

Tincture of coto-bark has been made from 1 part of the bark and 9 parts of alcohol.

Medical Action and Uses.—The bitterness and astringency of nectandra are due in a great measure to its alkaloid, *beberina*. According to its original promoters, beberina had all the virtues without the objectionable qualities of quinine, such as the production of tinnitus, headache, etc. In small doses it appeared to be a stomachic tonic. In experiments upon the frog, in which the alkaloid was used hypodermically, it caused tetanic retraction of the limbs in the same manner as quinine, but these effects were not produced by either substance when given by the stomach. Nor did the tetanism resemble that of strychnine, since it was not intensified by external excitation.

In the treatment of *periodical fevers* this substance proves to be very inferior in efficacy to quinine, since it fails in at least one-half of the cases. It has also been vaunted in the treatment of periodical *headaches* and *neuralgias*, as an antihectic remedy in *consumption*, as a tonic in *atonic dyspepsia*, in *menorrhagia*, *leucorrhœa*, etc. It may, on the whole, be regarded as an imperfect substitute for quinine. The *dose* of beberine is from 1 to 3 grains (Gm. 0.06–0.18) as a tonic, and from 5 to 10 grains (Gm. 0.30–0.60) as an antiperiodic medicine. (See Beberinæ Sulphas.)

Coto-Bark. Burkart observes that from 8 to 15 grains (Gm. 0.5–1) of coto-bark produces eructations, nausea, a continued feeling of warmth in the stomach, and even vomiting. The tincture, applied to the skin, causes redness and heat. Cotoin and paracotoin are excreted with the urine (*Amer. Jour. Phar.*, Jan. 1880, p. 26).

Coto, although belonging to the same natural family as Nectandra, does not in the least resemble it in its properties or medicinal uses. Indeed, there is nothing whatever in its sensible qualities, and especially no astringency, to denote its possession of a power to control sweating and diarrhœa, the affections for which it is chiefly used. Its smell is rather aromatic and its taste acrid and somewhat bitter. In Germany it has been clinically studied by several physicians, whose results substantially agree with one another. The most elaborate report of them has been furnished by Fronmüller. Of *diarrhœa*, against which other remedies had for the most part proved useless, colliquative forms following *typhoid fever* or accompanying *phthisis*, it cured the greater number of cases in the former category and palliated all in both diseases. Even when most efficient the medicine could not be abruptly discontinued without risking a return of the symptoms. In the successful cases the quantity of the tincture taken during the day varied from 10 to 500 drops, but the most usual quantity was 50 drops (Gm. 3.30) three times a day Similar results have been reported by Yeo (*Practitioner*, xxiii. 257), but Dr. Gee gave the "liquid extract of coto-bark for the diarrhœa of phthisis, typhoid fever, and lardaceous disease without the least benefit" (*St. Bart's Rep.*, xv. 232). Large doses are evidently more efficient than small ones. Unless the tincture is well prepared, it occasions an unpleasant burning in the throat; but, properly made, the stomach not only tolerates it, but the appetite improves under its use, which is not apt to be the case when opium, tannic acid, acetate of lead, etc. are used for a similar purpose. Albertoni ascribes the medicinal power of cotoin to a power of dilating the blood-vessels, and thereby increasing absorption. But this rationale would scarcely apply to its utility in sweating. Indeed, its mode of action is unknown.

As regards immoderate *sweating*, Fronmüller observed in the case of a phthisical patient suffering at the same time from colliquative diarrhœa that both symptoms disappeared under full doses of tincture of coto. He prescribed it in ninety-one cases of excessive sweating—in thirty-four with complete, in thirty-six with partial success, and in twenty-one without result. Its beneficial effects generally lasted only one night. It appeared to be more efficient than other medicines commonly used under such circumstances. These results are substantially confirmed by Burkart, Rohne, and Stewart (*Edinb. Med. Jour.*, xxvii. 750), who, as well as Fronmüller, found that cotoin and paracotoin produced analogous effects. The latter has been tried subcutaneously in *cholera* in 3-grain (Gm. 0.20) doses. The urine of patients taking cotoin is said to assume a red color on the addition of concentrated nitric acid, at least during a few hours after the medicine has been used. In the summer complaint of this country, or *cholera infantum*, the medicine is reported to have been efficacious when used in an elixir (Parsons).

Coto-bark is not conveniently given in powder on account of its persistently acrid taste, but the proper dose is stated to be from 5 to 10 grains (Gm. 0.30–0.50), given three or four times a day. Cotoin has been used in doses of 1½ grains (Gm. 0.10), and paracotoin in doses of 4 or 5 grains (Gm. 0.30), three times a day. The tincture appears to have been found the most convenient preparation of coto-bark. It was made with 1 part of the bark to 9 of 85 per cent. alcohol, and given in average doses of about 2 fluidrachms (Gm. 8), sufficiently diluted. Yeo states that as the resin is precipitated from the tincture or fluid extract on the addition of water, either preparation should be given in an emulsion, so that each dose should contain about 5 minims of the active ingredient.

NICCOLI SULPHAS.—SULPHATE OF NICKEL.

Sulfate de nickel, Fr.; *Nickelsulfat*, G.
Formula $NiSO_4.7H_2O$. Molecular weight 280.

Origin.—The metal nickel was first obtained in 1751 by Cronstedt from *niccolite* or *kupfernickel*, a pale, copper-colored mineral, the composition of which is NiAs. The metal exists in various ores found in Sweden, Germany, and other parts of Europe, and in North America in Pennsylvania and near Lakes Huron and Superior; it is also present in a few mineral waters. It is prepared from the oxide or carbonate by reducing it at a white heat in the presence of charcoal or organic matters.

Preparation.—Sulphate of nickel may be prepared by dissolving pure carbonate of nickel in diluted sulphuric acid, concentrating the solution, and crystallizing at or below 20° C. (68° F.), or precipitating it with alcohol. The salt is extensively manufactured on the large scale from impure carbonate, the process involving the separation of other metals, like arsenic, iron, copper, and cobalt.

Properties.—The salt forms either a green crystalline powder or it is generally seen in emerald-green, transparent, rhombic prisms, which effloresce on exposure, losing $1H_2O$, and being at the same time converted into an aggregation of octahedral crystals. A salt containing $6H_2O$ is also obtained by crystallization from an acid solution at above 20° C. (68° F.). The salt has a sweetish and styptic taste and a slight acid reaction, is soluble in about 3 parts of water at 15° C. (59° F.), insoluble in alcohol and ether, and loses at 103.3 C. (218° F.) 38.5 per cent. (the salt with $6H_2O$, 34.2 per cent.) of water, the remaining molecule of water being expelled above 250° C. (482° F.). The solution of nickel sulphate, on being mixed with a saturated solution of ammonium sulphate in excess, gives a precipitate of *nickel-ammonium sulphate*, $(NH_4)_2Ni(SO_4)_2.6H_2O$. This salt is blue-green, almost insoluble in solutions of alkali sulphates, but soluble in about 8 parts of water; it, like the sulphate, is largely used for the electro-plating of iron, copper, and other metals with nickel.

Allied Salts and Metallic Nickel.—NICCOLI CARBONAS.—Carbonate of nickel, *E.;* Carbonate niccolique, *Fr.;* Nickelkarbonat, *G.*—It is pale-green or blackish-green, of variable composition, and is prepared by precipitating the solution of a nickel salt with sodium or potassium carbonate.

NICCOLI BROMIDUM.—Bromide of nickel, *E.;* Bromure de nickel, *Fr.;* Nickelbromür, *G.* $NiBr_2$-$3H_2O$; mol. weight 271.6.—It is prepared by digesting nickel with bromine and water, or by dissolving nickel carbonate in hydrobromic acid and crystallizing. It crystallizes in green deliquescent needles or prisms, which are soluble in alcohol, ether, and water; the latter solution on exposure is decomposed, depositing nickel hydrate.

NICCOLI CHLORIDUM.—Chloride of nickel, *E.;* Chlorure de nickel, *Fr.;* Nickelchlorür, *G.*—The hydrated salt is green, very deliquescent, and contains $6H_2O = 45.4$ per cent. The anhydrous chloride is yellow, or, in the presence of cobalt, has a green tint; it sublimes in yellow lustrous scales.

NICKEL is a malleable metal, resembling silver in color and lustre. It is attracted by the magnet, has the density 8.8, melts at a somewhat lower temperature than iron or cobalt, does not readily tarnish on exposure, and is but little attacked by dilute acids. The *sesquioxide*, Ni_2O_3, and its hydrates are black or black-brown, and dissolves in acids with the evolution of oxygen. The *monoxide*, NiO, is greenish-gray or yellowish-gray; its hydrate is a green crystalline powder, and its salts are likewise green, or in the anhydrous state yellow, and have a slight acid reaction. The solution of the acetate gives a black precipitate with sulphuretted hydrogen; other nickel salts with ammonium sulphide. Alkalies and alkali carbonates produce green or pale-green precipitates, which dissolve in ammonia with a blue, and in ammonium carbonate with a greenish-blue, color. Potassium ferrocyanide produces greenish-white precipitates; potassium cyanide, a similar precipitate soluble in excess of the cyanide; and if to this solution caustic soda and chloride be added and heat applied, a precipitate of black nickel hydrate is produced (difference from cobalt). A concentrated solution of oxalic acid precipitates nearly all the metal as *nickel oxalate* from simple salts, but not from solutions of the double salts.

Action and Uses.—In 1824, Gmelin inferred that *sulphate* of nickel is not active, since 20 grains of it produced no effect upon a dog except depression and vomiting, and only after 2 hours. 10 grains injected into the jugular vein of a dog caused its death by arresting the heart, and 5 grains occasioned vomiting, diarrhœa, prostration, partial paraplegia, and feeble action of the heart, from which, however, the animal recovered. Injected into the connective tissue, a solution of the salt was absorbed, but induced no symptoms (*Edinb. Med. and Surg. Jour.*, xxvi. 136). In 1852, Simpson stated that this preparation appeared to act as a gentle tonic, that it does not occasion nausea and vomiting like the sulphates of zinc and copper, and that its action and that of manganese were comparable to the action of iron. He reported the cure by it of inveterate periodical *neuralgia* of the face after it had resisted iron, quinine, and many other medicines. He prescribed it in doses of from ½ to 1 grain three times a day (*Month. Jour. of Med. Sci.*, 3d Ser., vi. 136). In 1869, Broadbent attributed the cure of *anæmia* and *amenorrhœa* to the *chloride* of nickel in 2-grain doses (*Trans. Clin. Soc. Lond.*, ii. 125). By Bernatzik it was compared to cerium, and by Schuhhardt to iron and manganese (*Arzneimittellehre*, ii. 106, 283). Dr. J. M. Da Costa (pamphlet, 1883) found that in doses of 5 grains the *sulphate* caused giddiness as well as nausea, but no such soporific effect as had been attributed to it. The doses employed by him varied from 1 to 3 grains. He thought that it relieved the pains of rheumatism, checked diarrhœa, and allayed irregularity due to valvular disease of the heart. In some instances it appeared to him beneficial in chronic gastric catarrh. It was of no use in night-sweats nor in typhoid fever. *Bromide* of nickel, used by Dr. Da Costa in doses of from 5 to 10 grains, seemed to him to exert the peculiar power of other bromides, but in smaller doses than they. In several cases it suspended *epileptic* seizures after the failure to do so of the alkaline bromides. He found that it slightly lowered the temperature, affected the pulse but little if at all, did not act on the bowels or the skin, and perhaps increased the urine a little. He concluded that "its effect on the nervous system is that of a sedative, without, however, producing a weakening or depressing influence."

NIGELLA.—FENNEL-FLOWER.

Faux cumin, Fr.; *Schwarzkümmel*, G.

The seeds of Nigella sativa, *Linné*, and of Nig. damascena, *Linné*.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—Both plants are annuals, indigenous to Southern Europe and the Levant. They have finely-divided leaves like fennel; the second species has also a similar involucre. The fruit consists of five united follicles, which contain numerous seeds. Both plants are cultivated in gardens, and are known respectively as *nutmeg-flower* and *ragged lady*.

Description.—The seeds are about $\frac{1}{10}$ inch (2.5 Mm.) long, triangular-ovate, rough, of a dull-black color, internally white, contain a fleshy albumen enclosing a small straight embryo, and have a somewhat acrid taste. When rubbed the seeds exhale a peculiar odor, that of the first species being camphoraceous and resembling cajuput, while that of the second species resembles the odor of strawberries. The latter are sometimes sold as *magnolia-seeds;* they differ from the former also in being rounded at the angles and having the testa deeply netted-wrinkled.

Constituents.—Reinsch (1841) obtained 35 per cent. of fixed oil, which, according to Lepine, is orange-yellow and solidifies at 2° C. (35.6° F.) Flückiger (1871) found in it myristin, palmitin, and stearin. The volatile oil is lighter than water, colorless, shows a blue fluorescence, has an odor different from that of the seed, and, according to Flückiger, consists of a terpene and of the compound $C_{20}H_{24}O$. Reinsch's *nigellin* is an extract-like yellow mass having the consistence of turpentine and a bitter taste. H. G. Greenish ascertained (1880–82) that petroleum benzin becomes fluorescent with the seeds of N. damascena, but not with those of N. sativa, which contain *melanthin*, not found in the former seeds. This principle is nearly insoluble in water, ether, benzol, benzin, and carbon bisulphide, very soluble in alcohol, is acrid, foams similar to parillin, consists of $C_{20}H_{33}O_7$, and by acids is split into sugar and *melanthigenin*, $C_{14}H_{23}O_2$; both principles are colored dark-violet by warm sulphuric acid and rose-red by cold pure sulphuric acid.

Medical Action and Uses.—Nigella is closely analogous in its properties to coriander, anise, and cumin, and like them is used in the East as a condiment for food, and medicinally as a carminative, aphrodisiac, emmenagogue, galactagogue, diuretic, and expectorant.

NITROBENZOLUM.—NITROBENZOL.

Oil of mirbane, E.; *Nitrobenzène*, *Essence de mirbane*, Fr.; *Mirbanöl*, G.
Formula $C_6H_5NO_2$. Molecular weight 123.

Preparation.—Benzol is added in small portions to warm fuming nitric acid, when a violent action takes place and a dark-red liquid is formed, which is mixed with water and the oily precipitate washed with the same liquid. 100 parts of benzol yield between 135 and 140 parts of nitrobenzol.

Properties.—Nitrobenzol is a yellowish oily liquid having the spec. grav. 1.209, crystallizing in needles at 3° C. (37.4° F.), and boiling at 205° C. (401° F.). It has a strong odor resembling that of oil of bitter almond—hence the incorrect name *artificial oil of bitter almonds*—a sweet taste, and dissolves in concentrated sulphuric and nitric acid, and in all proportions in alcohol and ether. In its alcoholic solution it is readily converted into aniline through the influence of nascent hydrogen.

The different benzols yield also different nitro-products. One has the specific gravity 1.19, boils between 210° and 220° C. (410° and 428° F.), and has a cinnamon-like or unpleasant fatty odor, which is still more unpleasant in nitrobenzol boiling between 225° and 235° C. (437° and 455° F.)

Pharmaceutical Uses.—The low-boiling nitrobenzol is often used for scenting soaps and in various perfumes as a tolerably good substitute for the more costly oil of bitter almond, which is sometimes adulterated with it (see OL. AMYGD. AMARÆ), but its most important use is in the manufacture of aniline (see page 205).

Physiological Action.—*On Animals:* The experiments of Dr. Letheby and others show that the toxical phenomena vary not only with the dose of this poison, but very singularly in the time of their coming on, so that several or even many hours may elapse before they appear. Filehne's experiments have shown very clearly that under favorable circumstances nitrobenzol is rapidly absorbed and produces its effects rapidly. The cases in which they were notably delayed he explains by saying that the liquid does not readily mix with the contents of the stomach, and hence if this organ contains much food, its surface may not be reached by the poison until a considerable interval has elapsed. This explanation may apply to many cases, but it does not to those in which, as stated below, the action of the poison was retarded even for days. When the poison is speedily fatal the animal is affected with giddiness, inability to walk, complete loss of voluntary power, occasional spasms of the dorsal muscles, or general epileptiform convulsions; the pupils are widely dilated, the heart's action is tumultuous or irregular, and the breathing difficult. Consciousness is retained until life is extinct. When the action of the poison is slower and its visible effects are delayed for several days, there is suddenly observed a look of distress, perhaps vomiting, an epileptiform fit, followed by exhaustion and then by renewed fits, which occur at irregular intervals; between them the limbs are in constant motion. Death takes place through exhaustion, or else voluntary power is gradually restored, and the animal recovers. The post-mortem appearances consist of extreme congestion of the blood-vessels of the brain and its membranes; the cavities of the heart and the veins are full of black, coagulated blood; the lungs are congested to a less degree, but there is no trace of gastric lesions. All of the above phenomena relate to the action of nitrobenzol when introduced into the stomach. When it is injected into a blood-vessel it is mortal almost as rapidly as prussic acid. Within a minute it destroys a rabbit, with convulsions and dilated pupils. If, however, it is very gradually introduced, there may be paralysis without spasm (Filehne).

On Man: Numerous cases have been published of poisoning by nitrobenzol—sometimes by its being swallowed, sometimes by the inhalation of its fumes, and sometimes by its application to the skin. A remarkable illustration of the potency of this poison is furnished by several cases of females affected by the odor of the so-called "almond glycerin soap," and by that of a person who, while using such a soap in a warm bath, fainted from the effects of nitrobenzol set free by the heat, and was ill for some time afterward. A case is also recorded of a man who, having used a liniment containing this product in the treatment of scabies, became partially paralyzed, while his head was drawn back, and his face, hands, mouth, and pharynx were all cyanosed, and the breath and matters vomited smelled of bitter almonds. In this case, as in some others, the blue tint remained for at least a week. The symptoms produced in man are identical with those observed in animals, except the purple color of the skin, which appears to be due in part to venous congestion, but in part also to the inability of the blood to absorb oxygen. This condition of the blood helps to explain the dyspnœa which attends some cases of poisoning by this substance, and also the extreme cyanosis, which so far surpasses both in degree and duration that which is due to merely asphyxiating causes. The opinion that this blue color of the skin is in part due to the presence of anilin derived from the decomposition of nitrobenzol in the body is ascribed by Filehne to an error of manipulation by which anilin was developed. The mode of death and the lesions found post-mortem are also essentially the same as in animals—the tarry dark blood, congested lungs, heart and brain, etc. In one case the liver is described as being of a deep-purple color. All these phenomena and lesions support the conclusion of Lewin (*Virchow's Archiv*, lxxvi. 443), that the poisonous action of nitrobenzol depends upon its destructive effect upon the red blood-corpuscles, which prevents the supply of oxygen essential to life. Whether recovery or death occur, the peculiar odor of nitrobenzol persists for many days. The probable fatal dose of nitrobenzol may be stated to be between a few drops and 2 drachms.

Medical Uses.—The only disease, so far as we are informed, in which the preparation has been used is *scabies*, but its dangerous effects from accidental conditions, and the ease of poisoning by it in this very disease to which reference has been made, ought to exclude it altogether from medical practice.

In *poisoning* by nitrobenzol the proper remedies consist of emetics to remove the poison in the stomach, and of stimulants, internally and externally, carbonate of ammonia, electricity, artificial respiration, the hot bath, and a simultaneous cold douche upon the head and spine, frictions of the skin, etc. Oil and alcohol, which dissolve the poison, are contraindicated.

Nitropentan has been the subject of some physiological experiments. In dogs and cats, when the inhalations were continued from 8 minutes to 1 hour, convulsions began to occur which gradually increased in intensity until they passed into true epilepsy. The peristaltic movements of the intestines were quickened and the feces were evacuated. The urine was also discharged; sometimes the saliva flowed profusely, and the pupils were dilated. The pulse was not materially affected, and the vessels of the pia mater underwent no change during the inhalation (Schadow).

NITROGENII MONOXIDUM.—Nitrous Oxide.

Laughing gas, E.; *Oxyde nitreux*, *Protoxyde d'azote*, Fr.; *Stickstoffoxydul*, *Lachgas*, G.
Formula N_2O. Molecular weight 44.

Origin.—Nitrous oxide was first obtained by Priestley (1772) by acting upon nitric oxide with moist iron filings; he also noticed that ignited bodies burn in this gas with a brighter flame than in atmospheric air. The composition of the gas was determined by

Deimann and Troostwijk (1793), who prepared it from ammonium nitrate. H. Davy (1800) observed its exhilarating effects.

Preparation.—Nitrate of ammonium which is absolutely free from chloride is gradually heated to about 200° C. (392° F.), when the decomposition commences, and the heat may be slowly increased. The salt yields then water and nitrous oxide, without other products of decomposition; NH_4NO_3 yields $2H_2O + N_2O$. The gas is passed through a little warm water, which will retain any undecomposed salt or other product without retaining much of the gas. (For other precautions in the preparation of this gas refer to the decomposition of AMMONII NITRAS, on page 185.)

Properties.—Nitrous oxide is a colorless gas of a very slight agreeable odor and a sweetish taste. It has the specific gravity 1.6 (Dalton), and a liter of it at 0° C. (32° F.) weighs 1.97 Gm. It is not inflammable, but supports the combustion of ignited bodies, which burn more vigorously than in the open air. By the aid of pressure and cold it may be condensed into a thin, very mobile, colorless liquid, which at a temperature of about − 100° C. (− 148° F.) congeals to colorless crystals. The gas is soluble in water, alcohol, ether, volatile and fixed oils.

Nitrous Oxide Water.—The solubility of nitrous oxide in water has been determined by Carius (1855) as follows: Water absorbs at a barometric pressure of .76 meter and a temperature of

0°	5°	10°	15°	20°	25° C.,
1.3052	1.0954	.9196	.7778	.6700	.5963 measures of the gas.

Such an aqueous solution, prepared under a pressure of about five atmospheres, has been employed under the name of *oxygenous aërated water*.

Physiological Action.—The primary effect of inhaling nitrous oxide gas is stimulation of the whole system; a tingling sensation is felt all over the body, the senses seem unnaturally acute, the pulse become stronger and more frequent, the breathing is more rapid and shallow, and the face grows pale. If the inhalation is interrupted at this period a lively intoxication is developed. It was formerly the custom to have semi-public exhibitions of this appropriately called "laughing gas," in which one of the most familiar phenomena was a high degree of mental excitement, generally exhibited in rhapsodical declamation or singing, but sometimes also in a sudden fit of violent pugnacity, which subsided abruptly when the vapor was exhaled. But if the inspiration is not interrupted the breathing in about 1½ minutes begins to be stertorous; at the same time the pallor of the face is replaced by a cyanotic hue, and complete unconsciousness and anæsthesia ensue. Without a renewal of the inhalation it does not last more than a minute or two. Unlike ether or chloroform, it is apt to occasion muscular twitching, or even rigidity. In general, feeble persons are more quickly affected than the strong—children, females, and the aged more speedily than adult males.

The number of deaths due to the administration of this gas is surprisingly small when compared with those following chloroform, and even ether, and, as in the case of the latter agent, they may always, or nearly so, be fairly ascribed to the special condition of the patient or to the mode of administration of the anæsthetic. According to the statistics of Darin, 53 deaths occurred in 152,260 administrations of chloroform, or 1 : 2872; 4 in 92,815 of ether, or 1 : 23,203; and 3 in 300,000 of gas, or 1 : 100,000, one of which was due to an accident—namely, the falling of a cork into the air-passages. Other ill effects have occasionally been noticed; *e. g.* coma of several days' duration, hemiplegia, temporary catalepsy or hysteria, clonic convulsions, etc.

The mode in which nitrous oxide gas acts has been variously explained, and while it remains as difficult as ever to understand its soporific and anæsthetic power, it is very easy to refute the principal error in regard to it; which is, that it is merely an asphyxiating agent whose action consists in excluding the atmosphere from the lungs. This simple but very absurd hypothesis would liken the presence of the gas in the air-passages to that of a foreign body, or, more precisely, to that of an unirritating but irrespirable gas. But carbonic acid is such a gas, and, although it may prove fatal, it does not produce the discoloration of the skin which is characteristic of nitrous oxide. Besides, nitrous oxide is not irrespirable. The experiments of Zimmermann show that rabbits and pigeons may be confined in it not only for minutes, but for hours, and yet return to active life. It must not be forgotten that it not only contains oxygen, but a far larger proportion of it than exists in atmospheric air, and that very possibly a portion of the gas is decomposed, furnishing an amount of oxygen sufficient to maintain life, while the bulk of it remains unchanged and induces cyanosis, unconsciousness, and anæsthesia. This conjecture is not a mere hypothesis, for it is established by experiment that venous blood introduced into an atmosphere of nitrous oxide assumes the arterial color; that phosphorus undergoes oxidation in it; that seeds germinate and grow in it; and, above all, that it does not put out the light of a burning taper. Finally, a most important and, indeed, capital, fact is, that in the series of phenomena which it produces in animals immersed in it the organ which remains longest in action is the heart; and as the gas is very rapidly eliminated from the system, the brain and the lungs are soon relieved from its influence, while the heart continues to pulsate and repair whatever temporary damage may have been produced. To these conclusive scientific reasons must be added the equally conclusive practical observation made by every one who has witnessed the exhibition of nitrous oxide as "exhilarating gas." It was of common occurrence during such experiments that the subjects of them, while in a state of high mental exhilaration with combative propensities, inflicted severe injuries upon themselves, even to the breaking of the bones of the hand by striking solid objects, and yet they neither manifested any sense of pain at the time nor had any recollection of the cause of the injury on their return to consciousness.

Surgical Uses.—Nitrous oxide has been used in surgical operations, but chiefly in those requiring a comparatively short time for their performance. *Teeth* have been extracted with its aid in cases innumerable in this country and in Europe, and whoever has experienced its effects must be satisfied with the efficiency and convenience of its use. All surgical operations which can be quickly completed, from the opening of *abscesses* to the operation for *cataract*, have been successfully performed with its aid; and in numerous instances it has sufficed for operations lasting from 15 to 20 minutes. In 1865, Dr. Ziegler of Philadelphia proposed the inhalation of this gas for a variety of disorders, the chief of which were nervous and asthenic, and included *neuralgia*, *anæsthesia*, *hypochondria*, *insomnia*, etc., and it was employed soon afterward by Dr. Benjamin Lee (*Med. Record*, xvii. 494). It did not, however, seem to find many advocates. In 1880 attention was directed to it anew by Drs. Blake and Hamilton (*Med. Record*, xvii. 118; *Boston Med. and Surg. Jour.*, May, 1880, p. 469). In all of these instances the exhilarating, and not the anæsthetic, action of the gas was sought, and it was believed to act as a stimulant of the nervous system and the heart, very much as a moderate dose of alcohol does. It, however, did not retain its vogue. Nitrous oxide has also been employed as an anæsthetic in labor. According to Klikewitsch, four or five inhalations abolish sensation, but not consciousness; it involves neither danger nor inconvenience, and may be administered by an intelligent nurse (*Med. Record*, xxi. 514).

Administration.—The nostrils being closed, the gas may be inspired from the reservoir in which it is collected or from caoutchouc bags through a tube and mouthpiece furnished with valves opening outward to permit the breathed air to escape during expiration. It is also kept in wrought-iron vessels in a highly condensed or even a liquid state, and may thus be conveniently transported from place to place.

Bert proposed to prevent the "asphyxia" produced by nitrous oxide by mixing 85 parts of this gas with 15 of oxygen in a chamber filled with compressed air. Several surgical operations of considerable duration were successfully performed under these circumstances (*Bull. et Mém. de la Soc. de thérap.*, 1879, p. 71). But the method does not appear to have been accepted.

NITROGLYCERINUM.—Nitroglycerin.

Trinitoglycerin, Glonoin.
Formula $C_3H_5(NO_2)_3O_3$. Molecular weight 227.

Preparation.—Nitroglycerin was discovered by Sobrero (1847), and is at the present time prepared on a large scale by slight modifications of the process proposed by the discoverer and by E. Kopp. To about 7 pounds of a mixture composed of 1 part of nitric acid sp. gr. 1.47 and 2 parts of strong sulphuric acid, 1 pound of glycerin is slowly added, with frequent stirring and with the precaution of preventing the temperature from rising above 26.6° C. (80° F.). The mixture is then poured into a large quantity of water, and the oily sediment well washed with a diluted solution of alkali and of water. 10 parts of pure glycerin yield 19 parts of nitroglycerin.

Properties.—Nitroglycerin is a colorless or pale-yellowish oily liquid having the density 1.60 at 15° C. (59° F.), and when exposed to a low temperature crystallizes in long needles. It is without odor, but its vapors produce intense headache; its taste is sweet and pungently aromatic. When ignited in the open air it burns quietly and incompletely, but when heated in closed vessels or by percussion it explodes with great violence. On keeping it is gradually decomposed, oxalic acid being formed, besides nitrous acid and other gases, from the pressure of which explosions are apt to occur. Nitroglycerin forms the basis of various blasting-compounds known as *dynamite*, *giant powder*, *glyoxylin*, *dualin*, etc. It is nearly insoluble in water, but dissolves freely in ether, alcohol, and methylic alcohol; these solutions will likewise explode by percussion with a wet hammer. According to Alfred Nobel, who first prepared (1862) nitroglycerin for blasting purposes in Sweden, 1 volume of this compound yields about 10,400 volumes of gases and vapors. The products of this decomposition are water, carbon dioxide, nitrous oxide, and nitrogen.

Physiological Action.—Nitroglycerin is a powerful poison, and exerts a marked effect upon the nervous system even when given in minute doses. Its general effects may be summarily described as "accelerated respiration, paralysis, loss of reflex action, and apparently, to a great degree, of sensation, and death from stoppage of the respiration" (Brunton and Tait). In frogs it induces lethargy and paralysis, alternating with clonic and tonic convulsions; in cats and rabbits, convulsions, tetanus, paralysis, spasmodic breathing, frequent and feeble pulse, general anæsthesia, and death; and in dogs, the same effects, besides salivation and vomiting. On dissection the brain may be either pale or congested, and the lungs are engorged with blood, but the heart is empty. In man the symptoms following a dose of 2 drops of a 1 per cent. solution are said to be slight flushing of the face, a decrease in the fulness of the arteries, a rise in the pulse-rate, subsequent intense pallor, and a feeling of faintness lasting for a quarter of an hour. These effects appear, however, to grow milder if the medicine is repeated, and it is said that in one case the dose was ultimately increased to 20 minims of the solution described below every four hours (Murrell). It seems that its effects and those of nitrite of amyl are very similar. Both accelerate the action of the heart, but the influence of nitroglycerin is developed more slowly and lasts longer than that of nitrite of amyl. Several cases of death from poisoning with nitroglycerin have been reported (*Practitioner*, xxiv. 38)—in one case from rubbing a single drop upon the forehead for headache (Werber). A man and a woman partook of soup and coffee in which were 30 grains of dynamite. The symptoms were violent vomiting, burning pain in the head and stomach, and bloody evacuations. The woman died in 2½ and the man in 3 days (*Amer. Jour. Phar.*, li. 304).

Medical Uses.—When this preparation was first known it was for a short time employed in the treatment of certain functional nervous disorders, such as *asthma*, *epilepsy*, *headache*, etc., but it had quite fallen into disuse when Mr. Murrell (1879) claimed for it remarkable virtues in *angina pectoris*. The patients were at first placed upon a short course of camphor-water, after which a drop of the 1 per cent. solution of nitroglycerin in ½ ounce of water was ordered to be taken every four hours. His results have been confirmed by many physicians. Mr. Robson states that if the medicine be continued in gradually-increasing doses the attacks become less frequent as well as less intense (*Practitioner*, xxiv. 445). Dr. McCall Anderson (*Glasgow Med. Jour.*, July, 1881, p. 33) and Dr. Hammond (*New York Jour. of Med.*, Dec. 1882, p. 662) give similar testimony. As was to have been expected, not all cases of angina pectoris are benefited by this or by any other medicine. Those in which it acts most favorably are freest from organic lesions. Mr. Robson claims that it gives prompt relief in *asthma*, and others that it is of great use in *migraine* with pallor of the skin, in *puerperal convulsions*, and even in *epilepsy* (Hammond, *Med. Record*, xx. 471); that is to say, in the diseases for which it was originally used. As Huchard expresses it (*Bull. de thér.*, civ. 345), this agent, by congesting the nervous centres and paralyzing the capillaries, is serviceable in all conditions involving cerebral anæmia (nervous headache, vertigo, impoverishment of the blood) or cardiac debility (fatty degeneration, angina pectoris, Corrigan's disease, etc.). In *uræmic asthma* it acts like nitrite of amyl to relieve the distress and terminate the paroxysm. In *toothache* the 1 per cent. solution, applied on cotton wool, is stated to relieve the pain. It is also claimed that it increases the quantity of the urine and of its solid contents in chronic *Bright's disease* by "relieving the vascular tension" (*Braithwaite's Retros*, Amer. ed., 1883, p. 212). If diminished secretion of the urinary solids be due to fibrosis of the renal capillaries, this explanation is inadequate, although the clinical statement may be correct.

The proper antidotes for *poisoning* by nitroglycerin are stimulants—*e. g.*, alcohol, ammonia, coffee. If the patient is seen early, a mustard emetic should be administered.

Tabellæ nitroglycerini, *Br.* These tablets of nitroglycerin are to be made of chocolate, each weighing 2½ grains and containing $\frac{1}{100}$ grain pure nitroglycerin.

NUX VOMICA, *U. S.*, *Br.*—Nux Vomica.

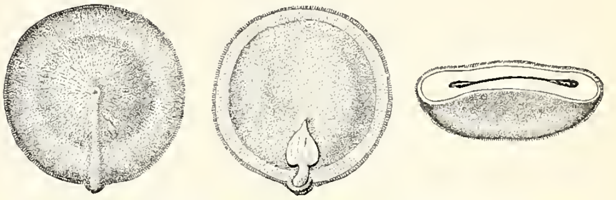
Semen strychni, P. G.; *Semen nucis vomicæ.*—*Poison-nut*, *Quaker buttons*, E.; *Noix vomiques*, Fr.; *Krähenaugen*, *Brechnuss*, G.

The seeds of Strychnos Nux vomica, *Linné*. Steph. and Church, *Med. Bot.*, plate 52; Bentley and Trimen, *Med. Plants*, 178.

Nat. Ord.—Loganiaceæ.

Origin.—The tree has a short, thick, often crooked trunk, opposite, oval, glossy, three- to five-nerved leaves, and small, funnel-shaped whitish flowers in small, terminal, paniculate cymes; the smooth, orange-colored berry is globular, about 2 inches (5 Cm.) in diameter, and contains about five seeds. The tree is common in many parts of Hindostan, Farther India, some of the East India Islands, and as St. lucida, *R. Brown*, is also found in Northern Australia. All parts of the plant possess a bitter taste, and are probably poisonous; the bark has at one time been sold in place of angustura-bark (see page 204). The white, gelatinous pulp of the fruit, it has been stated, is eaten in India by birds; it, however, contains strychnine (*Pharmacographia*). The seed is the only officinal portion. The quantity imported into the United States was 460,000 pounds in 1877 and 172,900 pounds in 1881.

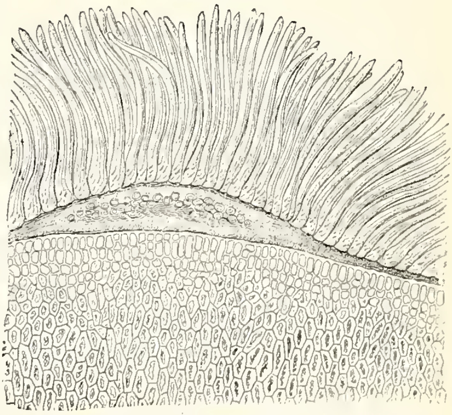
Fig. 191.



Nux Vomica: surface with raphe; longitudinal section, showing albumen and embryo; and transverse section, showing central cavity.

Description.—Nux vomica is in the form of an orbicular disk an inch (25 Mm.) or less in diameter, and $\frac{1}{6}$ to $\frac{1}{4}$ inch (4 to 6 Mm.) thick, nearly flat, or convex on one side and concave on the other, with the margin frequently thickened. The surface is of a grayish or greenish-gray color, and has a slight silky lustre from the closely-appressed soft hairs, directed toward the circumference and forming a soft ridge on the edge. Where the hairs have been rubbed off the dull-brownish testa becomes visible. In the centre of the concave side is the hilum, connected by a slightly elevated raphe with the chalaza, which forms a small protuberance on the edge in the immediate vicinity of the radicle. Schleiden, Berg, and others regard the latter as the hilum and the central scar as the chalaza. The thin testa encloses a yellowish-gray, somewhat translucent, horny, and very hard albumen (endosperm), which is of the same form as the seed, but has within it a large, flat, circular cavity. After softening the seed in hot water the edge may be readily trimmed down with a knife and the albumen split into two disks, which were united with each other merely on the margin to the width of about $\frac{1}{12}$ inch (2 Mm). The embryo is about $\frac{3}{8}$ inch (9 Mm.) long, and has a thick, club-shaped radicle and a pair of pale-greenish delicately seven-nerved, heart-shaped cotyledons $\frac{1}{5}$ inch (5 Mm.) in length, and projecting into the circular cavity. The seed is inodorous, but possesses a persistently bitter taste.

Fig. 192.



Nux Vomica: section through hilum and albumen, magnified 65 diameters.

Nux vomica is very difficult to powder, owing to the horny condition of the albumen. The powdering is considerably facilitated by drying the entire seeds for two or three days and breaking them up into several pieces, which are again dried for several days by means of warm air, and then reduced to powder of the desired fineness. If a drug-mill with chilled iron grinding-plates, admitting of regulation as to different degrees of fineness, be used, much labor may be saved in the final powdering in an iron mortar provided with a heavy pestle. Powdered nux vomica is of a light gray-greenish color.

Constituents.—The horny nature of nux vomica is probably due to protein compounds, of which it contains about 11.3 per cent. (*Pharmacographia*). Gummy matter.

fat, sugar, and *igasuric* acid, besides the alkaloids, are also contained in it. The acid was discovered by Pelletier and Caventou (1819), and by Höhn (1873) was regarded as a kind of tannin; the latter obtained it as an amorphous, yellowish-white mass of a strongly acid and somewhat astringent taste; its solution is colored dark-green by ferric salts, precipitated yellow by acetate of lead, and rapidly reduces an ammoniacal solution of silver.

The bitter and poisonous alkaloids *strychnine* and *brucine* are the medically important constituents of nux vomica, and are present in variable quantity; Dunstan and Short (1883) analyzed seven different commercial samples, in which the total amount of alkaloids varied between 2.74 per cent. in small Madras nux vomica and 3.90 per cent. in large silky Bombay nux vomica. (For an account of the first alkaloid, which is present to the amount of ¼ to ½ per cent., see the article STRYCHNINA in this work.)

Brucine, $C_{23}H_{26}N_2O_4$, likewise varies in quantity; Merck obtained only 0.12, Wittstein 0.5, Mayer 1.10 per cent.; by the latter it was estimated by means of potassio-mercuric iodide, and the presence of igasurine (see below) was not taken into account. The alkaloid was discovered by Pelletier and Caventou (1819) in the false angustura-bark, which was then supposed to be derived from Brucea antidysenterica, *Miller*, an Abyssinian shrub. It is one of the by-products of the manufacture of strychnine, and is obtained from the mother-liquor and alcoholic washings by neutralizing them with sulphuric acid, evaporating to crystallization, removing the mother-liquor, purifying the crystals by treatment with animal charcoal, precipitating with ammonia, and recrystallizing from boiling 80 per cent. alcohol; it contains then $4H_2O$. The anhydrous alkaloid dissolves in 850 parts of cold and 500 parts of boiling water (Pelletier and Caventou), while, according to Duflos, the crystallized alkaloid requires only 320 and 150 parts of water respectively. It is soluble in 7 parts of chloroform (Schlimpert), in 1.5 parts of alcohol, and in 70 parts of glycerin (Cap and Garot). It is soluble also in ammonia, creasote, amylic alcohol, and very slightly so in benzin, volatile and fixed oils, and is insoluble in ether. It fuses in its water of crystallization at a little over 100° C. (212° F.), and the anhydrous alkaloid, according to Claus and Roehre (1881), at 178° C. (352.4° F.), yielding a colorless liquid; at a higher heat it burns, leaving voluminous charcoal. In contact with strong nitric acid brucine acquires a blood-red color, which changes to orange, and finally yellow; if now stannous chloride be added, a beautiful violet-red is produced. A similar color is obtained by using sulphurous acid, and lustrous brick-red needles are formed by using ammonium sulphide in place of stannous chloride. These reactions are not interfered with by the presence of a little strychnine. A number of the colored compounds thus produced appear to possess little stability; but Roehre (1878, 1881) isolated the red compound, which is *dinitrobrucine*, forms a bright vermilion-red amorphous powder, and is insoluble in ether, very sparingly soluble in alcohol, but freely soluble in water. The end-product of the reaction of nitric acid upon brucine was ascertained by Strecker (1854) to be a weak base, *kakoteline*, $C_{20}H_{22}N_4O_5$, which forms orange-colored scales insoluble in water, but dissolving with a yellow color in ammonia, becoming green and brown on heating. Commercial brucine generally contains traces of strychnine, as proven by Cownley (1876) and Shenstone (1877), and, according to the latter, may be completely freed from it by partial precipitation, brucine being precipitated from its solutions by strychnine.

Igasurine was discovered by Desnoix (1854) by concentrating the filtrate and washings of the lime precipitate in the decoction of nux vomica. The crystals thus obtained are stated by Schützenberger (1858) to be a mixture of not less than nine different alkaloids, which he distinguished by prefixing to igasurine the letters *a*, *b*, *c*, etc. However, Jörgensen (1871) and Shenstone (1877, 1881) found the supposed igasurine to be impure brucine, though it is not unlikely that one or more other alkaloids may be present. (See STRYCHNINA.)

Other Species of Strychnos.—STRYCHNOS TIEUTE, *Leschenault*, is indigenous in Java; the seeds closely resemble nux vomica, but are smaller and whiter in color. The decoction of the root-bark, evaporated to an extract, is the principal ingredient of the arrow-poison, *upas-tieute;* it contains strychnine and brucine.

STR. POTATORUM, *Linné*, is indigenous to India. The seeds are subglobose, ½ inch (12 Mm.) or less in diameter, brownish-gray in color, and of an insipid not bitter taste. They do not contain strychnine, and are used in India as *clearing nuts* for cleansing muddy water, also in diabetes and as an emetic. In 1871 they were sent to the United States as *Indian-gum nuts.*

STR. COLUBRINA, *Linné*. This yields the true *lignum colubrinum*, in place of which the branches of the nux vomica tree are often sold in India. It differs from the latter in being more crooked and knotty; the wood is harder and darker colored; the bark has bright rust-colored warts, is thicker, and has more scattered stone-cells of a bright-yellow color. All parts of the plant are bitter and poisonous; the wood was found by Pelletier and Caventou to contain strychnine and brucine.

STR. GAUTHIERIANA, *Pierre.* The bark is used in China as *hoàng-nàn;* it resembles nux-vomica bark, but is thinner, blackish-gray, more verrucose, and upon transverse section shows more irregular striæ and fewer stone-cells; it contains strychnine and brucine.

AKAZGA—*M'boundou, Boundou, Ikaja,* or *Quai*—is a shrubby plant indigenous to the equatorial region of Western Africa, and appears to be a hitherto unknown species of Strychnos. It is about 6 feet (1.8 M.) high, with a stem nearly an inch (25 Mm.) in diameter. The dense hard wood is covered with a firmly-adhering bark having sometimes numerous yellow tubercles, of a yellowish-orange, or in some parts light-red, color, with a light-brown inner surface, and characterized by a continuous layer, three or four cells deep, of indurated parenchyma. The leaves are opposite, oval-acuminate in shape, and attain a length of 3 to 6 and even 12 inches (8 to 30 Cm.). The seeds are subglobular, downy, about ⅝ inch (15 Mm.) in diameter, and consist of albumen, with a central cavity into which the embryo with its five-ribbed cotyledons projects. The bark has a strongly bitter, faintly aromatic taste, and a distinct bitterness is also perceived in the other parts of the plant.

Thomas R. Fraser (1867) has obtained an alkaloid, *akazgine,* which crystallizes from its alcoholic solution, is readily soluble in chloroform, carbon disulphide, benzol, and ordinary ether, is colored brown by concentrated mineral acids, and dissolves in dilute acids, yielding colorless salts, which are rather less persistently bitter than strychnine salts, and are precipitated by the bicarbonates of potassium and sodium; the precipitates occurring with the usual reagents for alkaloids are not crystalline. Heckel and Schlagendauffen (1881) obtained from the drug an alkaloid having the color-reactions of strychnine.

(See also CURARE, p. 530, and IGNATIA, p. 809.)

Off. Prep.—Abstractum nucis vomicæ, Extract. nucis vomicæ fluid., *U. S.;* Extract. nucis vomicæ, Tinct. nucis vomicæ, Strychnina, *U. S., Br.*

Medical Action and Uses.—The action and uses of nux vomica are identical with those of strychnine, and will be treated of in connection with the latter. It may be mentioned in this place, however, that the activity of nux vomica is too variable to render it eligible as a medicine. It may be prescribed in the *dose* of from 1 to 5 grains (Gm. 0.06–0.30) three times a day, and gradually increased from the minimum quantity until its characteristic effects begin to be manifested. The extracts and the tincture are best adapted for its administration.

Dr. Livon has made some experiments upon animals with a bark brought from Thibet, called *hoàng-nàn,* and which contains brucine. Its action differs from that of strychnine in producing tetanoid spasms, which commence in the hinder legs of the frogs and dogs employed, and thence extend to the rest of the body. In poisoning by brucine the spinal excitability, it has been alleged, persists several hours after the animal's death, whereas it ceases almost immediately after death caused by the Thibetan poison. But Vulpian (*Les Substances toxiques, etc.,* p. 613) declares that on frogs, at least, the action of hoàng-nàn is identical with that of strychnine and brucine. The conclusions of this eminent investigator and of Galippe in regard to the preparation as a medicine agree with that we have drawn from the published records concerning it (Lisserteur, 1879; Piffard; Barthélemy, etc.). "The reports of its virtues are, to say the least, greatly exaggerated. As to its use in rabies, one must have an inordinate dose of credulity to believe in it as a cure of this terrible affection." It is also to be borne in mind that hoàng-nàn is a compound medicine, and that it contains arsenic, which may very well account for its reported efficacy in certain diseases of the skin, and even in leprosy.

AKAZGA.—It appears from the narrative of Prof. Fraser of Edinburgh, who carefully investigated the nature and action of akazga, that it is used as an ordeal in West Africa. "The supposed witch is obliged to drink a certain quantity of the infusion prepared from the bark, and to step over a number of akazga-sticks placed parallel to one another at the distance of 2 feet. If this can be done, the person is pronounced innocent; if guilty, difficulty is experienced in stepping over the sticks; they appear like large logs, to surmount which suitable efforts are made, and these are rendered more and more difficult by spasmodic muscular twitches, until the victim staggers, and ultimately falls in tetanic convulsions. . . . . In those cases in which the trial is successfully undergone a copious flow of urine is described as occurring, and by this means the poison is supposed to be removed." The physiological action of the alcoholic extract of akazga, and that of the alkaloid akazgin, correspond to those of nux vomica and strychnine. Each grain of the alkaloid is equal to about 7 grains of the extract or 50 grains of the dried bark in physiological effects, which consist essentially in tetanic convulsions. As yet no therapeutical applications appear to have been made of akazga or its alkaloid.

M'boundou, an African ordeal-poison, was found by Testut to exhibit different modes of action according to its dose, the smaller doses causing convulsive, the larger paralytic, phenomena. He therefore concluded that it contained two principles—the one exciting the reflex function, the other paralyzing it (*Amer. Jour. Phar.*, li. 323). But Heckel and Schlagendauffen inferred that its only active constituent is strychnine, and that it occasions tetanic or paralytic phenomena according to the dose of it administered. Their conclusion agrees with the previous one of Richet (*Bull. de thérap.*, c. 223), and is confirmed by the later observations of Vulpian (*Cours de Pathol. exper.*, p. 616), who found in experiments upon frogs that a period of relaxation preceded the convulsive phenomena, often by several hours or even days.

NYMPHÆA.—Water-Lily.

Pond-lily, E.; *Nénuphar*, *Lune d'eau*, Fr.; *Seerose*, *Wasserlilie*, G.

Nat. Ord.—Nymphæaceæ.

Description.—The following species, of which two belong to North America, have been employed:

Nymphæa odorata, *Aiton*, *Sweet-scented water-lily*. It has a horizontal immersed rhizome which is 2 or 3 inches (5–8 Cm.) thick, marked on the upper side with broad subcircular or oblong leaf-scars, and on the lower side with the remnants or scars of the thick fleshy rootlets, brown externally, yellowish-white internally, fleshy, with irregular wood-bundles; after drying deeply wrinkled, spongy, and light. It is without odor, and has a bitter mucilaginous somewhat astringent taste. The leaves are large, orbicular-cordate, and entire; the flowers are 4 or 5 inches (10 or 12 Cm.) broad, many-petalous, white, and very fragrant.

Nymphæa alba, *Linné*, the European water-lily, resembles the preceding, the chief differences being found in the shape of the fruit and the greater number of its stigmas.

Nuphar advena, *Aiton* (Nymphæa, *Michaux*), *Yellow pond-lily*, *Spatterdock*. The rhizome resembles the above, and is nearly of the same dimensions. The leaves are heart-shaped at the base, with rather divergent lobes, and vary between ovate and roundish in outline. The flowers have six yellow sepals and numerous small yellow petals, which resemble the stamens.

Constituents.—The rhizome of Nymphæa alba was examined by Morin (1819) and Carminati, and that of N. odorata by Bigelow. Tannin, mucilage, etc. were found, but the bitter principle was not isolated. W. Gruening (*Thesis*, Dorpat, 1881) examined the rhizome and seeds of Nymphæa alba and of Nuphar luteum, *Smith*. The principal constituents are tannin and gallic acid, besides starch, gum, resin, albumen, etc. The alkaloids previously observed by Dragendorff were obtained in an amorphous, and probably not entirely pure, condition; that from Nymphæa was pale reddish-brown, insoluble in water, and readily soluble in alcohol, ether, and diluted acids; sulphuric acid colors red-brown, after the addition of potassium chromate changing slowly to light-green; Fröhde's reagent colors red, then green. *Nupharine* is white, soft above 40° C. (104° F.), easily soluble in alcohol, chloroform, ether, amylic alcohol, acetone, and diluted acids; on heating the solution in diluted sulphuric acid in a steam-bath, it gradually turns brown, and finally blackish-green. The alkaloids appear to be not poisonous.

Medical Action and Uses.—The root of our native pond-lily is astringent and demulcent, and is used internally for the cure of *bowel complaints*, topically in cataplasm for *ulcers*, and in decoction for *leucorrhœa* and *dysentery*. The European species, N. alba, was once reputed to be anaphrodisiac, and the juice of the fresh root is said to be acrid, and even capable of reddening the skin. An ointment prepared with it is used to stimulate the scalp when the *hair* tends to fall out.

ŒNOTHERA.—Evening Primrose.

Onagre, Fr.; *Nachtkerze*, G.

Œnothera biennis, *Linné*.

Nat. Ord.—Onagraceæ.

Description.—This very variable plant is common throughout North America in fields and waste places, and has been naturalized in Europe. It has a conical *root*, which is ½ to 1 inch (12–25 Mm.) thick at the base, 4 to 6 inches (10–15 Cm.) long, with spreading branches, externally pale-brown or sometimes reddish, with a thin bark, internally white, fleshy, inodorous, of a sweetish taste, and in the second year woody and tough. The *stem* is from 3 to 6 feet (0.9–1.8 M.) high, rough, hairy, often purplish. The *leaves* are alternate, ovate-oblong or oblong-lanceolate, 3 to 5 inches (7–12 Cm.) long, somewhat petiolate, acute, nearly entire, and short-hairy. The *flowers* are in terminal leafy spikes, have a sessile cylindrical ovary united with the long tubular calyx, four obcordate yellow petals, and eight stamens, and produce a four-valved capsule containing numerous seeds. The herb is inodorous and has a mucilaginous and mild astringent taste. The root and the flowering plant are used.

Constituents.—Diot Chicoisneau (1834) found the plant to contain much mucilage; his *œnotherin* was a mixture of several bodies, which have not been separated from one another. Braconnot found tannin in the stem.

Medical Action and Uses.—The late Dr. R. E. Griffith, in his *Medical Botany*, after speaking of the mucilaginous and acrid qualities of the herbs and leaves, states that he made use of it in several cases of *infantile eruptions* which had resisted other modes of treatment, and became satisfied that it was highly beneficial—a judgment which his subsequent experience confirmed. It is advised that about the flowering season the small twigs with the bark of the large branches and stem, retaining their leaves, should be dried in the shade. Of these a strong decoction is made, with which the eruptions should be bathed several times a day. We are not acquainted with any later and confirmatory reports upon this plant. It has also been used in *diarrhœa* and in *asthma*.

OLEA DESTILLATA.—VOLATILE OILS.

Olea ætherea s. volatilia, Ætherolea.—Essential (ethereal or distilled) oils, E.; *Huiles volatiles (éthérées, essentielles, distillées), Essences*, Fr.; *Flüchtige (Ætherische) Oele*, G.

Characters.—Volatile oils are those proximate principles to which in the majority of cases the odor of plants is due. They have no chemical, and but few physical, properties in common with the fixed oils, but, like the latter, they are generally soluble in ether, chloroform, bisulphide of carbon, etc., and when dropped upon paper leave a stain resembling that produced by fat, but which, unlike the latter, disappears upon the application of heat. Freshly-prepared volatile oils are generally freely soluble in petroleum benzin, but, according to Belohoubek (1882), after exposure and partial oxidation yield with this solvent a more or less turbid mixture. Their specific gravity usually ranges between 0.85 and 0.99; a few are still lighter, and some are heavier than water, one reaching the specific gravity 1.180. All are inflammable and burn with a bright but very sooty flame. They possess the odor of the plants from which they have been obtained, but are usually less fragrant, which is probably due to the presence in the plants of other odoriferous compounds, perhaps compound ethers, which, being more soluble in water, are removed during the distillation; it is on this account that medicated waters distilled from the drug, almost without exception, possess a more agreeable odor and taste than when prepared from the volatile oil.

When exposed to the air volatile oils become ozonized, and are more or less rapidly converted into a viscid oil or even solid resin; to the presence of ozone is due their bleaching effect upon corks, indigo solution, etc. (See a paper by Dr. J. L. Plummer in *Amer. Jour. Phar.*, 1853, pp. 398 and 508; also, 1860, p. 46.)

Origin.—Volatile oils are met with in a large number of plants, and may exist in every part thereof, from the root to the seed. If found in several parts of the same plant, the volatile oils obtained from them generally differ more or less, not only in odor and other physical properties, but frequently also in chemical composition. They are often separated in the plant in distinct cells, appearing as glands in the herbaceous portion, or distributed throughout the interior tissue, or forming tubes, as in the fruits of the Umbelliferæ. Very frequently they are associated with resins, and even exude either naturally or from incisions, holding resins in solution (oleoresins and many gum-resins). In a number of plants they are known to be produced under the action of a ferment, like emulsin and myrosin, upon other compounds, such as amygdalin and myronic acid; but in most cases it has been impossible to demonstrate either the precise tissue where they are produced or the compounds which yield them. There is, however, reason to believe that, at least in some cases, they result from the splitting of glucosides, resins, and similar principles. All volatile oils yield by spontaneous oxidation resinous compounds, which, however, have thus far been found to be entirely distinct from the resins with which the former have been naturally associated.

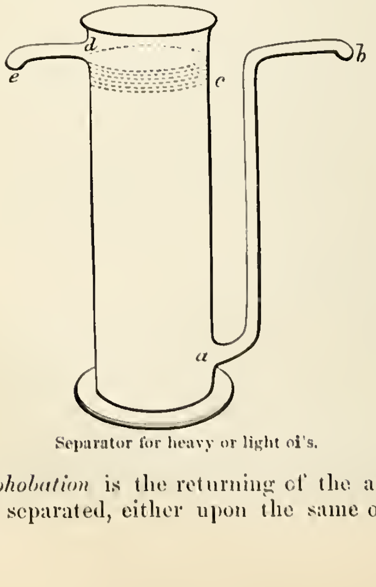
Among the products of the destructive distillation of organic bodies compounds are often found which possess the general characters of volatile oils, but usually have an empyreumatic odor persistently adhering to them; they are called *empyreumatic volatile oils*. Odorous compounds, sometimes known as *ferment oils* (*fermentolea*), are also produced during the fermentation of bruised vegetables or their expressed juice; they are probably alcohols or compound ethers.

Preparation.—In a few instances, where the volatile oils are separated in cells of the epidermal tissue and not associated with resinous or fatty matters, as in the fruits of many Aurantiaceæ, they may be prepared by expressing that tissue after removing it by grating. By far the largest number, however, require to be distilled with water. Herbaceous plants, flowers, and leaves which are not of a leathery nature usually need no previous comminution, but firmer parts of plants, and those containing the volatile oil in the inner tissues, must be more or less ground or broken. Though fresh plants are usually readily softened and permeated by water, a short maceration before the distillation begins is rather advantageous, and may be regarded as very desirable if dried plants are employed; it is unnecessary in case the volatile oils are to be distilled off from resinous compounds; but whenever the volatile oil does not pre-exist, but is produced by the reaction of two principles in the presence of water, a prolonged maceration in cool or lukewarm water is required.

The *distillation* is accomplished in stills made of copper or iron, a sufficient quantity of water being introduced to cover the material and prevent empyreuma; the latter object is more completely attained if a perforated false bottom is placed a few inches above the bottom of the still and the material packed upon it. Direct heat is then applied until the water boils briskly, and is maintained at this temperature until the distillate is no longer charged with volatile oil. Some volatile oils are obtained of better quality and greater fragrance if the direct application of fire to the still is avoided and the volatilization is accomplished by the introduction, near the bottom, of steam under pressure; a wooden tank may then be converted into a still by cutting a suitable aperture in the top and surmounting it with a still-head. Steam distillation is particularly applicable for flowers like those of the orange, lavender, chamomile, etc., and for the labiate and other herbs.

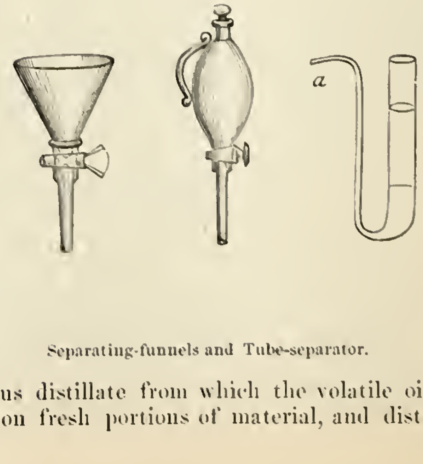
Although volatile oils have a higher boiling-point than water, the majority boiling above 140° C. (284° F.), their vapors diffuse readily in the vapors of water at the boiling temperature of the latter, and are thus easily carried over. Greater difficulty, however, is experienced with those volatile oils which have either an exceptionally high boiling-point or a specific gravity near or exceeding that of water; the addition to the water of about 3 per cent. of table-salt is then advisable, whereby the boiling-point is somewhat raised, and, as the water distils over, it may be gradually increased to about 109.5° C. (229° F.). The volatile oils of cloves, cinnamon, santal-wood, etc. are thus more readily obtained than with water alone.

Fig. 193.



Separator for heavy or light oils.

Fig. 194.

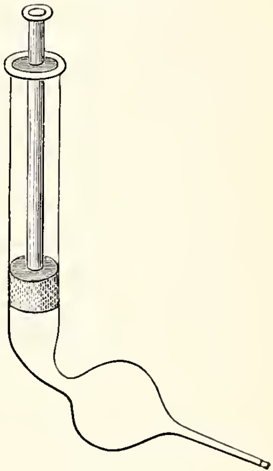


Separating-funnels and Tube-separator.

Cohobation is the returning of the aqueous distillate from which the volatile oil has been separated, either upon the same or upon fresh portions of material, and distilling again. The process is rendered necessary with cloves, santal-wood, etc., the firm tissue of which, containing the volatile oils, is not easily ruptured or thoroughly permeated by water, and with the petals of rose and similar articles which contain only a minute proportion of volatile oil.

Separation.—On cooling, the distillate separates into two layers, one being a solution of the volatile oil in water, the other the pure oil. A tall cylinder or flask is used, which near the bottom has a glass or other tube inserted and curved upward to a short distance below the top. The heavy water separating at the bottom will commence to discharge through the lateral tube *b* as soon as the vessel is nearly filled with the distillate, upon which will float a layer of volatile oil; this layer may be withdrawn by means of a small siphon, or, better still, through a lateral tube *e* inserted near the top of the vessel. If the volatile oil, however, is heavier than water, the conditions will be reversed, and the oil will flow through *a* and run off at *b*. The last portions of volatile oil are removed from the water by means of a separating-funnel (Fig. 194), the separation being effected with a perforated glass stopper inserted in the neck or by inclining the vessel (Fig. 194) through the tube *a*. For very small quantities a bulb-pipette or syringe-pipette will be found useful, the tube of which is drawn out to a fine point. By a suitable arrangement the separated odorous water may be returned to the still while the distillation is progressing.

FIG. 195.



Syringe-pipette.

If volatile oils are present only in minute quantities, frequent cohobation is required, but even then too much is often lost by being retained in the water, as in the case of violets, tuberoses, etc. To obtain these delicate perfumes, Millon and Commaille (1868) employed purified bisulphide of carbon, with which the material is exhausted, and on the spontaneous evaporation of which all the odoriferous compounds are left behind.

The process of *enfleurage* is likewise adapted for obtaining delicate perfumes: A number of trays or frames are covered with a layer of purified tallow or other inodorous fat, and then with flowers, the latter, if necessary, being replaced by fresh flowers in a few days; when the fat is sufficiently charged with the perfume it constitutes the *pommades* used by perfumers. Liquid fats may be used in a similar manner for extracting such perfumes, the liquid portion of oil of ben being employed, because it resists rancidity for a long time; the *huiles antiques* are obtained in this manner. By digesting the solid or liquid perfumed fat with pure alcohol the odorous principles are taken up by the latter, the spirit then constituting the *extracts* of perfumers; the small portion of fat entering solution separates on exposure to a low temperature.

L. Wolff (1877) proposed a process for preparing volatile oils whereby distillation may either be entirely avoided or materially shortened. Petroleum benzin dissolves from plants chiefly the volatile and fixed oils and wax which are left after evaporating the solvent. The volatile and fixed oils may then be separated either by distillation with water or by agitation with alcohol, removing the fat and wax, and separating the volatile oil from the alcohol by mixing with water.

Rectification is not unfrequently desirable, since resinous compounds and coloring matter may thereby be removed and the odor improved; it is best accomplished by mixing the volatile oil with half of its own weight of an inodorous liquid fat, and distilling the mixture from a solution of table-salt, as stated above.

Composition.—C and H, or C, H, and O, are the elements forming the large majority of the volatile oils; a few (oil of mustard, asafetida, etc.) consist of sulphuretted compounds, and are generally characterized by a disagreeable penetrating odor; some others (oil of bitter almonds, cherry-laurel, etc.) contain hydrocyanic acid, from which, however, they may be freed without otherwise altering their composition or modifying their odor. The first class mentioned, the hydrocarbons, are mostly *terpenes*, consisting of two or more isomeric modifications having the composition of $C_{10}H_{16}$ or a multiple thereof. The oxygenated volatile oils likewise consist proximately of at least two principles, boiling at different temperatures. The one having the lowest boiling-point is called *elæopten*, and very often is a hydrocarbon of the composition $C_{10}H_{16}$ or $C_{10}H_{14}$. *Stearopten* is that portion which volatilizes last and congeals at about the ordinary temperature; in composition it is not unfrequently an oxide or hydrate of the hydrocarbon. The stearopten of oil of rose is a hydrocarbon, C_nH_{2n}, and has a lower boiling-point than the fragrant oxygenated portion. Stearoptens—or *camphors*, as they are sometimes called—crystallize from the volatile oils on exposure to a low temperature, the crystallizing-point depending partly on the fusing-point of the stearopten and partly on the amount of the solvent elæopten. The variation in the proportion of the two proximate constituents is due to the influence of climate, soil, and cultivation, and modifies to some extent the effect upon polarized light.

The *color* of volatile oils appears to be due to distinct compounds. Piesse (1863) separated from oil of wormwood, patchouly, etc. a volatile dark-blue body, *azulene* (according to Gladstone [1863] *cœrulein*), of the composition $C_{16}H_{26}O$, which he stated to be present in all blue-colored volatile oils, while those having a different color are free from it or contain it in smaller proportion, mixed with more or less of yellow or brown resin.

Preservation.—Since volatile oils oxidize when in contact with air, and the oxidation is accelerated in the light, they should be kept in well-stopped vessels protected from the light. Various contrivances, which readily suggest themselves, have been recommended. Bottles of amber-colored glass, which excludes the actinic rays, are very suitable; and the addition of a small quantity of alcohol, which in our experience need not exceed 3 per cent., will prevent for a long time, if not the oxidation, at least the marked change of odor, which oils of orange, lemon, peppermint, and others undergo. Menigaut as early as 1835 proposed for the same purpose the addition of an equal weight of alcohol.

Restoration.—Resinified volatile oils, the flavor of which has not been impaired, may be restored to their former limpidity by rectification (see above). Small quantities of such volatile oils Curieux (1858) recommended to be agitated for fifteen or twenty minutes with a magma formed by mixing solution of borax with animal charcoal, when the resinified portion will unite with the borax, leaving the oil limpid and the odor restored.

Adulterations.—Among the numerous methods which have been recommended for detecting the principal adulterations to which volatile oils are subject, the following are simple, reliable, and easily executed:

(*a*) *Fixed oils* are indicated by the permanent greasy stain left upon paper or by the residue left on distilling the suspected oil with water. Since the fats are mostly insoluble, and the volatile oils mostly soluble in 85 per cent. alcohol, this solvent will leave the former behind; minute quantities of fixed oils, however, will escape detection by this method.

(*b*) *Alcohol* will cause a diminution of the volume of the volatile oil when this is agitated with an equal bulk of water or glycerin in a graduated tube; the difference indicates approximately the amount of the adulteration. If olive oil is used in place of water, the alcohol, unless present in a very small quantity, will separate. Fused calcium chloride and dry acetate of potassium are insoluble in volatile oils, but in the presence of alcohol become either soft or liquid. Tannin, which has been recommended for the same purpose, is soluble in oil of bitter almonds, cinnamon, and a few others. Dragendorff recommends metallic sodium, which produces a brisk evolution of gas in the presence of even 5 or 10 per cent. of alcohol, while hydrocarbons are not at all, and oxygenated oils but slightly, acted on in the cold. Aniline-red is soluble in alcohol and insoluble in volatile oils, but if the oils contain alcohol they are colored red by the dry aniline color.

(*c*) *Cheap volatile oils* are often difficult to detect. On rubbing a few drops of the volatile oil between the hands, or heating them gradually in a dish, or evaporating them from bibulous paper, and observing the odor from time to time, a marked difference of it is indicative of such adulteration. The hydrocarbons being mostly cheaper and less freely soluble in 85 per cent. alcohol than the oxygenated oils, an adulteration with the former will generally be recognized by the solvent mentioned.

The solubility of santal-red in some volatile oils (Voget), the different reaction of these oils with iodine (Tuchen), the change of color produced on heating oxygenated volatile oils with a little nitro-prusside of copper, and the prevention of this reaction by oil of turpentine and other hydrocarbons (Heppe, 1856), and the behavior of the volatile oils toward strong mineral acids, potassa, bromine, sulphide of lead, and other chemicals,—may, at least occasionally, be utilized for the purpose of detecting adulterations. (See *Proceedings Amer. Phar. Assoc.*, 1858, p. 344, and 1859, p. 338.)

OLEA PINGUIA.—Fixed Oils.

Fats, Fatty oils, E.; *Huiles grasses, Huiles fixes,* Fr.; *Fette, Fette Œle,* G.

Characters.—Fats are peculiar compounds obtained both from the animal and the vegetable kingdom. In their pure state they are often colorless, inodorous, and tasteless. Many are liquid at the ordinary temperature (*oils* or *fixed oils* proper), but by cautious cooling may generally be separated into fats of different fusibility. Others have a soft consistence (*fats* proper, or *butters*), and mostly yield liquid fats when subjected to a gradually increased pressure, while a fat of a higher fusing-point remains in the press-cloth. Those of a firmer consistence are sometimes termed *tallows*, and when hard and more or less brittle at the common temperature they are often popularly and commercially known as *waxes*. They are all lighter than water, and vary in specific gravity generally between .913 and .956, though some are as light as .860. They are insoluble in water, sparingly soluble in cold alcohol, but generally freely soluble in ether, chloroform, carbon disulphide, benzol, and light petroleum oils. The hot alcoholic solution of the solid fats separates them on cooling, generally in a crystalline form. When heated, the solid fats fuse to transparent oils and solidify again on cooling. Heintz observed that by raising the heat very slowly some fats show two fusing-points, which for pure stearin were found at 55° C. (131° F.) and 71.6° C. (160.9° F.), and also two congealing-points, the latter depending upon the temperature to which the fat had been heated and upon the rapidity with which it had cooled. After having been heated considerably beyond the fusing-point some solid fats remain liquid for a long time after cooling; at a higher temperature, usually in the neighborhood of 300° C. (572° F.), an ebullition is observed, accompanied by decomposition, the boiling-point gradually rises, and extremely acrid and irritating vapors are evolved, causing a copious flow of tears, and containing *acrolein.* (See GLYCERIN, p. 735.)

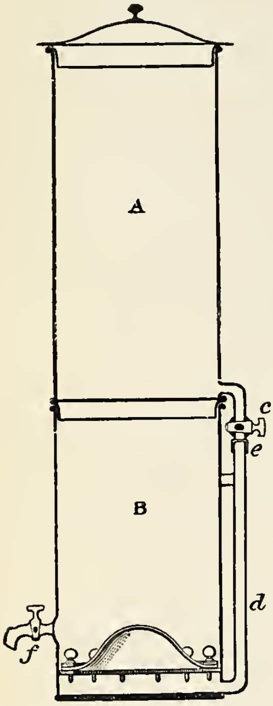
Fats are more or less unctuous to the touch, and when in a liquid condition dropped upon paper leave a permanent grease-spot unless they are crystalline and so hard that they may be rubbed off. They are not inflammable at the ordinary temperature, but when heated to incipient decomposition burn more or less readily by the aid of wick and with a sooty flame. When their surface is considerably increased by being spread over porous bodies they are rapidly oxidized, whereby the heat may be increased to such an extent as to ignite the entire mass.

Origin.—All plants, and perhaps all parts of plants, contain fat, though often in minute quantity. The liquid and solid fats are most likely generated from starch and other carbohydrates and allied compounds; De Luca (1862) proved that the fixed oil of olives increases in quantity as the mannit of the green olives disappears, and that the access of air and light facilitates the conversion. It is not unlikely that certain protein compounds may likewise be the source of fats. In the animal economy fats are, at least partly, produced in a similar manner.

Preparation.—From animal tissues rich in fat the latter is obtained by fusion either by itself or in the presence of water, and removal of the tissue by skimming or straining. Vegetable tissues containing notable quantities of fat yield it on being subjected to powerful pressure, either at the ordinary temperature or between plates which are heated to a little beyond the fusing-point of the fat; but since a certain quantity of the fat is mechanically retained by the tissues, a larger yield is had by the use of a solvent, such as carbon disulphide or petroleum benzin, which on being distilled off leaves the fat behind. When the bruised or cut vegetables are boiled with water, the fused fat rises to the surface, and may either be skimmed off or obtained by straining, expression, and subsequent separation from the water; such fats are usually inferior to those obtained from the dried article by pressure alone.

Purification.—The impurities contained in fats are protein and mucilaginous compounds derived from the vegetable tissue, and may be removed through a well-dried filter; the filtration is facilitated by a somewhat elevated temperature. An apparatus suitable for this purpose, and for filtering through flannel in an upward direction and under pressure of a column of the oil, was constructed by W. R. Warner (1861): A is the reservoir containing the oil; B, the recipient of the filtered oil. On the large scale the purification is effected by the gradual addition to the oil of ½ to 2 per cent. of sulphuric acid, whereby the impurities are carbonized; the oil is then agitated with water to remove adhering acid, decanted, and often filtered through charcoal, or through tow, moss, or similar material, upward filtration being preferred. The use of sulphuric acid for the purification of oils was introduced in England by Gowen (1790). Chloride of zinc has a similar effect, according to R. Wagner, if used in concentrated solution, 1 to 1½ per cent. being required; and Barreswil (1858) recommended for the same purpose the saponification of a small proportion of the fat by means of a weak solution of potassa or soda. From 1 to 2 per cent. of ammonia will often be effectual, and as mechanical agents for separating the impurities powdered clay and plaster of Paris have been found to serve a good purpose. The loss sustained in purification varies with the nature and amount of the impurities, and in some cases reaches 15 or 20 per cent. of the crude oil.

Fig. 196.



Warner's Oil-Filter.

Bleaching.—The treatment of fats with sulphuric acid usually destroys also the coloring matter wholly or in part; treatment with animal charcoal renders the fats lighter, and many are bleached (and often become rancid) by exposure to the direct sunlight, a strip of lead being sometimes introduced into the fat if liquid, or this is occasionally agitated with an aqueous solution of ferrous sulphate. Palm oil is bleached by being rapidly heated to 240° C. (464° F.) and keeping it at this temperature for 10 minutes. The same effect is produced upon oil of poppy-seed by heating it for 5 hours to between 90° and 95° C. (194° and 203° F.). Oxidation of the coloring principle by means of permanganic or chromic acid or hypochlorites has likewise been recommended.

Composition.—Nearly all animal and vegetable fats are mixtures of two or more fats having a different fusing-point; those which are liquid at the ordinary temperature separate in the cold granular masses of the solid fats contained in them, while those which are solid at the common temperature often yield by expression a liquid oil. With comparatively few exceptions, fats are compound ethers of the triatomic alcohol glycerin (see page 734), and the acids contained in them belong to two series, the fatty acid group of the general formula $C_nH_{2n}O_2$, and the oleic acid group of the formula $C_nH_{2n-2}O_2$. The most important members of the first group are stearic ($C_{18}H_{36}O_2$), palmitic ($C_{16}H_{32}O_2$), myristic ($C_{14}H_{28}O_2$), lauric ($C_{12}H_{24}O_2$), and butyric ($C_4H_8O_2$) acids. To the second group belong, besides oleic acid ($C_{18}H_{34}O_2$), erucic ($C_{22}H_{42}O_2$) and hypogæic ($C_{16}H_{30}O_2$) acids, the former being found in oil of mustard, the latter in oil of ground-nut. All these acids are monobasic, and the neutral fats therefore contain 3 molecules of the acid to 1 of the ether radical, C_3H_5; these compounds are conveniently named from the acid by changing the termination to *in;* thus *stearin* or *tristearin* is $C_3H_5.(C_{18}H_{35}O_2)_3$, and *olein* or *triolein* has the formula $C_3H_5.(C_{18}H_{33}O_2)_3$. The fats most widely distributed are olein, stearin, palmitin, myristin, and laurin, which are inodorous when pure, while the fats of the volatile acids have a distinct odor, the most important being *butyrin*. Fats which on exposure to air gradually solidify through the absorption to oxygen, the so-called *drying oils*, are supposed to contain *olin*, the composition of which is not known; the drying fat of linseed oil has been named *linolein*.

The fusing-points of the above-named pure fats are as follows: Stearin, 55° C. (131° F.); palmitin, 48° C. (118.4° F.); myristin, 31° C. (87.8° F.); laurin, 44° C. (111.2° F.). The margarin of older chemists is a mixture of palmitin and stearin; olein and butyrin are liquid at common temperatures.

Preservation.—Fats should be kept in a dry place at a low temperature, and protected from light and air. On being exposed to the atmosphere the fats gradually become rancid, and this change is accelerated by the presence of animal and vegetable tissue, protein, and mucilaginous compounds; hence the importance of careful purification. The rancidity is due to the generation of odorous compounds, perhaps some acrolein and volatile fatty acids, besides some coloring matter. Rancid fats may be improved, and to a certain extent restored, by washing with warm water or by treating them with magnesia or other weak alkali, and afterward washing them well. Treatment with strong alcohol or agitation of the oil with a little powdered borax and exsiccated sodium carbonate has likewise been recommended.

Adulterations.—The higher-priced fats are not unfrequently adulterated with cheaper ones, and, owing to the similarity of composition, such admixtures are difficult to recognize. A change of the fusing-point in the solid and of the congealing-point in the liquid fats is not unfrequently produced by addition of other fats, and other criteria are afforded by the color, consistence, odor, and taste, sometimes also by the specific gravity. The non-drying oils when subjected to the influence of nitrous acid become solid, the olein being converted into the solid isomeric compound *elaidin*, which fuses between 25° and 28° C. (77° and 82° F.), and solidifies again on cooling. The test is made by agitating for a short time 1 part of copper in small pieces with about 5 parts each of nitric acid and the oil, and setting the mixture aside; the separation of elaidin commences in about an hour, and the solidification is generally completed in about 6 hours. Almond oil and olive oil are scarcely colored thereby, but become opaque; the drying oils (linseed, poppy-seed, hemp-seed, and nut oils) remain liquid, while the following become thicker, but not solid: castor, cotton-seed, sunflower-seed, and benne-seed oil, the latter acquiring also a red color.

On carefully placing a drop of oil or oleoresin upon the surface of chemically pure water contained in a perfectly clean glass vessel, distinct figures are formed, which were termed *cohesion-figures* by C. Tomlinson (1864), and which have a distinct character for the different liquids. These cohesion-figures have been recommended as a means of identifying the liquids, and possibly also of determining the presence of admixtures.

The character of the soda soap may likewise serve to indicate an adulteration with drying oils; for this purpose the oil is agitated with one-third of its weight or more of soda solution, specific gravity 1.33 (containing 30 per cent. NaHO), and the mixture boiled until saponification has been effected; after cooling, the soap of the drying oils will be soft, and should oils of Cruciferæ (mustard, etc.) have been present, the aqueous filtrate will impart a black color to paper moistened with solution of lead acetate, owing to the sulphur present in the oil. The melting-point of the mixed fatty acids separated from the soap by hydrochloric acid has been suggested by O. Bach (1883) as a means for recognizing the purity of the fats; the results with the acids were as follows:

From	cotton-seed oil,	melting	at	38° C.,	congealing	at	35° C.;
“	sesame oil,	“	“	35° C.,	“	“	32.5° C.;
“	ground-nut oil,	“	“	33° C.,	“	“	31° C.;
“	olive oil,	“	“	26.5°–28.5° C.,	“	“	22° C.;
“	sunflower oil,	“	“	23° C.,	“	“	17° C.;
“	rape-seed oil,	“	“	20.7° C.,	“	“	15° C.;
“	castor oil,	“	“	13° C.,	“	“	2° C.

Concentrated sulphuric acid produces with different fixed oils mixtures varying in color: 8 or 10 drops of the oil are placed upon a china plate, 2 or 3 drops of sulphuric acid are added, and after a few seconds mixed by stirring; the color of the mixture will be as follows: with *almond oil*, yellow, changing to pale brownish-yellow; with *olive oil*, yellow, turning brownish; with *lard oil*, yellow and brown; with *cotton-seed oil*, yellow and brown; with *ground-nut oil*, yellow and green-brown; with *benne oil*, brown-red, becoming gelatinous; with *sunflower oil*, red-brown and brown; with *hemp-seed oil*, brown, black, and solid; with *linseed oil*, brown-red to blackish-brown; with *rape-seed oil*, greenish-blue or brownish-green; with *poppy-seed oil*, yellow to brownish-green; with *castor oil*, brownish to gray-brown. When larger quantities of oil are mixed with sulphuric acid a rise of temperature takes place, which is not alike for different oils. According to Behrens (1852), when a cold mixture of equal parts of nitric and sulphuric acid is added to an equal weight of oil, *benne oil* acquires a green, *ground-nut oil* a red, and *olive oil* a yellow color. (See also Ol. Amygdal. Express.)

The effect of nitric acid upon the oils depends not only upon the composition of the latter, the presence of coloring matter, etc., but likewise upon the strength of the acid and the temperature. Bach (1883) recommends testing the oils by agitating for 1 minute 5 Ccm. each of oil and nitric acid; the test-tube is afterward placed in boiling water for 5 minutes, and finally set aside for 18 hours at about 15° C.; the results obtained were, with—

Olive oil,	cold,	pale-green;	hot,	orange-yellow;	final	result,	solid.
Cotton-seed oil,	“	yellowish-brown;	“	reddish-brown;	“	“	butyraceous.
Sesame oil,	“	white;	“	brownish-yellow;	“	“	liquid.
Ground-nut oil,	“	pale rose-color;	“	brownish-yellow;	“	“	solid.
Sunflower oil,	“	dingy-white;	“	reddish-yellow.			
Rape-seed oil,	“	pale rose-color;	“	orange-yellow;	“	“	solid.
Castor oil,	“	pale rose-color;	“	golden-yellow;	“	“	butyraceous.

Lipowitz (1868) observed that the admixture of drying in non-drying oils may be detected by triturating 8 parts of the oil with 1 part of chlorinated lime; in the course of a few hours the mixture, if made with non-drying oils, will separate a layer of limpid oil, while no oily layer will separate from the mixture containing a drying oil. This appears to be due to the rapid oxidation of the latter.

Since most of the fats are without action upon it, polarized light does not afford a means of distinguishing them; of the officinal oils, only castor oil has a decided rotation to the right.

OLEANDER.—Oleander.

Laurier rose, *Laurose*, Fr.; *Oleander*, *Rosenlorbeer*, G.

The leaves of Nerium Oleander, *Linné*.

Nat. Ord.—Apocynaceæ.

Origin.—This well-known ornamental shrub grows wild in Southern Europe, Northern Africa, and Western Asia, and thrives best in moist ground. It is 10 to 15 feet (3–4.5 M.) high, often arborescent, with a gray or greenish-gray nearly smooth bark, ternately-divided branches, and showy dark rose-colored or white flowers. All parts are reputed to possess poisonous properties.

Description.—The leaves are whorled in threes, leathery, smooth, dark-green and glossy above, nearly sessile, linear-lanceolate, 4 to 6 inches (10–15 Cm.) long, finely pointed at the apex, entire on the margin, and delicately feather-veined. They are without odor and have a nauseous and bitter taste.

Constituents.—Lukowski (1861) obtained two alkaloids from the leaves and branches by carefully precipitating their decoction with tannin; the tannate of pseudocurarine is soluble in an excess of tannin, and the alkaloid liberated by oxide of lead. *Pseudocurarine* is amorphous, yellowish, tasteless, and inodorous, insoluble in ether, freely soluble in water and alcohol, and yields uncrystallizable salts. *Oleandrine* is a yellowish resinous body, slightly soluble in water, very soluble in alcohol, chloroform, and ether, of a strongly bitter taste, and poisonous. Its salts are uncrystallizable. Bitteli (1875) observed that oleandrine loses its poisonous properties when heated to 240° C. (464° F.), and that the hydrochlorate is crystalline; he regards the pseudocurarine as a mixture of different principles containing a little oleandrine. Schmiedeberg (1882) ascribes the poisonous action to oleandrine, while a second principle, *nerianthin*, is stated to be a glucoside and to possess only a feeble action. Pelikan (1866) considered the poisonous principle to be a yellow acrid resin, which, according to Latour (1857), possesses acid properties. The latter chemist determined also the presence of tannin, fat, and other common principles.

Allied Plants.—Nerium odorum, *Aiton* (N. odoratum, *Lamarck*). It is indigenous to and cultivated in India, and resembles the oleander, but has longer leaves and fragrant flowers with a fringed paracorolla. The bark somewhat resembles mezereon-bark, but breaks with a short fracture. Examined by H. G. Greenish (1881), fixed oil was obtained, and two bitter poisonous glucosides, both of which are insoluble in benzin, benzol, and carbon disulphide. *Neriodorin* is a transparent yellow tenacious mass, readily soluble in chloroform, colored deep reddish-brown by ferric chloride, and precipitated by basic lead acetate and by potassio-mercuric iodide. *Neriodoreïn* is a lemon-yellow powder, insoluble in chloroform, colored slightly brown by ferric acetate, and not precipitated by potassio-mercuric iodide nor by basic lead acetate until a little ammonia has been added.

Thevetia yccotli, *De Candolle* (Cerebera thevetioides, *Knuth*), is an elegant tree with dark-green foliage and golden-colored flowers, indigenous to the damp hot regions of the Mexican Cordilleras, where it is known as *joyote*. It bears an ovoid-globular crested and laticiferous drupe containing four (or by abortion two) seeds, which have a thin papery testa, a reticulate tegmen, two orbicular, unequal, crested cotyledons, and a short conical radicle. The joyote-seeds are extremely acrid, and, according to Herrera (1877), yielded by pressure 40 per cent. of oil resembling almond oil. The expressed seeds yielded to ether more oil, to distilled water albuminous and extractive matter, and to alcohol a crystalline acrid principle, *thevetosin*, which is sparingly soluble in ether, carbon bisulphide, and fixed and volatile oils, is insoluble in water, and on being treated with dilute nitric acid is split into glucose and a resinoid substance.

Thevetia (Cerbera, *Kunth*) cuneifolia and Th. ovata, *De Candolle*, are likewise known as joyote and as *narcisos amarillos*, and probably possess similar properties.

Thev. neriifolia, *De Candolle* (Cerbera Thevetia, *Linné*), is a West Indian shrub, the bark of which is used as an anti-periodic.

Geissospermum læve, *Baillon*, known in Brazil as *paó pereira*, is a tree the intensely bitter bark of which has been much used in that country. Santos (1838) separated from it an alkaloid, *pereirine*, which in its impure state, as a brown-yellow amorphous powder, is employed in Brazil. Bochefontaine and De Freitas (1877) proposed to call it *geissospermine*, and Hesse (1877) adopted this name for the alkaloid, which is nearly insoluble in ether and water and readily soluble in alcohol and dilute acids; it crystallizes in small white prisms, dissolves in strong nitric acid with a purple-red color, becoming orange-yellow on heating, and in concentrated sulphuric acid at first colorless, rapidly changing to blue, and gradually to a pale color; its composition is $C_{19}H_{24}N_2O_2.H_2O$. A second alkaloid, *pereirine*, is easily soluble in ether, forms a grayish-white amorphous powder, and is colored blood-red by nitric and violet-red by sulphuric acid; it appears to be present in larger proportion than the preceding one. The leaves of this tree, which were sent to Europe as *caroba-leaves*, have also a bitter taste, and probably contain the same alkaloids.

STROPHANTUS HISPIDUS, *De Candolle.* The plant, called *inée*, is indigenous to tropical Africa, where the seeds are used in the preparation of an arrow-poison. Hardy and Gallois (1877) isolated from the seed the poisonous neutral principle *strophantin*, which forms white crystals and is soluble in water and slightly soluble in alcohol and chloroform. The hairy seed-crown contains *ineine*, a non-poisonous crystalline alkaloid.

Physiological Action.—According to Kurzak, the leaves, flowers, bark, and wood of oleander are poisonous. Their action was studied by Orfila and by himself. The effects of an extract upon rabbits, birds, and frogs consisted essentially of paralysis of the voluntary and involuntary muscles, including the heart, the former muscles being from time to time convulsed, and death occurred from arrest of the respiration, and then of the heart. After death the heart was flaccid, and it and also the large veins were distended with dark blood. Several fatal cases of poisoning in man have been traced to this plant, and two at least to eating birds that had devoured its berries. In the south of Europe the bark is said to be used as a rat-poison and a decoction of the leaves to destroy *lice.* Domestic animals have been poisoned by drinking water in which oleander-leaves had been soaking. According to Landerer, the essential oil irritates the skin (Husemann, *Toxikologie*, p. 503). According to Schmiedeberg, the leaves of oleander contain two chemically different, non-nitrogenous constituents—neriine and oleandrine—which agree, however, in their action. The former is said to be identical with the "digitalëin" of digitalis (*Centralbl. f. d. g. Therapie*, i. 299). Thevetine and theveresin have been thoroughly tested in experiments on animals by Blas and by T. Husemann (*Archiv für exp. Pathol. u. Phar.*, v. 228). The former has upon frogs the same effects as digitalin, and its lethal dose is also nearly the same (Gm. 0.001–0.003). It first hurries the respiration and renders it irregular, and kills by producing a tonic contraction of the ventricle of the heart, with a corresponding engorgement of the auricle and of the general circulation. Voluntary motion is not destroyed, although motility is impaired in the hind legs. The same effects, essentially, were produced by theveresin in the dose of Gm. 0.05. Experiments upon dogs and rabbits led these observers to recognize a strong analogy between the effects of these glucosides and the effects of digitalin, helleborin, and other analogous products. They produce repeated attacks of vomiting (in dogs), and sometimes watery diarrhœa and profuse salivation, with extreme prostration, so that the animal lies still and will not change his posture except during the efforts at vomiting. The cerebral functions seem to be impaired, at least at the beginning of the attack; later, when exhaustion has become complete, the animal remains motionless, as if narcotized. The breathing is labored, but the pupils are unchanged, and muscular tremor is constant, although spasms are either absent or only occur just before death. As above stated, in animals killed by these poisons the ventricle is contracted, yet in exceptional cases it is found dilated with dark blood. The vomiting produced by thevetin is doubtless due in part to its irritant qualities, for when it is injected hypodermically the punctures are apt to produce absceses. The venous congestion of the stomach, which gives the interior of the organ a blue color, is partly due to the cardiac obstruction and partly to the repeated efforts at vomiting. According to Prof. Carpio (*Phila. Med. Times*, ix. 396), the thevetin of Thevetia yccotli produces symptoms almost identical with those above described, and kills by arresting the heart either in diastole or in systole. The experiments of Cerna (*Ibid.*, p. 426) led him to the following among other conclusions: Thevetin produces death by asphyxia and by cardiac paralysis; applied to the skin, it irritates, with a sensation of burning; it produces convulsions of cerebral and paralysis of spinal origin; increases intestinal paralysis; lowers the temperature; locally applied, it contracts the pupil; and it increases salivation. Warden has confirmed the statement as to the production of convulsions (*Amer. Jour. Phar.*, liv. 301).

Decourtilz, in his *Flora of the Antilles*, speaks of T. neriifolia as an acrid poison, of the bark as a drastic purgative, of the fruit as emetic, and of an extract of the plant as a remedy for intermittent fever. He describes the case of a young negro who had eaten of the green fruit, and who was affected with chills, delirium, and other nervous symptoms, nausea, and a thready pulse; he had irregular spasms, followed by extreme agitation, with singing, laughing, and weeping, and then by a fixed blank look. He seemed tending to coma, but was relieved by an emetic. In 1857, Balfour and Maclagan published a narrative of two children poisoned by the seeds of the same plant. Presently there occurred drowsiness, interrupted every few minutes by the discharge of a quantity of frothy mucus from the mouth, by vomiting also, and diarrhœa. The skin was cool and moist, the pulse slightly slower than natural and rather weak. The vomiting was performed without straining and by regurgitation. It is worthy of notice that one of the children who had been suffering from intermittent fever had no return of the paroxysms.

The following conclusions were drawn by Bochefontaine and De Freitas from experiments on guinea-pigs and dogs with the watery and also the alcoholic extract of the bark of G. læve, and with geissospermine used hypodermically: 1. Geissospermine is not a local irritant, or is feebly so. 2. It is poisonous. 2 Mgm. of it are fatal to a frog, and half a Mgm. paralyzes the animal. 1 Cgm. will kill a guinea-pig weighing 668 Gm., but no less than fourteen times this quantity are necessary to paralyze a small dog. 3. In several experiments it slowed the heart's action and the respiration, and diminished the arterial blood-pressure. 4. Its first effect was to lessen voluntary motion, the animals being at the same time inert and insensible, although the reflex movements were not prevented, but at first suspended. 5. Subsequently reflex motility was destroyed. Hence the drug expends its power primarily upon the motor centres of the brain, and subsequently on those of the spinal cord. 6. The sensory nerves appear to retain their function as long as the motor nerves. When the main artery of a frog's hind leg is tied, and the poison is given hypodermically in a fore leg, the limb protected by the ligature and the free hind limb equally lose reflex irritability. 7. This excitability becomes extinct only after the animal has been for some time torpid and inert. 8. Muscular contractility is not affected by geissospermine. Hence it may be inferred that the active principle of this plant is capable of "abolishing the physiological functions of the central gray nervous substance, and particularly of the gray axis of the bulb and the spinal cord."

Medical Action and Uses.—Oleander is one of the plants whose flowers are said to render honey poisonous, and the experiments described above seem to show that its active principle is a heart-poison. It has been used in *epilepsy*, but fruitlessly.

OLEATA.—Oleates.

Oléates, *Olées*, Fr.; *Oleate*, G.

This class of preparations was first proposed by Lhermite (*Jour. Phar. Chimie*, Oct., 1854, p. 301) but did not attract attention until recommended by Prof. John Marshall (1872). They are made from oleic acid by combining with it metallic bases or alkaloids, nearly all of which dissolve easily in the acid on trituration in a mortar. The application of a high heat should be avoided, since oleic acid is very readily altered by it and some of the metallic oxides are reduced. The medicinally employed oleates are solutions of oleates in an excess of oleic acid.

The preparation of mercuric oleate by double decomposition was recommended by Louis Dohme (1873), who combined oleic acid with potassa and precipitated the soap solution with mercuric nitrate. Subsequently, Van Harlingen (1873) proposed decomposing a solution of soap, made of almond oil, with a soluble salt of mercury, zinc, or other metal. These precipitates, like those obtained with good Castile soap, are mixtures of oleates with palmitates. But Dr. L. Wolff (1881) observed that if a solution of 1 part of Castile soap in 8 parts of hot water be set aside in a cool place for 24 hours, much of the sodium palmitate will be deposited, and the clear solution will yield with salts of metals precipitates, from which the oleates will be dissolved by benzin, in which the palmitates are insoluble or nearly so.

Oleatum aconitinæ, Oleate of aconitine, is made by dissolving 2 grains of the alkaloid in 98 grains of oleic acid.

Oleatum atropinæ and Oleatum strychninæ are made of the same strength, representing 2 per cent. of the alkaloids.

Oleatum morphinæ, Oleate of morphine, is prepared by dissolving 5 grains of the alkaloid in 95 grains of oleic acid. It soon grows darker in color, but retains its efficacy, at least in part.

Oleatum quininæ, Oleate of quinine, is made by dissolving 25 grains of the dry alkaloid in 75 grains of oleic acid.

Oleatum plumbi, Oleate of lead, containing 20 per cent. of oxide, is readily made by digesting at a temperature of about 65° C. (149° F.), and is a yellowish tenacious ointment.

Oleatum zinci. Dr. Squibb recommends it to be made with 5 per cent. of zinc oxide, when it is a soft solid. Made with 20 per cent. of oxide, according to A. W. Gerrard (1872), it is hard and friable, but transparent when melted; this contains an excess of zinc oxide. The *Br. P.* directs oxide of zinc 1 ounce, oleic acid 9 ounces.

Oleopalmitate of zinc is whitish, pulverulent, somewhat resembling powdered soapstone. *Oleopalmitate of bismuth* has an unctuous consistence. *Oleopalmitate of copper* has a blue-green color.

OLEATUM HYDRARGYRI, *U. S., Br.*—Oleate of Mercury.

Hydrargyrum oleicum, s. *oleïnicum,* s. *elaïnicum.—Mercuric oleate,* E.; *Oléate mercurique,* Fr.; *Quecksilberoleat, Mercurioleat,* G.

Preparation.—Yellow Oxide of Mercury, thoroughly dried, 10 parts (10 grains); Oleic Acid 90 parts (90 grains); to make 100 parts (100 grains or about 2 fluidrachms). Heat the oleic acid, contained in a porcelain vessel, to near 74° C. (165.2° F.), taking care not to exceed this temperature. Gradually add the oxide of mercury and stir until it is dissolved.—*U. S.*

Made with nearly pure oleic acid, it is a thick yellowish liquid, which will keep unaltered for a long time unless too high a heat has been employed; but if made with crude commercial oleic acid, containing much palmitic acid, it is of an unctuous consistence and gradually deposits some metallic mercury. The *Br. P.* directs trituration without heat.

Medical Action and Uses.—Oleate of mercury was proposed and introduced by Marshall (1872) for making an ointment more cleanly and at the same time more efficient than mercurial ointment, because more readily absorbed after its mere application to the integument without friction. It, however, was liable to the objection of irritating the skin in many cases unless it was diluted with olive oil or lard. In order to proportion the strength of the preparation to the different degrees of susceptibility of the skin, it contained different percentages of the oxide of mercury, from 3 up to 20 per cent., and as the stronger were apt to produce pain, 1 grain of morphia was combined with each drachm of the preparation. It was painted on the affected part with a brush or mop, and not rubbed in like ordinary liniments or embrocations.

It was originally applied to *joints* affected with *chronic inflammations,* synovial or rheumatic; to indurations of the *mammæ* and *lymphatic glands;* to the pustules of *sycosis;* to the seat of itching in *pruritus pudendi et ani;* and to destroy *lice* infesting the genitals. A mass as large as a pea or bean of the 20 per cent. oleate was placed in the child's axilla in cases of congenital *syphilis;* the application, repeated night and morning for 5 or 6 days, produced its constitutional effects without any sign of uncleanliness. In the non-ulcerated forms of *syphiloderma* affecting the face, neck, or hands the 10 per cent. solution was found a valuable adjunct to their treatment. This solution was also applied to non-ulcerated indurations and *condylomata,* to the eyelids in *syphilitic iritis,* and to hard *nodes* and certain forms of *syphilitic testicle.* It is alleged to have cured bromidrosis, or *fetid sweating* of the axilla (*Lancet,* May 8, 1880). Most of these results were soon after their announcement confirmed (Hill, Martini, 1873), but not those relating to non-syphilitic inflammatory affections. With the exception of a suggestion that it would form an excellent substitute for the ointment of yellow oxide of mercury in the treatment of diseases of the eye (1878), there does not appear to have been any other account published of this preparation, from which it may be inferred that experience has not confirmed the estimate of its value entertained by its proposer.

OLEATUM VERATRINÆ, *U. S.*—Oleate of Veratrine.

Veratrinum oleïcum.—Oléate de vératrine, Fr.; *Veratrinoleat,* G.

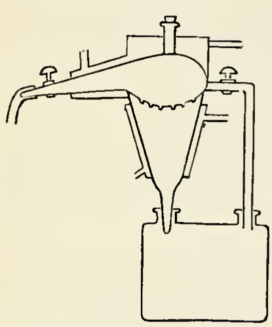
Preparation.—Veratrine 2 parts (2 grains); Oleic Acid 98 parts (98 grains); to make 100 parts (100 grains or about 2 fluidrachms). Rub the veratrine with a small quantity of the oleic acid in a warm mortar to a smooth paste. Add this to the remainder of the oleic acid, heated in a porcelain capsule on a water-bath, and stir until it is dissolved.—*U. S.*

Action and Uses.—This preparation contains half as much of the alkaloid as veratrine ointment. Like that compound, it is useful as an application to neuralgic centres. It should be applied with a mop.

OLEORESINÆ.—Oleoresins.

Oléo-résines, Extraits éthérés, Fr.; *Œlharze, Ætherische Extrakte*, G.

Fig. 197.



Percolator, with still and condenser, for preparing oleoresins.

These preparations consist mainly of fixed or volatile oils associated with resin and some other constituents, and are directed to be prepared by exhausting the powdered drug with ether. The great volatility of this solvent renders it necessary to percolate in a well-closed apparatus, in which the pressure is equalized by connecting the receiving vessel with the top of the percolator by means of a tube (see page 607). The ethereal tincture is afterward transferred to a suitable still, and the ether distilled off from a water-bath with a moderate heat. Various apparatuses have been constructed to accomplish the exhaustion with the smallest possible quantity of ether by using the same liquid over again until the material has been exhausted; for this purpose the recipient is placed in water of about 50° C. (122° F.); the ether vapors ascending through the connecting tube mentioned above are condensed in a suitable refrigerator, and the ether is again passed into the percolator, the operation being repeated as often as required. The annexed cut, taken from Parrish's *Pharmacy*, represents such an apparatus, which is best made of tinned sheet iron, or preferably of copper well tinned on the inside; it explains itself, and it is merely necessary to state that the head is perforated at the bottom for the equal distribution of the menstruum, and jacketed above for the condensation of the ether. The percolator being likewise jacketed, it may be immersed in warm water, and the ether recovered which remains in the powder after exhaustion; or, if distillation be inconvenient, the greater portion of the ether may be displaced by means of alcohol.

If the operation has been carefully conducted, the ether thus regained is not at all or but very slightly impregnated with volatile oil; nevertheless, it must be regarded as unfit for internal use, and should be reserved for a similar subsequent operation.

OLEORESINA ASPIDII, *U. S.*—Oleoresin of Aspidium.

Oleoresina filicis, U. S. 1870; *Extractum filicis liquidum*, Br.; *Extractum filicis*, P. G.; *Oleum filicis maris.—Oleoresin or Liquid extract of male fern*, E.; *Extrait éthéré (Huile) de fougère mâle*, Fr.; *Wurmfarnextrakt, Wurmfarnöl*, G.

Preparation.—Aspidium, in No. 60 powder, 100 parts (10 oz. av.); Stronger Ether a sufficient quantity. Put the aspidium into a cylindrical glass percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Keep the oleoresin in a well-stopped bottle. *Note.*—Oleoresin of aspidium usually deposits, on standing, a granular-crystalline substance. This should be thoroughly mixed with the liquid portion before use.—*U. S.*

The processes of the other pharmacopœias are essentially identical with the above, except that maceration instead of percolation is directed by the P. G. It should be remembered that only that portion of the rhizome is to be used which has still a greenish color; the oleoresin will then have a greenish or brownish-green color, while the entire rhizome with the stipes yields a brown preparation, which not unfrequently forms a jelly, probably from the separation of pectin compounds. The officinal oleoresin separates a granular deposit of filicic acid, which must be well mixed with the liquid portion on dispensing. The yield is about 10 to 15 per cent. (1–1½ oz. av.).

"The oleoresin, well stirred and diluted with glycerin, should not show any starch-granules when examined under the microscope."—*P. G.*

Medical Action and Uses.—Since the introduction into practice of this preparation, whose activity depends upon the filicic acid it contains, the treatment of *tæniæ* has been rendered prompt and certain, at least so far as relates to the armed tænia and T. bothriocephalus. It appears to act as a poison to the parasites, which are discharged dead. The medicine may occasion nausea, griping, and even vomiting, but usually acts without causing either pain or uneasiness. It is well to prepare the patient by administering a purgative dose of castor oil or of calomel, or a saline cathartic, in order to remove the mucus in which the head of the parasite is imbedded. This should be done about 12 hours before the oleoresin is administered, and the diet should be restricted to milk and light broths. The oleoresin is best prescribed in capsules each containing 6 or 7 grains (Gm. 0.40–0.46). Some advise that an equal quantity of ether should be contained in every one. Of these capsules two should be taken every 15 minutes until 1½ or 2 fluidrachms (Gm. 6–8) of the oleoresin have been used. In the course of 2 or 3 hours purging begins, and after several stools the worm is generally expelled, dead. It has been suggested that the patient should evacuate the bowel in a vessel nearly full of water, so that the parasite need not break and that its parts may be readily distinguished.

A case of fatal poisoning by 1½ ounces of this preparation is recorded (*Med. Times and Gaz.*, Oct. 1882, p. 482). The oleoresin of Aspidium marginale, a common fern of this country, has been successfully used for tape-worm in 3-grain doses.

OLEORESINA CAPSICI, *U. S.*—OLEORESIN OF CAPSICUM.

Oléorésine (*Extrait éthérée*) *de capsique*, Fr.; *Spanischpfeffer-Oelharz*, G.

Preparation.—Capsicum, in No. 60 powder, 100 parts (10 oz. av.); Stronger Ether a sufficient quantity. Put the capsicum into a cylindrical percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Lastly, pour off the liquid portion, transfer the remainder to a strainer, and, when the separated fatty matter has been completely drained, mix all the liquid portions together. Keep the oleoresin in a well-stopped bottle.—*U. S.*

It is a dark brown-red rather thick liquid, separating on standing a granular deposit of fat, which mechanically encloses a portion of the oleoresin, that may be recovered by washing several times with small quantities of ether. Instead of draining the fat, we prefer to decant the clear oleoresin and wash the remainder as stated. The yield is about 4 per cent. The oleoresin has but little odor, but possesses an extremely hot and fiery taste.

Off. Prep.—Emplastrum capsici, *U. S.*

Medical Uses.—This preparation appears to be nearly superfluous as an internal medicine, since all the virtues it can exert in that manner are sufficiently exhibited by capsicum. It is occasionally added to liniments to increase their rubefacient action, but is more beneficially incorporated in plasters, such as soap or lead plaster, for a similar purpose. The *dose* may be stated at 1 minim (Gm. 0.06), well diluted.

OLEORESINA CUBEBÆ, *U. S.*, *Br.*—OLEORESIN OF CUBEB.

Extractum cubebarum, P. G.; *Extractum cubebæ æthereum.*—*Oléorésine de cubèbe*, Fr.; *Kubebenextrakt*, G.

Preparation.—Cubeb, in No. 60 powder, 100 parts (10 oz. av.); Stronger Ether a sufficient quantity. Put the cubeb into a cylindrical percolator provided with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Transfer the remainder to a close vessel, and let it stand until it ceases to deposit a waxy and crystalline matter. Lastly, pour off the oleoresin. Keep the oleoresin in a well-stopped bottle.—*U. S.* The formula of *Br.* is practically identical with this.

The German Pharmacopœia has a similar preparation, made, however, by extracting the cubebs with a mixture of equal weights of ether and alcohol; it probably contains less volatile oil, a portion of which must volatilize with the last portions of alcohol, The oleoresin, as prepared by the above formula, is of a brown-green, or sometimes of a grass-green, color, the difference being due to the presence of more or less chlorophyll. On standing it deposits some waxy matter and cubebin, which are removed by decantation. The remaining liquid, amounting to between 18 and 25 per cent. of the cubebs used, consists mainly of fixed and volatile oils, the active resins, and chlorophyll. An alcoholic ether dissolves more brown coloring matter.

Off. Prep.—Trochisci cubebæ, *U. S.*

Medical Uses.—Investigations for the purpose of discovering upon which of the constituents of cubeb its medicinal value depends have not reached a perfectly definite conclusion, but it may be considered that its most active element is cubebic acid, which, when taken in doses of from 70 to 90 grains (Gm. 4.60–6), produces a lively sensation of heat in the stomach, increases the urine, and renders it hot and irritating. In the dose of 150 grains (Gm. 10) it occasions also eructation, flatulence, a pervading sense of warmth, and some quickening of the pulse. The *dose* of the oleoresin is stated to be from 5 to 30 minims (Gm. 0.30–2), which may be given on sugar or preferably enclosed in gelatin capsules.

OLEORESINA LUPULINI, *U. S.*—OLEORESIN OF LUPULIN.

Oleoresina lupulinæ, U. S. 1870; *Extractum lupulini æthereum.—Oléorésine de lupuline*, Fr.; *Ætherisches Lupulinextrakt*, G.

Preparation.—Lupulin 100 parts (10 oz. av.); Stronger Ether a sufficient quantity. Put the lupulin into a narrow cylindrical percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Keep the oleoresin in a well-stopped, wide-mouthed bottle.—*U. S.*

The yield is variable, often about 50 per cent. It is of a dark reddish-brown color and semi-fluid in consistence, and has the odor and taste of the drug.

Medical Uses.—This preparation probably contains all the medicinal virtues of hop. It is, however, seldom used. It may be prescribed in *doses* of from 2 to 10 or more grains (Gm. 0.10–0.60), in pill or capsule.

OLEORESINA PIPERIS, *U. S.*—OLEORESIN OF PEPPER.

Oléorésine de poivre noir, Fr.; *Ætherisches Pfefferextrakt*, G.

Preparation.—Pepper, in No. 60 powder, 100 parts (10 oz. av.); Stronger Ether a sufficient quantity. Put the pepper into a cylindrical percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated and the deposition of piperine, in crystals, has ceased. Lastly, separate the oleoresin from the piperine by expression through a muslin strainer. Keep the oleoresin in a well-stopped bottle.—*U. S.*

The officinal process yields about 5 per cent. of a greenish-black oleoresin, consisting of a mixture of volatile and fixed oil holding the pungent resin and some piperine in solution. It is an officinal substitute for the so-called *oil of black pepper*, which is obtained as a by-product in the manufacture of piperine, and has essentially the same composition, except that the volatile oil is present in small quantity only.

Medical Uses.—The medical uses of this oleoresin are probably few and unimportant, since it contains but a small proportion of piperine, which is of some value as a medicine. Its *dose* is 1 or 2 minims (Gm. 0.05–0.10).

OLEORESINA ZINGIBERIS, *U. S.*—OLEORESIN OF GINGER.

Extractum zingiberis æthereum.—Oléorésine (*Piperoïde*) *de gingembre*, Fr.; *Zingiberin*, *Ætherisches Ingwerextrakt*, G.

Preparation.—Ginger, in No. 60 powder, 100 parts (10 oz. av.); Stronger Ether, a sufficient quantity. Put the ginger into a cylindrical percolator provided with a stopcock and arranged with a cover and receptacle suitable for volatile liquids; press it firmly, and gradually pour stronger ether upon it until 150 parts (15 oz. av. or about 18 fluidounces) of liquid have slowly passed or until the ginger is exhausted. Recover the greater part of the ether by distillation on a water-bath, and expose the residue in a capsule until the remaining ether has evaporated. Keep the oleoresin in a well-stopped bottle.—*U. S.*

Coated ginger yields between 8 and 10 per cent., and the uncoated (Jamaica) ginger between 5 and 7 per cent., of oleoresin, which, as prepared from the latter, is lighter in color, rather more limpid, and perhaps more agreeable in flavor. The appellation *piperoid* originated with Beral. The present process differs somewhat from that formerly officinal, the use of alcohol for displacing a definite amount of ether poured upon the powdered ginger being abandoned. This was an exception for which there was no good reason, unless the same rule applied to all the officinal processes for oleoresins.

Medical Uses.—This oleoresin may possibly fulfil some useful purpose for which ginger in substance and its tincture are inadequate. The oleoresin is, in fact, only a concentrated ethereal tincture. The *dose* is 1 minim (Gm. 0.06), largely diluted.

OLEUM ADIPIS, *U. S.*—LARD OIL.

Huile de graisse, Fr.; *Schmalzöl*, *Specköl*, G.

A fixed oil prepared from lard at a low temperature.

Preparation.—Lard is kept for some time near the freezing-point of water enclosed in strong canvas bags, and then subjected to a gradually-increased pressure. About 60 or 62 per cent. of oil is obtained.

Properties.—Lard oil is a thin, transparent, oily liquid, usually of a pale-yellowish color or nearly colorless. Its specific gravity is .9165, but may vary between .910 and .920. If expressed at a sufficiently low temperature the oil becomes opaque near 0° C. (32° F.), and congeals at about — 5° C. (23° F.); but the commercial oil usually commences to separate a white granular deposit a little below 10° C. (50° F.) and solidifies at or near — 1° C. (30° F.). Good lard oil has a slight fatty odor, is free from rancidity, and has a bland taste.

Composition.—Its consists mainly of olein, with variable quantities of palmitin and stearin.

Off. Prep.—Unguentum hydrargyri nitratis, *U. S.*

OLEUM ÆTHEREUM, *U. S.*—ETHEREAL OIL.

Oleum vini.—*Heavy oil of wine*, E.; *Huile d'ether*, *Huile de vin pésante*, *Huile volatile éthéré*, Fr.; *Schweres Weinöl*, G.

Formula $(C_2H_5)_2SO_4.(C_2H_4)_2SO_3 = C_8H_{18}S_2O_7$.

A volatile liquid consisting of equal volumes of heavy oil of wine and of stronger ether.

Preparation.—Alcohol 24 parts (24 oz. av. or 28 fluidounces); Sulphuric acid 54 parts (54 oz. av.); Distilled Water 5 parts (1 oz. av.); Stronger Ether a sufficient quantity. Add the acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand for 12 hours; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well-cooled condenser, distil by means of a sand-bath at a temperature between 150° and 157° C. (302°–314.6° F.) until the liquid ceases to come over or until a black froth begins to rise in the retort. Separate the yellow ethereal liquid from the distillate, and expose it to the air for 24 hours in a shallow capsule. Then transfer the remaining liquid to a wet filter, and when the watery portion has drained off, wash the oil which is left, while on the filter, with the distilled water. When this also has drained off, transfer the oil to a graduated measure, and add to it an equal volume of stronger ether.—*U. S.*

The reaction upon each other of alcohol and sulphuric acid in the production of ether is explained under ÆTHER, page 122, sulphovinic acid, $HC_2H_5SO_4$, being first formed. When this acid is heated with a further supply of alcohol, ether distils over; if water instead of alcohol be added and then heat applied, alcohol distils over and sulphuric acid is set free; on heating the sulphovinic acid by itself, gas is copiously given off, consisting chiefly of *ethylene* (*æthene*, *elayl*, *olefiant gas*), C_2H_4, sulphuric acid being regenerated; $HC_2H_5SO_4$ yields C_2H_4 and H_2SO_4, while the free sulphuric acid determines further decomposition, the mass becomes charred, and sulphurous and carbonic acids are met with among the gaseous products. On heating sulphuric acid to about 150° C. (302° F.) and adding slowly sulphovinic acid, heavy oil of wine is produced, besides other gaseous compounds and carbonaceous matter.

Instead of operating with pure sulphovinic acid, alcohol and sulphuric acid may be allowed to react upon each other, whereby the products must necessarily be still more complicated, owing to the presence of uncombined alcohol and sulphuric acid, together with water and sulphovinic acid, which have resulted from the reaction of the two former; in all cases the temperature to which such mixtures are heated exerts an important influence, determining, as it rises, further decomposition. On keeping sulphuric acid at a temperature of 160° C. (320° F.) and passing the vapors of absolute alcohol into it, Lose obtained ethylene, sulphurous acid, water, and heavy oil of wine, while the retort contained sulphuric, isæthionic, and thiomelanic acids; but on previously diluting the acid with water to the amount of 30 per cent. and using 80 per cent. alcohol, Mitscherlich obtained in the distillate only water and ethylene, with traces of alcohol and ether. The carbonaceous mass mentioned before has been named *thiomelanic acid;* it is a black, rather dense, glossy mass, forming with bases insoluble compounds, and having a complex composition, approaching the empirical formula $C_{28}H_{16}SO_7$. *Isæthionic acid*, $C_2H_5HSO_4$, is syrupy, and isomeric with sulphovinic acid.

The production of heavy oil of wine evidently depends upon the absence of water and the generation of sulphurous acid, the latter being accompanied by the production of thiomelanic acid. An excess of sulphuric acid is required for this purpose, and this is directed in the above formula, the quantity of acid being about four times greater than is theoretically necessary for the production of sulphovinic acid. On mixing the acid and alcohol a turbidity is seen, and subsequently a white precipitation takes place, consisting of sulphate of lead, which was dissolved in the sulphuric acid; this should be removed to avoid the concussions, which would endanger the safety of the retort. When distillation begins, ether and water come over, which are followed by sulphurous acid gas, ethylene, and heavy oil of wine, and the distillate finally consists of an aqueous solution of sulphurous acid and a yellowish ethereal solution of the oil. The gaseous acid should be conducted into the open air or may be utilized for the preparation of sulphites. By exposing the ethereal portion of the distillate to the air, the ether evaporates, leaving the oil contaminated with some acid watery liquid, which is removed by draining upon a wet filter and washing, after which the oil is measured and dissolved in an equal volume of ether. This has been found necessary to avoid the spontaneous decomposition and separation into two liquids which would otherwise take place.

The process now officinal is essentially that devised by Squibb (1858), with some modifications suggested by C. L. Diehl (1864). The proper management of the heat influences the yield very considerably; to reduce the formation of ether to its smallest quantity, the mixture should be rapidly heated to near the lowest temperature mentioned in the directions (302° F.), and should never be permitted to fall much below it; if it should arise above 160° C. (320° F.), there is great danger of foaming to such to such an extent that the mixture will run over and the charge be lost. Diehl found it of advantage to let the temperature rise to 157° or 158° C. (314.6° or 316.4° F.), then to dampen the fire and allow the distillation to proceed spontaneously until the temperature is reduced to 150° C., when heat is again cautiously applied as before, and then heating repeated four or five times until the charge is nearly exhausted, which requires from 10 to 12 hours when working with 5 to 7 gallons of the mixture. The attention required for smaller quantities is nearly the same. With good management the yield varies between about 1.6 and 2.3 per cent., and averages about 2 per cent. of the weight of the alcohol employed. (See also a paper in *Amer. Jour. Phar.*, 1865, p. 100.)

Properties.—Pure heavy oil of wine is a yellowish, thickish, oily liquid of a peculiar aromatic odor and pungent, refreshing, bitterish taste, somewhat like that of mint. It is neutral to test-paper, and has the specific gravity 1.129, or, according to Serullas, 1.133, when quite pure. It is very slightly soluble in water, but dissolves readily in alcohol and ether. On being kept for some time crystals of *etherin* are separated, which have the same elementary composition as ethylene, are nearly tasteless, and on warming have an odor similar to that of oil of wine; the crystals have the spec. grav. .98, melt at 110° C. (230° F.), and distil at 260° C. (500° F.) without leaving any residue. In contact with cold water the oil of wine is slowly, with warm water rapidly, decomposed into sulphovinic acid and light oil of wine containing etherin in solution. This light *oil of wine*, or *etherol*, has likewise the elementary composition of ethylene, but its formula is probably C_8H_{16}; it is yellowish, of a peculiar odor, specific gravity 0.921, insoluble in water, soluble in alcohol. It boils at 280° C. (536° F.), is tough like turpentine at — 25° C. (— 13° F.), and solid at — 35° C. (— 31° F.).

Diluted with ether, as directed by the Pharmacopœia, oil of wine has the specific gravity 0.910, a pale-yellowish color, and an ethereal odor, besides that peculiar to the pure oil.

Composition.—The analyses of Serullas, Liebig, and others lead to the empirical formula $C_8H_{18}S_2O_7$. Serullas regarded heavy oil of wine as the double sulphate of ethyl and ethylene; Liebig, as ethylsulphate (sulphovinate) of etherol: the latter view appears to be the more correct one if the decomposition with water is taken into consideration. Alkalies also decompose it into sulphovinate of the alkali, liberating etherol. Or it may be related to *sulphuric ether* or *ethyl sulphate*, discovered by Wetherill (1848), which is a yellowish oil of the specific gravity 1.120, has a peppermint-like odor and pungent taste, and the composition of which is expressed by the formula $(C_2H_5)_2SO_4$. *Sulphurous ether* or *ethylsulphite*, $(C_2H_5)SO_3$, which was discovered by Ebelmen and Bouquet (1845), has the spec. grav. 1.17 at 0°, boils at 208° C. (406.4° F.), and is decomposed by potassa into potassium sulphite and alcohol.

E. C. Hartwig (1881) examined the oily liquid which may be obtained by distilling the acid residue left in the distillation of ether. This oil has been sold as oil of wine, but is totally different from both the heavy and light oils of wine mentioned above, and consists of hydrocarbons, ethers, and ketones, among them *ethylamylic ether*, $C_2H_5.C_5H_{11}O$, which boils at 112° C. (233.6° F.); *diisoamylene*, $C_{10}H_{20}$, boiling at 157° C.; *ethylamyl ketone*, $C_2H_5.C_5H_{11}.CO$, boiling near 155° C. (311° F.); and several others having a higher boiling-point.

Off. Prep.—Spiritus ætheris compositus, *U. S.*

Medical Uses.—Ethereal oil is not used as a medicine except as an ingredient of the compound spirit of ether.

OLEUM AMYGDALÆ AMARÆ, *U. S.*—OIL OF BITTER ALMOND.

Oleum amygdalarum (amararum) æthereum.—Essence d' amandes amères, Fr.; *Bittermandelöl*, G.

The volatile oil obtained from the seeds of Amygdalus communis, var. amara, *Linné*.

Nat. Ord.—Rosaceæ, Amygdaleæ (see page 188).

Preparation.—Bitter almonds are deprived of most of their fixed oil by pressure between warm plates; the press-cake is powdered, mixed with about six times its weight of water, the mixture digested for a day or two at a temperature of about 50° C. (122° F.), and then distilled.

The oil does not pre-exist in the almonds, but is produced through the decomposition of amygdalin by emulsin, hydrocyanic acid and sugar being at the same time formed; $C_{20}H_{27}NO_{11}$ (amygdalin) and $2H_2O$ yield $C_{12}H_{24}O_{12}$ (glucose), C_7H_6O (oil of bitter almond), and HCN (hydrocyanic acid). This decomposition must first be effected before distillation is resorted to; but while digesting the mixture too high a heat must be avoided, which would coagulate the emulsin and render it ineffective. Distillation by superheated steam is preferable to the use of the naked fire, in order to avoid empyreuma. The water from which the volatile oil has been separated still retains notable quantities of it in solution, which may be recovered by fractional distillation. To avoid the troublesome concussions during distillation, and to bring all the amygdalin under the influence of emulsin, Michael Pettenkofer (1861) recommends the exhaustion of the greater portion of the bitter-almond cake with boiling water, whereby the albuminoids are coagulated and the amygdalin is dissolved from the softened tissue; one-twelfth of the press-cake, unboiled, is then added to the cold mixture, and after sufficient maceration distillation is proceeded with. The yield varies considerably, but is usually over 1 per cent., and occasionally reaches 3 per cent. The importation of the oil into the United States amounted to 1602 pounds in 1877, and to 4093 pounds in 1883.

Properties.—Oil of bitter almond is colorless or yellowish, limpid, has a peculiar aromatic odor, resembling that of hydrocyanic acid, and a bitter and burning taste. Freshly prepared, it has in alcoholic solution a neutral reaction to test-paper, but old oil changes the color of blue litmus to red. It varies in spec. grav. between 1.06 and 1.075, and boils at about 180° C. (356° F.). When freed from hydrocyanic acid and rectified, its spec. grav. is lowered to 1.043 or 1.049, but it retains the aromatic almond odor. It is soluble in 300 parts of water and in all proportions of alcohol and ether. It also dissolves without change of composition in *cold* nitric or sulphuric acid, but with fuming or with warm nitric acid it is first converted into crystallizable nitrobenzaldehyd, and finally into benzoic acid, red nitrous vapors being evolved. With concentrated sulphuric acid bitter-almond oil turns deep-red, and on warming black, with evolution of carbonic acid gas. On being agitated with an aqueous solution of potassium bisulphite a crystalline compound is formed.

Composition.—Pure oil of bitter almond was formerly regarded as the hydride of the radical benzoyl (C_7H_5O), but in its chemical relation it is the aldehyd of *benzalcohol*, C_7H_8O, which was discovered by Cannizaro (1853), is a colorless, faintly aromatic oil, and by careful oxidation yields *benzaldehyd* or bitter-almond oil, C_7H_6O, and this, by further oxidation on exposure to the air or by means of oxidizing agents, is converted into benzoic acid, $C_7H_6O_2$. It is this latter compound which crystallizes from old oil of bitter almonds.

Pure benzaldehyd (*artificial oil of bitter almond*) is now largely made in Europe from *toluol*, C_7H_8, a liquid hydrocarbon contained among the products of the destructive distillation of coal.

The crude oil contains variable quantities of *benzimid*, *benzoin*, and *hydrocyanic acid*, from the latter of which it may be freed by agitation with mercuric oxide, or, preferably, ferrous hydrate (a mixture of lime with solution of ferrous sulphate), and subsequent distillation. Potassa and other alkalies may likewise be employed, but an excess is apt to decompose the oil with the production of benzoic acid and benzalcohol. According to Völkel, hydrocyanic acid is contained in the crude oil in the form of a compound, $C_7H_6O.HNC$, which is a yellowish, nearly inodorous, bitter oil of spec. grav. 1.124, and boiling at 170° C. (338° F.). *Benzimid* has the composition $2C_7H_6O.C_7H_6(CN)_2$, and forms in the pure state colorless, pearly, inodorous crystals, which on being boiled with water and hydrochloric acid are decomposed into oil of bitter almond, formic acid, and ammonia. *Benzoin*, $C_{14}H_{12}O_2$, crystallizes in inodorous and tasteless, colorless prisms which are polymeric with oil of bitter almond, and are converted into the latter by passing their vapor through a red-hot tube.

Adulterations.—The principal adulterations are nitrobenzol, alcohol, and chloroform, the last two being sometimes used together to leave the specific gravity unchanged. By distilling a little of the suspected oil from a test-tube placed in a water-bath kept at a temperature not exceeding 65° C. (149° F.), the chloroform will distil over, while alcohol will distil at about 80° C. (176° F.), the distillates showing the behavior of these compounds. On dropping oil of bitter almond containing alcohol into water, the drops, while floating or subsiding in the water, will become milk-white. *Nitrobenzol* (see NITROBENZOLUM) has an odor similar to that of bitter-almond oil and a sweet taste, and is nearly insoluble in water. We found it convenient (1857) to test for it by dissolving 15 grains of the oil in 2 drachms of alcohol, adding 15 grains of caustic potassa, heating for a few minutes, evaporating to one-third, and cooling. The pure oil will leave a brownish-yellow liquid, soluble in water, with but slight turbidity; while if nitrobenzol be present the residue will be dark-brown, sometimes crystalline, and not dissolve clear in water, depositing a brown-yellow sediment in proportion to the amount of the adulterant. The test depends upon the conversion of nitrobenzol, $C_6H_5NO_2$, into *azoxybenzid*, $C_{12}H_{10}N_2O$, which dissolves in alcohol and ether, but is insoluble in water. Wagner (1866) proposed to agitate 5 Ccm. of the suspected oil with 10 Ccm. of solution of sodium bisulphite spec. grav. 1.225, and dilute with water to 50 Ccm. in a graduated tube; pure bitter-almond oil will dissolve, while the nitrobenzol (spec. grav. 1.20) will separate as an oily layer. More delicate tests for this substance depend upon its reduction to *aniline*. According to Hoffmann (1845), the oil is diluted with ether and some alcohol, after which some zinc and hydrochloric acid are added; after the evolution of hydrogen has ceased the ethereal layer is evaporated spontaneously, and the residue mixed with a few drops of solution of chlorinated lime, when a purplish-blue color will be produced. Jacquemin (1876) recommended adding a few drops of the oil to a solution of stannous chloride in caustic soda, and afterward a drop of carbolic acid and some solution of chlorinated soda, when the blue color of erythrophenylate of sodium will appear. Boyveau (1879) noticed an adulteration with a substance of undetermined origin, which gives with an equal volume of sulphuric acid a red mixture, changing to brown, turbid, becoming thick, and in a few days solidifying, while a similar mixture with pure bitter-almond oil darkens in color, but remains liquid and clear.

Pharmaceutical Preparations.—IODINIZED OIL OF BITTER ALMOND was proposed by Dr. Blackwell (1878). It is prepared by leaving in contact for two or three months 1 part of iodine and 2 parts of oil of bitter almond, and dissolves easily in alcohol, ether, glycerin, fats, etc. It probably contains *benzol iodide*, C_7IH_5O, which was discovered by Liebig and Wöhler (1832), and when pure crystallizes in colorless fusible laminæ having a somewhat pungent aromatic odor.

Off. Prep.—Aqua amygdalæ amaræ, *U. S.*

Medical Action and Uses.—Oil of bitter almond exceeds diluted hydrocyanic acid in its poisonous power, since 100 parts of the oil contain nearly 13 parts of anhydrous hydrocyanic acid, while the diluted acid contains but 2 per cent. of the latter compound. 1 drop of it has been known to kill a cat. In man grave and even fatal effects have resulted from a dose of 17 drops, but, on the other hand, recovery has taken place after the swallowing of ½ ounce or more when remedial measures were at once applied. Medicinally, it is one of the best forms in which hydrocyanic acid can be administered, owing to its comparatively stable composition. The proper occasions for its use are indicated under HYDROCYANIC ACID. It may be prescribed in doses varying from ¼ drop to 1 drop (Gm. 0.015–0.05), and conveniently in mixture of almond.

OLEUM AMYGDALÆ EXPRESSUM, *U. S.*—ALMOND OIL.

Oleum amygdalæ, Br.; *Ol. amygdalarum*, P. G.; *Ol. amygdalæ dulcis.—Expressed (sweet) oil of almond*, E.; *Huile d'amande (douce)*, Fr.; *Mandelöl, Süssmandelöl*, G.

The fixed oil expressed from the seed of Amygdalus communis, var. amara or dulcis, *Linné.*

Nat. Ord.—Rosaceæ, Amygdaleæ (see page 188).

Preparation.—Almond oil is made both from sweet and bitter almonds. To obtain an unobjectionable oil, the almonds are freed from adhering dust by agitating them upon a sieve and removing discolored pieces, after which they are ground or well bruised in an iron or stone mortar, enclosed in canvas bags, and subjected to considerable pressure between polished steel plates, which should not be heated beyond about 30° C. (86° F.). The oily edges of the press-cake may be powdered and again expressed, when an additional quantity of oil will be obtained. The yield is 40 to 45 per cent. from sweet, and 35 to 38 per cent. from bitter, almonds; a little more when a hydraulic press is used. Expressing the residue at a higher temperature will yield more oil, which, however, is of inferior quality. The expressed turbid oil is set aside in a cool place, and then decanted from the sediment, which may be filtered. Over 30,000 pounds are annually imported into the United States; in 1867 only 10,544 pounds were entered.

Properties.—The oil is nearly colorless or of a pale-straw color, almost inodorous, and has a bland slightly nutty taste. It is a thin oily fluid, and does not congeal until cooled to about —20° C. (—4° F.); its specific gravity is 0.914 to 0.920; exposed to air, it readily turns rancid, acquiring an acrid odor and taste, dissolving in all proportions in pure ether, chloroform, benzin, fixed oils, etc., but it is not a drying oil. It dissolves sparingly in alcohol and readily in the usual solvents for fats; alcohol on being agitated with the oil dissolves most of the coloring matter of the latter, together with a small proportion of the oil.

Composition.—It consists mainly of olein, with a minute quantity of palmitin. (See OLEUM OLIVÆ.)

Tests.—Sulphuric acid and chlorinated lime (see OLEA PINGUIÆ) will detect most of the cheaper oils, the behavior with the former reagent having been adopted as the test of purity by the U. S. P. "If 15 parts of the oil be well agitated with a mixture of 3 parts of fuming nitric (nitroso-nitric) acid and 2 parts of water, the mixture should be whitish, not brown or red (absence of cotton-seed, ground-nut, benne, etc. oil), and after several hours should form a solid white mass (absence of drying oils), the aqueous liquid being nearly colorless."—*P. G.* The expressed oil of bitter almonds forms a rather soft solid by this treatment.

The *oils of peach-* and *apricot-seeds* are very similar to almond oil. Their presence may, however, be shown, according to Hager (1870), by agitating the oil with an equal bulk of 25 per cent. nitric acid, which mixture may be warmed to 60° C. (140° F.), and still remain white or faintly yellowish if the almond oil be pure, but become deeper yellow in proportion to the amount of the other oils present. The two oils mentioned become at once yellowish, and gradually orange-yellow. Bieber (1877) recommended mixing 5 parts of the oil with 1 part of a cold mixture consisting of equal weights of sulphuric acid, water, and fuming nitric acid. Almond oil gives a yellowish-white mixture; oil of peach-kernels, a reddish one, changing to dark orange; benne oil, yellowish-red, becoming orange-red; an admixture of 5 or 10 per cent. of one of these oils may thus be detected.

When agitated with half its bulk of solution of lead subacetate, almond oil yields a nearly white emulsion-like mixture, while a similar mixture prepared with other oils is mostly more or less yellow. Almond oil, exposed in a test-tube for 20 minutes to a temperature of −5° C. (23° F.), should not produce a white granular deposit (absence of olive oil, lard oil, etc.).

Off. Prep.—Oleum phosphoratum, *U. S.*, *Br.;* Unguentum aquæ rosæ, *U. S.;* Unguent. cetacei, Unguent. hydrarg. oxidi rubri, Unguent. plumbi subacetat. comp., Unguent. simplex, *Br.*

Medical Action and Uses.—The expressed oil of almond is a singularly bland and agreeable oil and very useful as a demulcent. It was formerly used to allay *cough* and all irritations of the respiratory passages. It may be prescribed in doses of 1 or several fluidrachms (Gm. 4–16) in an emulsion made with mucilage or yelk of egg and white sugar.

OLEUM ANETHI, *Br.*—Oil of Dill.

Essence d'aneth, Fr.; *Dillöl*, G.

Preparation.—The volatile oil is obtained from the fruit of Anethum graveolens, *Linné* (nat. ord. Umbelliferæ), by distillation with water. The yield is about 3 to 5 per cent.

Properties.—Oil of dill has a pale-yellow color, gradually changing to reddish-brown, the peculiar aromatic odor of the fruit, and a sweetish and warm afterward pungent taste. Its specific gravity varies between .85 and .89, and its rotating power is about 206° to the right. It dissolves iodine with the evolution of some vapors, and is colored red-brown by sulphuric acid.

Composition.—The oil contains a hydrocarbon, *anethene*, $C_{10}H_{16}$, which has an odor resembling that of lemon, and an oxygenated portion which, according to Gladstone (1872), is isomeric with the *carvol* of oil of caraway. This carvol is obtained by treating the oil with alcoholic solution of ammonium sulphide and decomposing the crystalline compound with an alkali. Both fractions are dextrogyre. According to Nietzki (1874), the oxygenated oil is identical with carvol, and amounts to about 30 per cent., while the terpene consists of two compounds—one boiling between 155° and 160° C. (311° and 320° F.), and having the odor of turpentine: it amounts to about 10 per cent. of the oil; the remaining fraction of 60 per cent. boils between 170° and 175° C. (338° and 347° F.), has a mace-like odor, and acquires the characteristic dill odor on the addition of a little carvol.

Medical Action and Uses.—Oil of dill is very seldom used in this country; like anise oil, etc., it may be employed to relieve flatulent *colic* and externally as an anodyne. *Dose*, from 2 to 5 drops (Gm. 0.10–0.30), in hot water and sugar.

OLEUM ANIMALE ÆTHEREUM.—Animal Oil.

Oleum animale Dippelii.—Dippel's animal oil, E.; *Huile animale de Dippel*, Fr.; *Ætherisches Thieröl*, G.

Preparation.—On the dry distillation of bones and other animal substances a fetid, brown, thick, oily liquid is obtained, known as *bone oil*, *crude*, or *fetid animal oil*. This is purified for medicinal use by distilling it in a retort or flask, which is heated by a sand-bath, as long as a thin oil passes over. This is then mixed with four times its weight of water, and rectified in a metallic still as long as the distillate is colorless or but slightly yellow. The oily liquid is separated from the water, and at once put into small vials, well corked and preserved in a dark place. Though previously known and medicinally employed, it was first prepared from dried blood by J. C. Dippel in 1711.

Properties.—*Rectified animal oil* is a colorless or yellowish, thin, oily liquid which has the average spec. grav. 0.80. It has a very penetrating empyreumatic and ethereal but not a fetid odor, and a pungent, acrid, afterward cooling and bitter taste. It has a slight alkaline reaction to test-paper, dissolves in about 80 parts of water, and is readily soluble in alcohol, ether, and fixed and volatile oils. Exposed to light and air, it rapidly darkens in color and acquires a thicker consistence.

Constituents.—This is a very complex mixture, containing a large number of volatile bases like *pyrrol*, C_4H_5N, *pyridine*, C_5H_5N, *picoline*, C_5H_7O, *lutidine*, C_7H_9N, *collidine*, $C_8H_{11}N$; also methylamine, propylamine, butylamine, and others. It contains also a neutral liquid which boils at 65.5° C. (150° F.), and different hydrocarbons.

Pharmaceutical Preparation.—Ammonii carb. pyro-oleosa (p. 178).

Physiological Action and Medical Uses.—Given to dogs, it produces paralysis of the hinder legs and general convulsions. A fluidrachm (Gm. 4) of this oil destroyed a medium-sized dog in 15 minutes. Given to man in medicinal doses, it excites a sense of warmth in the abdomen, renders the pulse more frequent and stronger, and increases the sweat and urine. A tablespoonful of it (Gm. 16) is said to have killed a man almost instantaneously, and 1½ ounces (Gm. 48), taken by a woman with suicidal intent, caused violent vomiting and intense pain. After death the mouth and throat were dry and shrivelled and the stomach inflamed and ecchymosed (Werber, *Archiv d. Heilkunde*, xi. 544). Formerly, the oil was used in the *typhoid state* of febrile affections, in *hysteria*, *chorea*, *epilepsy*, *paralysis*, chronic *rheumatism*, and *sciatica*, and to expel *tapeworms*. Internally, it was prescribed in doses of from 5 to 10 drops, and from that to 30 or 40 drops (Gm. 0.30–2.60), mixed with powdered sugar or in sulphuric ether or Hoffmann's anodyne. Externally, it was applied by friction, pure or in liniments.

Formerly, a preparation known as Chabert's oil, and which was procured from a mixture of impure empyreumatic oil with oil of turpentine by distillation, was in high repute as a cure for *tape-worm*. Its offensive taste and smell and harsh action caused it to be laid aside when the various tæniacide medicines now in use began to be employed.

OLEUM ANISI, *U. S., Br.*—OIL OF ANISE.

Essence d'anis, Fr.; *Anisöl*, G.

The volatile oil distilled from the fruit of Pimpinella Anisum, *Linné* (nat. ord. Umbelliferæ, see p. 207), and the oil distilled from the fruit of Illicium anisatum, *Linné* (nat. ord. Magnoliaceæ, see p. 811). The latter is properly called *Oleum anisi stellati* (*Ol. badiani*, *Ol. illicii anisati*).—Oil of illicium or of star-anise, *E.;* Huile volatile de badiane, *Fr.;* Sternanisöl, *G.*

Preparation.—The oil is obtained by distillation of the fruit with water. The yield from anise is 1½ to 2½ per cent.; from star-anise, 2½ to 4 per cent.

Properties.—Both volatile oils are pale-yellow, becoming darker by age, and have a sweet aromatic taste and an agreeable aromatic odor, differing somewhat in the two oils. The spec. grav. is .97 to .99, rising in old oils sometimes to 1.028 (Zeller). At a low temperature the oils solidify into a crystallizing mass, the freezing-point of the true anise oil being usually near 10° C. (50° F.), and of star-anise oil near 2° C. (35.6° F.). It varies, however, very considerably, not only in oils as obtained from different material, but because it changes on keeping and becomes lower; the requirement of the U. S. Pharmacopœia, that oil of anise "at 10° to 15° C. (50°–59° F.) solidifies to a crystalline mass which does not resume its fluidity until the temperature rises to about 17° C. (62.6° F.)," is too strict, and would exclude pure oils. The German Pharmacopœia formulates this property as follows: "The oil congeals in the cold to a white crystalline mass, which melts partly at 15° C. (59° F.), and when completely fused forms a colorless, strongly refractive, very aromatic liquid." The volatile oil distilled from anise-chaff (pedicels, unripe fruit, etc.) is said to contain more stearopten and to congeal at a higher temperature than the oil of the ripe fruit (Martius). The reactions of the oils of anise and of illicium are so similar that they do not afford any reliable means for distinguishing them. Both oils are entirely neutral to test-paper, have a very slight right or left rotating power, are freely soluble in alcohol, and with strong alcohol form clear solutions in all proportions. The importation of anise oil into the United States increased from 3900 pounds in 1867 to 30,659 pounds in 1883, and was only 4000 pounds in 1878.

Composition.—Oil of anise contains a small quantity of a hydrocarbon having the composition $C_{10}H_{16}$, but consists mainly of *anethol*, $C_{10}H_{12}O$, sp. grav. .98; this exists in two modifications—one liquid, the other solid, at the ordinary temperature and fusing at about 20° C. (68° F.), and both boiling between 220° and 225° C. (428° and 437° F.); they are present also in oil of fennel, and a liquid modification in the oil of Artemisia Dracunculus, *Linné*, or *tarragon*, has the spec. grav. .945 and boils at 206° C. (402.8° F.). Anethol has a fainter but more agreeable odor than oil of anise. It is not altered on being boiled with potassa solution; chromic acid converts it into colorless, inodorous, and nearly tasteless crystals of *anisic acid*, $C_8H_8O_3$; nitric acid yields the same compound, or anisoic, anisylic, and oxalic acids, according to its concentration and duration of action. Sulphuric acid colors it red, and water separates afterward inodorous *anisoin;* this is isomeric with anethol, like *metanethol* and *metanethol camphor*, which are produced under certain conditions. Landolph (1875) found Russian oil of anise to contain 90 per cent.

of a mixture of anisic aldehyd and anise camphor, to which he gives the formula $C_{10}H_{16}O$.

Adulterations.—Oil of anise has been met with adulterated with alcohol, camphor, wax, and spermacti, the last three for the purpose of raising its congealing-point. Anise oil adulterated with alcohol becomes milk-white on being dropped into water. Camphor is detected in the pressed crystalline mass by its odor, the other two by their insolubility in 80 per cent. alcohol. Leonhardi (1878) reports the oil to be sometimes largely adulterated with the stearopten of Russian fennel oil, which is detected by the fennel odor developed on heating.

Tests.—The solution in alcohol should not become dark-colored on the addition of a little ferric chloride (phenol, etc.). 1 drop of anise oil, triturated with sugar and afterward agitated with 500 Gm. of water, should impart to the latter the pure flavor of anise (absence of other volatile oils).—*P. G.*

Pharmaceutical Preparations.—LIQUOR AMMONII ANISATUS, *P. G.* Dissolve 1 part of oil of anise in 24 parts of alcohol, and add 5 parts of ammonia-water. The liquid is yellowish and clear.

Off. Prep.—Essentia anisi, *Br.*; Spiritus anisi, *U. S.*; Tinct. opii ammoniata, *Br.*; Tinct. opii camphorata (camphoræ comp.), *U. S. Br.*; Trochisci glycyrrhizæ et opii, *U. S.*

Medical Action and Uses.—Like other aromatic essential oils, when given to animals in large doses it occasions lethargy and insensibility. In medicinal doses it acts as a local and general stimulant, and is used to expel *flatus*, allay *colic*, and prevent the griping of drastic purgatives. It has also been employed in the treatment of *chronic bronchitis*, associated with carbonate or muriate of ammonium. It may be prescribed in *doses* of from 2 to 6 drops (Gm. 0.1–0.40), on sugar or in emulsion.

OLEUM ANTHEMIDIS, *Br.*—OIL OF CHAMOMILE.

Oleum chamomillæ romanæ.—Essence de camomille romaine, Fr.; *Römischkamillenöl*, G.

Preparation.—The volatile oil is obtained from the flowers of Anthemis nobilis, *Linné* (nat. ord. Compositæ), by distillation with water. The yield is variable, between about ⅕ and ½ per cent.

Properties.—Fresh flowers seem to yield a blue-colored oil, while that obtained from dried flowers has a green or yellow color, or if blue changes rapidly to green and yellow. It has the odor of the flowers and a warm, aromatic taste; it imparts a red color to litmus-paper, and begins to boil at about 160° C. (320° F.), the boiling-point rising gradually to above 200° C. (392° F.). It is sometimes distilled from the entire plant, and has then a greenish color, which on exposure changes to yellow. Its specific gravity is .90.

Composition.—The oil does not combine with sodium bisulphite. Potassa decomposes it, and B. Jaffé (1865) separated in this way 58 per cent. of impure and 30 per cent. of pure angelicic acid. Demarçay (1875) arrived at the conclusion that it is a mixture of several compound ethers, among which the butylic and amylic angelates and valerianates preponderate. Koebig (1873) did not find valerianic acid, but besides angelate isolated isobutylate and tiglinate of anthemol and of a new hexyl ether; these ethers appear to be present in the fresh oil. Demarçay had noticed that under the influence of heat angelicic acid is converted into the isomeric tiglinic acid.

Off. Prep.—Extractum anthemidis, *Br.*

Medical Action and Uses.—Oil of chamomile is stimulant and anti-spasmodic, and is used to allay *vomiting* and relieve flatulent *colic* and to modify the irritant action of cathartics in pill or mixture. It is often added to liniments used for *sprains, rheumatic pains*, etc. *Dose*, from 1 to 5 drops (Gm. 0.05–0.30).

OLEUM AURANTII CORTICIS, *U. S.*—OIL OF ORANGE-PEEL.

Oleum aurantiorum.—Essence d'orange, Fr.; *Pomeranzenschalenöl*, G.

A volatile oil extracted by mechanical means from fresh orange-peel.

Nat. Ord.—Aurantiaceæ.

Preparation.—The volatile oils of both the bitter and sweet orange-peel are articles of commerce, and both are prepared in the southern part of Europe by superficially rupturing the ripe fruit, so as to puncture only the oil-glands imbedded under the yellow rind; or the fresh peel is forcibly twisted, which operation causes the glands to discharge the oil, this being collected first upon a sponge, and by wringing the same when saturated in a suitable bowl. A third method of preparing oil of orange-peel consists in superficially grating the fruit, so as to remove only a thin layer of the rind containing the oil-glands; the grated mass is then deprived of the greater part of the volatile oil by pressure, and the residue is sometimes distilled with water, whereby it yields a less fragrant volatile oil. The importation of oil of orange-peel amounted to 9133 pounds in 1882.

Properties.—The volatile oils of the two orange-peels are distinguished as—

Oleum aurantii dulcis.—Oil of sweet orange-peel, *E.;* Essence d' orange douce, Essence de Portugal, *Fr.;* Apfelsinenöl, Portugalöl, *G.*

Oleum aurantii amari.—Oil of bitter orange-peel, *E.;* Essence de Bigarade, *Fr.;* Pomeranzenöl, *G.*

The first one is usually employed in making elixir of orange, but, though it differs from the latter somewhat in flavor and in being more readily altered by exposure to air, the two oils are alike in chemical composition and in all their essential properties. Oil of orange is of a pale or greenish-yellow color, limpid, varies in its specific gravity between 0.835 and 0.885, boils near 180° C. (356° F.), and rotates polarized light considerably to the right. It has a neutral reaction to test-paper, an agreeable orange odor, and an aromatic slightly bitter taste. It dissolves freely in absolute alcohol, and requires about 2 parts of alcohol and about 8 or 10 parts of alcohol spec. grav. .850 for solution; oil of sweet orange-peel dissolves more readily than the bitter variety. Powdered iodine acts energetically upon the fresh oil, producing orange-colored vapors, but with old oil merely a radiating wavy motion without colored vapors. Sulphuric acid causes a deep-red or red-brown color. Nitric acid colors greenish-yellow, and on warming leaves a brown-yellow resin. Exposed to the air, oil of orange gradually becomes thicker and acquires a terebinthinate odor. This change is prevented, or at least considerably retarded, by adding to the oil 5 per cent. of strong alcohol, and decanting or filtering, if necessary, from the precipitate; this is very properly recommended by the Pharmacopœia for preserving the oil.

Composition.—Oil of orange consists mainly of the hydrocarbon *hesperidene*, $C_{10}H_{16}$, and contains a small portion of an oxygenated body, $C_{10}H_{16}O$, boiling near 220° C. (428° F.). Hesperidene yields with hydrochloric acid gas a crystallizable compound having the composition $C_{10}H_{16}.2HCl$. C. R. A. Wright (1874) obtained also a liquid compound with hydriodic acid, and by oxidation with nitric acid a slowly-crystallizing hexabasic acid, *hesperisic acid*, $C_{20}H_{26}O_{17}.2H_2O$, was produced. By combining hesperidene with bromine and distilling the compound, *cymene*, $C_{10}H_{14}$, passes over, identical with that contained in cumin oil and with that obtainable from camphor. Wright found also small proportions of a substance, $C_{40}H_{64}O_5$, boiling above 240° C. (464° F.), and of a non-volatile resin, $C_{20}H_{30}O_3$.

Off. Prep.—Elixir aurantii, Spiritus aurantii, Spiritus myrciæ, *U. S.*

Medical Action and Uses.—The essential oil of orange-peel is irritant and narcotic. Persons employed in manufacturing it suffer greatly from erythmatous, papular, and vesicular eruptions of the skin, especially of the hands and face, and also from nausea, vomiting, and other dyspeptic symptoms, headache, neuralgia, and a sort of intoxication denoted by confusion of the mind and senses, and impaired muscular power. Oil of orange-peel is used almost exclusively as a flavoring or perfuming ingredient of medicinal compounds.

OLEUM AURANTII FLORUM, *U. S., P. G.*—Oil of Orange-Flowers.

Oleum florum naphæ, Oleum neroli, s. naphæ.—Oil of neroli, E.; *Essence de fleur d'oranger, Néroli*, Fr.; *Pomeranzenblütenöl, Neroliöl*, G.

A volatile oil distilled from the fresh flowers of Citrus vulgaris, *Risso.*

Nat. Ord.—Aurantiaceæ.

Preparation.—This volatile oil is obtained in the preparation of orange-flower water, upon the surface of which it separates in small proportion. It is manufactured chiefly in the southern part of France from the flowers of the bitter orange, which yield about 0.6 per cent. of oil. The flowers of the sweet orange and of allied plants are far less aromatic and have a more or less different odor. Over 400 pounds of oil of neroli were imported into United States in 1882.

Properties.—According to Flückiger and Hanbury, pure oil of neroli is of brownish hue, a bitterish aromatic taste, neutral to test-paper, and of the density of 0.889 at 11° C. (51.8° F.). It shows a bright violet fluorescence when mixed with alcohol, or more distinctly by pouring a little alcohol on the surface of the oil and causing the liquid to gently undulate. The oil assumes an intense permanent crimson hue on being shaken with a concentrated solution of bisulphite of sodium. Although very fragrant, the odor of the volatile oil differs somewhat from that of orange-flowers and of distilled orange-flower water. The oil dissolves, according to Zeller, in from 1 to 3 parts of alcohol spec. grav. .850, the solution becoming opalescent or turbid with more alcohol. Carbon disulphide likewise yields a turbid solution (Flückiger). Iodine acts energetically upon neroli oil, colored vapors being given off; sulphuric acid colors it dark orange-red or red-brown; nitric acid changes the color to yellow and rust-brown. The oil deviates polarized light somewhat to the right. The commercial oil is usually yellowish or reddish-yellow, and is frequently adulterated with oil of bergamot and orange-leaves. Old resinified oil is less fragrant, but may, in a measure, be restored by rectification with water.

Composition.—Oil of neroli is a hydrocarbon, $C_{10}H_{16}$, containing a small quantity of inodorous crystallizable camphor. The former distils between 185° and 195° C. (365° and 383° F.), displays the violet fluorescence in a marked manner, and retains the odor of the original oil (Flückiger). Neroli camphor was observed by Boullay (1828), and, according to Plisson (1829), may be obtained from the oil by treatment with alcohol of spec. grav. .850, in which it is nearly insoluble. It crystallizes from ether or hot alcohol in pearly needles or prisms, melts at 55° C. (131° F.), and when pure is inodorous and tasteless.

Off. Prep.—Spiritus odoratus, *U. S.*

Medical Action and Uses.—Oil of orange-flowers belongs rather to the perfumer's than to the pharmaceutist's art, but it may be employed to mask the smell of mixtures, ointments, etc.

OLEUM BERGAMII, *U. S.*—Oil of Bergamot.

Oleum bergamottæ.—Essence de bergamotte, Fr.; *Bergamottöl*, G.

The volatile oil obtained by mechanical means from the fresh rind of the fruit of Citrus Bergamia, var. vulgaris, *Risso et Poiteau*, s. C. Aurantium, var. Bergamia, *Wight et Arnott.* Bentley and Trimen, *Med. Plants*, 52.

Origin.—The fruit is of a lemon-yellow color, and grows upon a small tree in Southern Italy, evidently a variety produced by cultivation; it is by some botanists regarded as closely related to Citrus Limetta, *Risso*, or with this plant as a variety of C. Limonum, *Risso*, while others regard it as a hybrid of C. medica and C. Aurantium, *Risso*. The juice of the fruit has a bitter and acid taste.

Preparation.—The oil-vessels contained in the rind of the fruit are ruptured by means of a machine wherein the fruit is subjected to a rotatory motion; the oil thus obtained deposits on standing a waxy matter, from which it is decanted. The amount imported into the United States was 40,460 pounds in 1858, and 51,782 pounds in 1882.

Properties.—Oil of bergamot has a green or greenish, sometimes a yellowish, color, and after rectification is colorless. Its specific gravity varies between .86 and .89, and its boiling-point between 180° and 195° C. (356° and 383° F.). It has a bitterish aromatic taste and an agreeable odor, less pleasant after rectification. It has a neutral or slightly acid reaction to test-paper. It dissolves 25 per cent. of carbon disulphide and 8 per cent. of alcohol .966, and is soluble in half its weight of alcohol sp. gr. .85, and in all proportions in strong alcohol and in glacial acetic acid; the alcoholic solution becomes dingy-brown with ferric chloride. It deviates polarized light to the right from 7° (*Pharmacographia*) to 40° (Gladstone), and reacts briskly with iodine, giving off purplish and yellow vapors.

Composition.—The amount of oxygen has been found to vary between 2.6 and 16.14 per cent. in different portions of the distillate. The oil appears to be a mixture of hydrocarbons of the formula $C_{10}H_{16}$ with various hydrates. Distilled with phosphoric anhydride, a volatile oil of the odor of turpentine is obtained. The waxy matter mentioned above crystallizes from alcohol in silky, colorless, inodorous, and tasteless needles; this *bergamot camphor* or *bergaptene* has the composition $C_9H_6O_3$.

Adulterations.—Oil of bergamot is often adulterated with oil of orange, and occasionally with oil of turpentine, and requires then a larger amount of alcohol for solution. The volatile oils obtained by distillation with water of the leaves and of the nearly exhausted rind, when mixed with oil of bergamot, render it less fragrant.

Off. Prep.—Spiritus odoratus, *U. S.*

Medical Action and Uses.—It is a stimulant like other volatile oils, but is seldom employed except for the purpose of scenting ointments and toilet tinctures.

OLEUM BUBULUM.—NEAT'S-FOOT OIL.

Oleum pedum tauri, *Axungia pedum tauri.*—*Huile (Graisse) des pieds du gros bétail*, Fr.; *Klauenöl*, *Ochsenklauenfett*, G.

Preparation.—It is made by boiling neat's feet, deprived of their hoofs, with water, skimming off the oil which rises to the surface, and keeping it for some time on warm water. After the impurities have settled it is ready for use.

Properties.—Neat's-foot oil is a pale-yellow and (when of good quality) nearly inodorous and bland, liquid oil, which has the specific gravity .915 at 15° C. (59° F.), is but slightly thickened on exposure, does not readily turn rancid, and requires to be cooled to below the freezing-point of water before it congeals to a soft white mass. On saponification it yields glycerin and oleic acid with a little stearic acid. Neat's-foot oil is turned brown by sulphuric acid or a mixture of sulphuric and nitric acids; nitric acid colors it yellow; and it gradually congeals when in contact with nitroso-nitric acid.

Medical Action and Uses.—Neat's-foot oil is much used in softening leather and rendering it pliable. Perhaps this operation may have suggested its administration in medicine as a substitute for cod-liver oil. If it had been efficient, of which there is no proof, its singularly repulsive smell and taste as it is usually met with, and its tendency to cause diarrhœa, would speedily have condemned it.

OLEUM CAJUPUTI, *U. S., Br.*—OIL OF CAJUPUT.

Oleum cajeputi, P. G.—*Oil of cajeput*, E.; *Essence de cajeput*, Fr.; *Cajeputöl*, G.

The volatile oil obtained from the leaves of Melaleuca Cajuputi, *Roxburgh* (s. M. minor, *Smith*). *Trans. Lond. Med. Bot. Soc.*; Steph. and Church, *Med. Bot.*, plate 84; Bentley and Trimen, *Med. Plants*, 108.

Nat. Ord.—Myrtaceæ.

Origin.—The species mentioned is a small tree, which has lanceolate entire leaves and terminal spikes of small white flowers with exserted stamens. It is indigenous to the East Indian Islands. Bentham regards it as a mere variety of M. Leucadendron, *Linné*, which extends into Farther India, the Philippines, and a considerable portion of Australia, and often attains a moderately large size, sometimes growing to the height of 90 feet (27 M.). The oil is prepared in Celebes, Bouro, and other islands of the Molucca Sea by distilling the leaves with water. 1146 pounds of cajeput oil entered the United States in 1867, and 7019 pounds in 1881.

Properties.—Oil of cajeput is limpid, of a green or bluish-green color, a penetrating odor, suggesting that of camphor, rosemary, and mint, and a bitterish, warm, camphoraceous, afterward cooling taste. The specific gravity varies between .914 and .930; its boiling-point is near 173° C. (343.4° F.). It does not congeal at −25° C. (−13° F.), is freely soluble in alcohol, and does not affect litmus-paper. It dissolves iodine quietly or with the evolution of few reddish vapors; ammonia turns it yellowish, and sulphuric acid colors it brown, reddish, and finally purplish-brown. On heating 5 parts of cajeput oil to 50° C. (122° F.), and then adding 1 part of powdered iodine, the solution on cooling congeals to a magma of black crystals, which by recrystallization from alcohol or ether may be obtained as yellowish-green prisms having a metallic lustre, and which liquefy on keeping (Schmidl). By rectification the oil becomes colorless.

Composition.—Blanchet determined its composition to be $C_{10}H_{16}.H_2O$. Schmidl (1860) obtained, between 175° and 178° C. (347° and 352.4° F.), two-thirds of the oil as a colorless distillate which has the composition stated. and is the hydrate of a hydrocarbon named *cajeputene*, the latter obtainable by repeated distillation over phosphoric anhydride. Cajeputene, $C_{10}H_{16}$, boils between 160° and 165° C. (320° and 329° F.), has an agreeable odor of hyacinth, and is slightly soluble in alcohol. Two other hydrocarbons of the same composition and sparing solubility in alcohol are obtained at the same time, of which *isocajeputene* boils at 176° C. (348.8° F.) and has a less agreeable odor, while *paracajeputene* is thick, yellow, and shows a blue fluorescence. Gladstone (1872) found the hydrate of cajeputene, or *cajeputol*, also in the volatile oils of Melaleuca ericifolia and linarifolia, *Smith*, and of Eucalyptus oleosa, *F. Mueller*; it is dextrogyre, its rotating power varying between 10° and 30°.

The green color of the oil is sometimes, at least, in part due to copper, the presence of which may be proven by agitating the oil with dilute hydrochloric acid when its green color disappears, and testing the watery liquid with ferrocyanide of potassium, when a red-brown color or precipitate will occur. However, cajeput oils have been observed which were entirely free from copper, the green being due to chlorophyll.

Adulterations.—The admixture of oil of turpentine is indicated by decreased solubility in alcohol and the more violent reaction with iodine. Imitations made by mixing various volatile oils are detected by the same means and by their different odor; such mixtures remain liquid when treated with one-fifth of iodine, as described above. The oils examined by Gladstone cannot, it seems, be distinguished from the officinal.

Off. Prep.—Linimentum crotonis, Spiritus cajuputi, *Br.*

Medical Action and Uses.—This oil has long been prized in the East as a stimulant and diaphoretic medicine, and employed in dropsy, flatulent colic, chronic rheumatism, paralysis, hysteria, etc. It may be used internally as a remedy for *flatulent colic*, particularly when it is produced by cold or by the retrocession of gout or rheumatism, in *dysmenorrhœa* occasioned by temporary uterine congestion, in *cholera morbus*, and in epidemic *cholera*. In the last-named disease it has been largely employed by Oriental physicians. It is of marked utility in cases of *nervous vomiting*, *nervous dysphagia*, *dyspnœa*, and *hiccough*. It has also been used as a *vermifuge*. As a local stimulant and rubefacient it is useful, when diluted with olive oil or added to camphorated liniments, in cases of *functional paralysis* and *muscular rheumatism*. With olive oil or glycerin it is introduced on cotton into the auditory canal for the relief of *otalgia* and of *deafness*. It is one of the best remedies for *toothache* depending upon caries when a drop of it upon cotton is introduced into the hollow tooth, and a few drops of it rubbed upon the painful part relieve *nervous headache* and *local neuralgia*. It is a useful stimulant in chronic *scaly affections of the skin* and in *acne rosacea*. It may be given internally in *doses* of from 2 to 10 drops (Gm. 0.10–0.60) on sugar, with Hoffmann's anodyne, or with tinctures, or infusions of anti-spasmodic medicines. As a vermifuge it may be mixed with honey in the proportion of 1 part to 30 or more, and dessert-spoonful doses of the mixture may be given every hour or two. It may also be administered by enema.

Melaleuca flaviflora yields an oil which is closely analogous to cajeput oil, and is used for similar purposes by the people of New Caledonia—viz. externally for the relief of neuralgia, muscular rheumatism, and gout, and internally as a vermifuge, especially for rectal ascarides, in enema (*Bull. de thérap.*, xcvii. 402). M. paraguayensis is said to be a sudorific. An extract prepared from it has been employed in the treatment of rheumatism, gout, syphilis, yellow fever, and cholera (*Med. Record*, xvi. 132).

OLEUM CARI, *U. S.*—OIL OF CARAWAY.

Oleum carui, Br.; *Oleum carvi*, P. G.—*Essence de carvi*, Fr.; *Kümmelöl*, G.

The volatile oil distilled from the fruit of Carum Carui, *Linné*.

Nat. Ord.—Umbelliferæ.

Preparation.—The bruised fruit is distilled with superheated steam; the yield is variable, but averages about 4 per cent., and may be as high as 7 per cent. The fruit which is grown in northern countries is generally richer in oil than that from more southern localities. The first portion of the distillate contains mainly carvene, the odorous carvol coming over last. 3600 pounds passed into the United States in 1867, and 9143 pounds in 1882.

Properties.—Oil of caraway is limpid, colorless, or pale-yellow, becoming brown and viscid on exposure. Its specific gravity is usually between .90 and .92, but in old oil may rise to .97. When fresh it has no action on litmus; its odor is agreeable, its taste aromatic. It dissolves readily in alcohol, turns polarized light to the right, and commences to boil at 175° C. (347° F.). The German Pharmacopœia recognizes only oil of caraway which has been deprived of much of the carvene; such oil should have a specific gravity of not less than .910, and should boil briskly at 224° C. (435.2° F.); its solution in a equal weight of alcohol should acquire a reddish or pale-violet color on the addition of a drop of test solution of ferric chloride; and a mixture of 10 parts of the oil, 8 parts of alcohol, and 1 part of ammonia-water, on being saturated with hydrosulphuric acid gas, should congeal to a white crystalline mass.

An inferior oil of caraway is made from the refuse or "chaff" of the fruit; it is less agreeable in odor, and not unfrequently mixed with oil of turpentine.

Composition.—By repeated fractional distillation Völkel (1840) separated *carvene*, $C_{10}H_{16}$, which has little odor and taste, boils at 173° C. (343.4° F.), and has a strong dextrogyrate rotation. The higher boiling fraction contains *carvol*, $C_{10}H_{14}O$, which is liquid, has an agreeable caraway odor, boils at 227° C. (440.6° F.) (Gladstone), or at 250° C. (482° F.) (Varrentrapp), and has a levogyrate rotation. In contact with alcoholic solution of ammonium sulphide carvol yields white silky needles of $(C_{10}H_{14}O)_2.H_2S$, from which it is again separated by potassa. Carvol (see also OL. ANETHI) is isomeric with menthol of spearmint, myristicol of nutmeg, thymol, cuminic alcohol, and *carvacrol;* the latter is a rather viscid, colorless, or yellowish oil resembling creasote in odor and taste, and may be obtained by distilling a mixture of oil of caraway and potassa until carvene has been expelled, decomposing the residue by sulphuric acid, and rectifying the oil.

Off. Prep.—Confect. scammonii, Pilula aloes Barbad., *Br.;* Spirit. juniperi comp., *U. S.*

Medical Action and Uses.—The properties of this oil are nearly identical with those of oil of anise. Given to animals in large doses, it causes death by asthenia. It may be used in the treatment of *flatulent colic* and whenever a gastric stimulant or a carminative is required. Locally, it acts, like other essential oils, as an *anæsthetic.* It may be administered in sweetened water, ether, or Hoffmann's anodyne, in the *dose* of from 1 to 10 drops (Gm. 0.05–0.60).

OLEUM CARYOPHYLLI, *U. S., Br.*—OIL OF CLOVES.

Oleum caryophyllorum, P. G.—*Essence de girofle*, Fr.; *Nelkenöl*, G.

The volatile oil distilled from the flower-buds of Eugenia caryophyllata, *Thunberg. Nat. Ord.*—Myrtaceæ.

Preparation.—The volatile oil is obtained from cloves by distilling them with water For this purpose the cloves require to be bruised; cohobation should be repeatedly resorted to, and salt may be added (see OLEA DESTILLATA) in order to raise the boiling-point. If the cloves have been properly bruised, the three or four times repeated distillation of the water from the same cloves is usually sufficient; but if the powder be very coarse the distillation will have to be repeated more frequntly. At present the distillation is usually effected with superheated steam. At first, the oil coming over is chiefly the light portion which floats on the water; afterward the heavy portion distils, and the two portions united constitute the commercial article. The yield is 15 to 20 per cent. Clove-stalks are said to be sometimes used in Europe in the distillation of this oil. In the United States cloves from South America are employed for distilling the oil, and the entire want is now supplied in this country. In 1867 the amount imported was 956 pounds, which decreased in 1877 and 1878 to 2 pounds, and was 302 pounds in 1881.

Properties.—When recently distilled, oil of cloves is somewhat thicker than most other volatile oils, and has a pale-yellow color, but may be obtained colorless by rectification, and becomes thicker, darker, and finally yellowish-brown, on keeping. It has a strong odor of cloves, a burning aromatic taste, and boils at 240° C. (455° F.). Its specific gravity varies between 1.034 and 1.056; oil of clove-stalks, though agreeing in odor, has a density of about 1.009. Oil of cloves dissolves freely in alcohol, the solution having a slight acid reaction and yielding with ferric chloride a purplish-blue color. Sulphuric acid colors the oil blood-red, finally blue; and it acquires also a blue or violet color when exposed in a thin layer to bromine vapor; iodine dissolves in it quietly; strong potassa solution converts it into a crystalline mass of eugenate of potassium; a soft yellowish crystalline mass is also obtained on agitating the oil with an equal volume of stronger water of ammonia; fuming nitric acid acts violently upon the oil, sometimes with ignition. The oil is without action or with but slight action (− 4°, Gladstone) upon polarized light.

Composition.—On distilling a mixture of cloves with excess of potassa the colorless distillate is the *light oil of cloves*, and has the composition $C_{15}H_{24}$; its odor is distinct from that of cloves—more terebinthinate; it has the density .918, and boils at 251° C. (483.8° F.). On decomposing the eugenate of potassium with sulphuric acid and rectifying the separated oil, *eugenic acid* or *eugenol*, $C_{10}H_{12}O_2$, is obtained as a colorless oil having the odor of cloves, the specific gravity 1.076 (Stenhouse), 1.0785 (Pettit), and boiling at 247.5° C. (477.5° F.); it yields with bases crystallizable salts, which, with the exception of the barium compound, are decomposed by much water or alcohol, and are colored blue or purple by ferric salts. By fusion with potassa, eugenol is decomposed into protecatechuic and acetic acids. L. C. Pettit (1880) obtained 72 per cent. of eugenol, which became red, and then purple, with sulphuric acid; the potassium compound was found to be soluble without decomposition in alcohol and glycerin, and sparingly soluble in benzin. On boiling acetic anhydride with eugenic acid, *aceto-eugenol* is formed, and from this compound vanillin may be obtained by treating it carefully with a weak solution of potassium permanganate, rendering the liquid alkaline, concentrating, and acidulating, when the vanillin may be extracted with ether (Tiemann, 1878). By treating eugenic acid in an atmosphere of carbonic acid with sodium, Scheuch (1863) obtained the sodium salt of *eugetinic acid*, $C_{11}H_{12}O_4$, which is crystallizable, soluble in water, colors ferric salts deep-blue, and is decomposed by heat into carbonic and eugenic acids. The same author proved likewise the presence in oil of cloves of salicylic acid, most probably in the form of an ether.

Adulterations.—The determination of the boiling-point and the specific gravity are sufficient for detecting most adulterations to which oil of cloves is sometimes subject; on treating the suspected oil with alcoholic solution of potassa the odor of cloves disappears and the nature of the adulteration is established. For the detection of carbolic acid Jacquemin (1875) recommended adding a trace of aniline, shaking with water, and adding a little chlorinated soda, when a blue color will be produced. Flückiger (1870) proposed to shake 1 part of oil with 50 parts of hot water, concentrate the aqueous liquid by evaporation at a moderate heat, add a drop of ammonia and a little chlorinated lime; in the presence of carbolic acid a green color, passing into blue, will be produced. "Hot water, on being agitated with oil of cloves, should not acquire an acid reaction, and after cooling the clear filtrate should not turn blue or green on the addition of a drop of solution of ferric chloride (carbolic acid), but it should become yellow with lime-water. The oil should yield a clear solution with an equal weight or a little more of alcohol spec. grav. .894 (oil of turpentine, copaiva, etc.)."—*P. G.*

Off. Prep.—Confect. scammonii, Pil. colocynth. comp., Pil. colocynth. et hyoscyami, *Br.*

Medical Action and Uses.—The action and uses of oil of cloves are essentially the same as those of the oils of caraway and anise. It is seldom employed internally, but it is sometimes used to allay the pain of *carious teeth* and of *earache*. The *dose* is from 2 to 5 drops (Gm. 0.10–0.30).

OLEUM CHENOPODII, *U. S.*—OIL OF CHENOPODIUM.

Oil of American wormseed, E.; *Essence de chénopode anthelmintique*, Fr.; *Chenopodiumöl*, *Amerikanisches Wurmsamenöl*, G.

The volatile oil is obtained from the fruit of Chenopodium anthelminticum, *Linné.*

Nat. Ord.—Chenopodiaceæ (see page 424).

Preparation.—Distillation with water or by means of superheated steam yields this volatile oil. Much of it is distilled in Maryland and in some of the Western States. The fruit yields about 3 to 3½ per cent., the fresh herb ½ to 1 per cent. The Western oil is rather less pungent than the Baltimore oil of wormseed.

Properties.—Oil of wormseed is colorless or yellowish, limpid, becoming brown and thick on exposure. It has the peculiar odor of wormseed and a bitterish, pungent, and somewhat cooling, aromatic taste. Its specific gravity is about .920 (*U. S.*); when fresh it is .902 to .91, and increases by age to .960. It is readily soluble in alcohol, the solution having a neutral reaction. It boils at 180° to 190° C. (356° to 374° F.), dissolves iodine slowly, and turns brown-red when boiled with nitro-prusside of copper.

Composition.—Garrigues (1854) found oil of wormseed to be a mixture of a hydrocarbon, $C_{10}H_{16}$, and a liquid oxygenated oil, $C_{10}H_{16}O$. The former has the density .932, boils near 176° C. (350.6° F.), and yields a liquid and a crystalline compound with chlorine. The specific gravity of the latter is .987, its boiling-point 245° C. (473° F.).

Medical Action and Uses.—Several cases of poisoning by this oil are recorded. A child six years old took several successive doses of 15 drops each for worms. The symptoms were insensibility, stertor, rattling in the throat, a small, feeble, and frequent pulse, convulsions of one side of the body, cold extremities, and death in 36 hours (*Boston Med. and Surg. Jour.*, xlv. 373). A man aged sixty-three years took an ounce of it in divided doses during 1 day. He fell into a deep sleep, and then into coma, with profuse sweating and salivation. The respiration was 33, the pulse 106, the pupils dilated. Before death, which took place the same day, the respiration rose to 44 and the pulse to 143 (Gable, *Phila. Med. Times*, x. 404). In another case several children took an uncertain dose of the oil. The one most deeply affected was soporose, breathing heavily, and when aroused was very deaf and had severe headache and ringing in the ears. The stupor continued for several days with an aggravation of the several symptoms; pulse 100, respiration 58 (North, *Med. Record*, xviii. 349). A case reported as one of "poisoning by oil of chenopodium" (*Maryland Med. Jour.*, Nov. 1878) appears to us to have been an example of chronic disease of the brain terminating in softening of that organ. Wormseed oil is chiefly used as an anthelmintic, although occasionally employed for the cure of *intermittent fever*, *hysteria*, *chorea*, and other *nervous affections*. In America it is one of the most popular remedies for *lumbricoid worms*, but it has also been used successfully to expel *tæniæ*. It is true that in Europe some observers have tended to discredit its efficacy, and even in this country there is more evidence of its utility in cases of gastro-intestinal *dyspepsia* among children, which is often mistaken for verminous disease, than of its direct vermifuge powers. It may be given to children in *doses* of from 5 to 10 drops (Gm. 0.30–0.60) on sugar, and twice daily for several days, when it should be followed by a dose of castor oil.

OLEUM CINNAMOMI, *U. S., Br., P. G.*—OIL OF CINNAMON.

Oil of Ceylon cinnamon, E.; *Essence de cannelle*, Fr.; *Zimmtöl*, G.

The volatile oil distilled from cinnamon-bark (see page 475).

Preparation.—The British and French Pharmacopœias recognize only the volatile oil of Ceylon cinnamon, which is almost exclusively prepared in Ceylon by distilling the chips and refuse bark with water; the German Pharmacopœia has admitted only the oil of Chinese cinnamon; while the U. S. Pharmacopœia recognizes both volatile oils by the above title. Judging from the custom-house entries, but little of the Ceylon oil is imported into the United States. The importation in 1877 amounted to 15 pounds, in 1881 to 783 pounds, while 20,685 pounds of oil of Chinese cinnamon (or Cinnamon cassia) were imported in 1867, and 104,116 pounds in 1881. The latter oil is sometimes distilled in the United States. Ceylon cinnamon yields ½ to 1 per cent., Chinese cinnamon ½ to 1½ per cent., of volatile oil.

Properties.—Oleum cinnamomi zeylanici.—Oil of Ceylon cinnamon, *E.;* Essence de cannelle de Ceylon, *Fr.;* Zeylonzimmtöl, *G.*—It is a pale-yellow or reddish liquid, becoming red-brown and thicker on exposure, finally separating crystals of cinnamic acid. It has a strong but agreeable cinnamon odor and a sweet and at the same time hot, aromatic taste. Its specific gravity is about 1.035 (1.0097, Jackson, 1882), and increases by age. It remains clear at the freezing-point of water (at −10° C. = 14° F., *U. S. P.*), but at a still lower temperature (at −20° C. = −4° F., Bizio) separates a stearopten; it has no action on polarized light or shows a slight left rotation, is readily soluble in alcohol, sparingly soluble in benzin, and has a neutral reaction on litmus-paper when fresh, and an acid reaction when old. It dissolves iodine almost quietly, and soon forms a thick mass; fuming nitric acid imparts to it a carmine color without causing effervescence; boiling with nitro-prusside of copper turns it red, then dark-brown; its alcoholic solution is somewhat darkened by ferric chloride. Good oil of cinnamon does not congeal when agitated with strong solution of potassa.

Oleum cinnamomi cassiæ, s. Oleum cassiæ.—Oil of Chinese cinnamon, Oil of cassia, *E.;* Essence de cannelle de Chine, *Fr.;* Zimmtkassienöl, *G.*—It resembles the preceding oil very closely in all its properties, except that its color is more brownish, its odor less delicate, its taste less sweet, and its specific gravity greater, being usually 1.055 to 1.065 (1.0366, Jackson, 1882); sometimes it is slightly dextrogyre.

Composition.—Both oils contain variable quantities of hydrocarbon, but consist chiefly of *cinnamic aldehyd*, C_9H_8O, and when old also resin and cinnamic acid, $C_9H_8O_2$. In its pure state cinnamaldehyd is a colorless oil, heavier than water, combines with strong nitric acid in the cold, forming crystals, which are soluble in alcohol and ether, decomposed by water, and when heated yield oil of bitter almond and benzoic acid. Oxidizing agents generally, when acting upon cinnamaldehyd, generate the odor of bitter almonds, and finally produce benzoic acid; heated with solid potassium hydrate, potassium cinnamate is formed, hydrogen being given off; $C_9H_8O + KHO$ yields $C_9H_7KO_2 + H_2$. *Cinnamic acid* crystallizes in shining, colorless prisms, which are inodorous, dissolve freely in alcohol, ether, and boiling water, fuse at about 130° C. (266° F.), boil and volatilize without decomposition at about 295° C. (563° F.), and it is oxidized by chlorinated lime and hot dilute nitric acid to oil of bitter almond and benzoic acid.

Adulterations.—Oil of cinnamon is sometimes mixed with oil of cassia, which is best detected by the difference in their physical properties pointed out above. An adulteration with oil of cloves or oil of cinnamon-leaves cannot be detected by the odor, except on heating, when acrid vapors will be given off. The behavior to ferric chloride, strong potassa solution, and cold fuming nitric acid affords additional means for detection. "A solution of 4 drops of oil of cinnamon in 10 Ccm. of alcohol should, on the addition of 1 drop of test solution of ferric chloride, give merely a brown but not a green or blue color (carbolic acid, oil of cloves, etc.)."—*P. G.*

Allied Oils.—Oleum cinnamomi foliorum.—Oil of cinnamon-leaves, *E.;* Essence de feuilles de cannellier, *Fr.;* Zimmtblätteröl, *G.*—The leaves are distilled in Ceylon with sea-water. The oil is a rather viscid brown liquid, having the specific gravity 1.053 and a strong clove-like and faint nutmeg-like odor; after treatment with potassa the odor resembles that of cinnamon. Stenhouse (1854) found in the oil a terpene and eugenol, with a small quantity of benzoic acid; the latter could not be detected by Schaer (1882). N. A. Kuhn (1877) showed the presence of cinnamic acid.

Oleum cinnamomi radicis.—Oil of cinnamon-root. *E.;* Essence de racine de cannellier, *Fr.;* Zimmtwurzelöl, *G.*—It is yellow, lighter than water, and has an odor like that of a mixture of cinnamon and camphor and a camphoraceous taste.

Off. Prep.—Aqua cinnamomi, Spiritus cinnamomi, *U. S.*

Medical Action and Uses.—Excessive doses of this oil given to rabbits produce violent action of the heart, hurried respiration, distress, evacuation of solid feces, insensibility, slow and labored respiration, cold extremities, and death. The gastro-intestinal mucous membrane is not inflamed. The oil is much employed to give an agreeable flavor to medicinal compounds and render them acceptable to the stomach. If the virtues attributed to cinnamon (see Cinnamomum) in uterine hæmorrhage are real, they would probably be displayed more efficiently by the oil than by any other preparation of the medicine. The *dose* is 1 or 2 drops (Gm. 0.05–0.10).

OLEUM COCOS, *P. G.*—Cocoanut Oil.

Oleum cocois.—*Cocoanut butter*, E.; *Beurre de coco*, Fr.; *Kokosnussöl*, G.

From Cocos nucifera, *Linné.*

Nat. Ord.—Palmæ.

Origin.—The cocoanut tree is now met with in all tropical countries. It grows to a height of 70 or 80 feet (21–24 M.), and has at the apex a tuft of leaves which are 12 feet (3.6 M.) and more long and have numerous narrow rigid and long leaflets. The yellowish-white flowers produce the well-known cocoanuts, which in their unripe state contain a sweetish liquid. The seeds contain much fixed oil, which is obtained by hot pressure or on being boiled in water. The seeds of Cocos butyracea, *Linné*, of Brazil, yield a similar oil. Nearly 267,000 gallons of cocoanut oil were imported into the United States in the year 1876–77, and nearly 1,000,000 gallons in 1882, principally from Ceylon.

Properties.—Cocoanut oil is of a butyraceous consistence, white, and has a peculiar not agreeable odor, which is also observed in the soap prepared with it; its taste is mild and bland, but on exposure to the air it becomes rancid and acquires an acrid taste. Its melting-point varies between 22° and 28° or 30° C. (71.6°–82.4°–86° F.): the cold pressed oil melts at 20° C. (68° F.) or less. The fused, thin, transparent, yellowish oil congeals between 18° and 12° C. (64.4° and 53.6° F.). After having been heated to 240° C. (464° F.) it remains liquid for several days. The oil is readily saponified at a low temperature, the soap being white, hard, and capable of uniting with much water near 18° C. (64.4° F.).

Composition.—By cold pressure it may be separated into a liquid and solid portion, both of which are glycerides. According to Görgey and Oudemans, the acids contained in cocoanut oil are palmitic and myristic, but principally lauric, acid, together with caprinic, caprylic, and capronic acids.

Medical Action and Uses.—Cocoanut oil has been tried as a substitute for cod-liver oil, but, like other succedanea for that product, was found inefficient. It was given in doses of a tablespoonful (Gm. 16). It is chiefly valuable for its economical and pharmaceutical uses.

OLEUM COPAIBÆ, *U. S., Br.*—Oil of Copaiba.

Oleum balsami copaivæ.—*Essence de copahu*, Fr.; *Copaibaöl*, G.

The volatile oil distilled from copaiba (see page 503).

Preparation.—The oil is obtained by distilling copaiba with water, a metallic still being preferable to a glass retort; a considerable quantity of water, or preferably steam, should be used, or the distilled water returned to the still until all the oil has been obtained. All that is consumed in the United States is prepared here from Para copaiba, which yields 50 to 60 per cent., or even more.

Properties.—Oil of copaiba is limpid, colorless, or pale-yellowish, and on exposure becomes slowly thicker and yellow. It has the odor of copaiba, a pungent bitterish taste, neutral reaction to test-paper, spec. grav. .88 to .91, and boils at about 250° C. (482° F.). It is soluble in an equal weight of alcohol (*U. S. P.*), dissolves in about 40 parts of alcohol spec. grav. .85, mixes with iodine without violent reaction, and yields with hydrochloric acid gas a liquid and a crystallizable compound. It deviates polarized light to the left.

Composition.—The oil has the elementary composition of oil of turpentine, and consists of several isomeric modifications of $C_{15}H_{24}$, differing in boiling-point, in the behavior to polarized light, and probably in other properties.

Adulterations.—The addition of oil of turpentine is detected by the odor and by the more violent reaction with iodine.

Medical Action and Uses.—Oil of copaiba is poisonous to rabbits in doses of an ounce or more. The symptoms produced by it are hurried breathing, palpitation, restlessness, frequent micturition, diarrhœa with mucous or bloody stools, and death by asthenia. After death a partial destruction of the gastro-intestinal epithelium is the only lesion observed. Upon the human skin it acts very feebly as an irritant. When taken internally it is excreted by the urine, which then furnishes a precipitate with nitric or muriatic acid. It is very doubtful whether this oil has any efficient control over *gonorrhœa*, the disease for which copaiba itself is chiefly employed. It probably is more useful in chronic pulmonary catarrh or *chronic bronchitis*, since it is apparently through the lungs that the odorous constituent of all oleoresins is eliminated. But clinical evidence upon this point is wanting, unless, indeed, the negative proof afforded by the silence of all competent authorities be accepted as sufficient. The *dose* of the oil is from 10 to 15 drops (Gm. 0.60–1).

OLEUM CORIANDRI, *U. S., Br.*—OIL OF CORIANDER.

Essence de coriandre, Fr.; *Korianderöl*, G.

The volatile oil distilled from the fruit of Coriandrum sativum, *Linné.*

Nat. Ord.—Umbelliferæ (see page 509).

Preparation.—Coriander-fruit is ground, and then distilled with water or by means of steam. The yield varies between ½ and 1 per cent.

Properties.—It is colorless or pale-yellow, has a mild and agreeable aromatic odor and taste of coriander, a spec. grav. of .86 to .87, commences to boil at about 150° C. (302° F.), and dissolves readily in alcohol. Iodine and fuming nitric acid act energetically upon it, the latter producing a greenish resin.

Composition.—The oil has the composition $C_{10}H_{18}O$, and is isomeric with borneol. From Kawalier's investigations (1852) it appears sometimes to contain also a hydrocarbon, $C_{10}H_{16}$.

Adulteration.—Leonhardi (1878) mentions oil of orange, which is detected by its insolubility in an equal bulk of 85 per cent. alcohol.

Off. Prep.—Syrupus sennæ, *Br.*

Medical Action and Uses.—Like oil of anise, fennel, etc., this oil is aromatic and carminative, and is used in flatulent *colic*, to relieve the pain of *rheumatism*, *neuralgia*, etc., and to mitigate the griping operation of certain purgatives. It corrects the odor and taste of fluid extract of senna better than any other aromatic. *Dose*, 1 to 5 drops (Gm. 0.05–0.25).

OLEUM CUBEBÆ, *U. S., Br.*—OIL OF CUBEB.

Oleum cubebarum.—Oil of cubebs, E.; *Essence de cubèbe*, Fr.; *Kubebenöl*, G.

The volatile oil distilled from the fruit of Cubeba officinalis, *Miquel* (nat. ord. Piperaceæ).

Preparation.—Cubebs are ground, and then distilled with steam or with water, when repeated cohobation is necessary. The yield is about 10 per cent., but varies considerably with the quality of the fruit. It is distilled in the United States, little being imported—558 pounds in 1867, none in 1876, and only 5 pounds in 1877.

Properties.—Oil of cubebs has a greenish or yellowish tint, but after rectification is colorless, and on exposure becomes thick like olive oil. It has the odor of cubebs, a warm, camphoraceous, aromatic taste, spec. grav. .92, a neutral reaction, boils at about 250° C. (482° F.), dissolves in 25 parts of alcohol sp. gr. .85, and turns polarized light to the left. Iodine dissolves in the oil quietly, but evolves some vapors; concentrated sulphuric acid colors it yellow, and, on warming, red.

Composition.—Oglialoro (1875) showed the oil to be a mixture of three levogyrate hydrocarbons, of which one is $C_{10}H_{16}$, is present in small quantity and boils between 158° and 163° C. (316.4° and 325.4° F.); the remaining two have the composition $C_{15}H_{24}$, and boil between 262° and 265° C. (503.6° and 509° F.); only one of these yields a crystallizable compound with HCl, melting at 118° C. (244.4° F.). At a low temperature the oil sometimes separates inodorous crystals of *cubeb camphor*, which has the formula $C_{30}H_{48}.2H_2O$, and fuses at 65° C. (149° F.).

Medical Action and Uses.—In the dose of an ounce oil of cubeb produces symptoms in rabbits almost identical with those of oil of copaiva. but more strongly marked. In man it causes, occasionally, an eruption, as copaiva does. It displays no curative virtues in gonorrhœa. The *dose* is from 10 to 15 drops (Gm. 0.60–1) or more.

OLEUM ERIGERONTIS CANADENSIS, *U. S.*—Oil of Canada Erigeron.

The volatile oil distilled from the fresh flowering herb of Erigeron canadense, *Linné*.
Nat. Ord.—Compositæ.

Preparation.—The fresh herb (see page 586) is distilled in the United States with water or by means of steam.

Properties.—Oil of erigeron is a limpid, pale-yellow liquid of a peculiar aromatic, persistent odor, somewhat like that of hemlock (Abies canadensis), and of an aromatic not very pungent taste. It has the spec. grav. .845, and commences to boil at about 155° C. (311° F.), the boiling-point rising to 185° C. (365° F.); the redistilled oil is colorless, and neutral to test-paper. It dissolves iodine without explosion, is gradually colored reddish by potassa, and slowly acted on in the cold by fuming nitric acid. The oil becomes thick and reddish-brown by age, dissolves freely in ether and absolute alcohol, but is only moderately soluble in 80 per cent. alcohol.

Composition.—The oil contains oxygen, as ascertained by Procter (1854), but, according to Beilstein and E. Wiegand (1882), it consists mainly of a terpene, $C_{10}H_{16}$, boiling at 176° C. (349° F.), and yielding a crystalline compound with HCl, which melts near 48° C. (118.4° F.).

Medical Action and Uses.—This oil has had a certain reputation for controlling *uterine hæmorrhage*, and the plant from which it is derived was held by the aborigines to quicken *uterine contractions*. The evidence respecting its virtues is conflicting, and seems, on the whole, not adapted to inspire much confidence. Like other nervo-vascular stimulants, it is said to have been useful in the *typhoid state*. The *dose* is from 5 to 10 drops (Gm. 0.30–0.60).

OLEUM EUCALYPTI, *U. S.*, *Br.*—Oil of Eucalyptus.

Essence d'eucalyptus, Fr.; *Eucalyptusöl*, G.

The volatile oil distilled from the fresh leaves of Eucalyptus globulus or Eucalyptus amygdalina, *Labillardière*, and some other species of Eucalyptus.
Nat. Ord.—Myrtaceæ.

Origin and Preparation.—The first species mentioned above is described on page 593. The second species, which in Australia is known as *peppermint tree*, sometimes attains a height of over 400 feet (120 M.), and, being more accessible, its foliage is frequently subjected to distillation with water, and the volatile oil thus obtained is sold as eucalyptus oil. Bosisto states (see *Am. Jour. Phar.*, 1876, p. 372) that 1000 pounds of the fresh leaves of the following species yield the quantities of oil stated: E. obliqua, *L'Heritier*, called *stringy bark*, 80 oz.; E. globulus, *Labillardière*, 120 oz.; E. sideroxylon, *Bentham*, called *iron bark*, 160 oz.; E. oleosa, *Mueller*, known as *mallee*, 200 oz.; while E. amygdalina yields 500 oz. of volatile oil.

Properties.—These volatile oils are colorless or pale-yellow, thin liquids, becoming thicker and somewhat darker by age. They are neutral to test-paper, are highly and more or less pungently aromatic in odor and taste, that of E. globulus being camphoraceous, that of Eu. amygdalina somewhat resembling peppermint, while others have a more terebinthinate or lemon-like odor, and that of Euc. persicifolia, or *peach gum*, like oil of bitter almonds, with which it agrees in containing hydrocyanic acid. The specific gravity of these oils varies between .88 and .94, and their boiling-points between about 130° and 200° C. (266° and 392° F.).

Composition.—The dextrogyre oil of E. globulus was examined by Cloëz (1870) and by Faust and Homeyer (1874). Cloëz regarded the oil as being chiefly composed of *eucalyptol*, $C_{12}H_{20}O$, boiling at 178° C. (352.4° F.), and yielding with phosphoric anhydride two compounds, $C_{12}H_{18}$, of which *eucalyptene* boils at 165° C. (329° F.), and *eucalyptolene* at above 300° C. (572° F.). Faust and Homeyer, however, obtained from the oil about 60 per cent. of a *terpene*, $C_{10}H_{16}$, boiling between 172° and 175° C. (342.6° and 347° F.), 30 per cent. of *cymol*, $C_{10}H_{14}$, the remainder being a *terpene* boiling at 150° C. (302° F.), and an oxygenated compound, probably $C_{10}H_{16}O$, which they named *eucalyptol*, Cloëz's compound of the same name being a mixture of the first two hydrocarbons, which rapidly combine with oxygen. The oil of E. amygdalina does not appear to contain eucalyptol.

Action and Uses.—For an account of the virtues ascribed to this oil the reader is referred to the article Eucalyptus. The *dose* of the oil is from 2 to 5 drops.

OLEUM FŒNICULI, *U. S., P. G.*—Oil of Fennel.

Essence de fenouil, Fr.; *Fenchelöl*, G.

The volatile oil distilled from the fruit of Fœniculum vulgare, *Gaertner* (see p. 709).

Nat. Ord.—Umbelliferæ.

Preparation.—Bruised fennel is distilled with water, or, preferably, by means of superheated steam. The yield is about 3½ or 4 per cent. The oil used in the United States is chiefly procured from Germany and France, from 800 to 1000 pounds being annually imported.

Properties.—Oil of fennel is colorless or yellowish, has a neutral reaction, an agreeable fennel odor, a sweetish aromatic taste (*oil of sweet fennel*), and is of the spec. grav. .96 to .99 (not less than .960, *U. S.*, *P. G.*); it congeals below 10° C. (50° F.), sometimes not until cooled below the freezing-point of water, and Zeller obtained an oil which remained liquid at $-20°$ C. ($-4°$ F.); moreover, the congealing-point of the oil becomes lower by age. An oil which does not congeal between 5° and 10° C. (41° and 50° F.), as required by the Pharmacopœia, cannot, for this reason alone, be considered impure. (See also Ol. Anisi.) Boiled with nitro-prusside of copper, oil of fennel turns yellowish-brown or red-brown; on the addition of iodine it becomes thick like an extract, or even brittle. It is soluble in alcohol in all proportions, and turns the ray of polarized light to the right.

Composition.—The difference in the physical properties is due to the variable proportion of liquid and solid *anethol* contained in it. (See Ol. Anisi.) The oil also contains a hydrocarbon isomeric with oil of turpentine.

Tests.—The solution in alcohol should not become dark-colored on the addition of a little ferric chloride (phenol, etc.). 1 drop of the oil, triturated with sugar and afterward with 500 Gm. of water, should impart to the latter the pure flavor of fennel (other volatile oils).—*P. G.*

Off. Prep.—Aqua fœniculi, Spiritus juniperi comp., *U. S.*.

Medical Action and Uses.—The action of fennel oil when given to animals in large doses appears to be identical with that of oil of anise. Its medicinal operation closely resembles that of the same oil. It is used in *flatulent* disorders and to qualify the action of harsh purgatives, and is sometimes employed as a *galactagogue* and as an *emmenagogue*. The *dose* is from 5 to 10 drops (Gm. 0.30–0.60).

OLEUM GAULTHERIÆ, *U. S.*—Oil of Gaultheria.

Oil of wintergreen, E.; *Essence de gaulthérie*, Fr.; *Wintergreenöl*, G.

The volatile oil distilled from the leaves of Gaultheria procumbens, *Linné* (see p. 724).

Nat. Ord.—Ericaceæ.

Preparation.—The entire plant is generally collected, and while fresh distilled with water or with the aid of steam. It is largely made in New York, Pennsylvania, and some of the New England States. The average yield is about .5 per cent., and varies between .4 and .8 per cent. G. W. Kennedy (1882) showed that much of the commercial oil of wintergreen is obtained from Betula lenta (see page 317), the young shoots being distilled after having been cut into short pieces and subjected to brief maceration with water; the yield is about .23 per cent.

Properties.—Oil of gaultheria is usually of a reddish color, but may be obtained colorless by rectification. According to I. E. Leonard (1884), the color is usually due to the presence of a little iron, and is readily removed by citric acid. It has a strong and agreeable aromatic odor and a sweetish, warm, aromatic taste, and begins to boil at a little above 200° C. (392° F.). It is the heaviest of the volatile oils, its density being 1.180 at 15° C., which is also that of oil of sweet birch. Occasionally, oil of gaultheria is lighter (1.170), in consequence of containing a light hydrocarbon, but the extent of this variation has not been fully determined. The oil is neutral or faintly acid to test-paper; has a slight dextrogyre rotation, and dissolves readily in alcohol and but to a small degree in water; the solutions acquire a dark-purple color on the addition of ferric chloride. The pure oil is not colored on the addition of strong nitric acid, but soon congeals into colorless crystals of a nitro-compound. A solid crystalline mass is also obtained on agitating the oil with concentrated solution of potassa or soda.

Composition.—Procter (1842) recognized the presence in this oil of salicylic acid. Cahours subsequently (1843) proved it to consist to the amount of about 90 per cent. of *methylsalicylic acid* (*methyl salicylate* or *mono-methylsalicylic ether*), $CH_3.C_7H_5O_3$, which with some other salicylic ethers is now also artificially prepared for use in the arts. H. P. Pettigrew (1883) showed the oil of sweet birch to be pure methyl salicylate, to boil constantly at 218° C. (424.4° F.), and on saponification to yield methyl alcohol and salicylic acid. Pure methyl salicylate is a colorless oil, has the spec. grav. 1.18, boils at 222° C. (431.6° F.) (Cahours), and forms crystalline compounds with the alkalies. The remaining constituent of oil of wintergreen—of which Pettigrew (1884) obtained only 0.3 per cent.—is *gaultherilene*, a colorless thin hydrocarbon of the formula $C_{10}H_{16}$, boiling at 160° C. (320° F.), and having a strong peculiar odor, described as pepper-like by Cahours. Volatile oils of similar composition have been obtained from Gaultheria hispidula, G. punctata, G. leucocarpa, Polygala pauciflora, and Monotropa Hypopitys.

Adulterations.—The great density of this volatile oil prevents its adulteration with most cheaper ones, which would reduce its specific gravity. A mixture of alcohol and chloroform has been employed for the purpose, but is readily detected by the low boiling-point and the character of the first fractional distillate. The most common adulterant is oil of sassafras, which is colored dark-red and converted into a brown-red resinous mass by strong nitric acid. The pure oil yields nearly colorless crystals of *methyl nitrosalicylate*. "When heated to about 80° C. (176° F.) the oil should not yield a colorless distillate having the characteristics of chloroform or of alcohol. On mixing 5 drops of the oil with 5 drops of nitric acid the mixture should not acquire a deep-red color, and should not solidify to a dark-red, resinous mass (absence of oil of sassafras)."—*U. S.*

Off. Prep.—Spiritus gaultheriæ, Trochisci morphinæ et ipecacuanhæ, *U. S.*

Medical Action and Uses.—Its action in large doses closely resembles that of the other aromatic essential oils. In the case of a boy nine years old ½ ounce (Gm. 16) of it occasioned vomiting, purging, epigastric pain, fever, labored and slow respiration, dulness of hearing, and an uncontrollable desire for food. Two girls, fourteen and fifteen years old, drank, the one about an ounce, the other about 2 ounces, of the oil. Both were seized with vertigo, weakness, hot skin, frequent pulse, cold sweats, labored breathing, and dulness of hearing. In the elder there was inability to speak, with cramp in the epigastrium and convulsions. The younger patient recovered; the elder died in about 10 hours from congestion of the brain and convulsions. The odor of gaultheria was perceived in the perspiration and the breath had a pungent odor (Fichtner, *Med. News*, Nov. 1881, p. 698).

In 1880, Perier made use of a mixture of essence of wintergreen and tincture of quillaia in the local treatment of chronic cystitis, and a 1 per cent. solution of the former in vaseline as an antiseptic (*Med. Record*, xviii. 262). In 1881, Gosselin and Bergeron determined that, like alcohol and salicylic acid, this oil prevents putrefactive fermentation, and that when duly diluted with an alcoholic solution it does not irritate the tissues, but hastens the healing of their wounds and other lesions. These surgeons made use chiefly of a solution consisting of 100 parts each of alcohol and water, with 2½ parts of oil of gaultheria (*Archives gén.*, Jan. 1881, p. 16). The large proportion of methyl salicylate contained in the oil naturally led to its employment in *rheumatism*. It was apparently first used for this purpose by Mr. Casamayor of Brooklyn, N. Y. (*Ephemeris*, i. 30), and next by Dr. Kinnicutt of New York (*Med. Record*, xxii. 505). Twelve cases of acute [articular] rheumatism treated by the latter gave an average duration of the pyrexia of 3½ days; of the joint pains, 4½ days; of the stay in hospital, 24½ days. The oil was given at first in doses of 10 minims every 2 hours until eight doses had been taken, and afterward the doses were increased as well as their frequency. The reporter believes that his cases presented less than the usual proportion of heart-complications, but if so the oil must differ in its effects from its active element, salicylic acid. Dr. Austin Flint (*Phila. Med. Times*, xiii. 846) and Dr. Gottheil (*Med. Record*, xxiv. 258) have reported analogous results. It is sometimes used as a carminative, but most frequently to conceal the taste of nauseous medicines. It assists in flavoring the compound syrup of sarsaparilla. The *dose* may be stated at 5 or 10 drops (Gm. 0.30–0.60). This oil may be given in powdered sugar, or floated on water, or in gelatin capsules. It does not readily cause disgust.

OLEUM GOSSYPII SEMINIS, *U. S.*—Cotton-Seed Oil.

Oleum gossypii.—Cotton oil, E.; *Huile de coton*, *Huile de semences de cotonnier*, Fr.; *Baumwollsamenol*, G.

A fixed oil expressed from the seed of Gossypium herbaceum, *Linné*, and of other species of Gossypium, and subsequently purified.

Nat. Ord.—Malvaceæ.

Origin and Preparation.—(For remarks on the cotton-plant see page 743). After the seeds have been deprived of the cotton they are about $\frac{1}{3}$ inch (8 Mm.) in length and $\frac{1}{6}$ inch (4 Mm.) in width, of an irregular ovoid shape, have a brown, hard, somewhat brittle testa with a prominent raphe along its entire length, and contain a whitish embryo with large, folded cotyledons and numerous blackish resin-glands imbedded in its tissue. For obtaining the oil the testa is crushed in a suitable machine and removed by winnowing; the kernels (embryo) are then ground, and, enclosed in bags, are subjected to hydraulic pressure. A bushel of seeds yields about 2 gallons of oil, or, by weight, 100 parts of seeds give shells and cotton-fibre 47, press-cake 38, and oil 15 parts. The air-dry seeds contain oil 21.5, albuminoids 28, other organic substances 33.5, ash 9, and water 8 per cent. The average composition of the press-cakes is oil 7.5, albuminoids 20, other organic compounds 51, ash 8.5, and moisture 13 per cent.

Purification.—The crude oil is of a more or less deep-brown color, turbid, thickish, and contains a large percentage of albuminous matter. On standing, a portion of the impurities subside, and the oil, now termed "clarified," becomes clear and of an orange color. On treating it with boiling water or superheated steam the albuminoids are coagulated, and a still lighter colored or refined oil is obtained. The final bleaching is effected by agitating the oil well with a small portion of alkali solution and heating.

Properties.—Bleached cotton-seed oil is perfectly transparent, and has a pale straw-yellow collor, a bland nut-like taste, and a neutral reaction. Its specific gravity at 15° C. (59° F.) is .925–.927 (.920–.930 *U. S. P.*); that of the crude oil, .930–.932. It is very sparingly soluble in alcohol, but dissolves readily in ether, chloroform, benzin, etc. Near 5° C. (41° F.) the oil begins to deposit palmitin, but it does not congeal until cooled to $-1°$ or $-2°$ C. (30° or 28.4° F.). Exposed to the air, the oil gradually thickens, but it does not solidify; by the elaidin test it is converted into a yellow or brownish soft mass. Sulphuric acid, sp. grav. 1.75 or more, imparts at once a dark-red or brown color, and gradually forms a thick jelly-like mass; weaker sulphuric acid applied in the cold causes a deeper yellow or orange color. Nitric or hydrochloric acid scarcely affects the color, but fuming nitric acid colors orange-brown. Warmed with concentrated solution of zinc chloride, a brown color is produced. When agitated with concentrated solution of lead subacetate, S. S. Bradford (1882) noticed after some time the production of a red tint, and considers this behavior as a reliable test for the detection of cotton-seed oil in olive oil. The oil is readily saponified by strong solutions of alkali, with the exception of a bright-yellow coloring matter, which may be obtained by agitating the soap with benzin.

Composition.—Cotton-seed oil consists chiefly of olein and palmitin, and about 1.8 per cent. of a bright-yellow liquid hydrocarbon. According to O. Bach (1883), the fatty acids of this oil melt at 38° C. (100.4° F.) and congeal again at 35° C. (95° F.). From that portion of the oil saponified in the bleaching process F. Kuhlmann (1861) obtained a pigment by heating the soapy sediment with 4 per cent. of sulphuric acid for several hours to 100° C. (212° F.), washing with water, and dissolving in alcohol. This *cotton-seed blue*, $C_{17}H_{24}O_4$, is amorphous, readily destroyed by oxidizing agents, insoluble in water, diluted acids, and alkalies, sparingly soluble in carbon disulphide and chloroform, soluble in 77 parts of alcohol and 8.4 parts of ether, and dissolves with a purple color in sulphuric acid; it is bleached on exposure to light and air.

Pharmaceutical Uses.—The oil is used by the U. S. P. for liniments in the place of olive oil.

Allied Oils.—Oleum fagi.—Beech oil, *E.;* Huile de faines, *Fr.;* Buchelöl, Buchheckeröl, *G.*—The fruit of the European beech tree, Fagus sylvatica, *Linné* (nat. ord. Cupuliferæ), is in some parts of Europe used for the preparation of oil, of which, after the removal of the integuments, about 22 per cent. is obtained. The press-cake is said to have a deleterious effect when eaten by cattle or horses, but is used for feeding hogs and poultry. The oil is yellow and of a mild odor and taste, or, if expressed with heat, somewhat acrid, but becomes mild by age. It does not easily turn rancid, has the spec. grav. .921 to .923, congeals at about −17.5° C. (.5° F.), consists mainly of olein with little palmitin and stearin, and behaves to nitric, fuming nitric, and sulphuric acids in a similar manner as cotton-seed oil, but assumes a flesh color with zinc chloride. On saponification it yields a rather soft soap.

Oil of Brazil Nuts. Bertholletia excelsa, *Humboldt et Bonpland* (nat. ord. Lecythidaceæ), is a large tree indigenous to Brazil, where it is known as *castanheiro de Para.* The globular fruit is about 10 inches (25 Cm.) in diameter, and contains sixteen to twenty seeds, called *Brazil nuts* or *Para nuts*—Chataigne du Brésil, *Fr.;* Paranuss, *G.* These are 1¼ to 2 inches (3–5 Cm.) long, three-edged, convex upon the back, have a rough, brown-gray, hard testa, and contain a white kernel of an almond-like taste and yielding about 60 per cent. of fixed oil. This is pale-yellow, bland, easily turns rancid, congeals at −1° C. (30° F.), becomes red and red-brown by sulphuric acid and rose-colored by zinc chloride, and consists of olein with palmitin and stearin. A similar oil is yielded by the *Sapucaya nuts,* the seeds of Lecythis Zabucajo, *Aublet,* of Brazil.

Uses.—This oil has been substituted for olive oil in several officinal preparations, and may be employed in all the surgical manipulations in which the latter was originally used.

OLEUM HEDEOMÆ, *U. S.*—Oil of Hedeoma.

Oil of pennyroyal, E.; *Essence de pouliot américain,* Fr.; *Poleiöl,* G.

The volatile oil distilled from the fresh herb of Hedeoma pulegioides, *Linné.*
Nat. Ord.—Labiatæ.

Preparation.—The fresh herb (p. 758) is distilled with water or by means of steam.

Properties.—The oil is a limpid, colorless, or yellowish volatile liquid of a peculiar pungent, mint-like odor and taste, and has a specific gravity of .94 to .95. It has a neutral reaction, is readily soluble in alcohol, and dissolves iodine with a brisk explosive reaction, yielding a viscous liquid. A mixture of the oil with chloral hydrate and sulphuric acid acquires a brownish-green color.

Fresh European pennyroyal (Pouliot, *Fr.;* Polei, *G.*), Mentha Pulegium, *Linné,* s. Pulegium vulgare, *Miller* (Bentley and Trimen, *Med. Plants,* 201), yields about 1 per cent. of a volatile oil having a similar odor, according to Kane a density of .925 to .927, a boiling-point near 185° C. (365° F.), and the composition $C_{10}H_{16}O$. The volatile oil of Pulegium micranthum, *Claus,* of Southern Russia, examined by Buttlerow (1854), has the same composition, but a greater density and higher boiling-point.

Composition.—Oil of hedeoma contains oxygen, but its exact composition has not been ascertained.

Medical Action and Uses.—It has essentially the same action and virtues as the associated volatile oils; that is to say, it is an aromatic stimulant, carminative, and emmenagogue under fit conditions, and is added to embrocations to increase their anodyne and rubefacient action. The *dose* is from 2 to 10 drops (Gm. 0.10–0.60).

OLEUM JUNIPERI, *U. S., Br., P. G.*—Oil of Juniper.

Oleum fructus (vel baccæ) juniperi.—Oil of juniper-berries, E.; *Essence de genièvre,* Fr.; *Wachholderbeeröl,* G.

The volatile oil distilled from the fruit of Juniperus communis, *Linné* (see p. 850).
Nat. Ord.—Coniferæ.

Preparation.—Ripe or nearly ripe juniper-berries are well bruised, mixed with table-salt and water, and distilled either over the naked fire or by the aid of steam. The yield is usually ½ to ¾ per cent., and sometimes exceeds 1 per cent. Over 7000 pounds are annually imported from Europe into the United States; in 1878, only 2813 pounds.

Properties.—Oil of juniper-berries is colorless or pale greenish-yellow, limpid, but on exposure rapidly thickens and turns yellow, and ultimately reddish-brown, at the same time acquiring an acid reaction; the fresh-distilled oil from old juniper-berries is thickish and light-yellow. Its specific gravity is about .870, but varies between .85 and .90; it begins to boil at 155° C. (311° F.), or if obtained from ripe berries at 205° C. (401° F.) (Blanchet), has the peculiar odor of the berries, and a warm, aromatic, somewhat sweetish and terebinthinate taste, shows a neutral reaction to test-paper, turns polarized light slightly to the left, and is slightly soluble in alcohol, forming with 10 or 12 parts of 80 per cent. alcohol or with 2 or 3 parts of officinal alcohol a more or less turbid solution; but it yields clear mixtures with carbon disulphide in all proportions. Iodine dissolves slowly in the limpid oil, but acts more energetically upon the thickened oil, sometimes producing fulmination; sulphuric acid colors it brown and red. Old oil of juniper contains formic acid, from which it may be freed by sodium carbonate and rectification.

Composition.—The oil is a mixture of hydrocarbons of the general formula $C_{10}H_{16}$, which differ in their boiling-point (see above), a portion boiling at 282° C. (539.6° F.) (Soubeiran and Capitaine). It yields with hydrochloric acid gas a liquid compound.

Adulteration.—The similarity of oil of juniper and oil of turpentine in specific gravity, boiling-point, and behavior to solvents and reagents renders the detection of an adulteration with the latter rather difficult, except by the formation of a solid compound with hydrochloric acid gas, and by its different odor, particularly after exposure. "1 drop of the oil, triturated with sugar and agitated with 500 Gm. of water, should not impart a sharp taste to the latter."—*P. G.*

The *oil of juniper-wood*, obtained by distillation with water, has a different, more terebinthinate odor, and is at first limpid and colorless, but on exposure becomes thick, yellow, and finally dark-brown.

OLEUM JUNIPERI EMPYREUMATICUM, s. Oleum cadinum—Oil of cade, *E.;* Huile de cade, *Fr.;* Kadeöl, *G.*—is an empyreumatic, dark-brown, tar-like liquid obtained from the wood of Juniperus Oxycedrus, *Linné.* The empyreumatic oil of common juniper-wood is said to be frequently sold in its place.

Off. Prep.—Spiritus juniperi, *U. S.*, *Br.;* Spiritus juniperi comp., *U. S.*

Medical Action and Uses.—Oil of juniper is stomachic, carminative, and diuretic. In large doses it occasions in animals the same effects upon the nervous and vascular systems as other essential oils, with the addition of diuresis. The last-mentioned operation is evident in man as an effect of medicinal doses. It reddens, and may even blister, the skin. It is an efficient ingredient of diuretic infusions and mixtures, is much used to promote urination in the form of Holland gin, and when inhaled from an atomized solution its diuretic virtues are sometimes promptly and distinctly manifested. The *dose* is from 5 to 15 drops (Gm. 0.30–1).

Oil of cade is extensively used in Europe in the treatment of *psoriasis*, *pityriasis rubra*, *chronic eczema*, *prurigo*, etc. It is applied either in liniments or in soft potash soaps, pure or dissolved in alcohol. The preparations have the same effect as the analogous ones made with tar, but are less irritating, have less smell, and are less injurious to the clothing. Oil of cade has been given internally as an anthelmintic.

OLEUM LAVANDULÆ, *U. S., Br., P. G.*—OIL OF LAVENDER.

Essence de lavande, Fr.; *Lavendelöl*, G.

The volatile oil distilled from Lavandula vera, *De Candolle* (see p. 875).

Nat. Ord.—Labiatæ.

Preparation.—Oil of lavender is distilled in Great Britain and France from the flowers alone or from the flowering-tops or the entire plant, steam heat being usually resorted to. The flowers yield about ½ per cent. of the oil; the quantity, however, varies, and seems to increase in plants grown in southern localities. Stem and leaves yield a small portion of less fragrant oil. The title given above means in the British and German Pharmacopœias the *oil of lavender-flowers*, while the U. S. P. recognizes by it the oil distilled from the flowering-tops or the whole herb. 32,443 pounds were imported into the United States in 1877, and 54,930 pounds in 1882.

Properties.—The oil is very limpid, colorless, yellowish or greenish-yellow, and neutral, and acquires by age an acid reaction and viscid consistence. Its specific gravity is near .890, but varies between .87 and .91; it commences to boil at about 185° C. (365° F.), dissolves in its own weight of alcohol specific gravity .835 to .850, and yields clear mixtures with all proportions of strong alcohol and with acetic acid of 90 or more per cent. It has a levogyre action, reacts briskly and with some detonation on the addition of iodine, and acquires a brown color when agitated with corrosive sublimate. Exposed to a low temperature, it sometimes separates stearopten. Its fragrance varies with the part of the plant used for distillation; its taste is bitterish and pungent. The better quality is known in commerce as *oil of garden lavender.*

OLEUM LAVANDULÆ FLORUM, *U. S.*—Oil of lavender-flowers, *E.*—has the same prop erties, but a much more agreeable odor; the U. S. P. directs this oil to be used for preparing Spiritus lavandulæ, Spiritus odoratus, and Spir. ammoniæ aromaticus.

Composition.—The most volatile portion is a hydrocarbon of the formula $C_{10}H_{16}$. The stearopten is stated by Dumas to be identical with camphor. According to Lallemand (1859), the terpene boils at 175° C., and a second one between 200° and 210° C. (392° and 410° F.); the oxygenated fraction of the oil contains acetic, and probably also valerianic, acid in combination as ethers. Bruylants (1879) found the terpene to boil at 162° C. (323.6° F.), and ascertained the presence of formic and acetic acids, of 10 per cent. of resin, and of 65 per cent. of borneol and camphor. Shenstone (1882) ascertained that the boiling-point of the terpene is raised by continued heating, and suggests that the oxygenated compound is not camphor, but easily converted into it by oxidizing agents.

Adulteration.—The admixture of oil of turpentine is detected by the decreased solubility in alcohol. *Oil of spike lavender* has a deeper green-yellow color and a more terebinthinate, camphoraceous odor, but agrees with oil of lavender in solubility; according to Lallemand, it contains a dextrogyre hydrocarbon boiling at 175° C. (347° F.), and a stearopten apparently identical with camphor; but Bruylants (1879) regards it as differing from oil of lavender, mainly in containing a larger proportion of terpene. Alcohol which may be present as an adulteration is recognized in the distillate obtained at about 80° C. (176° F.).

Off. Prep.—Liniment. camphoræ comp., *Br.;* Tinctura lavandulæ comp., *U. S., Br.*

Medical Action and Uses.—This preparation is very seldom used alone, although it may be used to calm *nervous headache* by rubbing a few drops of it upon the temples or by its internal use in the *dose* of 4 or 5 drops (Gm. 0.30). Its carminative and general stimulant operation is usually obtained through the simple and compound spirit of lavender.

Oil of lavender-flowers is more fragrant than the oil distilled from the herb and flowers, but its action, uses, and *dose* are about the same.

OLEUM LIMONIS, *U. S., Br.*—OIL OF LEMON.

Oleum citri, P. G.; *Oleum de cedro, Oleum limonum.*—*Essence de citron, Essence de limon*, Fr.; *Citronenöl, Limonenöl*, G.

The volatile oil extracted by mechanical means from the fresh peel of Citrus Limonum, *Risso.*

Nat. Ord.—Aurantiaceæ.

Preparation.—The fresh rind of nearly ripe lemons is pressed between the fingers in such a manner that the oil-cells are ruptured, the exuding oil being received upon a sponge, which when saturated is expressed; or the oil-cells are ruptured by a process of superficial grating, the oil being drained off. An oil of inferior fragrance is obtained by grating the outer rind completely off and distilling the magma with water. Oil of lemon is manufactured in Southern France and Italy. 34,227 pounds of oil of lemon and orange were imported in 1867 by the United States; in 1881 the importation of oil of lemon amounted to 111,375 pounds.

Properties.—Oil of lemon has a pale-yellow color, is limpid, neutral, of a very agreeable fragrance and mild, aromatic, bitterish taste. As received in commerce, it is usually turbid, but becomes clear on standing; by age it acquires a thicker consistence and a pungent terebinthinate odor and taste, which change is prevented or retarded by the addition of 5 per cent. of alcohol and decantation of the clear oil from the sediment; this treatment is now recommended by the Pharmacopœia for the preservation of the oil. Its specific gravity is about .852; it commences to boil at about 160° C. (320 F.), rotates polarized light to the right, produces a brisk fulmination with iodine, yields with Fröhde's reagent a deep orange-brown color (Dragendorff, 1876), and by hydrochloric acid gas is converted into a liquid and a solid compound, which, distilled over lime, yield again colorless oils, the former *citrylene*, the latter *citrene* (or *citronyl*), having a lemon-like odor. Oil of lemon yields with 7 parts of alcohol specific gravity .839 a turbid solution, but is soluble in all proportions in carbon disulphide or absolute alcohol.

Composition.—Aside from a small quantity of an oxygenated compound, oil of lemon consists of several hydrocarbons having the general formula $C_{10}H_{16}$. W. A. Tilden (1879) states that at least 70 per cent. of the oil consists of *citrene*, $C_{10}H_{16}$, boiling at 176° C. (348.8° F.), having an odor like hesperidene; 6 per cent. consists of *cymene*, $C_{10}H_{14}$, and the remaining portion contains several hydrocarbons, an alcohol, $C_{10}H_{18}O$, boiling above 200° C. and its acetic ether.

Adulterations with the volatile oils of other fruits of the genus Citrus are very difficult to detect; odor and taste must be chiefly relied on. "1 drop of the oil, triturated with sugar and agitated with 500 Gm. of water, should impart to the latter the pure odor of lemon."—*P. G.*

Off. Prep.—Linimentum potassii iodidi cum sapone, *Br.;* Spiritus ammoniæ aromaticus, Spir. odoratus, *U. S.*, *Br.*

Medical Uses.—Oil of lemons is used almost exclusively as a flavoring agent and as a perfume.

OLEUM LINI, *U. S., Br., P. G.*—Flaxseed Oil.

Linseed oil, E.; *Huile de lin*, Fr.; *Leinöl*, *Leinsamenöl*, G.

The fixed oil, expressed without heat, from the seed of Linum usitatissimum, *Linné.* *Nat. Ord.*—Linaceæ.

Preparation.—This oil is made on the large scale by thoroughly drying the seed with the aid of heat, crushing, and forcibly expressing it. The yield by cold pressure is 16 to 20 per cent., by hot pressure 25 to 28 per cent. It is largely manufactured in this country; in 1867 over 3,200,000 gallons were imported into the United States, but the quantity decreased to 963 gallons in 1877, and was 12,169 gallons in 1883. The importation of flaxseed amounted in the years indicated to 1,769,192 bushels, nearly 85,000,000 pounds, and over 42,700,000 pounds respectively.

Properties.—Expressed in the cold, linseed oil is limpid, neutral to test-paper, yellowish or yellow, and of a peculiar bland not unpleasant odor and taste. For use in the arts linseed oil is obtained by hot pressure, is somewhat thicker, brownish, has more odor, and a somewhat acrid taste. Its specific gravity is about .936, but may vary between .928 and .953 (.936–940, *P. G.*). It imparts a yellow color to alcohol on being agitated with it, dissolves in 40 parts of cold and 5 parts of boiling alcohol, in 5 parts of absolute alcohol, in 1.5 parts of ether, and in all proportions of oil of turpentine, chloroform, benzin, and carbon disulphide. At a low temperature it becomes thicker, and congeals at −27° C. (−16.6° F.) to a yellowish mass. It yields with alkalies a very soft soap. In contact with fuming nitric acid it ignites, but when agitated with nitric acid of specific gravity 1.33 it turns green, and afterward brown; it does not solidify in contact with nitrous acid. Exposed to the air, it gradually thickens, becomes rancid, and finally solidifies; linseed oil thickened by exposure is incompletely soluble in alcohol. Crude oil which is mixed with mucilaginous matters quickly turns rancid and acquires an acid reaction; to obviate this change, the seed before expression is completely deprived of water. Linseed oil begins to boil at about 130° C. (266° F.), the boiling-point gradually rising, and when it has lost about 5 or 8 per cent. of its weight it constitutes *boiled linseed oil*, which is darker in color, thicker, and dries more rapidly than the unboiled oil.

Composition.—According to Mulder (1865), linseed oil is a mixture of about 80 per cent. of *linolein* with palmitin, myristin, and some olein, all being glycerides. *Linoleic acid* has the formula $C_{16}H_{28}O_4$, and is a colorless acid liquid readily soluble in alcohol and ether, and on exposure to air is converted into the hydrate of *oxylinoleic acid*, which in its pure state is colorless and has the composition $C_{16}H_{26}O_5$, and on continued exposure, more rapidly if frequently moistened with ether, is transformed into *linoxyn*, $C_{32}H_{54}O_{11}$. This latter compound is insoluble in ether, and is produced in a few days on the exposure of boiled linseed oil. The acrid taste of linseed oil seems to be due to the presence of a little resin; according to others, to traces of volatile fatty acids.

Pharmaceutical Preparations.—Oleum lini sulfuratum, s. Balsamum sulphuris. 6 parts of linseed oil are intimately mixed in an iron vessel with 1 part of sublimed sulphur, and the mixture boiled over a slow fire in an iron vessel, with constant stirring, until the whole has united into a homogeneous mass. It has about the consistence of a thick syrup, and is of a dark red-brown color. Diluted with three times its weight of oil of turpentine, it constitutes Oleum terebinthinæ sulfuratum, s. Balsamum sulphuris terebinthinatum.

Other Drying Oils.—The drying oils of walnut-, hemp-, sunflower-, poppy-, and pumpkin-seeds are described elsewhere in connection with the drugs.

Grape-seed Oil.—Huile de raisin, *Fr.;* Traubenkernöl, G.—The seeds of the different varieties of Vitis vinifera, *Linné* (nat. ord. Vitaceæ), yield from 10 to 20 per cent. of fixed oil, which is light-yellow or brownish, inodorous, faintly bitter, and congeals near −16° C. (3.2° F.). It dries very slowly, and consists, besides palmitin and stearin, chiefly of the glyceride of *erucic acid*, $C_{22}H_{42}O_2$; this acid melts at 34° C. (93.2° F.), and yields acetic and arachic acids on being fused with potassa.

MADIA OIL is obtained from Madia sativa, *Molina* (nat. ord. Compositæ, Tubulifloræ), an annual herb, native of Chili and cultivated in Europe, Africa, and Asia. The brownish-gray, quadrangular, four-ribbed akenes, which are destitute of pappus, yield about 40 per cent. of fixed oil. This is yellow, bland, of a peculiar odor, and has the spec. grav. .930, and congeals near −20° C. (−4° F.). On exposure to air it becomes rancid and slowly acquires a soft-solid consistence. By nitric acid it is colored brown-red, by sulphuric acid greenish and brown. Besides palmitin and stearin, it contains an olein, which seems to differ from that of other oils.

NIGER-SEED OIL. Guizotia oleifera, *De Candolle*, s. Verbesina sativa, *Roxburgh* (nat. ord. Compositæ, Tubulifloræ), is indigenous to and cultivated in India and Eastern Africa. The subcylindrical, black, and glossy akenes yield about 40 per cent. of a thin yellow oil having a nutty flavor and congealing below −10° C. (14° F.). It is colored orange-yellow by nitric acid, and gray-green and brown by sulphuric acid, dries to a soft varnish, and consists of myristin, palmitin, and apparently two oleins, one of which is closely related to linolein.

CANDLE-NUT OIL, KEKUNE OIL, BANKUL OIL. The candle-nut-tree, Aleurites triloba, *Forster*, s. A. moluccana, *Willdenow*, is extensively cultivated in the islands of the Pacific and Indian Oceans and in India. The whitish kernels have a bland nutty flavor and yield about 60 per cent. of nearly colorless oil, which dries rapidly and is colored dark orange-red by nitric acid and yellow to brown by sulphuric acid. It consists of an olein resembling linolein, besides myristin, palmitin, and stearin.

Medical Uses.—Flaxseed oil is a laxative in the *dose* of 1 or 2 ounces (Gm. 32–64). It has been recommended to be given in this manner as a remedy for *hæmorrhoids*. Only cold-pressed oil should be used internally. Its most important application is in the treatment of *burns* when mixed with an equal quantity of lime-water. The same mixture is also applied with advantage in *impetigo*.

OLEUM MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—OIL OF PEPPERMINT.

Essence de menthe poivrée, Fr.; *Pfefferminzöl*, G.

The volatile oil distilled from Mentha piperita, *Linné* (see page 972).
Nat. Ord.—Labiatæ.

Preparation.—The fresh herb is distilled with water, or preferably with steam. For medicinal purposes the oil should be rectified by steam distillation. It is largely produced in Michigan, New York, and other States of the Union, and to some extent is exported to Europe, while, on the other hand, some European rectified oil of peppermint is imported into the United States. In Great Britain the yield is stated to be from 8 to 12 pounds of oil per acre (*Pharmacographia*); in the United States it is said to be sometimes as high as 20 pounds (Stearns, 1858).

Properties.—Oil of peppermint is a colorless, or more frequently yellowish or greenish-yellow, liquid, which on exposure becomes brownish and viscid. Its specific gravity is usually near .90, but varies between .84 and .94. It commences to boil near 190° C. (374° F.), and at a low temperature sometimes deposits crystals of menthol. It has a peculiar pungent odor and a warm, aromatic, somewhat camphoraceous, and when old also bitterish, taste, followed by a sensation of cold, which is most noticed on drawing air into the mouth. It dissolves clear in from 1 to 3 parts of 80 per cent. alcohol, the solution usually becoming opalescent with more alcohol, and depositing slowly a minute white precipitate. It is neutral to test-paper when fresh, and turns polarized light to the left. In its action toward reagents it shows very considerable differences. Some oils of peppermint yield with sodium bisulphite a solid compound which has not been further examined (Flückiger). Jehn (1873) observed that chloral hydrate produces with this oil a rose- and cherry-red color, and Dragendorff (1875) proved that this reaction is occasioned by some unknown constituent of impure chloral hydrate, and becomes less distinct the purer the reagent is. Strong nitric acid colors it purplish to brown, but when from 50 to 70 drops of the oil are mixed with 1 drop of nitric acid specific gravity 1.2, the mixture is gradually changed from yellowish to brownish, and finally to a permanent violet, blue, or greenish-blue when viewed in transmitted light, while in reflected light the mixture is of a red-copper color and opaque; the reaction, which is not prevented by oil of turpentine, may be hastened by warming the mixture or by decreasing the oil (Flückiger, 1871). Schack (1878–81) observed that an alcoholic solution of the oil and salicylic acid gradually becomes copper-green, and that the melted acid becomes at once blue-green on the addition of the oil; phenol and most acids, but not carbonic acid, have a similar effect, and a mixture of 1 Ccm. of glacial acetic acid and 1 drop of oil of peppermint, slightly warmed, shows a blue color in transmitted light and a blood-red in reflected light; but menthol or oil of crisped mint does not yield the reaction. Picric acid dissolves in oil of peppermint with a yellow color, gradually, or when slightly heated more rapidly, changing to green; in presence of water and air a reddish-yellow is afterward produced (Frebault, 1874). Iodine does not act energetically with the oil, but dissolves and renders it thicker. With ethereal or chloroformic solution of bromine a rose-red or violet color is produced, changing gradually to a dirty pink or purplish color. In consequence of insufficient weeding of the mint-fields, American oil of peppermint is not unfrequently mixed with oil of erigeron, acquires a rank "weedy" smell, and seems to be disposed to resinify more rapidly.

Composition.—Oil of peppermint owes its peculiar odor to *menthol* (mint camphor, mint stearopten), $C_{10}H_{20}O$, which is chiefly contained in the last portions obtained on subjecting the oil to fractional distillation. It forms colorless prisms which fuse at 42° C. (76° F.), and boil at 212° C. (414° F.). Distilled with phosphoric anhydride, it yields *menthene*, $C_{10}H_{18}$, which is a colorless liquid of an agreeable odor. According to Moriga (1881), oil of peppermint contains probably also an oil of the formula $C_{10}H_{18}O$, which may be prepared from menthol by oxidation with potassium bichromate; but by treatment with fuming nitric acid menthol yields at first an explosive oil, afterward crystals of an acid, $(C_5H_8O_4)_2H_2O$, melting at 97° C. (206.6° F.); this compound is not identical with pyrotartaric acid, with which it agrees in composition. A compound isomeric with borneol had been found by Beckett and Wright (1875) in the liquid portion of Japanese peppermint oil, but, according to Flückiger and Power (1880), is not present in the oil distilled at Mitcham, which contains, besides menthol, several hydrocarbons of the formulas $C_{10}H_{16}$ and $C_{15}H_{24}$, and having a terebinthinate somewhat lemon-like odor.

Adulterations.—Besides oil of erigeron, alcohol, castor oil, and oil of turpentine have been employed for the purpose; the presence of the last two bodies renders the oil not readily soluble in 80 per cent. alcohol, and the last one mentioned causes it to be acted on with more violence by iodine. Menthol is sometimes met with in commerce as *Japanese* or *Chinese oil of peppermint*, and is obtained from a plant which, according to Holmes, is nearly related to Mentha canadensis, *Linné*. On one occasion it was largely adulterated with magnesium sulphate.

Off. Prep.—Aqua menthæ piperitæ, *U. S.;* Essentia menthæ piper., *Br.;* Pilul. rhei comp., Spiritus menthæ piper., *U. S., Br.;* Trochisci menthæ piper., *U. S.*

Medical Action and Uses.—Elsewhere (see MENTHA PIPERITA) are described the carminative and anodyne virtues of peppermint, which belong to all its preparations, and especially to its essence (*Spiritus menthæ piperitæ*), which is merely an alcoholic solution of the oil. The latter appears to possess in a remarkable degree the analgesic properties of its class. Anciently, peppermint was employed by the Romans as an application to the temples for the relief of headache, and within a few years it became known that the oil (stearopten) was used by the Chinese for a similar purpose In imitation of their practice, it has been a good deal employed as a local anodyne in *neuralgia* and *neuralgic headache*, applied over the supraorbital, the temporal, or other nerve in which the pain is most severe. A small wad of compressed cotton saturated with the oil should be laid upon the painful spot, covered with a piece of sheet caoutchouc, and bound firmly in its place. Merely painting the skin with the oil by means of a brush or a tuft of cotton will sometimes answer the purpose. In local *rheumatic* affections the latter method is often very efficient. It has also been used successfully as a topical anodyne in superficial *burns* and *scalds* and in *zona*. According to Duncan, it is, like its homologue *thymol*, antiseptic (*Practitioner*, xxiii. 47). Lober recommends the addition of the oil or the essence of peppermint to mixtures given internally in treatment of gonorrhœa. It is said to allay urethral pain (*Bull. de thérap.*, xcii. 105).

In *dental caries* this oil is quite as efficient in relieving pain as oil of cloves, and more permanent in its effects than chloroform. For internal use oil of peppermint may be prescribed in *doses* of from 1 to 3 drops (Gm. 0.05–0.15), but the officinal spirit is to be preferred.

OLEUM MENTHÆ VIRIDIS, *U. S., Br.*—OIL OF SPEARMINT.

Essence de menthe verte, Fr.; *Römisch-Minzöl*, G.

The volatile oil distilled from Mentha viridis, *Linné* (see p. 973).
Nat. Ord.—Labiateæ.

Preparation.—The fresh herb is distilled in the United States and Great Britain with water or by means of steam; the yield is about ¼ to ½ per cent.

Properties.—It resembles oil of peppermint in color, specific gravity, changes produced by exposure, and behavior to iodine and to polarized light, but differs from it in odor and the slight cooling taste. We have noticed that fresh oil of spearmint usually dissolves clear in all proportions, while old oil yields a turbid solution with more than 3 parts of 80 per cent. alcohol. Its boiling-point, according to Kane, is 160° C. (320° F.). Its odor, like that of oil of peppermint, is preserved for a long time by the addition of 3 or 4 per cent. of alcohol.

Composition.—Gladstone (1863) separated from the oil a hydrocarbon, $C_{10}H_{16}$, and an oxygenated oil, $C_{10}H_{14}O$, to which the odor is due, and which has the density .9515 and boils at 225° C. (437° F.).

Off. Prep.—Aqua menthæ viridis, *U. S.*, *Br.;* Spiritus menthæ viridis, *U. S.*

Medical Uses.—Oil of spearmint is less used than the oils of peppermint and horsemint. It appears to be less powerful than those oils, and may be prescribed in *doses* of from 2 to 5 drops (Gm. 0.10–0.30), diluted with sweetened water or in the form of spirit of spearmint.

OLEUM MORRHUÆ, *U. S.*, *Br.*—Cod-Liver Oil.

Oleum jecoris aselli, P. G.; *Oleum hepatis morrhuæ.*—*Cod oil*, E.; *Huile de morue*, *Huile de foie de morue*, Fr.; *Leberthran*, *Stockfischleberthran*, G.

The fixed oil obtained from the fresh liver of Gadus Morrhua, *Linné*, and of other species of Gadus (Class Pisces; Ord. Teleostia; Fam. Gadidæ).

Origin.—The *common cod*, formerly called Asellus major, inhabits the Northern Atlantic, and is frequently met with on the North American coast on and near the Banks of Newfoundland, where it seems the *hake*, G. Merluccius, *Linné*, s. Merluccius communis, *Cuvier*, *pollack*, G. (Merlangus, *Cuvier*) pollachius, *Linné*, and *haddock*, G. æglifinus, *Linné*, are likewise used to some extent for the same purpose. On the Norwegian coast, according to De Jongh (1843), cod-liver oil is mainly produced from the *dorse*, G. Callarius, *Linné*, but also from the *pollack*, the *coal-fish*, G. (Merlangus, *Cuvier*) carbonarius, *Linné*, the *whiting*, Merlangus vulgaris, *Cuvier*, s. G. Merlangus, *Linné*, and the *ling*, Gadus (Lota, *Cuvier*) Molva, *Linné*.

Preparation.—On the coast of Norway the carefully-cleaned livers are placed in baskets or barrels exposed in a sunny place, where the oil slowly exudes, and is removed and filtered; or the livers are slowly heated in a steam- or water-bath, or sometimes boiled with water, the oil being skimmed off from the surface. (See *Proc. Amer. Phar. Assoc.*, 1876, p. 810.) On the coast of North America cod-liver oil is now generally very carefully prepared. The introduction of ice as a means of preserving has developed the business of transporting codfish fresh to the inland cities during the catching season, from December to March, and likewise that of the proper preparation of cod-liver oil from fresh livers on shore by means of gradually applied steam-heat, whereby the oil is separated from the tissues, the watery portion subsiding; the oil is placed in butts in the cooling-room until it freezes solid, when it is put into canvas bags and expressed; the hard, yellowish residue, consisting of stearin and liver débris, is sold to soapmakers, while the clear oil is bottled or put into dry barrels. (See *Amer. Jour. Phar.*, 1854, p. 1; 1870, p. 214; 1883, p. 471; *Proc. Amer. Phar. Assoc.*, 1875, p. 659.)

Properties.—The purest cod-liver oil is of a pale-yellow color, never quite colorless unless artificially bleached; it is limpid, has a slight odor and taste, and a faint acid reaction; but if prepared at a high temperature, or if the livers are allowed to more or less putrefy, it has a more decided reaction and a pale or darker reddish-brown color, the darkest varieties being transparent only in thin layers, and having a repulsive fishy odor and a bitterish acrid taste. The acridity and fishy smell are less marked in the light-brown oil, and still less in the yellow or white oil, which is nearly bland. At 15° C. (59° F.) the spec. grav. of light cod-liver oil is .920 to .925, of the dark-colored about .930. Cold alcohol dissolves not over 2.5 per cent. from the yellow, but about 6 per cent. from dark-brown, cod-liver oil; boiling alcohol dissolves 1 or 2 per cent. more. Ether, chloroform, and carbon disulphide dissolve it in all proportions; the oil is soluble in 2.5 parts of acetic ether. At a low temperature a granular crystalline deposit is separated, in largest proportion from the darker-colored oil, but good medicinal cod-liver oil should at 0° C. (32° F.) deposit very little or no stearin (*P. G.*). On the addition of sulphuric acid a violet color, soon changing to brown-red, is produced, due to the presence of biliary compounds; the violet color is also produced on shaking a solution of 1 drop of cod-liver oil in 20 drops of carbon disulphide with 1 drop of sulphuric acid, but the color is very transient and becomes pale-red and brownish. Nitric acid colors cod-liver oil purple, afterward violet and brown. In contact with nitrous acid the oil becomes thicker, but does not solidify.

Composition.—Cod-liver oil has been repeatedly analyzed, and found to be a mixture of several glycerides, the principal one being olein, with variable quantities of stearin, palmitin, and myristin, increasing with the darker color. Hopfer de l'Orme (1837) first proved the presence of iodine, which, according to L. Gmelin (1840), was supposed to be in combination with potassium; however, hot and cold water and alcohol fail to extract it, and the precise form in which iodine is present is still unknown. The same may be said of bromine, phosphorus, and sulphur. Chevallier, Donovan, Herberger, Marder, and others did not find iodine in all samples of cod-liver oil; some investigators have found it in the ashes of soap prepared from it, others in the mother-liquor after separating the soap. De Jongh determined its amount to vary between .029 in dark and .040 per cent. in light-brown oil. Mitchell Bird (1882), however, ascertained that 10,000 parts of pale Norwegian oil contained only between .21 and .18 parts; pale Newfoundland oil, .12 parts; and the pale-brown oils, .16 and .14 parts of iodine. Winckler's (1852) statement that glycerin could not be obtained from cod-liver oil, which he regarded as an organic whole containing oxide of propyl, has not been corroborated by other investigators. P. Carles (1882) determined the amount of free acid, calculated as acetic acid, to be 0.01 and 1.80 per cent. in pale and brown cod-liver oils respectively. De Jongh regards the acid reaction of cod-liver oil as being due to butyric and acetic acids, and has recognized the presence in it of several biliary acids and coloring principles, besides *gaduin*, $C_{35}H_{46}O_9$, which is dissolved from the lead soap by ether, and separated with oleic acid by sulphuric acid. By combining with soda, dissolving in alcohol of 30° B., and cooling to the freezing-point of water, the soap is deposited, and gaduin may be obtained on the addition of sulphuric acid; it is dark-brown, brittle, inodorous, tasteless, soluble with a red color in sulphuric acid, and reprecipitated by water. It is probably a derivative of bile. *Gadic acid* is the name given by Luck (1857) to a deposit obtained from a light-brown cod-liver oil; recrystallized from hot alcohol, it fused between 63° and 64° C. (145.4° and 147.2° F.).

Adulterations are very difficult to detect, because the colors mentioned above are but slightly modified by the presence of other oils, and the oils obtained from the livers of some other fishes show similar reactions. Some fish oils, however, are but slightly colored by sulphuric acid; others do not become violet at first, but at once turn brown-red or dark-brown. Such substitutions may be detected by this test. An adulteration with resin, noticed by Böttger in 1858, may be detected by the solubility of the adulterant in alcohol. In other respects the physical properties, as detailed above, still afford the best criterion of the purity and quality of cod-liver oil.

Allied Oils.—Oleum squali.—Shark oil, *E.;* Huile de requin, de selache, *Fr.;* Haileberthran, *G.*—It is made from the liver of the shark, Squalus Carcharias, *Linné*, and one or two allied species, and is the lightest of the fish-oils, its density at 15° C. (59° F.) being .870 to .880. It is light-yellow, has an acrid taste, and remains limpid at −6° C. (21.2° F.).

Oleum rajæ.—Ray oil, skate oil, *E.;* Huile de raie, *Fr.;* Rochenthran, *G.*—It is made from the liver of Raja Batis, *Linné*, and is employed in France and Belgium. The oil is pale- or bright-yellow, neutral, has the spec. grav. .928 at 15° C., a slight fishy odor and taste, and dissolves in 2 parts of ether. It is stated to contain more iodine than cod-liver oil. Oil is also extracted from the liver of the American *stingray*, Pastinaea hastata, *De Kay*.

Fish Oils.—These are in part obtained from different fishes, like the Alosa Menhaden, *Cuvier*, which is caught on the New England coast and yields *menhaden oil*, principally employed in leather-dressing. But among fish oils are also included the so-called *train oils*, obtained from the fleshy parts of different cetacean mammals; the principal ones are:

Oleum ceti.—Sperm oil, *E.;* Huile de cachalot, *Fr.;* Pottfischthran, *G.*—From Physeter macrocephalus, *Linné;* it is yellow or brown-yellow, of spec. grav. .920, and in the cold deposits spermaceti and stearin (see also page 417).

Oleum balænæ.—Whale oil, *E.;* Huile de baleine, *F.;* Walfischthran, *G.*—From Balæna mysticetus, *Linné*, and B. australis, *Desmoulins*, the Greenland or right, and the cape or southern, whale. The oil has a peculiar fishy odor and unpleasant taste, a density of .926, and begins to deposit a sediment at about 10° C. (50° F.).

Dugong Oil, from Halicore Dugong, *Cuvier*, which inhabits the waters of Eastern Australia and the Indian Archipelago, has been used in place of cod-liver oil in Australia.

Pharmaceutical Preparations.—Oleum morrhuæ ferratum has been recommended for some years. Bernbeck (1875) published a process of which the following is an outline: A solution of 1 part of well-dried neutral olive oil soap in 20 parts of hot water is precipitated by the gradual addition of a similar solution of 1 part of ferrous sulphate; the precipitated iron soap is rapidly collected on muslin, washed, and expressed to remove the water. This cake, though oxidizing superficially, will internally retain its whitish color for a long time. 4 parts of this soap are melted, and 96 parts of previously warmed cod-liver oil are added, and the heat continued for half an hour or more. This oil is of a dark-brown color, and contains 1 per cent. of metallic iron, mostly as ferrous oleate. A similar product is obtained by dissolving 1 or 1½ parts of ferric benzoate in 100 parts of cod-liver oil.

Oleum morrhuæ iodatum. Dissolve 1 part of iodine in a little ether, and add 1000 parts of cod-liver oil.

Extract of cod liver is the watery liquid obtained from the livers in preparing the oil, and evaporated; it yields 12½ to 15 per cent. of extract, which is said to consist of biliary constituents 60.6, water 21.8, the remainder being various salts. It was at one time (1866) recommended as a substitute for cod-liver oil.

Physiological Action.—When healthy animals eat cod-liver oil mixed with their ordinary food, it appears to promote their fattening if a moderate proportion is not exceeded. When more is given them, the digestion becomes deranged and their fat acquires a yellow color and a fishy taste. When the oil is rubbed into the shaven skin of dogs the animals appear to be in as good condition as if they had taken the oil internally, and the same evidences of its absorption are found in the bile and in the richness of the chyle in non-nucleated corpuscles. The experiments of Drs. Randolph and Roussel (*Phila. Med. Times*, xiv. 239) show that in 80 per cent. of infants treated by inunction of cod-liver oil a notable increase of fatty matters takes place in the stools. The fattening operation of the oil in man is familiar to every one; in connection with it the blood becomes richer in corpuscular elements, especially of red corpuscles, thereby, in certain cases, producing a morbid excess of nutritive action, which sometimes exhibits itself in hæmorrhage and sometimes in local congestions. When it is given in suitable doses and in appropriate cases it improves the appetite and digestion, but if taken in excess of the powers of assimilation, and too long continued, it impairs the appetite, renders the tongue foul, excites heartburn, rancid eructations, and even vomiting and diarrhœa, while itching of the skin and a papular eruption are produced, and the perspiration exhales a fishy smell.

Cod-liver oil is essentially a fat-producing agent, and thereby it retards the waste of nitrogenous tissues which is a characteristic of the diseases in which it is most serviceable. In this connection it should be borne in mind that among the various agents vaunted from time to time as remedies for consumption the most efficient have been oils and fats—*e. g.* asses' milk, cream, butter, fat pork, buffalo marrow, etc. But cod-liver oil has the advantage over all of these articles that it excels them in digestibility. On what the latter quality depends is not fully determined, but the most plausible opinion is that it is due to the portion of biliary matter which the oil holds in solution. It has been shown experimentally that different oils vary extremely in their diffusibility through membranes, and that cod-liver oil is six or eight times more diffusible than other oils, vegetable or animal. Such appears to be the simple fact, but the explanation of it is not easy. It has been ascribed to the presence in the oil of a certain proportion of bile, and it is asserted that when this bile is removed the oil loses its diffusibility in the same proportion. But, on the other hand, it is alleged that the process employed to remove the bile has not really that effect, but eliminates certain other constituents of the oil. However this may be, no more satisfactory theory has been proposed. Moreover, this view is corroborated by the experiment in which an animal with a biliary fistula became more and more emaciated as long as it used only its ordinary food, but regained flesh and strength when a due proportion of cod-liver oil was added.

Medical Uses.—From time immemorial cod-liver oil was used as a popular remedy for chronic gout and rheumatism, rickets, and scrofula in Great Britain and the countries bordering on the German Ocean, but it was not until about 1841 that it became generally known and used as a remedy for pulmonary consumption. The enthusiasm which inevitably attends the introduction of a new medicine of real efficacy exaggerated the benefits conferred by cod-liver oil in these several diseases, but time and well-considered experience have nevertheless proved it to be a valuable remedy. Its curative powers in *chronic rheumatism* have been strikingly shown in cases of that disease prolonged by a cachectic state of the system—cases in which the muscles grow rigid and the joints stiff, and when to the debilitating influence of these infirmities is added the influence of dampness, crowding, bad ventilation, and coarse and insufficient food, especially in persons of an originally scrofulous constitution. In regard to *scrofula* itself, the medicine is singularly efficacious when the disease affects the internal lymphatic glands and the bones under the bad hygienic conditions just enumerated. Yet it is by no means to be depended upon in cases of supposed mesenteric disease—not only because the enlargement of the abdomen which is thought to indicate its existence in children is commonly a result of splenic or hepatic disorder, but, still more, because true *tabes mesenterica* is most apt to be associated with incurable tuberculosis of the intestines. It is of little use in scrofulous enlargement of the parotid, thyroid, and submaxillary glands, or of the glands of the neck, axillæ, and groins; but its efficacy is seen in the cure of the ulcers left after the discharge of softened scrofulous matter from these parts. Its utility in *scrofulous ophthalmia* is far from being established; at least one-half of the cases receive no benefit from it. It is a more valuable remedy in all forms of idiopathic *strumous caries*, especially when it affects the epiphyses of the long bones; and it is still more evidently beneficial in *rachitis*. In the treatment of *white swelling* and other forms of *chronic arthritis*, and of *fistulæ* and *abscesses* in the neighborhood of joints, its powers are sometimes signally displayed. The various diseases of the skin to which scrofulous persons are peculiarly liable are often most favorably influenced by this medicine. Among them, *lupus vulgaris* is reputed to have been cured by it more frequently than by any other internal remedy, while some high authorities declare that no cure of existing lupus ever results directly from any kind of internal treatment whatever. It is true also that even when given for this disease it is generally associated with other and active medicines. In other scrofulous diseases of the skin, and especially of the scalp, this oil appears to have been used with success both internally and topically. Such diseases are *impetigo*, *chronic eczema*, *psoriasis*, and *favus*. Even *ichthyosis* is said to have been cured by similar means.

The great success which cod-liver oil at one time was believed to have gained as a cure for *pulmonary consumption* has tended more than any other cause to maintain the reputation of the medicine. It is now determined that it exerts little if any direct influence upon the structural elements of that disease, and that it can be said to cure only those rare cases in which other and especially hygienic methods have also restored consumptive patients to apparently good health. Such are the cases in which the patient is of a sluggish, lymphatic temperament, and in which the tubercular deposit is strictly limited to a small portion of one lung. The efficiency of the medicine is much more notable when a cavity is already formed than when the deposit is in a crude state. It plainly acts by maintaining the general health of the system while the local disease undergoes retrogression, for it constantly happens that although the latter process fails to occur, but on the contrary the destruction of the lung advances, yet the patient for a time gains weight and strength. In the more favorable examples the symptoms which depend upon the local lesion are mitigated, and even suspended, such as fever, sweating, cough, and expectoration. Yet in proportion as these symptoms prevail the oil fails to do good or is not tolerated. Although cod-liver oil is no longer claimed to be a cure for consumption, it still remains incomparably the most efficient medicine in prolonging the lives of the victims of this disease, and enabling them to take advantage of the hygienic measures upon which the main reliance must be placed. *Chronic bronchitis*, which is so apt to be mistaken for tubercular phthisis, is often signally benefited by this medicine and by the same mode of action. A like remark is applicable to numerous diseases of the *nervous system* due to or maintained by an exhausted condition of its functions.

In all diseases its use is contraindicated when it cannot be retained by the stomach or when it is not well digested, but causes eructation, heartburn, diarrhœa, etc., and generally when fever is present.

Administration.—The average *dose* of cod-liver oil is a tablespoonful (Gm. 15) three times a day an hour or two after meals. It is better to begin with half of this quantity. Various means have been employed to disguise the taste and smell of the oil and render it acceptable to the stomach. These means are generally superfluous among children, who often become fond of the medicine, and also among persons whose taste is not fastidious. The use of ether, naphtha, peppermint, and similar agents is objectionable, since they become volatilized in the stomach and renew the taste of the oil by eructation. Less apt to produce this effect is alcohol in the form of some distilled spirit, with which the mouth should first be washed, after which the oil, floating upon another portion of the liquor, may be rapidly swallowed. Malt liquor which froths readily is an excellent article for enveloping the oil and concealing its taste. Floated on iron-rust water, with some of which the mouth and fauces have just been washed, is another available means of effecting the same purpose. But the best of all is chewing a small fragment of smoked herring. As acid condiments are eaten with fishy food, so it has been proposed to administer cod-liver oil with a modicum of walnut or tomato catsup. The various emulsions made for concealing the taste of the oil become more objectionable to most patients than the oil itself; they are also too bulky, by reason of the proportion of the excipient they require. When the stomach tends to reject the oil this effect can sometimes be prevented by preceding each dose by one of a solution of cyanide of potassium containing not more than ⅛ grain (Gm. 0.008) of the cyanide. But the possible dangers of the misuse of this solution forbid its ordinary employment. It is better, as well as safer, to swallow a tablespoonful of lime-water or 5 or more grains (Gm. 0.30) of subnitrate or subcarbonate of bismuth a few minutes before the oil is taken. The oil has sometimes been mixed with arrowroot or with spermaceti, forming a bolus which may be taken enclosed in a wafer.

"*Oolachan*" oil, derived from a small fish that is caught on the north-western coast of North America, is said to form an efficient substitute for cod-liver oil.

OLEUM MYRCIÆ, *U. S.*—Oil of Myrcia.

Oil of bay, E.; *Essence de myrcie* (*de bay*), Fr.; *Myrcienöl*, *Bayöl*, G.

The volatile oil distilled from the leaves of Myrcia acris, *De Candolle*, s. Myrtus (Eugenia, *Wight et Arnott*, Pimenta, *Wight*, Amomis, *Berg*) acris, *Swartz*. Bentley and Trimen, *Med. Plants*, 110.

Nat. Ord.—Myrtaceæ.

Origin.—This medium-sized tree is known as *wild clove*, *wild cinnamon*, and *bayberry*, and is indigenous to the West Indies and Venezuela. The quadrangular branches bear opposite, shortly-petiolate, coriaceous, broadly oval, nearly obtuse, entire, strongly-veined, and pellucid-punctate leaves, which are about 3 inches (75 Mm.) long, and when bruised exhale an agreeable aromatic odor, somewhat similar to cloves. The flowers are small, reddish, and stalked; the fruit is a globular-ovoid smooth berry, resembling allspice. Much of the oil and the spirit (bay rum), particularly the latter, are now distilled in the United States, about 200 pounds of the oil being annually imported.

Preparation.—The leaves are distilled with water or by the aid of steam; at first a light oil, floating upon water, comes over, afterward an oil heavier than water; the light and heavy fractions, united, constitute the commercial oil. The yield is very variable (Markoe, 1877).

Properties.—Oil of myrcia recently distilled is of a light-brownish color, but becomes darker on exposure. It has an aromatic odor, resembling that of cloves and allspice, but more fragrant, and a warm, pleasantly spicy taste. Its specific gravity is about 1.040. It dissolves in alcohol in all proportions, the solution having a slight acid reaction. Strong potassa solution converts it into a crystalline mass of potassium eugenate. Sulphuric acid produces a red, afterward brown, color; iodine dissolves quietly in the oil; strong nitric acid causes a violent reaction.

Composition.—Prof. Markoe (1877) showed the oil to be a mixture of a hydrocarbon having at 15.5° C. (60° F.) the specific gravity .8356, and of eugenol, spec. grav. 1.055. L. C. Pettit (1880) obtained 41 per cent. of eugenol, which gave a crimson-red color with sulphuric acid. (For accounts of this volatile oil see *Amer. Jour. Phar.*, 1861, p. 297, and *Proceedings of Amer. Phar. Assoc.*, 1877, p. 435.)

Off. Prep.—Spiritus myrciæ, *U. S.*

Uses.—This oil is chiefly used as a perfume, and especially as an ingredient of bay rum (*Spiritus myrciæ*).

OLEUM MYRISTICÆ, *U. S., Br.*—Oil of Nutmeg.

Oleum nucistæ æthereum.—*Volatile oil of nutmeg*, E.; *Essence de muscade*, Fr.; *Ætherisches Muskatöl*, G.

The volatile oil distilled from the seed of Myristica fragrans, *Houttuyn*.

Nat. Ord.—Myristicaceæ.

Preparation.—Ground nutmegs are distilled by the aid of steam. The yield is between 2 and 3 per cent., but selected nutmegs yield sometimes as much as 8 per cent. Cloëz (1864) suggested exhaustion with carbon bisulphide and distilling the extract by means of steam.

Properties.—The oil is colorless or pale-yellowish, limpid, of specific gravity .92 to .95, of an agreeable aromatic odor, a warm somewhat camphoraceous taste, and dextrogyre to polarized light. It is readily soluble in alcohol, commences to boil at 160° C.

(320° F.), fulminates when brought into contact with iodine, is energetically acted on by nitric acid, becomes dark-red with Fröhde's reagent, and violet by hydrochloric acid (Dragendorff, 1877).

Composition.—The most volatile portion, after treatment with sodium, was found by Cloëz to be a left-rotating hydrocarbon, $C_{10}H_{16}$, having the odor of nutmeg and of lemon, and boiling at 165° C. (329° F.). It is the *myristicene* of Gladstone (1872), who named the oxygenated portion *myristicol*, $C_{10}H_{14}O$; this is dextrogyre, boils at 224° C. (435° F.), and does not, like menthol and carvol, yield a crystalline compound with H_2S. The *nutmeg camphor* of John (1821) or *myristicin* of Gmelin, which separates sometimes on standing, was ascertained by Flückiger (1874) to be myristic acid. (See below.)

Off. Prep.—Pil. aloes Socotr., Spirit. ammon. aromat., *Br.;* Spir. myristicæ, *U. S.*, *Br.*

Medical Uses.—Oil of nutmeg is seldom used in medicine; it may be employed for the same purposes as nutmeg in *doses* of 2 or 3 drops (Gm. 0.10–0.15).

OLEUM MYRISTICÆ EXPRESSUM, *Br.*—Expressed Oil of Nutmeg.

Oleum nucistæ, P. G.; *Adeps (Butyrum) myristicæ, s. nucistæ.*—*Nutmeg butter*, E.; *Beurre de muscade*, Fr.; *Muskatnussöl*, *Muskatbutter*, G.

Preparation.—This fixed oil is obtained in the East Indies by beating nutmegs into a paste, which is expressed between heated plates. The yield is about 28 per cent., and the annual importation into the United States is usually between 300 and 500 pounds; in 1880 it was 1964 pounds. The oil is incorrectly called *oil of mace.*

Properties.—It is found in commerce in the shape of blocks about 2½ inches (6 Cm.) thick and 10 inches (25 Cm.) long, and is wrapped in palm-leaves. It is solid and firm, unctuous to the touch, of a mottled appearance, orange-brown and whitish in color, of specific gravity .995, and has the fragrance and aromatic but bland taste of nutmegs. It melts at about 45° C. (113° F.), and is soluble in 2 parts of warm ether and 4 parts of boiling strong alcohol (Lecanu).

Constituents.—Cold alcohol dissolves about 6 per cent. of volatile oil (see above) and 24 per cent. of fat, accompanied by brown-yellow resinous matter, which has not been further examined. The remaining pulverulent white fat is *myristin*, $C_3H_5(C_{14}H_{27}O_2)_3$, which crystallizes from hot alcohol or ether and fuses at 31° C. (87.8° F.). Heintz (1854) found the melting-point of *myristic acid* at 53.8° C. (128.8° F.). Schmidt and Rœmer (1883) found 3 to 4 per cent. of free myristic acid, with a little stearic acid.

Adulterations.—Artificial mixtures made from animal fats are not soluble in the same amount of hot alcohol, and the portion insoluble in cold alcohol would be more or less greasy. "On warming 1 part of nutmeg butter with 10 parts of alcohol a solution should be obtained which, after cooling and filtering, is clear and pale-yellow, and with the addition of ammonia should become brownish, but not red (turmeric); ferric chloride should color the solution merely dingy-brown."—*P. G.*

Ceratum myristicæ, s. Balsamum nucistæ, *P. G.* Melt together yellow wax 1 part, olive oil 2 parts, and expressed oil of nutmeg 6 parts; pour into paper capsules and cut into square cakes.

Off. Prep.—Emplast. calefaciens, Empl. picis, *Br.*

Allied Fats.—Becuiba Tallow is expressed from the seeds of Myristica Becuhyba, *Schott*, s. M. officinalis, *Martius*, which is indigenous to Brazil. The fat resembles the officinal article, but has a sharp acidulous taste, melts at 47° C. (116.6° F.), and on treatment with cold absolute alcohol leaves 45 per cent. of yellow pulverulent residue undissolved.

Otoba Butter is prepared from Myristica Otoba, *Humboldt et Bonpland*, indigenous to Northwestern South America. It is yellowish, becomes brown by age, melts at 38° (100.4° F.), and has then an unpleasant odor. Its myristin melts at 46° C. (114.8° F.), and contains *otobit*, which is sparingly soluble in cold alcohol, crystallizes in colorless, inodorous, and tasteless prisms, and melts at 133° C. (271.4° F.) (Uricoechea, 1854).

Virola Tallow, Ocuba Wax, is prepared from Virola (Myristica, *Swartz*) sebifera, *Aublet*, indigenous to Guiana. The fat is yellowish, somewhat crystalline, completely soluble in alcohol, and melts at 45° to 50° C. (113°–122° F.).

Medical Uses.—Oil of nutmeg is sometimes used for the friction of *rheumatic* parts, but chiefly as a bland and smooth fatty substance that does not easily grow rancid, and is therefore suitable as an excipient of more active topical medicines.

OLEUM OLIVÆ, *U. S., Br.*—OLIVE OIL.

Oleum olivarum, P. G.—*Sweet oil*, E.; *Huile d'olive*, Fr.; *Olivenöl*, G.

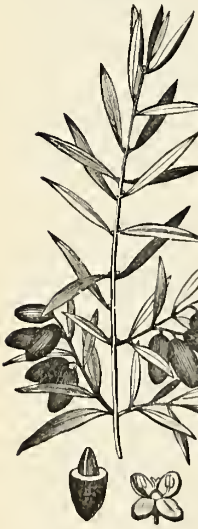
The fixed oil expressed from the fruit of Olea europæa, *Linné*. Woodville, *Med. Bot.*, t. 98; Bentley and Trimen, *Med. Plants*, 172.

Nat. Ord.—Oleaceæ.

Origin.—In its wild state the olive is almost shrubby, much-branched, and thorny, but under cultivation it is a medium-sized tree 30 or 40 feet (9–12 M.) high. It is indigenous to Western Asia, particularly Syria, and has been cultivated for a long time in the countries bordering on the Mediterranean. It has been introduced into the Southern United States, California, and several South American and other countries. The tree has evergreen, opposite, shortly-petiolate leaves, which are about 2 inches (5 Cm.) long, lanceolate, acute at both ends, entire and revolute on the margin, and densely scaly, silvery gray, brownish- or glaucous-green beneath. The numerous small white flowers are in axillary racemes, diandrous, have a two-celled and four-ovuled superior embryo, and produce a purplish-black ovate drupe about an inch (25 Mm.) long, with a greenish, firm sarcocarp and an obliquely oblong keeled putamen containing a single albuminous seed.

The leaves and bark have been employed in France as a febrifuge. De Luca (1861, etc.) found the leaves and green fruit to contain mannit, which diminishes in the latter as the fruit ripens, and disappears entirely when it becomes perfectly ripe. It contains then the largest amount of oil, equal in weight to nearly 70 per cent. of the sarcocarp.

FIG. 198.



Olea europæa, *Linné*.

Preparation.—The finest quality of olive oil is obtained by crushing the recently-collected ripe olives in a suitable mill to a pulpy mass, care being taken in some districts not to break the putamen containing the seed; the pulpy mass is then subjected to moderate pressure, the oil, called *virgin oil* (Huile vierge, *Fr.*; Jungfernöl, *G.*), being collected in cisterns containing water, from the surface of which it is subsequently skimmed. The press-cakes are afterward thoroughly mixed with water and the marc again expressed, using an increased pressure, whereby a second quality of oil is obtained; in some places cold water is first used for softening the press-cakes, and is followed by hot water. However, with the improvements in the construction of powerful presses this portion of the process is much simplified, and a larger yield of oil of fine quality is obtained. The oil still remaining in the marc is said to amount to between 9 and 12 per cent., and is extracted by means of carbon disulphide; or the marc is thrown into cisterns, which in Southern France are called *enfer*, and where an oil called *huile d'enfer*, having a disagreeable odor, separates upon the water. A larger amount of oil, but much inferior in quality, is yielded by expressing olives which have been kept in heaps and undergone a kind of fermentation; this oil is known in France as *huile fermentée*; and a still more inferior oil is prepared by again mixing the residue with boiling water and expressing. Though the seeds have a bitterish taste, Flückiger found the oil to be quite bland, to be a non-drying oil, and, if extracted with the oil of the fruit, to constitute about one-fortieth of the latter.

Olive oil enters commerce put up in bottles of various sizes, also in stone jugs and in barrels. The importation of olive oil into the United States amounts annually to over 400,000 gallons, fully three-fifths of which quantity is *salad oil.*

Properties.—Olive oil is a pale-yellow or greenish-yellow oily liquid, having a neutral reaction, a slight agreeable odor, and a bland taste, leaving, even in its freshest condition, a slight sense of acridity (*Pharmacographia*), which is somewhat increased on keeping. Its specific gravity at 15° C. (59° F.) is 0.9178, or between 0.915 and 0.918 (*U. S., P. G.*). At and below 10° C. (50° F.) olive oil separates white crystalline granules; near 2° C. (35.6° F.) it is of a butyraceous consistence; and it congeals completely at or below the freezing-point of water, yielding, however, by strong pressure, from 67 to 72 per cent. of liquid oil, which remains fluid at − 10° C. (14° F.), and is nearly pure *olein.* The solid portion fuses between 20° C. (68° F.) (Pelouze and Boudet) and 28° C. (82.4° F.) (Lecanu), and is easily soluble in ether. Olive oil is sparingly soluble in alcohol, freely soluble in ether, soluble in all proportions in chloroform, benzol, benzin, and carbon disulphide, and in about 5 parts of acetic ether. It does not readily become rancid, and belongs to the non-drying oils. When heated to 120° C. (248° F.) it becomes lighter, and at 220° C. (428° F.) nearly colorless, and at the same time rancid; it commences to boil at about 315° C. (600° F.).

Inferior qualities of olive oil are of a deeper hue, become cloudy, and congeal more easily, have a more decidedly acrid after-taste, and turn rancid on exposure.

The German Pharmacopœia recognizes two qualities of olive oil—the one intended for internal use and for ointments, the other used for the preparation of plasters:

OLEUM OLIVARUM, s. OLEUM PROVINCIALE.—Best olive oil, *E.;* Huile d'olive fine, *Fr.;* Provenceröl, *G.*—It is the oil described above.

OLEUM OLIVARUM COMMUNE.—Olive oil, *E.;* Huile d'olive ordinaire, *Fr.;* Baumöl, G.—This is the second quality of salad oil, has a brownish-yellow or green-yellow color, and, except a somewhat less pleasant odor and taste, agrees with the preceding.

Composition.—The liquid portion is *triolein* (olein), $C_3H_5(C_{18}H_{33}O_2)_3$, and is identical with the liquid portion of most non-drying fats, as far as they have been examined. The solid part was called *margarin* by Chevreul, which was proven by Heintz (1852) to be a mixture containing chiefly *palmitin.* Palmitic acid, $C_{16}H_{32}O_2$, was obtained from olive oil by Collett (1854), and also by Heintz and Krug (1857), who likewise isolated *arachic* (*butinic*) *acid*, $C_{20}H_{40}O_2$, and probably stearic acid. On saponification glycerin is obtained. The fats composing olive oil are, therefore, triolein, tripalmitin, triarachin, and possibly tristearin. Beneke (1862) announced also the presence of a small quantity of *cholesterin*, $C_{26}H_{44}O$, which is soluble in alcohol (see page 670).

Adulterations.—Olive oil is frequently adulterated with other bland oils, some of which are occasionally even substituted for it. The determination of its purity has been the subject of much research, but from the chemical identity of the constituent compounds of many oils, and the natural variation of their relative proportions in the same fat, it is evidently attended with many difficulties. A higher specific gravity than given above points to an admixture of other fats. The detection of drying in non-drying oils, and the testing by means of sulphuric acid, etc., have been described above.

Tests.—The Pharmacopœia gives the following: "If 1 part of olive oil be agitated in a test-tube with 2 parts of a cold mixture prepared from equal volumes of strong sulphuric acid and of nitric acid of sp. gr. 1.185, and the mixture be set aside for half an hour, the supernatant oily layer should not have a darker tint than yellowish (a dark color indicating the presence of other fixed oils)."—*U. S.* Olive oil remains pale-yellow or becomes greenish; benne oil turns reddish or red; sunflower oil, orange-yellow; ground-nut oil, reddish-brown; cotton-seed oil, dark-red. "If 1 Gm. of the oil be shaken for a few seconds with 1 Gm. of a cold mixture of sulphuric acid (sp. gr. 1.830) and nitric acid (sp. gr. 1.250) and 1 Gm. of disulphide of carbon, no green or red layer should separate on standing."—*U. S.* Foreign oils give the tints mentioned above. "If 12 parts of the oil be shaken frequently, during 2 hours, with 1 part of a freshly-prepared solution of 6 Gm. of mercury in 7.5 Gm. of nitric acid (sp. gr. 1.420), a perfectly solid mass of a pale straw-color should result."—*U. S.* "If 15 parts of olive oil be well shaken with 2 parts of water and 3 parts of fuming nitric (nitroso-nitric) acid, the mixture should be whitish, not red or brown (oils of ground-nut, benne-seed, and cotton-seed), and in one or two hours should separate into a slightly-colored liquid and a white solid mass."—*P. G.* The elaidin test is conveniently applied in the manner described under OLEA PINGUIA, where also the result with different oils is stated and the colors produced by sulphuric acid and other reagents. "If 5 drops of the oil are let fall upon a thin layer of sulphuric acid in a flat-bottomed capsule, no brown-red or dark-brown zone should be developed within 3 minutes at the line of contact of the two liquids (absence of appreciable quantities of other fixed oils of similar physical properties)."—*U. S.* "If 5 drops of the oil be well agitated with 15 drops of nitric acid spec. grav. 1.38, neither the acid nor the oily mass should acquire a red color (oils of benne, cotton-seed, etc.)."—*P. G.*

According to Cailletet (1877), the greenish color is occasionally produced by the presence of copper, in which case the oil will be colored brown on being agitated with an ethereal solution of pyrogallic acid.

Pharmaceutical Uses.—OLEUM CHLORINATUM, *Chlorinated oil*, is prepared by Dr. L. Wolff by passing chlorine gas into olive oil; it is a yellowish oil, and has been used in itch and other cutaneous diseases. According to Lefort (1852, 1853), olive oil, thus treated, contains chlorine substitution-products, the *chloroleic acid* having the formula $C_{18}Cl_2H_{32}O_2$, a brown color, the specific gravity 1.082, and containing 20.6 per cent. of chlorine.

Olea cocta, Olea infusa.—Oleoinfusions, Oleols, *E.;* Oléolés, Elæolés, Huiles médicinales, *Fr.;* Gekochte Oele, *G.*—These preparations were formerly much employed in Europe, and several of them have retained a place in the French Codex. They are made from herbs or flowers, either aromatic or narcotic, by digesting 1 part of the dry drug in 10 parts of olive oil, or by boiling 1 part of fresh narcotic herb in 2 parts of olive oil until the moisture has been dissipated. Ointment of stramonium was formerly prepared in a similar manner.

Off. Prep.—Cataplasma lini, *Br.;* Ceratum camphoræ, Cerat. cetacei, *U. S.;* Charta cantharidis (epispastica), Empl. plumbi, *U. S.*, *Br.;* Enema magnes. sulphat., *Br.;* Unguentum diachylon, *U. S.;* and several plasters, liniments, and ointments, *Br.*

Medical Action and Uses.—From time immemorial olive oil formed an important article of food in countries where the olive tree flourishes, and was used as butter is elsewhere. In the *dose* of 1 or 2 ounces it acts as a very mild laxative, but it is seldom administered for this purpose except to infants, for whom a sufficient dose is a teaspoonful. It has been used as an antidote to the poisonous effects of *cantharides*, and is probably efficient by protecting the stomach, as well as by occasioning vomiting, notwithstanding the theoretical objection that cantharidin is soluble in sweet oil. It has been extensively and efficiently employed by workmen in white-lead factories to keep the bowels free and prevent the absorption of the metal. A notion has been entertained that large doses of olive oil were capable of causing the discharge of *gall-stones*, and in proof of the statement a great number of bodies resembling these concretions has been found in the stools. On examination, however, they were found to consist of the partially saponified oil (*Boston Med. and Surg. Jour.*, Sept. 1881, p. 261). It is used in some places in Europe to prevent the poisonous effects of *vipers' bites*, both internally and locally, and by the latter method it is familiarly applied to allay the swelling and pain of *insects' bites and stings.* It is often poured into the *auditory canal* to destroy insects concealed therein, and large doses of it have been known to kill and expel a *tænia.* Externally, it is a convenient and efficient protective and lenitive for superficial *wounds, excoriations, burns, bruises*, and *sprains.* In the two last-mentioned injuries it should be applied warm, and in them also it affords a convenient vehicle for the application of camphor, morphine, and various other anodynes or stimulants. The same is true in regard to several local inflammations, especially *earache.* With lime-water it forms the liniment so useful in burns (*Linimentum calcis*). Anciently, the custom of anointing the body with oil was practised, as it still is in Oriental countries, after warm bathing, and also as a protective against the plague. It is now occasionally used to moderate excessive *sweating.* Warm oil is a soothing and efficient application, when made with appropriate pressure or friction, in lessening the pain and swelling of enlarged glands, particularly when they are actively engorged, as the *mammæ* during pregnancy and after parturition. It is sometimes injected into the rectum in *dysentery* and to destroy rectal *ascarides* (oxyures), and it is habitually employed to facilitate the introduction of *sounds, catheters, bougies, specula, pessaries*, etc. into the natural cavities of the body. It was an old custom to dip cutting surgical instruments in oil before incising the flesh.

The *dose* of olive oil as a laxative is 1 or 2 fluidounces (Gm. 32–64) for adults, and for infants 1 or 2 fluidrachms (Gm. 4–8).

OLEUM PALMÆ.—Palm Oil.

Huile (Beurre) de palme, Fr.; *Palmöl, Palmbutter*, G.

From the fruit of Elæis guineensis, *Jacquin.*

Nat. Ord.—Palmæ.

Origin.—The oil-palm is a tall tree indigenous to Western Africa and introduced into other tropical countries. It has large pinnate leaves with spiny petioles and long narrow linear leaflets. The fruit is a yellow mottled drupe about an inch (25 Mm.) long, and contains a leathery very oily sarcocarp, from which the fat is obtained by pressure or by boiling with water. The kernel yields likewise a bland oil which is white and melts at 25° C. (77° F.). Nearly 917,000 gallons of palm oil were imported into this country in the year 1876–77, and nearly 1,250,000 gallons in 1882.

Properties.—Palm oil is solid at low temperatures, butyraceous, of a reddish-yellow color, and when fresh of an agreeable violet-like odor, and fuses at 27° C. (80.6° F.). On keeping, it becomes lighter in color and acquires a rancid odor, a portion of the fat being decomposed into free acids and glycerin, the fusing-point rising at the same time, sometimes to 42° C. (107.6° F.). When rapidly heated to 240° C. (464° F.) it is bleached. It is partly soluble in alcohol, but entirely so in ether. Its specific gravity is .945.

Composition.—It consists chiefly of tripalmitin and triolein, and contains a peculiar ferment, inducing its decomposition. It is largely used in the preparation of soap; and to obtain the latter white, the oil is bleached by treating it with a solution of potassium bichromate and adding sufficient sulphuric and hydrochloric acids to form potassium sulphate and chromic chloride.

Other Palm Oils.—(See also OLEUM COCOS.) MACAJA BUTTER, obtained from the seeds of Cocos aculeata, *Jacquin*, of tropical America, has a yellowish color and a violet-like odor.

TUCUM OIL, from the fruit of Astrocaryum vulgare, *Martius*, of South America, has a bright-red color and an agreeable odor.

Medical Action and Uses.—Palm oil has hardly any peculiar virtues to distinguish it from other vegetable fats, except that it is less drying and more emollient. It is supposed to be especially adapted for bathing *bruises* and *sprains*. Its agreeable odor recommends it.

OLEUM PHOSPHORATUM, *U. S., Br., F. Cod.*—PHOSPHORATED OIL.

Huile phosphorée, Liniment phosphoré, Fr.; *Phosphorhaltiges Oel*, G.

Preparation.—Phosphorus 1 part (9 grains); Stronger Ether 9 parts (81 grains or 2 fluidrachms); Expressed Oil of Almond a sufficient quantity; to make 100 parts (900 grains). Introduce a sufficient quantity (about 3 fluidounces) of expressed oil of almond into a flask, heat it on a sand-bath to 250° C. (482° F.), and keep it at that temperature for 15 minutes. Then allow it to cool, and filter it. Put 90 parts (810 grains or 15½ fluidrachms) of the filtered oil, together with the phosphorus, previously well dried by blotting-paper, into a dry bottle capable of holding somewhat more than 100 parts; insert the stopper, and heat the bottle in a water-bath until the phosphorus melts; agitate it until the phosphorus is dissolved, allow it to cool, and add the ether. Lastly, transfer the solution to small glass-stoppered vials, which should be completely filled and kept in a cool and dark place.—*U. S.*

The process of the British Pharmacopœia differs from this in heating the almond oil only to 149° C. (300° F.), and in directing 16 grains of phosphorus to be dissolved in 4 fluidounces (Imperial) of the oil at a temperature of about 82° C. (180° F.). The U. S. P. has adopted Méhu's process (1868), who, however, directs heating the oil for 15 minutes to 150° C. (302° F.), and then to raise the heat for 10 minutes to 250° C. At first, air and moisture are given off; afterward certain organic matters are volatilized or destroyed; the oil becomes nearly colorless, and on cooling separates a little flocculent matter, which is separated by filtration. A piece of translucent phosphorus is then weighed out, well dried, and dissolved as directed. The French Codex directs phosphorus 1 Gm., almond oil 95 Gm., ether 4 Gm. The oil contains 1 per cent. (*U. S.*, *F. Cod.*), (.99 per cent. *Br.*) of phosphorus, the solubility of which in fixed oils is generally stated to be 1 in 100. According to Dr. Squibb (1876), phosphorus should be dissolved in oil only in an atmosphere of carbonic acid gas, and at once transferred into small dry and well-stopped bottles; he recommends to thus prepare a solution of well-dried phosphorus 1 part in cod-liver oil 99 parts.

Properties. Phosphorated oil is a clear yellowish oil having the odor of phosphorus and of ether, the presence of which prevents phosphorescence in the dark. The phosphorated oil of the British Pharmacopœia is strongly phosphorescent, and produces white vapors in contact with air, due to the oxidation of phosphorus.

Medical Action and Uses.—In so far as phosphorus is useful as a medicine it may be conveniently administered in this oil, which contains 3 grains of phosphorus in each fluidounce, and may be prescribed in the *dose* of from 5 to 10 minims (Gm. 0.30–0.60). It is very convenient as an addition to cod-liver oil in cases of *scrofula*, *chronic phthisis*, *paralysis* without central lesion of substance, *sexual debility*, and diseases referred to under PHOSPHORUS.

OLEUM PICIS LIQUIDÆ, *U. S.*—OIL OF TAR.

Huile (Essence) de goudron, Fr.; *Theeröl*, *Pechöl*, G.

A volatile oily liquid distilled from wood-tar.

Preparation.—Wood-tar is subjected to distillation, and that fraction of the distillate which is lighter than water collected by itself. (See Creasotum, p. 513, and Pix Liquida.)

Properties.—Oil of tar, recently distilled, is colorless, but gradually darkens, becoming yellowish, brownish, and dark red-brown, and depositing a black product. The oil has a strong tar-like odor and taste, an acid reaction, and a density of about .970; these properties are, however, subject to variation from differences in the composition of the tar.

Composition.—The oil is a mixture of various hydrocarbons, of acetic and *other acids*, and of undetermined empyreumatic products present in tar; prepared from tar of coniferous woods, the oil consists largely of oil of turpentine.

Action and Uses.—This preparation has the same action as tar itself, and, like it, is used largely in the treatment of squamous and some other *diseases of the skin*. In Europe the oil of cade, obtained from Juniperus oxycedrus, is held in higher esteem than oil of common tar. Oil of tar may be applied directly to the affected part, more or less diluted with some bland oil, or in an ointment. It has the advantage over tar ointments of being less unsightly and less destructive to clothing.

OLEUM PIMENTÆ, *U. S., Br.*—Oil of Pimento.

Essence de piment de la Jamaïque, Fr.; *Pimentöl, Nelkenpfefferöl*, G.

The volatile oil distilled from the fruit of Eugenia Pimenta, *De Candolle* (nat. ord. Myrtaceæ).

Preparation.—Allspice is ground, and then distilled with water or by means of steam, the volatile oil coming over usually in two fractions—a lighter and a heavier one, which are mixed. The average yield appears to be about 4 per cent., but is often much lower. Bonastre (1827) states that the seeds contain 5 per cent. and the remaining part of the fruit 10 per cent. of volatile oil.

Properties.—Oil of pimento is colorless or pale-yellow, becoming darker and thicker by age. Gladstone (1872) gives its specific gravity as 1.0374 at 10° C. (50° F.). In taste and in behavior to solvents and chemicals, (alcohol, test-paper, ferric chloride, potassa, iodine, etc.) it closely resembles oil of cloves; its odor, however, is more pleasant.

Composition.—Gladstone has corroborated the observation of Bonastre concerning the presence of *eugenic acid* and the close similarity of this oil to oil of cloves. L. C. Pettit (1880) obtained 61 per cent. of *eugenol*, which became red, and afterward purple, with sulphuric acid.

Medical Uses.—The oil of pimento is used for the same purposes, local and general, as other aromatic stimulants. The *dose* is from 2 to 6 drops (Gm. 0.10–0.30).

OLEUM RICINI, *U. S., Br.*—Castor Oil.

Oleum Palmæ Christi.—Huile de ricin, Fr.; *Ricinusöl*, G.

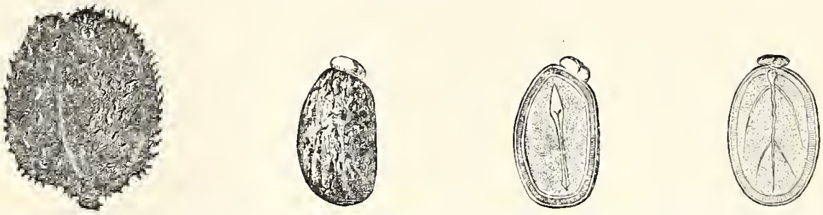
The fixed oil expressed from the seeds of Ricinus communis, *Linné. Bot. Mag.*, plate 2209; Bentley and Trimen, *Med. Plants*, 237.

Nat. Ord.—Euphorbiaceæ.

Origin.—The castor-oil plant appears to be indigenous to Southern Asia, but was early introduced into all tropical and subtropical countries, in many of which it has become naturalized, attaining in the tropics the size of a tree 30 to 40 feet (9–12 M.) high. It is often cultivated in temperate countries for ornament and other purposes, remaining an annual, varying in size from 4 to 14 feet (1.2–4.2 M.). Numerous varieties are now known, differing from one another in size and color of the stem and foliage, as well as of the fruit and seeds. The leaves are alternate, peltate, palmately seven- or nine-lobed; the inflorescence is paniculately spicate, terminal, finally axillary; the flowers are monœcious, apetalous, the staminate ones at the base of the panicle. The fruit is a subglobular, somewhat triangular, and grooved tricoccous capsule, which is sometimes nearly smooth, but mostly spinescent; each cell encloses a single oval or elliptic seed, which is from $\frac{1}{3}$ to $\frac{2}{3}$ inch (8–16 Mm.) long, $\frac{1}{6}$ to $\frac{1}{3}$ inch (4–8 Mm.) broad, flattened on one side, smooth, shining, of a gray color variegated with yellowish, brown, or reddish spots and lines, with a slightly-raised raphe along the flattish side and a prominent caruncle near one end; this, when detached, leaves a slight depression above the hilum. The testa is hard, but brittle; the inner seed-coat is thin, white, and has a brownish chalaza; the embryo is straight, white, has broad, foliaceous heart-shaped cotyledons, and is imbedded in an oily albumen having a bland and scarcely acrid taste.

Preparation.—Nearly all the castor oil which is at the present time consumed in the United States is manufactured from seeds grown in the country or imported. While in the year ending June 30, 1867, the importation of castor oil was 82,800 gallons and of the seeds 60,588 bushels, the quantities imported in 1882 were 904 gallons and 2,389,200 pounds respectively. The seeds, after having been crushed and freed from the integuments, or without removing the latter, are kiln-dried and subjected to powerful pressure; the oil thus obtained is heated with water to remove albuminous matters, and when clear drawn off into barrels or other suitable vessels. The yield is stated to be between 38 and 45 per cent., by cold pressure 25 to 30 per cent. More oil, but of inferior quality, is obtained by again expressing the marc and using a higher temperature and greater power; the additional yield is 6 to 8 per cent. The older method of obtaining the oil by boiling the seeds with water and skimming it from the surface has probably been abandoned in most countries. L. Boerner (1876) extracted from the press-cake with ether 14 per cent. of oil having a light-yellow color, while alcohol dissolved 21 per cent. of dark oily matter.

Fig. 199.



Ricinis communis, *Linné:* fruit, seed, and two longitudinal sections of seeds, showing embryo and albumen; natural size.

Purification.—Cold-pressed castor oil is nearly transparent, and requires no further purification. If opaque, the oil is filtered, either through paper or felt, or, as recommended by Pavesi (1857), is previously treated for several days with 1 per cent. of magnesia and 2.5 per cent. of purified animal charcoal; which treatment renders it nearly colorless and inodorous.

Properties.—Castor oil is viscid, transparent or nearly so, almost colorless or pale greenish-yellow, of a faint, mild, mawkish, but not repulsive odor, and a bland, afterward slightly acrid, taste. Its specific gravity varies between .950 and .960. At a low temperature it becomes thicker, and usually deposits white granules of solid fat; near —18° C. (0° F.) it congeals to a yellowish mass. It is only partly soluble in petroleum benzin, but is soluble in all proportions in absolute alcohol, ether, and glacial acetic acid, and at 15° C. (59° F.) in about 4 parts of alcohol spec. grav. 0.835. The oil has a neutral reaction to test-paper, but when exposed to the atmosphere in thin layers it becomes rancid, has an acid reaction, and slowly dries to a transparent varnish. In contact with nitrous acid, however, castor oil becomes much thicker, and finally congeals, requiring for this a longer time than the non-drying oils. Polarized light is by some samples turned to the right, by others to the left. It commences to boil at about 265° C. (509° F.), yields an oily distillate containing *œnanthol*, $C_7H_{14}O$, and *œnanthylic acid*, $C_7H_{14}O_2$, and leaves a black mass which is soluble in potassa. Castor oil, agitated with equal weights of water and nitric acid, yields a whitish mixture, turning yellow in the presence of nitrous acid; but when heated with dilute nitric acid or with potassium bichromate and sulphuric acid, œnanthylic acid is obtained. The oil is very readily saponified by alkalies.

Composition.—1. The Oil. Castor oil is composed of several fats, the acids of which have been the subject of repeated investigations. The solid, fatty acid is probably identical with, or closely related to, *palmitic acid;* the liquid one has been named *ricinic* or *ricinoleic acid*, $C_{18}H_{34}O_3$, and forms a colorless or wine-yellow, inodorous liquid, of a disagreeable acrid taste, solidifying below 0° C. (32° F.) to a granular mass, and under the influence of nitrous acid is converted into *ricinelaidic acid*, which has the same composition and crystallizes in silky needles. These acids differ from oleic acid in containing one more atom of oxygen, but they do not, like the latter, yield sebacic acid among their products of destructive distillation. Œnanthol or *œnanth-aldehyd* is a thin, colorless, strongly refractive liquid, having an agreeable odor and boiling at 154° C. (309.2° F.). Œnanthylic or *œnanthic acid* is oily, of a codfish-like odor, and, dissolved in strong alcohol and treated with hydrochloric acid gas, yields *œnanthic ether*, $C_2H_5.C_7H_{13}O_2$, which has a pleasant fruity odor, a specific gravity of 0.873, boils at 188° C. (370.4° F.), and is one of the constituents of wine. The acrid principle of castor oil has not been isolated.

2. THE SEEDS. Besides the oil, of which the seeds contain about one-half their weight, a considerable amount of protein compounds, some sugar, and mucilage are met with in them. Among the proteids is one which H. Bower (1854) regards as related to *emulsin*, inasmuch as it generates, with amygdalin, the odor of hydrocyanic acid. This observation was confirmed by Boerner (1876). The proteid is obtained by agitating the emulsion of the seeds with ether and precipitating the aqueous liquid with alcohol.

In 1864, Tuson announced the discovery of an alkaloid, *ricinine*, which is isolated by preparing an extract with boiling water, freeing it from the fat, exhausting with alcohol, filtering when cool, and crystallizing by concentrating the liquid. It is described as crystallizing in rectangular prisms and scales, possessing a slight bitter-almond taste, being sublimable, and containing nitrogen. Boerner (1876) found it necessary to treat the alcoholic liquid with magnesia; the crystals obtained by him resembled in behavior those of Tuson, but did not react with the usual reagents for alkaloids. Wayne (1874) isolated apparently the same principle from the leaves, and opposed its claim to be considered an alkaloid. Werner (1870) regarded it as a magnesium salt.

The seeds, freed from oil by pressure, are violently purgative, but the principle to which this action is due has not been isolated. On mixing the marc with water and allowing the mixture to ferment, Boerner obtained butyric and probably other volatile acids, but no acetic acid. These results were confirmed by Raab (1879). Flückiger obtained 10.7 per cent. of ash from the testa, but only 3.5 per cent. from the exsiccated kernel of the seed.

Off. Prep.—Collodium flexile, *U. S.*, *Br.*; Liniment. sinapis comp., Pilul. hydrarg. subchloridi comp., *Br.*

Allied Oil.—TAMBOR OIL, of Central America, has purgative effects, but does not gripe like castor oil. Hemsley (1882) ascertained it to be prepared from the seeds of Omphalea oleifera. *Hemsley* (nat. ord. Euphorbiaceæ).

Physiological Action.—Castor oil derives its purgative properties chiefly from an acrid principle contained in castor beans, which, when taken designedly or accidentally, have repeatedly occasioned violent pain, vomiting, purging, collapse, and even death, after which evidences of severe inflammation have been found in the mucous membrane of the stomach and intestines. An acrid principle exists also in the leaves of the plant. When castor oil was injected into a vein its taste was presently perceived in the mouth, and there followed nausea, eructation, rigidity of the muscles of the tongue, loss of speech, anxiety, and faintness, with general dulness and depression. At the end of 3 hours an unsuccessful motion to evacuate the bowels occurred, followed by feverishness and an indisposition of several weeks' duration. Given to nursing mothers, it invariably purges their infants. Rubbed upon the skin of the abdomen in young children, it has procured one or two loose stools. Taken in medicinal doses, it sometimes nauseates, seldom gripes, but is apt to cause a tendency to sleep. The first evacuations which follow are generally liquid, and contain more or less of the oil, either unchanged or converted into cheesy flakes or a soap-like scum floating on the surface of the dejection. It has long been observed that when used as an habitual laxative the dose may be progressively diminished. Indeed, unless this is done it is very apt to occasion constipation and all its attendant evils. In a case of hydræmia with venous pulsation castor oil, given by the mouth, did not purge, but exuded through the skin.

Medical Uses.—Castor oil is used as a purgative whenever the intention is simply to overcome *constipation*, or, on the other hand, to cure *diarrhœa* depending upon the presence of irritating substances in the bowel, or upon congestion, irritation, and excessive secretion produced by cold. In not a few cases, especially of infantile diarrhœa, the intestine is irritated at once by the presence of undigested food and by the vitiated secretions of its lining membrane; the patients are distressed by colic, tenesmus, and frequent stools, which are watery, mucous, and bloody in different proportions; the mouth is apthous and the anus inflamed. In such cases the first step should be thoroughly to cleanse the intestine by means of castor oil in small and repeated doses, preceded or not by a small dose of calomel or of mercury with chalk. The rest of the treatment may be confided to medicines of a different kind and to dietetic regimen. This purgative has the advantage over most others of analogous qualities that it has no tendency to exhaust the strength. Hence it is much used during *pregnancy*, and especially immediately before *labor*. There is a popular notion that it tends to relax the maternal organs. Castor oil has been highly recommended in *colica pictonum*, or Poitou colic, produced by acid drinks containing lead, and in *colica pictorum*, or painter's colic, caused by the habitual absorption of the metal. In the former affection it affords prompt relief; in the latter it has no superiority over other, and especially saline, cathartics. It sometimes suffices to expel *lumbricoid worms*, but cannot be at all depended upon for the removal of *tæniæ* unless they are previously killed by a proper tæniacide. In the forming stage of *laryngeal or bronchial inflammation* a laxative dose of castor oil is far superior to any other evacuant in promoting the bronchial secretion and thereby tending to hasten the cure. It is usually given after parturition when *milk fever* threatens, and later when signs of *mammary abscess* arise. It is also commonly prescribed after wounds and surgical operations to mitigate *traumatic fever;* it is said to palliate the pain caused by *renal calculi.* The local uses of castor oil were mainly suggested by the custom among African aborigines and their American descendants of applying castor-leaves to the mammæ to excite the flow of *milk.* They produce a slight irritation of the skin. A fluid extract prepared from the leaves and applied in the same manner is said to have a like effect, and a decoction has been used for the cure of *amenorrhœa.* Elsewhere abundant illustrations of this statement may be found (Stille, *Therapeutics*, 4th ed. ii. 504), and more recently (1880) Boucher and Fonssagrives have claimed the re-establishment of the secretion of milk by bathing the breasts with a decoction of the leaves, after which a poultice made of the same leaves was applied to the nipples (*Phila. Med. Times*, x. 415). The oil enters into numerous liniments, etc. for the cure of *alopecia.* Of these one of the best is composed of suet ʒij; castor oil ʒvj; gallic acid ʒss. Mix, and scent with essence of vanilla. Castor oil is often prescribed in emulsion with yelk of egg, mucilage, etc., but its activity is thereby diminished. Its taste may be disguised by giving with it an equal quantity of glycerin to which a few drops of oil of cinnamon have been added. It should not be taken in milk, coffee, hot soup, or any other articles of food, lest they become repugnant afterward. If the mouth and fauces are washed with an alcoholic liquid, or even with glycerin, the oil will not adhere, and therefore will not excite disgust; or it may be floated upon fresh orange-juice in a wineglass, and covered with another layer of the juice, and so tossed down the throat without its taste being perceived. Probably the best expedient of all is to envelop the oil with the froth of beer, ale, or porter in a wineglass; it may then be swallowed without even its presence being detected. The average *dose* of castor oil for an adult is from ½ ounce to an ounce (Gm. 16–32), taken at once or in separate portions according to the nature of the case. The *dose* for an infant is about a fluidrachm (Gm. 4). For an enema 1 or 2 fluidounces (Gm. 32–64) may be given in ½ pint of mucilage or soap and water.

Oil of Anda Assu, a product of Brazil, closely resembles castor oil in its operation. The seeds are said to have been used from a remote period as a purgative; the oil acts thoroughly and gently in doses of from 2 to 3 drachms, but in larger quantities is apt to purge harshly and profusely. A griping principle is said to reside in the embryo and the skin of the seed, both of which should be removed in preparing an emulsion of the seeds. The oil has not the nauseous taste of castor oil, and does not adhere so closely to the palate (*Edinb. Med. Jour.*, xxvii. 556, 646).

OLEUM ROSÆ, *U. S., P. G.*—Oil of Rose.

Oleum rosarum.—Attar (Otto) of rose, E.; *Essence de rose*, Fr.; *Rosenöl*, G.

The volatile oil distilled from the fresh flowers of Rosa damascena, *Miller.*

Nat. Ord.—Rosaceæ, Roseæ.

Origin and Production.—Roses are largely cultivated in India and various parts of Northern Africa for the production of rose-water and attar, which, however, are consumed in those countries. Large quantities of rose-water are distilled in Southern France, but little oil is obtained there. Commerce is almost exclusively supplied with oil of rose from the southern slope of the Balkan Mountains in Roumelia, the principal dépôt being the town of Kizanlik. The species of rose cultivated in that district, according to Baur (1867), is a variety of Rosa damascena, *Miller*, which grows to the height of over 6 feet (1.8 M.) and is raised in hedge-like rows. The flowers appear in May and June, and are collected before sunrise for distillation on the same day. The still used is made of copper, conical in shape, and has its globular head connected with a straight tin tube passing through a tub filled with water. The charge for each still is about 10 okes (or 27 pounds) of flowers and 20 okes of river-water, and the distillation is completed in 2 hours. The distillate is again distilled, the first sixth being set aside to allow the oil to separate, while the remainder, together with the water pressed from the exhausted flowers, is used for fresh roses in place of water. The average annual production of oil of rose is about 4000 pounds, of which quantity over 10,000 ounces are imported into the United States; in the year ending June 30, 1882, the importation amounted to 21,933 ounces.

Properties.—Oil of rose is pale-yellow, transparent, solidifies if slowly cooled above 10° C. (50° F.) to a perfectly transparent mass composed of scale-like crystals, which on rapid cooling are narrow, feathery, resembling prisms, and fuse again at a somewhat higher temperature (at 12°–15° C. = 53.6°–59° F., *P. G.*). The congealing- and fusing-points vary to some extent; the former is given by Baur at between 11° and 16° C. (51.8° and 60.8° F.); the latter, by Hanbury (1859), as lying between 16.1° and 18.3° C. (61° and 65° F.), and for English oil of rose was found as high as 32.8° C. (91° F.). Zeller observed the fusing-point of German oil of rose to be even 37.5° C. (99.5° F.). Oil of rose has a neutral reaction to test-paper, but Zeller found it to have an acid reaction (see *Adulterations* and *Tests* below); its specific gravity may vary between about .84 (.87, *Pharmacographia*) and .89. The odorous portion is quite freely soluble in alcohol, while the inodorous stearopten is sparingly soluble in this liquid: absolute alcohol yields with the oil a clear solution (Baur). The oil has the odor of the flowers in a high degree, and when suitably diluted with alcohol is very fragrant. Its taste is sweetish and rather mild.

Composition.—When oil of rose is mixed with about 3 parts of alcohol, and the undissolved portion repeatedly dissolved in a little ether and reprecipitated by alcohol, it is finally obtained as transparent, iridescent, inodorous scales, which, according to Saussure (1820), Blanchet (1833), and Flückiger (1868), have the formula C_nH_{2n}, fuse at 35° C. (95° F.), and distil above 280° C. (536° F.) (Blanchet). Flückiger gives the melting-point at 32.5° C. (90.5° F.) and the boiling-point at 272° C. (521.6° F.). This stearopten requires about 500 parts of alcohol for solution (Saussure), and is present in Turkish oil of rose to the amount of 6 or 7 per cent. (Hanbury), but in much greater proportion in oil obtained from roses grown in other parts of Europe. The elæopten of oil of rose contains oxygen, but its exact composition has not been ascertained; it remains liquid at −15° C. (5° F.) (Baur, 1872), and, according to Gladstone (1872), has the density .881 and boils at 216° C. (420.8° F.).

Adulterations.—The oil which is mostly employed for adulterating oil of rose is known in commerce as *Turkish oil of geranium*, and was shown by Hanbury (1859) to be entirely different from the volatile oil of pelargonium. It is obtained in India from Andropogon Schœnanthus, *Linné*, known as *roshé* or *rosé oil*, in Turkey as *idris yaghi* or as *entershah*, and in English commerce also as *oil of ginger-grass*; it is imported into Turkey for the purpose of adulterating oil of rose, but, according to Baur, first subjected to a refining process, which consists in agitating the oil with lemon-juice and water, and in bleaching it by exposure to the sun and air, whereby a little copper is removed, the color changed from brownish to pale-yellowish, and the originally harsh and sharp odor rendered mild; or the oil is, in Roumelia, sometimes distilled with rose-petals. The adulterations used outside of Turkey are *oil of rhodium*, distilled from the root of Convolvulus (Rhodorrhiza, *Webb*) Scoparius and floridus, *Linné*, which grow in the Canary Islands; and *oil of rose-geranium*, or French oil of geranium, distilled from the cultivated *rose-geranium*, Pelargonium roseum, *Willdenow*. These oils have an acid reaction; oil of rhodium also a bitter taste and an odor resembling that of a mixture of rose, cubeb, and copaiba.

Tests.—The most certain criteria of the purity of the oil of rose are, according to Baur—1, the odor, by which oil of rose-wood, sandal-wood, and others may be detected; 2, the temperature at which it congeals; and 3, the manner of crystallizing. Pure oil of rose exposed to a temperature of 12.5° C. (54.5° F.) should congeal in a few minutes; the crystals should be transparent, scaly, iridescent, and float in the liquid, while spermaceti, being heavier, is deposited as a solid opaque crust. "If a solution of 1 part of oil of rose in 5 parts of chloroform be diluted with 20 parts of alcohol, the mixture should separate crystalline scales and should not redden moist litmus-paper. 1 drop of oil of rose triturated with sugar and afterward agitated with 500 Gm. of water, should impart to the latter the pure odor of rose."—*P. G.*

Medical Uses.—It is used in medicine exclusively for perfuming ointments and lotions

OLEUM ROSMARINI, *U. S., Br.*—Oil of Rosemary.

Oleum anthos.—Essence de romarin, Fr.; *Rosmarinöl*, G.

The volatile oil distilled from Rosmarinus officinalis, *Linné.*

Nat. Ord.—Labiatæ.

Preparation.—This volatile oil is obtained from the flowering-tops, or more frequently from the entire plant, by distilling them with water or steam. Commerce is chiefly supplied with oil of rosemary from Southern France and Italy. About 20,000 pounds of it are annually imported.

Properties.—Oil of rosemary is a colorless or yellowish limpid liquid, varying in specific gravity between 0.88 and 0.91, has a pungent somewhat camphoraceous odor and taste, boils at 165° C. (329° F.), and is soluble in less than its own weight of 80 per cent. alcohol; old oil requires a larger quantity for solution. Mixed with iodine, it gives off reddish vapors, and strong sulphuric and nitric acid render it thick and brown-red. Fröhde's reagent colors it yellowish-brown. The oil deviates polarized light to the left.

Composition.—The presence of oxygen in oil of rosemary was proven by Saussure (1820). Gladstone (1863) regarded it as consisting almost entirely of a hydrocarbon very similar to that contained in the oil of Myrtus communis, *Linné.* Lallemand (1859), however, obtained by fractional distillation a hydrocarbon boiling at 165° C. (329° F.) and a liquid boiling at 200° C. (392° F.), from which a stearopten was obtained having the composition and most of the properties of camphor; treatment with diluted nitric acid increases the yield of camphor. Bruylants (1879) obtained about 8 per cent. of camphor, $C_{10}H_{16}O$, melting at 176° C. (348.8° F.), and about 5 per cent. of borneol, $C_{10}H_{18}O$; the hydrocarbon, $C_{10}H_{16}$, boils near 160° C. (320° F.).

Pharmaceutical Preparations.—Unguentum rosmarini compositum, s. Ung. nervinum, *P. G.* Melt together lard 16, suet 8, yellow wax 2, and expressed oil of nutmeg 2 parts, and while cooling add oil of rosemary and oil of juniper-berries each 1 part.—*P. G.* *Baume nerval* of the French Codex is a similar preparation.

Off. Prep.—Linim. saponis, Tinctura lavandulæ comp., *U. S.*, *Br.;* Spiritus odoratus, *U. S.;* Spiritus rosmarini, *Br.*

Medical Action and Uses.—This oil is poisonous to rabbits in the dose of 20 grains. A case is recorded in which, along with oil of wormwood, it caused the death of a child. Internally, it may be employed for the same purposes as other stimulant oils to relieve *colic*, promote *menstruation*, and allay *nervous disorder* due to debility. In ointments and liniments it is a useful ingredient for relieving *rheumatic* pains; it promotes the removal of swellings due to *rheumatism*, *sprains*, *bruises*, etc., and stimulates the growth of the hair in *alopecia* following febrile affections. Its vapor cautiously allowed to act on the conjunctiva sometimes improves *vision* impaired by nervous exhaustion. Internally, the *dose* is 1 or 2 drops (Gm. 0.05–0.10).

OLEUM RUTÆ, *U. S., Br.*—Oil of Rue.

Essence de rue, Fr.; *Rautenöl*, G.

The volatile oil distilled from Ruta graveolens, *Linné.*

Nat. Ord.—Rutaceæ.

Preparation.—This volatile oil is distilled with water or steam from the fresh and cut herb. Lewis obtained from the fresh flowering herb .82 per cent., and after the fruit had matured 2.6 per cent., of volatile oil; Zeller's yield was from dry herb about ¼ per cent., from fresh herb $\frac{1}{20}$, and from the seeds 1 per cent.

Properties.—Oil of rue is a colorless or greenish-yellow liquid having the peculiar odor of the plant, a pungent somewhat acrid and bitterish taste, a neutral reaction, and congealing at a low temperature in shining scales. The freezing-point varies in different samples—according to Geiss (1861), between − 2.5° and − 22.5° C. (27.5° and − 8.5° F.), that from the seeds congealing first. The specific gravity varies between .86 and .91. The oil is soluble in an equal weight of alcohol. Iodine dissolves quietly in the oil; sulphuric acid dissolves it with a brown-red color; and sodium bisulphite yields with it a crystalline compound. By the action of nitric acid *caprinic*, *pelargonic*, *caprylic*, and *œnanthylic acids* are produced, the products varying with the strength of the acid and its prolonged action.

Composition.—Aside from a small quantity of a hydrocarbon, $C_{10}H_{16}$, boiling below 200° C. (390° F.), oil of rue consists mainly of an oxygenated portion, which Cahours and Gerhardt (1845) stated to be *caprinic aldehyd*, $C_{11}H_{22}O$. Harbordt (1862) showed that it could not be an aldehyd, and regarded it as *methyl-caprinol*, $C_{10}H_{19}.CH_3.O$, and Strecker as a ketone having the formula $CH_3.CO.C_9H_{19}$. The latter view has been proven to be correct by the simultaneous observations made by Gorup-Besanez, F. Grimm, and A. Giesecke (1870). This *methyl-nonyl ketone*, when pure, is a colorless liquid with a bluish fluorescence, boiling at 225° C. (437° F.), crystallizing in scales near 5° C. (41° F.), and fusing again at 15° C. (59° F.).

Medical Action and Uses.—An experimenter, having taken within an hour three doses of oil of rue of 10 minims each, suffered uneasiness in the stomach, oppression and confusion of mind, aching in the loins, an urgent desire to urinate—the urine smelling of the oil—flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency, with diminished tension, of the pulse. These phenomena are essentially those produced by oil of wormwood and numerous other essential oils, and the therapeutic uses of oil of rue are the same as theirs—viz. in the treatment of *colic*, *amenorrhœa*, *dysmenorrhœa*, *uterine hæmorrhage*, and *verminous complaints*. It may be given in *doses* of from 1 to 5 drops (Gm. 0.05–0.30).

OLEUM SABINÆ, *U. S., Br.*—OIL OF SAVIN (SAVINE).

Essence de sabine, Fr.; *Sadebaumöl*, G.

The volatile oil distilled from Juniperus Sabina, *Linné.*

Nat. Ord.—Coniferæ.

Preparation.—Oil of savin is obtained by distilling the fresh branches with water or steam. The yield is between 1½ and 2½ per cent.; Voget obtained from the berries nearly 10 per cent. of volatile oil. About 500 pounds of this oil are annually imported.

Properties.—The crude oil has a yellowish or yellow color, and is obtained colorless on rectification. It has the peculiar terebinthinate odor of savin, a pungent, camphoraceous, and bitterish taste, and when fresh a neutral reaction; on exposure to air it becomes thicker, reddish or brown. It dissolves in absolute alcohol in all proportions, but yields an opalescent solution with 3 parts of 80 per cent. alcohol. Dragendorff (1876) found the fresh oil at 28° C. (82.4° F.) to dissolve in 0.9 parts, and after rectification in 3.7 parts, of 85 per cent. alcohol. Its specific gravity is about 0.91, but varies somewhat. It commences to boil near 160° C. (320° F.), but the greater part of the oil boils above 200° C. (390° F.). Mixed with powdered iodine, a brisk detonation results, and on the addition to the oil of an ethereal solution of bromine the color of the latter disappears instantly. The oil does not appear to yield a solid compound with hydrochloric acid gas. It rotates polarized light to the right.

Composition.—Dumas (1835) found it to agree with oil of turpentine in elementary composition. But W. A. Tilden (1877) showed the lower-boiling portion to have the composition $C_{10}H_{16}O$, while the remaining portion does not contain a terpene, but consists of hydrocarbons, which are easily polymerized by heat.

Medical Uses.—Oil of savin is an appropriate medicine in all of the cases to which savin itself is applied; that is to say, in *amenorrhœa* depending upon a torpid condition of the organs of generation, and in *dysmenorrhœa* occurring under similar conditions. Its repute as a remedy for *sterility* arises from its stimulant influence upon those organs, and the same is true of its power to control passive *uterine hæmorrhage* and *leucorrhœa*, especially of uterine origin. In all of the cases its efficacy depends upon its power of stimulation. Locally, oil of savin has been applied to benumb the sensibility of exposed nerves in *dental caries* and to promote the shrivelling of *condylomata*.

The *dose* of this oil is from 2 to 10 drops (Gm. 0.10–0.60). It may be given in emulsion, pill, or alcoholic solution.

OLEUM SANTALI, *U. S., Br.*—OIL OF SANTAL.

Oleum ligni santali.—Oil of sandal-wood, E.; *Essence de santal*, Fr.; *Santelöl*, *Sandelöl*, G.

The volatile oil distilled from the wood of Santalum album, *Linné* (nat. ord. Santalaceæ).

Origin.—The white santal is a small tree indigenous to Southern India and some of the East Indian islands, and cultivated in other parts of tropical Asia. Santalum Yasi, *Seemann*, of the Fiji Islands, S. Freycinetianum, *Gaudin*, and S. pyrularium, *A. Gray*, of the Sandwich Islands, and several other species, yield likewise sandal-wood.

The leaves of white sandal are opposite, and vary in shape between oval and lanceolate, and are smooth and glaucous beneath. The flowers are small, numerous, in paniculate cymes, very variable in color, and without odor. In India the trees are felled or dug up when the trunk is about a foot (30 Cm.) in diameter, the branches are cut off, and the trunk is left on the ground until the sap-wood has been mostly eaten away by ants, when it is trimmed, the heart-wood alone being used. Santalum lanceolatum, S. obtusifolium, S. ovatum, and other Australian species yield a wood of inferior odor.

SANTALUM ALBUM, LIGNUM SANTALI ALBUM, S. CITRINUM.—Santal-wood, Yellow (White) sanders-wood, *E.;* Bois de santal citrin, *Fr.;* Gelbes (Weisses) Santelholz, Sandelholz, *G.*—Santal-wood is in billets varying in thickness from about 3 to 8 or 9 inches (7–22 Cm.) and in color from whitish to brownish-yellow, the deeper-colored being more highly valued than the paler varieties. The wood is hard and heavy; when cut transversely it has a somewhat waxy lustre and irregular concentric zones alternately lighter and darker in color, sometimes rather indistinct, with very fine vessels and delicate medullary rays. When rubbed or rasped it has an agreeable aromatic somewhat roseate odor; its taste is aromatic, bitterish, and slightly acrid. Odor and taste, however, vary much with the origin of the wood.

Preparation.—The wood is distilled with water or steam, and yields from 2 to 5 per cent. of oil; in India, with imperfect stills, 2.5 per cent. is obtained (*Pharmacographia*). Dr. Bidie states that the roots yield the largest amount and finest quality of oil. Between 2500 and 3000 pounds of the oil are imported into the United States.

Properties.—Oil of santal is a thick, light-yellow liquid having in a high degree the aromatic odor of the wood from which it has been distilled, and a pungently aromatic taste; its reaction is neutral or slightly acid, and its behavior to polarized light either left- or right-rotating. Its density is usually about .96, and it is said to be occasionally heavier than water; Chapoteaut (1882) obtained from East Indian wood 1.25 to 2.8 per cent. of oil of the specific gravity .945. The oil begins to boil at 214° C. (417° F.), the boiling-point quickly rising to 255° C. (492° F.) (*Pharmacographia*). Chapoteaut's oil boiled between 300° and 340° C. (572° and 644° F). Dragendorff (1876) found oil of santal distilled from different varieties of wood to be soluble in all proportions of 91 per cent. alcohol, but East Indian oil yielded with 11 parts of 80 per cent. alcohol an opalescent solution, while the solutions of other varieties of oil were clear with 1.2 to 1.8 parts of the same alcohol. Old oil seems to be less soluble than that which has been recently distilled.

Constituents.—The physical differences pointed out indicate that oils prepared from different woods vary in their composition, but they appear to be oxygenated oils. Chapoteaut (1882) isolated two fractions, $C_{15}H_{24}O$, boiling near 300° C. (572° F.), and $C_{15}H_{26}O$, boiling at 310° C. (590° F.). Distilled with phosphoric anhydride, they yield the hydrocarbons $C_{15}H_{22}$ and $C_{15}H_{24}$, of which the former resembles the hydrocarbon of oil of cedar-wood, and the latter seems to be identical with oil of copaiba.

Santal-wood contains also a resinous principle, and a tannin which is colored green by ferric salts.

Adulterations.—Oil of santal is said to be adulterated with oil of copaiba and oil of cedar-wood; the former is sparingly soluble in alcohol sp. gr. .85. For detecting the latter Durand (1878) recommends agitating 1 Gm. of the oil with 1 Gm. of concentrated cuprammonium solution and 4 Gm. of water; after 24 hours' rest pure oil of santal gives a white opaque soap, while that with oil of cedar-wood is greenish.

Medical Action and Uses.—About 1865 oil of sandal-wood was introduced as a substitute for copaiva in the treatment of *gonorrhœa.* In some cases it was found to produce nausea or disturbance of the stomach, and the odor it communicated to the urine was described as sickening. Its smell upon the hands and breath was also said to be extremely persistent. But the more frequent statement was that it had a far less disagreeable smell than copaiva, and was generally preferred to it. In some cases it agreed with patients who could not tolerate copaiva. The general result, however, appears to be that while it possesses no decided superiority over that medicine, it is fully equal to it in efficiency. Like copaiva, it must be given for some time after the urethral discharge has ceased. Like that medicine also, it is very serviceable in chronic *diarrhœa*, especially of the mucous variety, and in chronic bronchitis.

Oil of sandal-wood may be given in *doses* of from 10 to 20 drops (Gm. 0.60–1.30) three times a day, according to the degree of inflammation present. It has been administered in capsules, or in mixtures such as the following: ℞. Oil of sandal-wood f℥ss; dilute alcohol f℥ijss; oil of cinnamon ♏xxv.—M. S.—1 or 2 teaspoonfuls two or three times a day. It may also be given mixed with powdered liquorice in wafers.

OLEUM SASSAFRAS, *U. S.*—OIL OF SASSAFRAS.

Essence de sassafras, Fr.; *Sassafrasöl*, G.

The volatile oil distilled from the wood of Sassafras officinale, *Nees.*
Nat. Ord.—Lauraceæ.

Preparation.—Oil of sassafras is distilled in Maryland and various other parts of the United States, mostly in the neighborhood of those places where a supply of the root may be obtained without requiring much transportation. The stills used are made of copper or iron, and usually connected with a lead condenser. The roots, together with the adhering bark. are cut into chips, about 10 bushels of which constitute a charge, and yield on an average about 4 pounds of the oil, the distillation requiring about 12 hours (Procter, 1866). If the root is dug up shortly after the tree has been cut, it appears to yield a colorless or yellow oil, but if the stumps are permitted to remain in the ground for some time they acquire a red color and yield a brown-red oil.

Properties.—As stated, oil of sassafras is either colorless or more frequently of various shades of yellow or brown-red, a difference which does not affect its quality. When carefully rectified it may be obtained colorless, but on exposure again becomes colored. It has the odor of sassafras in a high degree, a warm aromatic taste, a neutral reaction, and a slightly dextrogyre rotatory power. Its specific gravity is usually about 1.090, and increases somewhat by age. It dissolves small quantities of water, becoming lighter thereby. It is freely soluble in alcohol, dissolves in 4 or 5 parts of 80 per cent. alcohol, acquires with cold nitric acid a dark-red color, being finally converted into a red resin, and is violently acted on by bromine, but dissolves iodine quietly.

Composition.—According to Grimaux and Ruotte (1869), potassa solution extracts from oil of sassafras a body which appears to be a phenol, has the odor of eugenol, and assumes a bright-green color with ferric chloride. By fractional distillation a hydrocarbon, *safrene*, $C_{10}H_{16}$, is obtained, which boils between 155° and 157° C. (311° and 314.6° F.), and is dextrogyre. The oxygenated portion, *safrol*, $C_{10}H_{10}O_2$, constitutes nine-tenths of the oil, is without action on polarized light, distils between 230° and 235° C. (446° and 455° F.), remains liquid at $-20°$ C. ($-4°$ F.), and yields with bromine crystals of $C_{10}H_5Br_5O_2$. On cooling the oil in a freezing mixture Saint-Evre (1843) obtained crystallized *sassafras-camphor*, $C_{10}H_{10}O_2$, which remained solid at 5° C. (41° F.), and after being fused congealed again at 7.5° C. (45.5° F.).

Off. Prep.—Trochisci cubebæ, *U. S.*

Medical Action and Uses.—The action and uses of this oil do not differ materially from those of numerous other essential oils. It is alleged, however, to prevent the usual effects of tobacco when mixed with it and smoked, and the narcotic action of hyoscyamus when associated with that drug. The *dose* is from 2 to 10 drops (Gm. 0.10–0.60).

OLEUM SESAMI, *U. S.*—OIL OF SESAMUM.

Benne oil, *Gingili oil*, *Teel oil*, E.; *Huile de sésame*, Fr.; *Sesamöl*, G.

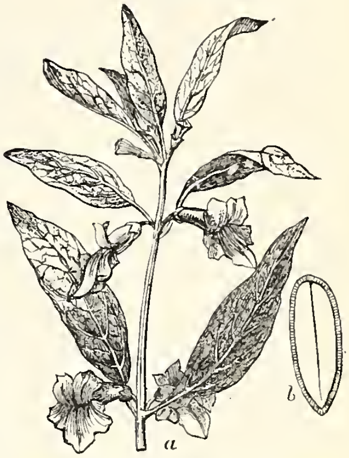
The fixed oil expressed from the seeds of Sesamum indicum, *Linné.* Bentley and Trimen, *Med. Plants*, 198.
Nat. Ord.—Pedaliaceæ.

Origin.—Benne is an annual herb which is indigenous to India, but is now not found in the wild state; it is largely cultivated in most tropical countries and in the warmer portions of the temperate zone. It grows from 2 to 5 feet (0.6–1.5 M.) high, and has an erect, branching, bluntly quadrangular, and hairy stem, alternate or sub-opposite leaves, and short-stalked axillary flowers, with large white bell-shaped five-lobed and somewhat two-lipped corollas. The fruit is capsular, two-valved, four-celled, quadrangular and linear-oblong in shape, and contains numerous seeds, which are small, flattened, oval or ovate, smooth and shining, vary in color between whitish, yellow, reddish-brown, and blackish, have a sweetish oily taste, and contain a straight embryo with a short radicle and large plano-convex oily cotyledons. Sesamum orientale, *Linné*, is now regarded as being identical with this species.

SESAMUM, *U. S.* 1870.—Benne, Sesame-leaves, *E.*; Feuilles de sesamé, *Fr.*; Sesamblätter, *G.*—The leaves are mostly employed in the fresh state. They are from 3 to 5 inches (75–125 Mm.) long, long-petiolate, ovate or lance-oblong in outline, narrowed or rounded or somewhat heart-shaped at the base, more or less pointed above, entire on the margin or irregularly toothed, and the lower ones frequently cut into three-toothed lobes or distinct leaflets. The leaves are prominently veined on the lower surface, are smoothish or somewhat pubescent, and have a mucilaginous taste. Their principal constituent is mucilage, which is precipitated from its aqueous solution by alcohol.

Preparation.—Oil of benne is obtained by subjecting benne-seeds to pressure; the yield is in the neighborhood of 50 per cent. of the weight of the seeds. About 14,000 gallons of this oil were imported into the United States in 1876, and 126,271 gallons in 1883.

Fig. 200.



Sesamum indicum, *Linné*: *a*, flowering branch; *b*, section of seed.

Properties.—Benne oil has a yellow color, usually of a deeper hue than expressed almond oil, is thinner at ordinary temperatures than most other fixed oils, is nearly inodorous, and has a bland and agreeable peculiar taste, and the specific gravity 0.923 at 15° C. (59° F.). Near the freezing-point of water it becomes opaque, and congeals usually at about − 5° C. (23° F.), while the oil extracted by solvents congeals at about 5° C. (41° F.), forming a yellowish-white mass; when heated to between 150° and 200° C. (302° and 392° F.) it is decolorized. At 300° C. (572° F.) it assumes a brown color, and at 335° C. (635° F.) it commences to boil. It is a non-drying oil, and on exposure to air does not readily turn rancid. Concentrated sulphuric acid converts it into a brown-red gelatinous mass; nitric acid specific gravity 1.18 colors it gradually orange-yellow, and when of greater strength, red; with a mixture of nitric and sulphuric acid it is transiently colored green, afterward red and brown-red; in contact with nitrous acid it becomes reddish and brown-red, and gradually forms a semi-solid mass.

Composition.—Flückiger (*Pharmacographia*) found benne oil prepared by himself to contain 76 per cent. of olein; the acids of the solidifying portion appear to be stearic, palmitic, and myristic acids. A small quantity of a peculiar, probably resinous, substance may be extracted from the oil by agitation with glacial acetic acid or with alcohol; the acetic solution acquires a greenish-yellow, the alcoholic solution a blue afterward greenish-yellow, color on the addition of a cold mixture of equal weights of sulphuric and nitric acids. (See also p. 1033.)

Allied Oils.—The following four oils are obtained from seeds of the natural order Leguminosæ:

Kurung Oil is thickish, yellow, of the specific gravity .945, and begins to become turbid near 7° C. (44.5° F.). It comes from an East Indian tree, Pongamia glabra, *Ventenat*, s. Dalbergia arborea, *Roxburgh*, the odorous root and leaves of which are also used medicinally. The seeds are gray and kidney-shaped.

Ground-nut Oil, Pea-nut Oil.—Huile de pistache de terre, *Fr.;* Erdnussöl, *G.*—It is prepared from Arachis hypogæa, *Linné* (Bentley and Trimen, *Med. Plants*, 75), an annual herb indigenous to tropical America and now cultivated throughout the tropics; it is known in Brazil as *amendoim* or *mandobim*. The seeds contain about 45 per cent. of oil. This is pale-yellow, thin, has the density .920, and a peculiar nutty flavor, becomes turbid at about 3° C. (37.4° F.), and congeals near — 5° C. (23° F.). Nitrous acid causes the oil to congeal to a whitish mass; nitric acid colors it reddish, and sulphuric acid grayish-yellow, then green-brown. It consists of the glycerides of palmitic, *arachic*, and *hypogæic acids*. The latter is $C_{16}H_{30}O_2$, and crystallizes in needles which melt near 35° C. (95° F.). Arachic acid, $C_{20}H_{40}O_2$, melts at 75° C. (167° F.). Under the name of *katchung oil* this oil is largely used in India in the place of olive oil.

Soy Oil is prepared from Soja hispida, *Moench*, s. Dolichos Soja, *Linné*. The plant is indigenous to Japan, and largely cultivated in Southern Asia for its brownish or whitish ovate-reniform seeds, which are used as food, and for preparing a sauce called *soy:* when fresh they contain 14 to 16 per cent. of moisture and from 16 to 18 per cent. of a bland yellowish oil.

Nicker-seed Oil, from Cæsalpinia (Guilandina, *Linné*) Bonducella, *Roxburgh*. The seeds of this tropical climber, which are also known as *bonduc nuts*, are somewhat compressed, subglobular, or oblong, about $\frac{3}{5}$ inch (15 Mm.) broad, bluish or ashy gray, slightly ridged, and have a bitter taste. The expressed oil is used for embrocations. The seeds are used in India as a tonic and anti-periodic; they contain a white bitter principle soluble in ether and alcohol and slightly soluble in water (*Pharmacographia*). The bark of bonduc-root is likewise employed as a tonic.

Ben Oil, Behen Oil, is expressed from the seeds of Moringa pterygosperma, *Gaertner* (Mor. oleifera, *Lamarck*, Guilandina Moringa, *Linné*), and one or two allied East Indian trees of the nat. ord. Moringaceæ. The bark of the root has an odor and taste resembling horseradish. The seeds, known as *ben nuts*, are triangular-globose, pitted, and have elongated membranous wings on the angles; the seeds of Moringa aptera, *Gaertner*, are without wings; both are acrid, bitter, and emetic. They yield about 30 per cent. of fixed oil, which is yellowish, inodorous, bland, or if expressed at an elevated temperature somewhat bitter, acrid, and purgative. It retains its neutral reaction for a long time. It solidifies at about 0° C. (32° F.). but below 7° C. (44.6° F.) it deposits solid fats; the portion remaining liquid is used for extracting delicate perfumes from flowers. Oil of ben consists of the glycerides of moringic, oleic, myristic, palmitic, stearic, and behenic acids. *Moringic acid*, $C_{15}H_{28}O_2$, is liquid, and crystallizes at 0° C. (32° F.). *Behenic acid*, $C_{22}H_{44}O_2$, is crystalline, melts at 76° C. (168.8° F.), and solidifies at 70° C. (158° F.).

The slowly-drying bland or slightly-pungent oil expressed from the seeds of Camelina sativa, *Crantz*, s. Myagrum sativum, *Linné* (Leindotter, *G.*), is sometimes called *German sesame oil*.

Medical History and Uses.—Sesamum was anciently ranked among the most nutritious grains, and as tending especially to fatten, but it was also considered difficult of digestion. Hippocrates recommended consumptives to use bread made of it instead of wheat, and in pulmonary catarrhs prescribed an emulsion prepared with sesame, almond, and melon-seeds. To this day it serves to make bread in the East. Its oil was anciently used, and in India continues to be employed, for the same purposes as olive oil, but it has always been regarded as less agreeable and as less digestible. Externally, the bruised or ground seeds were applied in maturative poultices, and a decoction prepared with them was held to be emmenagogue and abortive. No mention is made by ancient writers of the mucilage of the young leaves. The seeds of sesame are used by the negroes of South Carolina in making broths, and are also eaten by them parched. The oil, which is very bland, is applied to the same purposes as olive oil. The mucilage is generally prepared from the fresh young leaves by infusing them in cold water. It is justly esteemed as a demulcent drink in *cholera infantum*, *dysentery*, and other disorders of the bowels.

Pongamia glabra furnishes the *kurung oil* which is employed in Hindostan in the treatment of various *skin diseases*. Pityriasis versicolor is mentioned as one of those in which it is efficient (*Amer. Jour. Phar.*, May, 1883, p. 267).

OLEUM SINAPIS VOLATILE, *U. S.*—VOLATILE OIL OF MUSTARD.

Oleum sinapis, Br., P. G.; *Oleum sinapis æthereum.—Oil of mustard*, E.; *Essence de moutarde*, Fr.; *Ætherisches Senföl*, G.

The volatile oil distilled from the seeds of Sinapis (Brassica, *Koch*) nigra, *Linné*. *Nat. Ord.*—Cruciferæ, Siliquosæ.

Preparation.—Black mustard-seeds are ground, deprived of most of their fixed oil by pressure, macerated with water at the common temperature, and then distilled. A small quantity of ground white mustard-seed is usually added to supply any possible deficiency of myrosin and ensure the decomposition of all the myronic acid. Since oil of mustard is soluble in water, the aqueous portion of the distillate is used in macerating a fresh portion of mustard. The yield is usually about ½ per cent., but occasionally as high as 1 per cent. Dircks (1883) obtained the following yield: black mustard-seed cake, 1.39 per cent.; rape-seed, .018 to .037; rape-seed cake, .020 to .109; yellow mustard-seed cake, .018; turnip-seed, .038; seed of Sinapis arvensis, *Linné*, .006. According to A. W. Hofmann (1882) the oil is best prepared artificially by boiling sulpho-urea with concentrated phosphoric acid.

Properties.—The crude oil has a yellow color; after rectification it is colorless or nearly so. It is neutral to test-paper, has the specific gravity 1.017 (1.016–1.022 *P. G.*, 1.017–1.021 *U. S.*), has no effect on polarized light, boils at 148° C. (298.4° F.), is somewhat soluble in water, freely so in alcohol and ether, and has a very pungent and acrid odor and taste. The oil dissolves completely in 3 parts and more of cold concentrated sulphuric acid without coloration, the mixture retaining a light-yellow color and remaining perfectly transparent; sulphurous acid gas is given off, the liquid becomes thicker, sometimes crystalline, and the piercing odor of mustard oil disappears; in the presence of other volatile oils a brown or red color is produced. Ammonia converts the oil into *thiosinamin* or *allylsulpho-urea*, $C_3H_5.NH.NH_2.CS = C_4H_8N_2S$, which crystallizes in colorless rhombic prisms having a bitter taste, melting at 70° C. (158° F.), and easily soluble in water, alcohol, and ether. This reaction was recommended by Flückiger (1880) as a quantitative test for the oil (see below).

Composition.—Oil of mustard is *sulphocyanide of allyl*, $C_3H_5.CNS$. Sometimes it contains also allyl cyanide and carbon disulphide, the latter, according to A. Hofmann, not exceeding .56 per cent., while Johanson (1881) found from .76 to 2 per cent.; both these compounds boil at a lower temperature. The oil is artificially prepared by decomposing allyl bromide or iodide by means of an alcoholic solution of potassium sulphocyanide. Using an allyl iodide obtained from glycerin and phosphorus iodide, Gerlich (1875) obtained a mustard oil which consisted of *isopropyl sulphocyanide*, $C_3H_7.CNS$, the density of which is 0.974. Mylius (1877) found in the artificial oil of commerce, besides 92.2 per cent. of allyl-mustard oil, some hydrocyanic acid, carbon disulphide, and polysulphides.

Tests.—The oil should not begin to boil below 148° C. (carbon disulphide boils at 48°, alcohol at 78°, allyl cyanide at 118° C.), and the first fraction of the distillate should have the same density as the oil. A mixture of 3 Gm. of oil of mustard, 3 Gm. of alcohol, and 6 Gm. of ammonia, heated to 50° (122° F.), gradually becomes clear, and on careful evaporation in a water-bath should leave between 3.25 and 3.50 Gm. of thiosinamin, having a brownish color, a leek-like but not acrid odor, a bitterish not persistent taste, and being soluble in 2 parts of warm water.—*P. G.*

Pharmaceutical Uses.—SPIRITUS SINAPIS, *P. G.*—Spirit of mustard, *E.;* Senfspiritus, *G.*—is a solution of 1 part of oil of mustard in 49 parts of alcohol.

Off. Prep.—Liniment. sinapis comp., *U. S.*, *Br.*

Medical Action and Uses.—Volatile oil of mustard is a powerful and almost caustic irritant, which, for fear of accident, should never be prescribed internally. It is said that it may sometimes be applied as an external counter-irritant upon parts to which a blistering plaster cannot readily be adapted, but there are none upon which cantharidal collodion cannot as readily be painted as this oil. As a rubefacient it may be used dissolved in olive oil or alcohol in the proportion of about 5 drops to the fluidrachm (Gm. 0.30 in Gm. 4).

OLEUM SUCCINI, *U. S.*—OIL OF AMBER.

Huile volatile de succin, Fr.; *Bernsteinöl*, G.

The volatile oil obtained by the destructive distillation of amber and purified by rectification.

Origin.—SUCCINUM, AMBRA FLAVA.—Amber, *E.;* Succin, Ambre jaune, *Fr.;* Bernstein, Agtstein, *G.*—This fossil resin is the exudation from a number of extinct coniferous trees of the sub-orders Abieteæ and Cupresseæ, the principal source of the Baltic amber being Pinites succinifer, *Goeppert*, s. Pityoxylon succiniferum, *Kraus.* It is principally obtained on the southern and south-eastern coast of the Baltic, where it is cast ashore or dug out of beds. It has also been found in the interior of Europe and in Siberia, Greenland, and North America. It is hard, somewhat brittle, whitish, yellow, or red-brown, transparent, translucent, or opaque, breaks with a conchoidal fracture, and frequently encloses vegetable fragments and insects. It is fragrant when heated, melts at about 287.5° C. (550° F.), dissolves in chloroform, but is insoluble in water, and only partly soluble in alcohol, ether, and volatile oils. Its density varies between 1.05 and 1.10. The annual production of amber in Prussia is estimated at 100,000 kilos. From 4000 to 7000 pounds of oil of amber are annually imported by the United States.

Preparation.—The oil is obtained by the dry distillation of amber, succinic acid being formed at the same time (see page 95). The crude oil is mixed with six times its volume of water, and distilled as long as oil is found in the distillate. The yield is usually stated to be from 60 to 70 per cent. of the crude oil; but Ebert (1865), who prepared the crude oil, obtained from 29 troyounces of amber 21 fluidounces of oil specific gravity 0.985, and on rectifying this with water only 2½ fluidounces, or about 12 per cent. of rectified oil specific gravity 0.903, while the density of the residue had increased to 1.019. Marsson (1850) obtained from amber 6 per cent. of rectified oil, 3.5 per cent. of succinic acid, and 58.3 of residuary resin (amber colophony). Döpping (1847) observed that the crude oil, after having been treated with potassa solution, dilute sulphuric acid, caustic potassa, and calcium chloride in succession, distilled between 140° and 170° C. (284° and 338° F.) and left a dark-brown residue. On again treating the distillate with burned lime, and repeating the distillation, the liquid had a higher boiling-point (up to 190° C., 374° F.) and was colorless.

Properties.—Crude oil of amber is a thick brown liquid of a strong empyreumatic and fetid odor, and variable specific gravity approaching the density of water; Marsson found it to be .922. Very similar products are obtained from copal, dammar, and other resins. In this state it is rarely employed in medicine, but is used in preparing

OLEUM SUCCINI RECTIFICATUM, *Rectified oil of amber.* This is thin, colorless or yellowish, becomes darker and thicker on exposure, has a spec. grav. of about .920, but varies in density between 0.88 and 0.99, and in the boiling-point as stated above. It has a pungent, empyreumatic, and somewhat balsamic odor, which is more pleasant than that of the crude oil, and a warm, acrid taste. It has a neutral or faint acid reaction, dissolves, according to Anthon (1835), in 2 parts of absolute alcohol, but requires at about 35° C. (95° F.) 30 parts of alcohol spec. grav. .855 for complete solution. Ebert found it soluble in 4 parts of alcohol spec. grav. .817, and in 17 parts of alcohol spec. grav. .835. It is readily soluble in ether, fixed and volatile oils, dissolves iodine, and, when heated, sulphur and caoutchouc. It absorbs some hydrochloric acid gas without forming a crystalline compound, and in contact with cold fuming nitric acid acquires a red afterward dark red-brown color, and is converted into a brown resinous mass having a peculiar musk-like odor, and formerly known and medicinally employed under the name of *artificial musk*. It was discovered by Marggraf (1759), and may also be obtained from oil of amber and ordinary or diluted nitric acid on the application of heat.

Composition.—In its purest state oil of amber is a mixture of several oils having the composition of oil of turpentine, $C_{10}H_{16}$.

Adulterations.—Oil of amber is not unfrequently adulterated with oil of turpentine and with coal oil; the former is recognized by the brisk reaction with iodine, and by the formation of terpin when left in contact with alcohol and nitric acid; the latter by the decreased solubility in alcohol.

Medical Action and Uses.—Oil of amber is a powerful irritant of the skin. When taken internally it is said to be stimulant and anti-spasmodic. It has been so given in various *mucous profluvia* of the lungs and urinary organs, in *retrocedent gout* and *rheumatism*, *eruptive fevers*, *hysteria*, *whooping cough*, and *amenorrhœa*. Externally, it may be employed in stimulating liniments for *rheumatism* and *paralysis* and rubbed upon the spine in the *convulsive disorders* of children. It has been applied as a stimulant discutient to *hæmorrhoidal tumors*. The *dose* is from 5 to 10 drops (Gm. 0.30–0.60), and on account of its acrid and offensive taste the oil should be enclosed in gelatin capsules.

OLEUM TEREBINTHINÆ, *U. S.*, *Br.*, *P. G.*—Oil of Turpentine.

Essence de térébenthine, Fr.; *Terpentinöl*, G.

The volatile oil distilled from turpentine. (See Terebinthina.)

Preparation.—Oil of turpentine is obtained by distilling the oleoresinous exudation of various species of Pinus. The crude turpentine is put into a large still, heat is applied, and a little water added from time to time to the contents of the still. The distillation is continued as long as oil passes over, when the resinous mass is run off through a stopcock placed at the bottom of the still, is passed through several strainers, and then constitutes *rosin*. (See Resina.) On condensing the distillate the oil of turpentine separates from the water and is dipped into barrels, in which it enters commerce.

Properties.—Oil of turpentine is a colorless, thin, volatile oil, the density of which varies between 0.855 and 0.87. When recently rectified it boils at about 150° C. (302° F.), but the temperature usually rises as the distillation progresses, and old oil does not generally commence to boil below 155° or 160° C. (311° or 320° F.). As procured from different sources, oil of turpentine shows great differences in its optical behavior, and on fractional distillation with or without water oils are obtained differing in the degree of their influence upon polarized light. American and German oil of turpentine are dextrogyre, while the French oil has a levogyre action. Odor and taste are peculiar, strongly terebinthinate, differing to some degree according to the source from which the oil has been obtained. When recently distilled, particularly after rectification with water, the oil has a neutral reaction and its odor is rather mild, but after exposure to air it becomes stronger, more unpleasant, and pungent; the oil then contains ozone, and gradually acquires a yellowish color and thicker consistence; at the same time resin and formic and acetic acids are produced, and, in the presence of moisture, also a hydrate of the oil. The aqueous solution of such oxidized oil has been used under the name of *sanitas* as an antiseptic; on evaporating it Kingzett (1880) obtained a dark-colored adhesive mass, $C_{10}H_{18}O_3$, which with sulphuric acid gave a dark-red color. Oil of turpentine dissolves in ½ or ¾ part of alcohol sp. gr. .816, in 1½ or 2 parts of alcohol sp. gr. .820, in 4 or 5 parts of alcohol sp. gr. .830, and in from 8 to 12 parts of alcohol sp. gr. .845; the solubility of oil of different origin and age varies more or less, and occasionally oil of turpentine has been observed which even with strong alcohol would not yield a perfectly clear solution. Bromine and powdered iodine act violently upon oil of turpentine; nitric acid oxidizes it, the violence of the action and the final products being influenced by the strength of the acid. Gaseous hydrochloric acid unites with oil of turpentine, forming two compounds: one, having the composition $C_{10}H_{16}HCl$, is known as *artificial camphor*, is crystallizable, and has the odor and taste of ordinary camphor, but is less pungent and somewhat terebinthinate. Three compounds with water are known; one, which is called *turpentine camphor* or *terpin*, has the composition $C_{10}H_{20}O_2$, and is obtained by leaving the oil in contact with alcohol and nitric acid.

Purification.—Only rectified oil of turpentine should be used internally. The partially resinified oil is best purified by rectification with water, or it may be repeatedly agitated with small portions of alcohol, which dissolves the resin, and afterward with water. The following is the formula of the German Pharmacopœia:

OLEUM TEREBINTHINÆ RECTIFICATUM.—Rectified oil of turpentine, *E.;* Essence de térébenthine rectifiée, *Fr.;* Gereinigtes Terpentinöl, *G.*—Agitate oil of turpentine 4 parts with lime-water 24 parts, and distil until 3 parts of oil have passed over; separate the clear oil from the water. Its solution in alcohol should not change the color of moist litmus-paper.

Composition.—When perfectly pure, oil of turpentine is free from oxygen and has the composition $C_{10}H_{16}$. On being distilled in the presence of sulphuric acid it is converted into several isomeric or polymeric oils, among which are *terebene* and *colophene*, the latter boiling at 310° C. (590° F.) and showing a blue fluorescence; it is also obtained on the dry distillation of rosin. By acting with sodium on turpentine hydrochlorate Letts (1879) obtained *turpenyl*, $C_{10}H_{17}$, a solid white volatile compound, and *diturpenyl*, $C_{20}H_{34}$, which is liquid and has a higher boiling-point.

Off. Prep.—Confectio terebinthinæ, Enema terebinth., *Br.;* Linim. cantharidis, *U. S.;* Linim. terebinth., Linim. terebinth. aceticum, Unguent. terebinthinæ, *Br.*

Allied Products.—TEREBENE, $C_{10}H_{16}$. It is a derivative of oil of turpentine, produced by the action of heat and of concentrated sulphuric acid or phosphoric anhydride. It is a colorless volatile oil, without influence on polarized light, has a rather agreeable thyme-like odor, the density .864 at 8° C. (46.4° F.), and the boiling-point 156° C. (312.8° F.), and acquires with iodine a dark-green, opaque appearance. It combines with hydrochloric acid gas, forming two liquid oils, one of which is heavier than water.

ABIETENE, C_7H_{16}. This is the volatile oil obtained from the terebinthinate exudation of Pinus Sabiniana, *Douglas*, the *nut pine* or *digger pine* of California. According to Wenzell (1872), the crude oil is colorless, and commences to boil at 101° C., the thermometer gradually rising to 115° C. (239° F.). Pure abietene boils at 101° C., has a strong penetrating orange-like odor, is highly inflammable, very volatile, of the spec. grav. .694 at 16.5° C., soluble in 5 parts by measure of 95 per cent. alcohol, dissolves freely iodine and bromine, and yields with chlorine a substitution-compound boiling at 260° C. Thorpe (1879) found it to have the composition of *heptane*, C_7H_{16}, to boil at 98.42° C., and to be slightly dextrogyre.

The volatile oil of Pinus ponderosa, *Douglas*, of California, which was examined by Sadtler (1879), seems to have the same composition.

Physiological Action.—Numerous experiments upon animals prove that oil of turpentine, however applied, is rapidly absorbed, and produces, according to the quantity employed, more or less of its characteristic effects; *e. g.* stimulation of the nervous system when relatively small doses are used, and paralyzing effects when large quantities are administered. The urine is increased and may be rendered bloody, the animals lose their muscular force and co-ordination, the breathing is laborious, and the action of the heart quickened. Death takes place by exhaustion and asphyxia. Binz has shown that large doses of it prevent or control the spasms excited by brucine. Its local operation is that of an irritant, causing pain, redness, and even vesication. In man the prolonged inhalation of its vapors produces vertigo, impaired vision, pain in the loins, strangury, and bloody urine, and, if very concentrated, a state of collapse. In females menorrhagia and dysmenorrhœa are sometimes added. Workmen when first exposed to its emanations suffer from headache, unsteady gait, irritability, smarting of the eyes, and lachrymation, impaired vision (particularly by artificial light), coryza, cough, granular pharyngitis, vomiting, and indigestion. Gradually, however, these symptoms subside and a tolerance of its action is established (*Bull. de thérap.*, xcvi. 508). The internal administration of large doses of the oil has produced heat in the stomach, vertigo, confusion of mind, extreme thirst, strangury, and a frequent discharge of urine exhaling an odor of violets. It is secreted with the milk. The bowels are not disturbed. Sometimes it causes itching and diaphoresis. Excessive or poisonous doses occasion graver symptoms. Thus, when 6 ounces were taken by a woman her body was found in a state of opisthotonos, the pupils were dilated, and the brain, lungs, stomach, and heart were gorged with blood. Yet a child aged fourteen months recovered after swallowing 4 ounces of the oil. It is recorded that the air of a cellar where turpentine was stored, and in which a boy was nearly asphyxiated, was found to be nearly deprived of its oxygen. Many instances of its narcotic action are on record. (Compare Begbie, *Works*, p. 283.)

Medical Uses.—Oil of turpentine has been used in almost every form of *hæmorrhage*, but most successfully when the bleeding was passive. The special affections include *epistaxis*, *hæmatemesis*, *hæmaturia*, *menorrhagia*, *post-partum* hæmorrhage, *purpura*, and the multiple hæmorrhages occurring under the influence of the *hæmorrhagic diathesis*. Even in external and traumatic hæmorrhages it has proved efficient. Its efficacy justifies the opinion of John Hunter, who termed it "the best, if not the only true, styptic." A cure of *aneurism* has even been attributed to its internal administration (*Times and Gaz.*, Nov. 1883, p. 543).

In *puerperal fever* this medicine once enjoyed a high repute, which it has in a great measure lost at the present time. For the varying estimates of its value a reason may probably be found in the indiscriminate manner of its employment. When it was prescribed in cases marked by a typhoid state in which excessive tympanites existed, there is no reasonable ground for doubting that it often successfully combated the nervous and cardiac depression of the disease, and, by lessening the distension of the abdomen, diminished the mechanical hindrances to hæmatosis. For the latter purpose it was applied as an epithem to the abdomen, as well as administered internally. This judgment appears to be justified by its recognized effects in other febrile affections of a typhoid type. In *typhus*, for example, it is of great utility both internally and externally—not only for its power of arousing the sluggish functions generally, but especially for combating the pulmonary congestion which is the gravest of the usual incidents of the disease. In *typhoid fever*, besides the general influences already mentioned, it is not only one of the most efficient remedies for intestinal tympanites, as in the cases referred to, but it also favorably controls the bronchial catarrh, and, in the advanced stages, probably exerts a local stimulant action upon the intestinal ulcers and checks the tendency to hæmorrhage from them. So, too, in *yellow fever* of a low type it may operate not only by its general stimulation, but also by its direct action upon the stomach, tending to control the hæmorrhage which is so grave a symptom in that disease. Its possible action in promoting the urinary secretion in this fever should not be overlooked. In *tympanites*, from whatever cause arising, it may become a valuable auxiliary in the treatment, whether administered by the mouth or rectum or applied to the skin of the abdomen. When given internally for the relief of this symptom it should generally be associated with a purgative, and especially with castor oil. It is most efficient in the treatment of *tænia*, and indeed in that of other *intestinal worms*, when a full dose of it is shortly followed by one of castor oil. A disadvantage of this treatment is, however, that as large doses of the oil are required they are apt to give rise to colic, if not to strangury.

Oil of turpentine has been supposed to dissolve *biliary concretions*, and in some cases it has, when associated with sulphuric ether, appeared to favor their discharge. It seems more probable that it should tend to prevent the formation of gall-stones than to dissolve them when once formed. Its diuretic virtues have caused it to be occasionally used to promote the expulsion of *urinary concretions*, and for this purpose it is said to have been efficacious in the form of baths of the vapor of oil of turpentine (Brémond). Impregnating the urine, it becomes a suitable remedy for *catarrh of the urinary passages* and for debility or *paralysis of the bladder*; and, very probably, in females this stimulation has served to cure *amenorrhœa* and to excite *uterine contractions* during labor. For these purposes, however, the oil is best administered by the rectum.

Although the *modus operandi* of this medicine in *sciatica* is totally unknown, its curative power is none the less certain. It has stood the test of a century's experience. Probably no other remedy is comparable with it in chronic examples of this painful and crippling affection. Some difference of opinion exists concerning the proper dose which should be given, some prescribing ½ ounce of it at bedtime for several successive nights, and others a dose of 30 drops three times a day. The latter is to be preferred at first. It may be gradually increased if necessary. The cases which are benefited by this treatment are more apt to occur in feeble than in robust persons, and are the effect of a prolonged rather than an abrupt action of cold and dampness. It has also been used in *facial neuralgia*, but apparently with inferior results. Its utility in *syphilitic iritis* is well established; it has generally been employed as a substitute for mercury in cases for which this medicine was ill adapted.

In all forms of *chronic bronchitis* oil of turpentine has, like other terebinthinates, been largely used, formerly by internal administration, and more recently by inhalation. It is especially useful in both ways in cases of *fetid bronchitis* and *gangrene of the lung*, in both, doubtless, by stimulating the tissues to a more healthy action rather than by any disinfectant virtue. The superiority of oil of turpentine in the latter affection is certainly due to its stimulant virtues. An atomized solution of 15 drops of oil of turpentine in sufficient water is recommended to be inhaled for about 10 minutes every hour, day and night, in the treatment of *diphtheria* (Edel). Bosse claims to have treated this disease very successfully by oil of turpentine given internally in doses of 2 or 3 drachms a day (*Times and Gaz.*, Jan. 1881, p. 101). Satlow states that the first effect of the oil is to remove the fetor, and then to render the exudation looser, softer, and thinner, and cause it to be thrown off, leaving no trace behind it. The full action of the remedy occupies 3 or 4 days. Of forty-three cases treated by Satlow, only one died, and that was of a paralytic sequel of the disease. He advises that only freshly-prepared oil be employed, and that doses to the extent of a teaspoonful daily should be given to children under two years of age, and of a dessertspoonful to those between that age and five years, and to adults a tablespoonful, and that each dose should be followed by a draught of milk (*Centralbl. f. d. ges. Therapie*, i. 447). It is worthy of remark, first, that the use of this mode of treatment was discovered through a child affected with diphtheria having accidentally swallowed a tablespoonful of oil of turpentine; and, second, that the most plausible explanation of its utility is, that it not only acts directly upon the membrane, but also as a stimulant to the whole system, as it does in adynamic states generally. It has naturally been referred to the power of oil of turpentine to destroy disease-germs, but the explanation is as inadequate as it is unnecessary. The vapors of this oil are also reported to be very efficient in *whooping cough*. The accidental discovery of the power of oil of turpentine to prevent *phosphorus-poisoning* has saved many lives. The immediate administration of the antidote is of course desirable, not only to check the local action of the phosphorus, but also to prevent its absorption in a dangerous form. About 12 hours has been assigned as the limit within which the oil is efficacious. It is alleged that oil of turpentine which has become oxygenated by long exposure to the air is the most efficient, but results do not entirely agree upon this point. It must not be prescribed in an oily or albuminous vehicle, such as white of egg, milk, soup, etc., and neither mucilaginous nor alcoholic drinks should be allowed, but only water. If possible the oil should be given pure, floated on water or in capsules. If it cannot be retained by the stomach, it may be thrown into the rectum, and its absorption by the skin from liniments and epithems, and by the lungs from an atomized preparation or simply from the air of the chamber saturated with the fume of the soil, may be employed as supplementary means. The *dose* of oil of turpentine in the cases now considered is about 10 drops (Gm. 0.60) every hour.

Oil of turpentine has long been employed *externally* as a stimulant, rubefacient, and counter-irritant in *neuralgia* and in *acute and chronic rheumatism*. It is generally mixed with olive oil, chloroform, camphor, narcotic extracts, etc. Baths of the vapor of the oil are the most efficient means of applying it, or baths of hot watery vapor (104° to 113° F.) with which a fine spray of oil of turpentine is mingled. Warm water baths in which has been dissolved a mixture of 8 ounces of turpentine and 2 pounds of washing soda have also been used with good effect. The oil is of singular virtue in relieving *tympanites* and *colic* in various diseases, but especially when the intestinal distension is owing chiefly to atony of the bowels, as in typhoid fever. It is best applied, mixed with olive oil, to the skin, which should then be covered with flannel dipped in hot water and wrung nearly dry. In the treatment of *burns* this oil is most efficient. The affected part should first be bathed with the oil, and then covered with soft lint saturated with liniment of turpentine or ointment of turpentine, so as thoroughly to exclude the air. Turpentine epithems are also of marked utility in inflammations of the respiratory organs, including *laryngitis*, *bronchitis*, *pneumonia*, and *pleurisy*. They probably act both as revulsives and through the absorption of the oil. They have also been found efficient in the treatment of *phlegmasia alba dolens*. Traumatic *erysipelas* has been treated advantageously by the ointment just mentioned, and also by simple lotions of oil of turpentine. The same method is equally applicable in cases of *frost-bite* and of superficial *gangrene*. An emulsion containing equal parts of oil of turpentine and tincture of camphor is said to be an efficient dressing for *carbuncles*. Indeed, there are few ulcers of an indolent character that are not benefited by this oil, applied either alone or in an ointment or cerate, as in the simple or compound resin cerate. Ulcers resulting from *mercurial salivation* tend to heal after being touched by the pure oil or washed with an emulsion containing it. It has been used successfully in the treatment of *scabies* and in *ringworm of the scalp*, in the one case destroying the Acarus scabiei, and in the other the Microphyton tonsurans. Foulis states that the fetor of putrefying substances will not adhere to the hands if they are anointed with oil of turpentine (*Edinb. Med. Jour.*, xxvi. 133).

The dose of oil of turpentine as a stimulant is from 5 to 20 or 30 drops (Gm. 0.30–2) three times a day. Such doses are conveniently administered in gelatin capsules. As an anthelmintic from 2 or 4 fluidrachms (Gm. 8–16) may be given at intervals of half an hour until three or four doses are taken. These doses are usually prescribed in an emulsion, with the addition of oil of cinnamon, cajeput, or rosemary to diminish nausea. Besides the rubefacient preparations above mentioned, a very efficient one may be made with equal weights of oil of turpentine, acetic acid, and liniment of camphor.

TEREBENE has been employed with striking success as a substitute for carbolic acid in the antiseptic dressing of *wounds*, *ulcers*, *burns*, etc. It thoroughly deodorizes the secretions and protects the surface to which it is applied from the contact of the air. It is supposed, like carbolic acid; to destroy morbid germs, since it deprives vaccine virus of its activity. It has been applied pure, and also in the proportion of 1 part to 6 of olive oil.

OLEUM THEOBROMÆ, *U. S.*—OIL OF THEOBROMA.

Oleum theobromatis, Br.; *Oleum concretum e semine Theobromæ cacao*, F. Cod.; *Oleum* (*Butyrum*) *cacao*, P. G.—*Butter of cacao*, E.; *Beurre de cacao*, Fr.; *Kakaobutter*, G.

The fixed oil expressed from the seed of Theobroma Cacao, *Linné.*

Nat. Ord.—Sterculiaceæ, Buettnerieæ.

Preparation.—In the manufacture of chocolate a portion of the cacao-seeds are deprived of their fat by removing the shells, heating the kernels to about 70° C. (158° F.), and pressing them between hot iron plates; the expressed fat is usually run into rectangular moulds and allowed to congeal. The yield from the different varieties of cacao is from 35 to 45 per cent.

Properties.—Cacao butter is a yellowish fat, gradually turning white by age. It is sufficiently hard at ordinary temperatures to be broken into smaller pieces, but softens by the warmth of the hand and melts when taken in the mouth. It has an agreeable odor and a bland chocolate-like taste, dissolves in ether, acetic ether, and by the aid of heat in strong alcohol, separating again from the latter solution on cooling, with the exception of a small portion which remains dissolved. Its specific gravity is 0.96 to 0.98, but is given by some authors as low as 0.900. It melts between 30° and 35° C. (*U. S. P.*, *P. G.*), forming a pale-yellow, transparent liquid which congeals at 20.5° C. (69° F.), the temperature rising to about 26.5° C. (79.7° F.). The fusing-point of cacao butter obtained from different commercial varieties of seeds has been determined by Trojanowski (1875) and Lamhofer (1877), and found to vary between 30° C. (86° F.) and 33° C. (91.4° F.). Pelouze and Boudet observed it in one instance as low as 29° C. (84.2° F.).

Composition.—Cacao butter is easily saponified, and yields glycerin, oleic, stearic, and a little palmitic acid (Stenhouse, Specht, and Gossman). Kingzett (1877) pointed out the existence in this fat of an acid having the composition $C_{64}H_{128}O_2$, for which he proposed the name of *theobromic acid.* This acid could not be detected by Vander Becke (1880) and C. Traub (1883); the latter, in addition to the acids mentioned above, determined also the presence of lauric and arachic acids, and regards the firm consistence and low melting-point to be due to the proportions in which these glycerides are combined.

Adulterations.—When mixed with other solid fats the fusing-point and specific gravity do not afford reliable tests for determining such admixtures. The presence of tallow may be detected by burning the oil with a wick for a short time, and then extinguishing the flame, when a peculiar tallow-like odor will be observed. For the detection of adulterations Björkland (1864) proposed to dissolve 2 Gm. of the fat in 4 Gm. of ether at 17° C. (62.6° F.), and to immerse the test-tube containing the solution in water of 0° C. (32° F.); if pure, cacao butter will separate granules in not less than 3 minutes, but usually in 5 or 8 minutes; if adulterated with tallow or suet, a turbidity will appear at once or within 2½ minutes, according to the quantity of the adulterant, of which 5 per cent. may thus be detected. When the congealed mixture is exposed to a temperature of about 14.5° C. (58° F.) it will gradually become clear again if the cacao butter was pure, but not if it was adulterated. Trojanowski and Lamhofer proved the value of this test, which has been adopted by the U. S. P. According to Lamhofer, petroleum benzin may be substituted for the ether with nearly identical results, except that the pure oil separates rather more slowly and is always granular, while other fats render the entire liquid cloudy.

"The solution of 1 part of oil of theobroma in 2 parts of ether should remain clear if kept for a day at a temperature of 12° to 15° C. (53.6° to 59° F.)."—*P. G.* This is a modification of the test proposed by Ramsperger (1876), who states also that aniline shows adulterations with tallow and wax almost as well as ether does.

Off. Prep.—Cacao butter is an ingredient of all officinal suppositories, except three admitted by the "Additions to the British Pharmacopœia."

Allied Fats.—More or less odorous fats are expressed from the seeds of several species of Bassia (nat. ord. Sapotaceæ). Bassia longifolia, *Linné*, yields the greenish *elloopa* or *illoopa oil.* Bassia butyracea, *Roxburgh.* gives the tallow-like *fulwa butter.* The *mahwah butter* melts at about 45° C. (113° F.), is greenish or yellowish, and comes from Bassia latifolia, *Roxburgh.* These fats come from India. The *shea butter*, *galam butter*, or *bambuk butter* is obtained from Bassia (Butyrospermum, *Kotschy*) Parkii, *De Candolle*, of tropical Africa. It is pale-greenish or grayish, has a cacao-like odor and mild taste, and melts at about 28° C. (82.4° F.). The fleshy mahwah-flowers are used as food and for distilling a spirit; when dry they are said to contain 50 per cent. of sugar.

Mafura Tallow has also a cacao-like odor and a mild taste, but it is of a yellowish color and melts at 42° C. (107.6° F.). It is obtained by boiling the seeds of Trichilia emetica, *Vahl*, s. Mafureira oleifera, *Bertero* (nat. ord. Meliaceæ), of tropical East Africa.

Medical Action and Uses.—Oil of theobroma has been used internally, in doses of from 15 to 30 grains (Gm. 1–2), as a nutrient and emollient remedy in cases of chronic affections of the *lungs* and *bowels*, and externally as a dressing for excoriated surfaces, *wounds*, etc. Its mildness renders it superior to lard for the latter purposes, and it is more emollient than spermaceti. It is the most eligible material for making suppositories. Its slight tendency to become oxidized fits it to protect surgical and other steel instruments from being corroded by exposure to the air.

OLEUM THYMI, *U. S., P. G.*—Oil of Thyme.

Essence de thym, Fr.; *Thymianöl*, G.

The volatile oil distilled from Thymus vulgaris, *Linné.*

Nat. Ord.—Labiatæ.

Preparation.—The flowering herb is distilled with water or steam. The yield varies between ¼ and 1 per cent. The oil is largely produced in France, and enters commerce either in the crude state as *huile rouge de thym* (*red oil of thyme*), or rectified as *huile blanche de thym* (*white oil of thyme*). During the year 1876–77 the United States imported 32,707 pounds of the former and 863 pounds of the latter kind; in 1882, 50,914 and 16,486 pounds were imported. The red oil is frequently sold as *oil of origanum.*

Properties.—Crude oil of thyme is of a deep reddish-brown color; the rectified oil is colorless or yellowish, and is the kind directed by the pharmacopœias. It has a strong aromatic odor and a pungent, warm, and afterward cooling taste, dissolves in one-half its weight of alcohol, and varies in density between 0.886 and 0.905. It does not fulminate with iodine.

Composition.—The more volatile portion of oil of thyme consists of two hydrocarbons—*cymene*, $C_{10}H_{14}$, and *thymene*, $C_{10}H_{16}$. The former is also a constituent of oil of cumin (see p. 524). The latter boils between 160° and 165° C. (320° and 329° F.), is levogyre, and yields with hydrochloric acid gas a liquid compound The stearopten is *thymol*, $C_{10}H_{14}O$, which is probably formed by oxidation; at least, Lallemand (1854) reports having received considerable quantities of thymol by passing air through the mixed hydrocarbons for several months. By agitating the commercial oil with soda solution, Gerrard (1878) obtained only variable quantities of an oily liquid, but no solid compound, and on exposure to a low temperature no thymol could be obtained; he concludes from this that the thymol is probably frequently extracted from the oil. A similar experience was reported by J. L. Lemberger (1882), who obtained from the rectified oil less than 1 per cent., while two samples of red oil yielded 16.67 and 38.75 per cent. of crude thymol.

Tests.—The presence of thymol, according to Hager (1882), is conveniently ascertained by spreading half a drop of it, by means of a small cork, upon a glass slide, so as to occupy 4 or 5 square Cm. The thymol begins to separate within 3 or 4 minutes in the central portion of this liquid, in numerous minute bodies recognizable with the naked eye; subsequently they appear also toward the margin, but less numerous. Under the microscope they are at first amorphous, but after an hour or two are easily recognized as crystals. "The solution of oil of thyme in alcohol should not be colored yellowish-brown on the addition of a drop of test solution of ferric chloride."—*P. G.*

Allied Oil.—The volatile oil of Thymus Serpyllum, *Linné*, according to E. Buri (1879), contains two phenols which do not congeal at − 10° C. (14° F.), and of which one imparts a yellowish-green color to ferric chloride, and yields a sulphonic acid, the salts of which, like the thymol sulphonates, produce with ferric salts an intense blue color. Jahns (1880) reported also the presence of a little thymol and carvacrol.

Physiological Action.—*On Animals:* Experiment has proved that oil of thyme, added to certain fermentable liquids in the proportion of 1 part per 1000, arrests saccharine and powerfully retards lactic fermentation, and checks the various processes of decomposition, even when used in relatively small quantities. Nevertheless, according to Marey, it has a very feeble action as a "germicide." It was speedily fatal when injected into the blood-vessels of dogs or rabbits in an emulsion containing the oil in the proportion of from $\frac{1}{200}$ to $\frac{1}{100}$ of the vehicle. From three to twenty times this dose was administered subcutaneously and by the mouth without serious consequences. An emulsion containing from 2 to 5 per cent. of the oil injected into the abdominal cavity caused narcosis and death from respiratory paralysis. In such experiments the temperature of the animals declined from 2° to 6° C. Their blood was dark and fluid, but the proportion of its red corpuscles was not diminished. The urine contained albumen and hyaline casts (Küssner).

On Man: It is comparatively harmless when administered internally, not disturbing digestion, although it arrests gastric fermentation. It is ten times less poisonous than carbolic acid, and hence may be used even in equal quantities with a very inferior risk. Some persons find its taste and smell as repulsive as those of carbolic acid, but others claim for it an agreeable aromatic odor and flavor. When taken internally by sensitive persons it causes ringing in the ears, and even deep somnolence, and collapse.

The following record of experiments will illustrate these differences, showing that they depend very much upon the dose of the medicine: Küssner took about 15 grains (Gm. 1) of thymol in the course of 24 hours in the form of pills, each of which contained 1½ grains (Gm. 0.10) of the oil. The medicine was continued for 4 days. No change was observed in the respiration, pulse, temperature, or urine, but a slight burning sensation was felt in the stomach which continued for nearly a fortnight after the medicine had been suspended. Balz, on the other hand, who gave thymol internally in doses of "30 grains a day or less," states that in a few instances nausea and vomiting were caused; there was copious sweating, with ringing in the ears, deafness, constriction of the forehead, reduction of temperature, and frequently diarrhœa. Violent delirium occurred several times, and in one case of typhoid fever unconsciousness and alarming collapse.

Uses.—The applications of thymol in medicine and *surgery* are identical with those of carbolic acid, to which it appears to be in no degree inferior for all the purposes to which the latter is applied. It has over this acid the great advantage of possessing an agreeable instead of a very offensive odor, and of not being an irritant or corrosive, and therefore of not causing pain. An objection has been made to it that in summer it tends to attract flies to the injured parts. Among surgeons who have expressed a favorable judgment of its antiseptic qualities is Mr. Spencer Wells, who in a series of *ovariotomy* operations gave it the preference over carbolic acid. He used a solution of 1 : 1000 for spray, irrigation, sponges, instruments, and all other antiseptic purposes. It has been employed to correct the *fetor* of suppurating *burns* and *gangrenous wounds* and *ulcers*. Indeed, it has been found to be an excellent anodyne for recent burns in a solution of 1 : 1000 of water. Where sloughs exist it causes them to separate more rapidly than usual, leaving more healthy granulations and a better cicatrix than after carbolic acid. A solution of 1 : 3000 was found an efficient lotion in a case of violent *stomatitis* and in seven cases of *diphtheria*, in which it was injected into the nostrils and throat. A similar solution atomized is of great benefit in *fetid bronchitis*. Its agreeable taste and smell adapt it especially to the last-named purposes. In obstetrical practice when the *lochia* are offensive, and in cases of fetid urine or vaginal *leucorrhœa*, and even when the discharge is due to *cancer of the uterus, vagina*, or *bladder*, not only is the fetor neutralized, but the inflamed and ulcerated tissues are favorably modified. It is a very efficient and agreeable *deodorizer* for the hands of surgeons and obstetricians. In lesions of the vagina and other accessible parts a lotion should be used several times a day, and cotton satured with thymolized glycerin may be left in contact with the diseased structure. For these different purposes the solution should vary in strength from 1 : 1000 to 1 : 4000 (Seyferth).

Injected into dead bodies, it preserves them from decomposition; applied pure to *warts*, it causes them to shrivel and disappear. In *skin diseases* it has been found useful in the same cases for which tar has so long proved to be the best topical remedy—that is to say, in *psoriasis* and chronic *eczema*, but especially in the former—and it has the advantage over tar of not staining the bed- and body-clothing. It is recommended to apply it in an ointment consisting of 1 ounce of soft paraffin and from 5 to 30 grains (Gm. 0.30–2) of thymol, or in a lotion consisting of thymol 5 grains (Gm. 0.30), rectified spirit and glycerin each 1 ounce, water to make 8 ounces. In "ringworm" Morris advises as a lotion, thymol ʒss; chloroform ʒij; olive oil ʒvj (*Practitioner*, xxvi. 362).

Thymol has not been much administered internally except by inhalation, but it has been thought to act advantageously in doses of from 3 to 5 drops (Gm. 0.15–0.25) of a 1 per cent. solution in cases of *vesical catarrh* and of *infantile diarrhœa*.

As a substitute for the antiseptic surgical dressing prepared with carbolic acid a solution is recommended as follows: Thymol 1 Gm., alcohol 10, glycerin 30, water 1000 Gm. This solution has no corrosive action on instruments immersed in it; it causes, however, a lively sensation of burning, accompanied with redness of the skin, but not with anæsthesia, and it does not produce desquamation of the epidermis. Neither does it, like carbolic acid, give rise to constitutional symptoms, nor occasion as much discharge from wounds as carbolic acid does. As a substitute for carbolic acid in the antiseptic method of dressing wounds, its effects are reported to be excellent. After forty-one out of fifty-nine operations the secretion was serous in only eight and purulent in two; in the remainder there was absolutely no secretion. Many of these operations involved large surfaces or were for diseased joints, etc. According to Ranke, the results obtained with thymol (antiseptically considered) are as good as those with carbolic acid, while the former presents these advantages: that the secretion of wounds treated by it is much less, and their rate of healing much quicker. Moreover, it produces no bad effects upon the system at large, and does not irritate the parts to which it is applied in solution (*Medical Times and Gazette*, March, 1878).

OLEUM TIGLII, *U. S.*—Croton Oil.

Oleum crotonis, Br., P. G.—*Huile de croton, Huile de graines de tilly*, Fr.; *Crotonöl*, G.

The fixed oil expressed from the seeds of Croton Tiglium, *Linné*, s. Tiglium officinale, *Klotzsch.* Woodville, vol. v.; Bentley and Trimen, *Med. Plants*, 239.

Nat. Ord.—Euphorbiaceæ.

Origin.—This species of croton is common in the wild state as well as cultivated throughout Hindostan and some of the East Indian and Philippine islands, and has been introduced into Japan and other countries. It is about 15 or 20 feet (4.5–6 M.) high, has alternate petiolate, acutely-ovate, serrulate leaves, and terminal racemes of unisexual flowers. The fruit is a tricoccous capsule, nearly ¾ inch (18 Mm.) long, each cell containing a single seed.

Semen (Grana) tiglii, Semen crotonis.—Croton-seeds, *E.;* Graines de tilly, Petits pignons d'Inde, *Fr.;* Granatill, Purgirkörner, *G.*

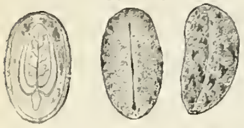
The seeds are about ½ inch (12 Mm.) long, oblong, flattened upon the ventral surface, and marked longitudinally by the slightly elevated raphe. The dorsal surface is rounded. Externally the seed is of a gray-brown color, mostly more or less mottled, or of a nearly uniform blackish color where the outer coat has been removed. The testa is brittle, and encloses an oily albumen of the shape of the seed and the thin foliaceous embryo. The seed is without odor, and has an oily afterward very acrid taste.

Preparation.—The fixed oil is obtained in India and in Great Britain by subjecting the seeds to pressure. The yield is between 50 and 60, or, according to other statements, between 30 and 40, per cent; the former amount probably refers to the kernels, the latter to the seeds, which are stated to yield from 33 to 36 per cent. of their weight of integuments. 5100 pounds of croton oil were imported into the United States in 1878, and in 1883 only 308 pounds.

Properties.—Croton oil from India is of a pale-yellow color; that made in England is of a more or less deep reddish-brown hue, the darker color being probably due to the greater age of the seed and to the higher temperature at which the oil is expressed. It has a slight, peculiar, somewhat rancid odor, and a taste which is at first mild, but afterward acrid and burning. Its reaction to test-paper is distinctly acid, and its consistence rather viscid. It is somewhat fluorescent, dissolves freely in ether, chloroform, carbon disulphide, and fixed and volatile oils, and varies in its behavior to alcohol, according to Warrington (1865) being more soluble in that menstruum when old and partly oxidized;

fresh croton oil requires about 60 parts of alcohol for solution. H. Senier (1878) ascertained that alcohol dissolves from freshly-expressed croton oil 20 per cent., and from such over three years old 60 per cent., and in 1883 showed that the portion insoluble in alcohol contains the purgative principle, while the vesicating principle is soluble in alcohol. The oil has a specific gravity of about .942, which increases with age to about .955. At a low temperature it separates white granules of fatty acid and congeals at about − 16° C. (3.2° F.). Exposed to air, it becomes more viscid, perhaps from the separation of fatty acids, and not from the presence of a drying oil, although, like the latter it is not solidified when in contact with nitrous acid.

Fig. 201.



Croton-seed: lateral and ventral view, and longitudinal section, showing embryo.

Composition.—The fats present in croton oil are glycerides of stearic, palmitic, myristic, and lauric acids, and of several volatile acids of the same series, like acetic, butyric, and valerianic acid; also the volatile *tiglinic acid*, $C_5H_8O_2$, which was recognized by Geuther and Frölich (1870), but had previously been observed by Schlippe (1858), who considered it to be identical with angelicic acid. However, it melts at 64° C. (147° F.), boils at 198.5° C. (389.3° F.), and is identical with Frankland and Duppa's methylcrotonic acid. In the fraction boiling above the temperature named, capronic, œnanthylic, or similar acids are probably present. They did not succeed in obtaining from croton oil an acid having the composition of Schlippe's *crotonic acid*, $C_4H_6O_2$. E. Schmitt (1879) corroborated these statements, and found among the volatile acids also formic acid. Schlippe's *crotonol*, $C_{18}H_{28}O_4$, has likewise not been obtained by other chemists; it was stated to be a yellowish viscid mass of a faint odor, and to be the rubefacient principle of croton oil. The drastic rubefacient properties, according to Buchheim (1873), reside in *crotonoleic acid*, which is present in the free state and as glyceride, and which seems to be related to ricinoleic acid, since, like the latter, it yields with nitric acid œnanthic acid, and on the distillation of its sodium salt gives œnanthol. But H. Senier has shown (1883) that the oil may retain its purgative action and may be deprived of vesicating properties (see above); the latter do not reside in the free acids present, nor in any basic constituent, but exist in a fat which is not readily saponifiable, and yields an acid of low melting-point and forming a lead salt soluble in ether.

Tests.—The process of Schlippe for preparing crotonol afforded us (1860) the means of detecting croton oil in other oils. The suspected oil is agitated with a solution of soda or potassa in dilute alcohol; the alcoholic liquid is separated, neutralized with hydrochloric acid, and a little of the oily layer separating is applied upon the arm, when in a few hours redness and the peculiar pustular eruption will appear. Should the quantity be small, the liquid is acidulated, agitated with ether, the ether evaporated, and the residue applied. Senier's observations explain the rationale of this process. The *Br. P.* requires croton oil to be entirely soluble in alcohol.

Allied Oils.—(See Curcas, page 532.) The oil obtained by bisulphide of carbon from the seeds of Euphorbia Lathyris, *Linné*, has been recommended by Zander (1878) as a cheaper substitute for croton oil.

Off. Prep.—Linimentum crotonis, *Br.*

History.—Our knowledge of this medicine was derived from the Orientals through the Arabians, it having been used from time immemorial in Hindostan as a purgative and external irritant. It was introduced into Europe in 1820.

Physiological Action.—*On Animals:* The seeds, reduced to a paste and administered to dogs, produce painful purging, and after death evidences of violent inflammation of the mucous membrane of the stomach and intestine are discovered. In Java they are employed for killing fish. The oil given to dogs acts rapidly as an emeto-cathartic. When injected into a vein by one experimenter, 5 drops caused vomiting and purging, and death in 2 hours. The stomach and intestine were inflamed. The same experiment performed by others indicated an action of the oil in depressing the heart and the nervous system, but gave no evidence of irritation of the alimentary canal before or after death.

On Man: A croton-seed, when chewed, has a sweet and oily taste, followed by a bitter and acrid savor and salivation; nausea, eructation, flatulent distension of the abdomen, colic, and diarrhœa follow. A single seed is reported in one case to have proved fatal. The oil, in the dose of 1 drop, occasions more or less of an acrid and burning sensation in the fauces and œsophagus, a sense of warmth in the stomach, nausea, and sometimes vomiting. In an hour or two some gurgling or slight colic is perceived in the bowels, followed somewhat suddenly by a watery stool with tenesmus, and heat about the anus.

Within 24 hours eight or ten more stools follow, and there is but little general disturbance of the economy, except considerable weakness. Sometimes, instead of producing evacuations, the oil causes epigastric uneasiness and oppression, palpitation of the heart, headache, feverishness, perspiration, and sleep. It would appear that the acrid principle of the oil is not the sole cause of its cathartic operation, for even after being thoroughly washed with alcohol and rendered mild to the taste, as well as incapable of pustulating the skin, it is still strongly purgative. When given in enema in the dose of 3 or 4 drops, croton oil operates purgatively.

In excessive doses this oil may act as a violent and fatal poison, producing severe pain and general collapse, without loss of consciousness. After death no lesion of the stomach or intestines may be found. There are, on the other hand, cases in which recovery has followed excessive doses. For example, a girl six years old having swallowed about 46 grains of croton oil mixed with milk and coffee, and when the stomach was empty, suffered acute gastric pain and violent and profuse vomiting. The emesis probably saved her life. In an other instance a woman 2 days after confinement took "over 2 teaspoonfuls of croton oil." No vomiting ensued, but violent purgation and collapse. Recovery took place, but the woman shed her finger- and toe-nails (*Richmond and Louisville Med. Jour.*, xiii. p. 651). In the case of an habitual drunkard who swallowed "a little less than 2 drachms of croton oil in a glass of whiskey" there was active vomiting, but no purgation, and some hours later the man was found dead. On examination the whole visceral peritoneum was of an intense dark-red color and the gastro-intestinal mucous membrane was of a like hue and almost disorganized (*Amer. Jour. of Med. Sci.*, Apr. 1874, p. 416). A woman in the seventh month of pregnancy took about 2 drachms of croton oil in the course of 2 hours. She too was collapsed after violent purging (without vomiting), and fell into labor; her child was born without assistance, and the woman recovered (*Phila. Med. Times*, xi. 370).

Externally, croton oil rubbed upon the skin occasionally produces purgation. Its ordinary effects are, however, local. In general, it brings out, after a few hours, an eruption of minute red pimples, which are always more numerous in proportion to the vascularity and delicacy of the skin, and are gradually converted into pustules, generally of an acuminated or rounded shape, but some are flattened and umbilicated; many are confluent. A red areola surrounds each of them, and they cause severe burning and itching. They augment for three or four days, and then remain stationary. Some break and others wither away. If numerous, they may form thick and extensive crusts. These are thrown off between the sixth and the twelfth day, and leave no cicatrix behind them. The endermic inoculation of the oil causes small but painful abscesses.

Uses.—In obstinate *constipation* of the bowels, and when there exists no contraindication arising from inflammation or structural alteration, croton oil is an appropriate purgative. But the observance of these conditions is very important. The oil is most appropriate when bulky doses are objectionable, and when the patient resists the administration of more usual cathartics. Of the former sort are cases of intestinal obstruction from accumulated fæces produced by simple torpor of the bowels, diseases of the nervous centres, the poison of lead, etc. Of the latter are the frequent instances of a refusal to take medicine among children and insane persons, but the oil should rarely be given to children. It is customary to administer it to the insane in milk broth—a most vicious and inhuman practice, since it arouses suspicion or an aversion to articles upon which the patients' lives may depend. In *lead colic* it has, to a great extent, superseded other purgatives. It should be given in the dose of 1 drop (Gm. 0.06) daily or twice a day, and need not interfere with the simultaneous use of narcotics internally and externally. Like other active purgatives, it has been employed to expel *tæniæ*, and it is even said to have done so when mixed with olive oil and rubbed upon the abdomen; but many surer remedies for these parasites exist. In like manner, it has been given successfully as a drastic purgative in different forms of *dropsy*, but it is unnecessarily harsh. Its irritant substitutive action has been invoked in *dysentery*, but safer and less harsh remedies are to be preferred. In *apoplexy* it is customary to employ it for its depletory revulsive action and for the convenience of its administration during the stupor of the attack. If the attack is one of congestive apoplexy, denoted by turgor of the face, laboring heart and pulse, etc., purgation is generally indicated, but in an opposite condition it is contraindicated.

Externally, croton oil has been used to relieve cerebral symptoms following the suppression of a cutaneous eruption and other causes; and in the various forms of *meningitis* it is the most efficient mode of counter-irritation of the scalp. It is less painful than tartar-emetic pustulation, and more permanent in its action than cantharides. It is an efficient counter-irritant in spinal *neuralgia*, but is objectionable on account of the difficulty of restricting its action to a definite area. It has been more successful in *sciatica* than in any other form of neuralgia. For this affection it has also been recommended internally, but upon less substantial grounds. It has been applied locally in chronic articular *rheumatism*, and is undoubtedly one of the best of the topical remedies for the disease. Its moderate but steady counter-irritation renders it peculiarly valuable in cases of *chronic bronchitis* and *chronic laryngitis*.

Tinea tonsurans, or ringworm of the scalp, has been treated successfully by croton oil, which is applied pure until the characteristic eruption appears, when a poultice is used to soften and remove the crusts of the original disease and those produced by the oil. It is recommended, when a large portion of the scalp is involved, that a small portion only should be treated at a time, on account of the irritation and fever which usually are excited. The conditions favorable to the success of this treatment are, however, far from definite.

Administration.—Croton oil may be given in emulsion or mixed with some other oil or in pill. Of these forms the last is to be preferred. The *dose* is from ¼ drop to 2 drops (Gm. 0.016–0.13). The following is a safe and convenient prescription: Add to 2 drops (Gm. 0.12) of croton oil enough alcohol to dissolve them, and then bread-crumb in sufficient quantity. Make from four to eight pills, and direct one to be taken every hour or two. Externally, the oil may be applied by means of a feather, brush, or other convenient instrument, and friction made with a rag until the skin becomes dry. It may be used pure or mixed with castor oil, olive oil, soap liniment, alcohol, or ether; or a piece of muslin somewhat smaller than one of adhesive plaster may be attached to the latter, and moistened with the oil before being applied to the skin. A mixture of 1 part of croton oil with 7 of oil of turpentine is more rapid in its action than the oil alone.

As antidotes to the *poisonous* effects of this oil, milk, olive oil, mucilage, gelatin soup, etc. may be given to envelop the acrid substance, and if it cause a tendency to collapse, opium and alcoholic liquids and warm stimulating baths should be employed.

OLEUM VALERIANÆ, *U. S.*—OIL OF VALERIAN.

Essence de valériane, Fr.; *Baldrianöl*, G.

The volatile oil distilled from the root of Valeriana officinalis, *Linné*.

Nat. Ord.—Valerianaceæ.

Preparation.—The volatile oil is obtained by distilling the crushed root with water or steam. The yield varies between ½ and 2 per cent., and is largest from valerian grown in dry localities. 5 pounds of oil of valerian were imported into the United States in 1876, and 167 pounds in 1878.

Properties.—When recently distilled from fresh root the oil of valerian is of a greenish or yellowish color, limpid, of a mild odor, and of a neutral reaction. On exposure to air it becomes deeper yellow and brown, viscid, and acquires a strong odor and an acid reaction. Old roots yield at once a dark, acid, and strongly odorous oil. Its taste is aromatic, somewhat camphoraceous, not burning; its density is near 0.94. It is readily soluble in alcohol, does not fulminate with iodine, and becomes purplish-black with ethereal solution of bromine, dark-red with sulphuric acid, purplish-red with hydrochloric acid gas, and blue with nitric acid.

Composition.—The latest investigation is by G. Bruylants (1878), who ascertained some new facts. The hydrocarbon, $C_{10}H_{16}$, was named *borneene* by Gerhardt (1841) and *valerene* by Pierlot (1859). The *valerol* of the latter differed from Gerhardt's valerol, $C_6H_{10}O$, which he believed to become oxidized in contact with air to *valerianic acid*, carbonic acid being given off at the same time. Bruylants explains the generation of valerianic acid in old oil of valerian from the decomposition of $C_{10}H_{17}.C_5H_9O_2$, which is the valerianic ether of borneol; besides this one, it contains the corresponding ethers of formic and acetic acids, the alcohol *borneol*, $C_{10}H_{18}O$, and its ether, $(C_{10}H_{17})_2O$. Gerhardt assumed the production of borneol from the hydration of borneene. (See OLEUM CAMPHORÆ, page 367.)

Medical Action and Uses.—In experiments upon animals with poisonous doses of this oil it appeared to blunt the reflex excitability after having primarily stimulated it, and to produce a similar effect when the same function was previously excited by strychnia. It has been used with advantage in *hysteria*, *chorea*, and even in *epilepsy*;

but it is most efficient in the first-named disease, and in the various functional nervous derangements which, without constituting hysteria, are nevertheless hysterical. It may be prescribed in *doses* of 1 drop (Gm. 0.06) and upward in pill, emulsion, or alcoholic solution.

OLIBANUM.—FRANKINCENSE.

Gummi resina olibanum, Thus.—Oliban, Encens, Fr.; *Weihrauch*, G.

From Boswellia Carterii, *Birdwood*, and other species of Boswellia. *Trans. Linn. Soc.*, xxvii. t. 29, 30, 31; Bentley and Trimen, *Med. Plants*, 58.

Nat. Ord.—Burseraceæ.

Origin.—The genus Boswellia is confined to India, Southern Arabia, and Eastern Africa. It comprises trees with imparipinnate leaves, serrate leaflets, small, racemose, decandrous flowers, and three-celled drupaceous capsules containing three seeds. The different species are still imperfectly known. B. Carterii may possibly be a polymorphous species, or several forms at present regarded as mere varieties may be distinct species, which grow only in two limited districts in South-eastern Arabia and in the Somali country of Eastern Africa. B. papyrifera, *Richard*, indigenous to Nubia and Abyssinia, yields a similar product, which, however, is not collected. B. thurifera, *Colebrook* (B. serrata and B. glabra, *Roxburgh*), affords a soft odorous resin which is used in India as incense. The fragrant resin of B. Frereana, *Birdwood*, of the Somali country, is used in the East as a masticatory.

Collection.—The collection of olibanum in the Somali country was described by Cruttenden (1846), and in Arabia by Carter (1847), who had visited these countries three years previously. Deep incisions are made from which a milk-white exudation flows, which gradually hardens, and is then collected. Olibanum enters commerce by way of Bombay. Over 80,000 pounds were imported into the United States in 1882.

Description.—Olibanum consists of roundish, oblong, or irregular-shaped separate tears. These vary in diameter between ⅛ and ½ inch (3–12 Mm.) or more, and are nearly colorless, pale-yellowish, or of a reddish hue, and covered with a whitish powder, resulting from the attrition of the pieces. When broken they exhibit a flat scarcely conchoidal fracture and a waxy lustre. Olibanum has a balsamic somewhat terebinthinate odor, softens between the teeth, and has a balsamic and slightly bitter taste. Triturated with water, it yields a white emulsion; alcohol dissolves the greater part of it. When heated it becomes soft and burns, diffusing an aromatic odor.

Olibanum of inferior quality is more deeply colored, often opaque, and more or less mixed with fragments of bark and other impurities.

Constituents.—By distillation with water a volatile oil is obtained varying in quantity from 4 (Stenhouse, 1840) to 7 per cent. Kurbatow (1871) found it to consist of *olibene*, $C_{10}H_{16}$, and an oxygenated portion boiling above 175° C. (347° F.). Olibene is the chief constituent of the oil, boils at about 157° C. (314.6° F.), has a turpentine-like odor, and yields with hydrochloric acid gas a crystalline compound. The resin amounts to 56 (Braconnot, 1808), or as much as 72, per cent. (Kurbatow), and, according to Hlasiwetz (1867), has the composition $C_{20}H_{30}O_3$. The gummy matter contained in olibanum was found by Hekmeijer (1858) to agree in behavior with gum-arabic.

Pharmaceutical Uses.—Olibanum is a constituent of most *fumigating powders*, for which there are a large number of formulas in existence; they contain also benzoin, storax, mastic, amber, cascarilla, orris-root, santal-wood, or other odoriferous drugs, which are reduced to a coarse powder, and when used thrown upon a heated surface. *Fumigating pastilles* are made of a similar composition, and should contain about 40 per cent. of ligneous material or charcoal and from 5 to 8 per cent. of potassium nitrate; the finely-powdered ingredients are well mixed, formed into a mass with mucilage of tragacanth, and then moulded into the desired shape.

Medical Action and Uses.—Although no longer officinal in either the United States or the British Pharmacopœia, olibanum is one of the most ancient, as it once was one of the most valued, of medicines. It was the frankincense of which so much is said in the Old Testament, and which was used by the Egyptians in embalming; it is spoken of in the Hippocratic writings as an expectorant in bronchial catarrh and in infantile asthma, as useful in expelling the lochia and promoting menstruation, as an ingredient of injections for leucorrhœa, and of ointments for various ulcers, including those caused by burns. Later it was applied in ointments to *chilblains, cutaneous eruptions*, and *inflammations of the eyes*. More recently it was an ingredient of various stimulating plasters, and its fragrant fumes were used to conceal *unpleasant smells*. The *dose* is stated to be from 30 to 60 grains (Gm. 2–4) given in emulsion.

OPIUM, *U. S., Br., P. G.*—OPIUM.

Meconium, Succus thebaicus.—*Opium*, E., Fr., G.

The concrete milky exudation obtained in Asia Minor from the unripe capsules of Papaver somniferum, *Linné*, by incision and spontaneous evaporation. Bentley and Trimen, *Med. Plants*, 18.

Officinal Forms of Opium.—OPII PULVIS, *U. S.*—Powdered opium, *E.;* Poudre d'opium, *Fr.;* Opiumpulver, *G.*—Opium dried at a temperature not exceeding 85° C. (185° F.), (60° C. = 140° F. *P. G.*), and reduced to a moderately fine (No. 50) powder. Powdered opium, for pharmaceutical or medicinal uses, should contain not less than 12 nor more than 16 per cent. (not less than 10 per cent. *P. G.*) of morphine when assayed by the process given under OPIUM. Any powdered opium of a higher percentage may be brought within these limits by admixture with powdered opium of a lower percentage in proper proportions.—*U. S.*

OPIUM, *U. S.*, *Br.*, *F. Cod.*, *P. G.* Opium in its normal moist condition should yield not less than 9 per cent. (after drying, 9.5 to 10.5 per cent. *Br.*) of morphine.—*U. S.*

OPIUM DENARCOTISATUM, *U. S.*, OPIUM DENARCOTINATUM.—Denarcotized opium, *E.;* Opium denarcotiné, *Fr.;* Denarcotinirtes Opium, *G.*—Denarcotized opium, when assayed by the process mentioned below, should yield 14 per cent. of morphine.—*U. S.*

Origin and Production.—The poppy-capsule, which is described elsewhere (see PAPAVER), contains under the epidermis a large number of laticiferous vessels which are variously branched and interlaced, and in the unripe state of the fruit are filled with a white milk-juice, which escapes when an incision is made. For its successful cultivation the poppy requires a deep, rich, and well-manured soil, and considerable attention until the plant has sufficiently matured to permit of the collection of the milk-juice. A few days after the petals have fallen the green capsule is scarified, with the precaution of not cutting entirely through the capsular integuments, as the juice would then flow into the capsule and be lost. In Asia Minor and Egypt one or two incisions are made transversely near the middle of the capsule, so as to run spirally around it. In India three or four vertical incisions are made from the base to the apex and on different sides of the capsule, the instrument used for the purpose, called *nushtur*, being a three- or four-bladed knife protected by means of twine, so as to prevent the blades from penetrating too deeply. The scarifications being made in the afternoon, the milk-juice is ready for collection the next morning, when its color will have changed from white to brown. The juice is then carefully scraped off with a knife, which is moistened from time to time with water, or in Asia Minor by drawing it through the mouth; in Persia oil is used to prevent the juice from adhering to the scraper.

In Asia Minor the juice is transferred to a poppy-leaf and formed into cakes varying greatly in size—from a few ounces to 2 pounds or more in weight. These soft cakes are subsequently often mixed together for the purpose of obtaining larger cakes, which are surrounded by one or two wilted poppy-leaves, afterward packed with a considerable quantity of the dry fruits of a species of Rumex, thus preventing the cakes from adhering to one another, and then transported to Smyrna or Constantinople, whence the European and American markets are chiefly supplied.

In *Egypt* opium is collected and prepared for the market in a manner similar to that just described. The production in that country at one time considerably declined, but has increased since Gastinel Bey (1865) proved that opium equal in quality to that of Asia Minor could be gathered by bestowing sufficient care upon the cultivation of the plant.

The juice gathered in *India* is usually quite soft in consequence of dew, and after collection separates a dark-colored fluid called *passewa*, which, together with the washings of vessels and some opium, is evaporated to a thick liquid called *lewa*, and this is employed in agglutinating the poppy-petals together, so as to form an envelope, and, after drying, a rather hard shell for the protection of the opium. The opium, which is moulded into spherical balls, requires much attention until it has been sufficiently dried for preservation. Each ball weighs a little over 4 pounds; forty of these are packed in separate compartments in a case, and are mostly exported to China. In the commerce of India this is known as *provision opium*; for home consumption the juice is evaporated by the heat of the sun and formed into square or sometimes circular cakes, which are wrapped in oiled paper.

Persian opium is formed into cylindrical sticks about 6 inches long, each of which is wrapped in paper, or into cones or small balls about 1½ inches in diameter, the wrapper of which is sometimes marked with Chinese characters. Since 1856, Persian opium has been sent to Constantinople, and there worked over so as to resemble that of Asia Minor. At the present time it is frequently seen in European commerce, and it is imported in considerable quantity into the United States to be used in the manufacture of morphine. It often comes in cakes weighing 1 or 1½ pounds, which are oily and always packed in *poppy trash*—*i. e.* the dried stalks and capsules ground into coarse powder.

China produces a large quantity of opium, all of which is consumed in that country: in addition it consumes notable quantities imported from Persia, as well as by far the largest portion of the opium which is exported from India. The samples which we have seen were flattish-globular in shape and wrapped in white paper; one specimen was oily, though less so than Persian opium, and another, to judge from its black-brown color, was prepared by the aid of artificial heat, though free from empyreuma.

In *Japan* the milk-juice is obtained by the longitudinal scarification of the poppy-capsules, and the opium is formed into flat cakes which are wrapped in paper.

Numerous experiments have been made in *Europe*, and opium of excellent quality has been obtained as far north as Sweden; but European opium is not an article of commerce, and its production appears to very limited. It is stated that Aubergier calls the opium raised by him in France *affium*, and that it is formed from the agglomeration of tears exuded from the incisions and entirely free from foreign admixture.

In *Algeria* opium has been produced since 1828—in limited quantities, however, and insufficient to be of any commercial importance. Rohlfs (1866) found an extensive culture of opium in the oasis of Tuat in the northern part of the great African desert.

Opium has also been raised experimentally in Victoria, *Australia*, and was stated by Mr. Bosisto (1876) to be of good quality.

About the year 1812 opium of fair quality was produced in the *United States*, chiefly, if not exclusively, in New England. After the close of the war the cultivation had to be abandoned—as it appears, mainly because the product became unsalable in consequence of extensive adulterations; more recently, however, opium-culture again attracted attention, more particularly during the late Civil War, when the drug was successfully produced in Virginia, Tennessee, and South Carolina. Prof. Porcher (*Resources of the Southern Fields and Forests*, p. 26) states that in the climate of South Carolina and Georgia the poppy should be planted in September; the plants are not killed during the winter; they thrive in the early spring, and the capsules are ready for incision in May. Several attempts made to obtain the poppy by planting in April and May failed, the seeds not coming up. A "garden square" yielded him 330 grains of very dry opium of excellent quality.

In Asia Minor the poppy-seed is sown at intervals from November to March. By following this course failure from frosts or other causes is guarded against, and the maturing of the poppy-heads is extended over a certain length of time. Since by the circular incisions made there all or nearly all the laticiferous vessels are cut, a second scarification is generally unprofitable, while an additional quantity of milky juice is usually obtained on repeating the vertical incisions after a day or two.

The *variety of poppy* cultivated in Asia Minor is the black, which has usually purple flowers and black, though occasionally white, seeds. This variety is that also which, in the experience of Aubergier in France and of Behr and Biltz in Germany, yields opium richer in morphine than that produced from the white-flowering and white-seeded poppy. The latter is, however, by some persons considered more advantageous for collection, and appears to be the only kind cultivated in Egypt, Persia, India, China, and Japan.

The *importation* of opium by the United States has of late years been steadily increasing; it amounted to 135,305 pounds in 1867, and rose to 385,060 pounds in 1881. Of opium prepared for smoking, 12.603 pounds entered the United States in 1870, and 298,153 pounds in 1883.

Description.—Opium is in subglobular, usually more or less flattened, irregular cakes, which are externally of a chestnut-brown or somewhat darker color, and bear on the surface the impressions of the veins of the poppy-leaf in which they had been enveloped; fragments of the leaf and some fruits of a Rumex are generally adhering to the surface. The whole mass is usually plastic, but on keeping a harder external crust is formed, while the interior portion retains its moist condition for a long time. When broken, some tears are usually observed in the interior, together with fragments of vegetable tissue which have been detached in scraping off the milk-juice. The cakes weigh from about 4 ounces to 2 pounds. The odor of opium is heavy and narcotic, its taste disagreeable and bitter. Examined under the microscope, some needle-shaped crystals are observed, but most of it consists of an amorphous or granular mass, aside from the vegetable tissue present. The crystals are best observed after the dry opium has been well moistened with benzol.

Smyrna, Turkey, or Constantinople opium is the only variety recognized by the different pharmacopœias and met with in American commerce. It has been stated above that Persian opium is often imported for the manufacture of the alkaloids. It is oily from the manner in which it has been collected. Its other distinctive characters and those of East Indian opium have already been briefly described. Both varieties contain usually a larger number of crystals than Turkey opium, and these crystals may not unfrequently be seen with the naked eye or by the aid of a lens.

Adulterations.—The principal admixtures observed by us in Turkey opium were pebbles, shot, and lead balls introduced into the interior of the cakes. When present these admixtures generally amount to several ounces, but are only occasionally seen. Of greater importance appears to be the introduction of excessive quantities of vegetable tissue during the collection of the juice, but it is impossible to estimate its quantity or state its allowable limits. Coarse adulterations, such as the aqueous extract of the poppy-plant and of the herb Glaucium luteum—which, according to Landerer, is sometimes made in Turkey—are rarely, if ever, seen in the imported opium, and are readily detected by the darker color and the hygroscopic nature of the product, and by the uninterrupted streak which it leaves on being drawn over paper, while good opium makes an interrupted mark. Such partly factitious opium, or fraudulent substitution of an extract having a narcotic odor, for opium said to have been of American origin, was noticed by Procter (1869) and Ebert (1873). Various kinds of resinous, saccharine, mucilaginous, and amylaceous substances, ashes, clay, gypsum, litharge, and sand, have been employed for like purposes, and occasionally opium has been met with in the market which contained so little morphine and other alkaloids as to lead to the inference that these principles had been extracted. Another impurity is an excessive amount of moisture. Squibb (1860) estimated the average loss in drying to be 19.5 or 20 per cent., and in drying and powdering 20 to 21 per cent. From a record of nearly 12,000 pounds of opium, nearly the whole of which was directly obtained from importers, we find the average loss to have been 21.2 per cent.; in some exceptional cases as high as 28 or as low as 15 per cent. Bengal provision opium contains 30 per cent. of moisture.

Examination.—Hager suggested the following course for determining the presence of adulterations: The sample is dried and powdered, and 25 grains of the powder are triturated with ½ ounce of boiling water; the formation of a stiff paste or mucilaginous liquid would indicate the presence of starch, flour, gum, or salep. 2 ounces of water are added, and the liquid filtered; the filtrate should be of a wine-yellow color, indicating the absence of liquorice or other aqueous extracts, which would impart to the filtrate a brown color; the liquid should likewise have an acid reaction, otherwise the admixture of chalk, litharge, or ashes may be inferred. On evaporating the filtrate to 1 ounce, ferrocyanide of potassium or the addition of twice its bulk of alcohol should not cause any precipitate; the former test would indicate the presence of salts of heavy metals; the latter an adulteration with gum or certain salts. The insoluble residue of opium left on the filter after washing and drying should weigh between 10 and 11½ grains; should it weigh more, sand, clay, or other insoluble substances may be present, and in case it weighs less, sugar, gum, or other soluble impurities are indicated. On agitating powdered opium with chloroform the mineral impurities and starch settle to the bottom, and the latter acquires a blue color on the addition of a little iodine. Mineral impurities are likewise indicated by the amount of ash left, which for genuine powdered opium is about 6 per cent., varying, however, between 4 and 8 per cent. The U. S. Pharmacopœia directs the estimation of the extract prepared with cold water from 100 parts of opium previously dried at 105° C. (221° F.); when evaporated to dryness the extract should weigh between 55 and 60 parts.

Constituents.—Opium is entirely free from starch and tannin. Among the principles ordinarily found in plants the following have been observed in opium: An odorous principle soluble in ether, benzol, and petroleum benzin; glucose, gum, pectin, a compound resembling caoutchouc, wax, fat, a small amount of resin, coloring matter, and that indefinite substance usually designated as extractive. The mineral constituents average 6 per cent., and 55 or 60 per cent. of dry opium is soluble in water, but the pure milk-juice, entirely free from vegetable tissue, yields a larger percentage to water.

The most important as well as the most interesting constituents of opium, however, are the alkaloids; in fact, the first vegetable alkaloid discovered was obtained from opium. In 1816, after a patient investigation extending over 11 years, Sertürner, apothecary at Eimbeck in Northern Germany, announced the discovery of *morphium.* He recognized this principle as a salifiable base, in some respects related to ammonia. A crystalline powder, probably morphine or containing it, was obtained by Ludwig as early as 1688, and was named *magisterium opii;* and in 1803, Derosne obtained this principle by precipitating the aqueous infusion of opium with ammonia, but regarded it as identical with his *salt of opium* (narcotine), which crystallized from the concentrated infusion. Seguin (1804) had likewise observed it. Since Sertürner's discovery a large number of alkaloids have been isolated from opium, which, arranged in the odor in which their isolation was announced, are as follows:

1. NARCOTINE, $C_{22}H_{23}NO_7$, was discovered by Derosne (1803), but its basic nature was first shown by Robiquet (1817). It may be extracted with ether from the precipitate produced by ammonia in the aqueous infusion of opium, and from the insoluble residue of the latter by exhausting it with hot acetic acid. It crystallizes in colorless shining rhombic prisms or white needles, which are tasteless and dissolve at about 15° C. (59° F.) in 100 parts of 85 per cent. alcohol, 33 parts of absolute ether, 2.7 parts of chloroform, 310 parts of amylic alcohol, or in 22 parts of benzol. The alkaloid requires 7000 parts of boiling water for solution, is insoluble in cold dilute acetic acid, is a weak base, and yields mostly uncrystallizable salts, which have a bitter taste and an acid reaction. Chloroform dissolves the alkaloid from the aqueous solutions of its salts (Dragendorff). Its solution in cold sulphuric acid is colorless, but turns slowly to yellow, orange, and red; it gives a blood-red color with a mixture of sulphuric and nitric acids. The alkaloid melts at 176° C. (349° F.). When boiled for a long time with water or heated with nitric acid, it is decomposed into *meconin*, $C_{10}H_{10}O_4$, and *cotarnine*, $C_{12}H_{13}NO_3$, which is a stronger base, soluble in ammonia, fusible in boiling water, and, on being boiled with very dilute nitric acid, is converted into *cotarnic* and *apophyllic acids*, the latter containing nitrogen. On heating narcotine with binoxide of manganese and dilute sulphuric acid, cotarnine is obtained, and in addition thereto *opianic acid*, $C_{10}H_{10}O_5$, which crystallizes in needles and fuses at 140° C. (284° F.). When heated with hydrochloric or hydriodic acid, it parts with one, two, or three methyl groups (CH_2), and yields new bases. Wright and Beckett (1876) showed that it may be converted into *vanillin.* According to Wegscheider (1883), opianic acid, heated above its melting-point, yields an anhydride, $C_{30}H_{28}O_{14}$, which by moderate fusion with potassa is converted into meconin and *hemipinic acid*, $C_{10}H_{10}O_6$, and on treating the latter under pressure with HCl, isovanillic and protocatechuic acids are obtained.

2. MORPHINE, $C_{17}H_{19}NO_3$, discovered by Sertürner (1816), is described in another place (see page 990); also its derivative, *apormophine* (page 220). On heating its hydrochlorate with silver nitrate to 60° C. (140° F.), *oxymorphine* or *pseudo-morphine* is formed (see below). In the presence of ammonia and air morphine is oxidized to *oxydimorphine*, $C_{34}H_{36}N_2O_6$, which is also obtained from morphine by the action of potassium permanganate, potassium ferricyanide, or nitrites (Broockmann and Polstorff, 1880).

3. CODEINE, $C_{18}H_{21}NO_3$, was discovered by Robiquet (1832), and by Grimaux (1881) prepared from morphine by heating it with methyl iodide and soda; it is therefore *methylmorphine.* (For description see page 481.) A number of interesting derivatives have been prepared from this alkaloid, which, however, with the exception of apomorphine, have not been medicinally employed. The melting-point of codeine is 155° C. (311° F.), as given by the German Pharmacopœia, not 150° C., as determined by Robiquet (Hesse, 1883).

4. NARCEINE, or *narceia*, $C_{23}H_{29}NO_9$, discovered by Pelletier (1832), is in long quadrangular prisms or white silky needles, which have a slight bitter taste, melt at 145.2° C. (291.6° F.), are insoluble in ether, and are sparingly soluble in cold alcohol and water. Fröhde's reagent renders it brown-green, yellow, afterward reddish. Erdmann's test produces a deep-yellow, brown-yellow, and finally a deep-orange color. Iodine not used in excess produces a blue color, nitric acid a rapidly-fading yellow color. The blue color obtained by Pelletier on the addition to narceine of strong hydrochloric acid and a small portion of water is not observed with the pure alkaloid, according to Winckler, Anderson, and others. Narceine is a weak base, and yields crystallizable salts which are mostly not freely soluble in water or are decomposed by water, the hydrochlorate yielding a highly basic salt (Wright and Beckett, 1876).

5. PSEUDOMORPHINE, also called *phormine* and oxydimorphine, $C_{34}H_{36}N_2O_6$, was discovered by Pelletier and Thibouniery (1835), and is probably present in opium after

exposure to ammoniacal vapors. It is a derivative of morphine, and is readily formed by warming an aqueous solution of morphine nitrite to 60° C. (140° F.) and crystallizing from ammonia-water. Hesse (1883) gives to the alkaloid the formula $C_{17}H_{17}NO_3$, and states that it absorbs water on exposure. It is a fine crystalline powder, is insoluble in water, alcohol, ether, and chloroform; dissolves in acetic acid; yields with hydrochloric acid a salt sparingly soluble in cold water; and is colored red by nitric acid and blue by ferric chloride, in which behavior it resembles morphine.

6. Thebaine, or *paramorphine*, $C_{19}H_{21}NO_3$, was discovered by Thiboumery (1835). It forms silvery scales or hard prisms; is soluble in ether, more freely soluble in alcohol, amylic alcohol, benzol, and chloroform, but nearly insoluble in water and alkalies. It is colored blood-red, afterward yellow, by sulphuric acid, yellow by nitric acid, orange-red by Erdmann's test, orange-yellow and finally colorless by Fröhde's reagent, and red-brown by chlorine-water and ammonia. The salts of thebaine crystallize readily. Diluted acids readily alter the alkaloid, yielding two amorphous isomeric bases, *thebenine* and *thebaïcine*, which are sparingly soluble in hot alcohol and insoluble in other simple solvents (Hesse).

7. Papaverine, $C_{21}H_{21}NO_4$, discovered by Merck (1848), forms colorless needles or prisms, which are slightly soluble in cold ether and alcohol, but readily soluble in hot alcohol, amylic alcohol, chloroform, and benzol. It melts at 147° C. (296.6° F.). Nearly all its salts are sparingly soluble in cold water and dilute acids, and its solutions part with the alkaloid on being agitated with chloroform. Warm sulphuric acid colors it deep-purple or violet-blue. Fröhde's reagent renders it bright violet-blue, then blue, yellowish, and finally colorless.

8. Rhœadine, $C_{21}H_{21}NO_6$, discovered by O. Hesse (1865), is in white tasteless prisms which are nearly insoluble in ether, alcohol, benzol, chloroform, water, and ammonia, and which yield with dilute acids tasteless and colorless solutions, acquiring an intense purple color on the addition of strong hydrochloric or sulphuric acid. Besides the coloring matter, an isomeric bitter, colorless base, *rhœagenine*, is formed in this reaction. The color produced by acids with Merck's *porphyroxin* (1837) depends on the presence of some rhœadine.

9. Cryptopine, $C_{21}H_{23}NO_5$, was discovered by T. and H. Smith (1867). It crystallizes in minute prisms, is sparingly soluble in water, ether, benzol, and cold alcohol, dissolves in potassa and chloroform, and forms bitter salts, which have a pungently cooling taste, and when dissolved in hot water usually produce a jelly-like mass, which is gradually changed to crystals. Sulphuric acid colors it yellow, soon turning violet-color, but in the presence of minute traces of ferric salt or of chlorine a dark violet-blue color is at once produced, which on warming turns dingy green.

10. Oxynarcotine, $C_{22}H_{23}NO_8$, was isolated from the mother-liquors of narceine by Wright and Beckett (1876). It dissolves in alkaline liquids, but is nearly insoluble in benzol, chloroform, and hot alcohol and water. Like narceine and narcotine, it yields *hemipinic acid*.

11. Gnoscopine, $C_{34}H_{36}N_2O_{11}$, was found by T. and H. Smith (1878) in the mother-liquors of narceine. It forms thin needles of a woolly appearance, melts with decomposition at 233° C., is soluble in chloroform and carbon disulphide, slightly soluble in benzol, and is insoluble in petroleum and in fusel oil. Sulphuric acid dissolves it with a yellowish color, becoming carmine-red with a trace of nitric acid.

The following alkaloids were discovered by O. Hesse (1870 and 1871), and may be prepared from the mother-liquors left in the preparation of morphine by Gregory's method:

12. Lanthopine, $C_{23}H_{25}NO_4$, is crystalline, tasteless, sparingly soluble in acetic acid, alcohol, ether, and benzol; is readily soluble in chloroform; is colored orange-red by nitric and pale-violet by sulphuric acid, the latter color changing to dark-brown on heating.

13. Meconidine, $C_{21}H_{23}NO_4$, is amorphous, colorless or yellowish, tasteless, easily soluble in alcohol, ether, benzol, chloroform, and acetone. It yields very bitter unstable salts, and is dissolved by sulphuric acid with an olive-green, and by nitric acid with an orange-red, color.

14. Laudanine, $C_{20}H_{25}NO_4$, crystallizes in hexagonal prisms, melts at 166° (331° F.), is sparingly soluble in ether and cold alcohol, soluble in benzol, chloroform, and alkalies; in ferric chloride with an emerald-green, in nitric acid with an orange-red, and in sulphuric acid containing iron with a rose-red, color, the latter changing to violet on heating. The hydriodate is sparingly soluble in cold water; the hydrochlorate is nearly insoluble in solution of sodium chloride.

15. **Codamine**, $C_{20}H_{25}NO_4$, crystallizes from ether in large six-sided colorless prisms; is easily soluble in chloroform, benzol, ether, alcohol, and boiling water; forms amorphous bitter salts, and dissolves in nitric acid with a dark-green, and in sulphuric acid containing iron with a blue, color, changing to green and dark-violet on warming.

16. **Deuteropine**, $C_{20}H_{21}NO_5$, homologous with cryptopine, requires further investigation.

17. **Laudanosine**, $C_{21}H_{27}NO_4$, is soluble in alcohol, chloroform, ether, and warm benzol; the crystals fuse at 89° C. (192.2° F.). It neutralizes acids, and yields with hydriodic acid a sparingly soluble salt. Pure sulphuric acid colors rose-red, in presence of ferric salt brown-red, on warming green and deep violet.

18. **Protopine**, $C_{20}H_{19}NO_5$, resembles cryptopine, and is with difficulty soluble in ether, alcohol, and benzol, more readily soluble in chloroform. The solutions of its salts do not gelatinize and have a bitter taste. The solutions in sulphuric acid turn yellow, red, and purple; in presence of ferric salt they are deep-violet.

19. **Hydrocotarnine**, $C_{12}H_{15}NO_3$, crystallizes in large colorless prisms, fuses at 55° C. (131° F.); volatilizes, partly unchanged, at 100° C. (212° F.); is easily soluble in benzol, ether, and alcohol, and forms readily soluble salts. It is formed from narcotine, besides meconin, by the action of nascent hydrogen.

From many of the above alkaloids derivatives have been obtained which are highly interesting in a scientific point of view, and which prove that at least between some of them there exists evidently a close relation. It is not unlikely that some of those enumerated above are the decomposition-products of others. This may most likely be affirmed to be true of Wittstein's *metamorphine* (1860), which was obtained in preparing morphine by Mohr's process (page 991), but has not been observed since. It liberated iodine from iodic acid, was colored red by nitric acid, but was not affected by ferric chloride. Hinterberger's *opiane* was proved by Hesse to be impure narcotine.

The *proportion* in which the alkaloidal constituents of opium are present in the drug is, without doubt, largely influenced by the climate, the nature of the soil, and the treatment to which the milk-juice is exposed in obtaining the opium. Most of the pharmacopœias require dried opium to contain not less than 10 per cent. of morphine; good Smyrna opium frequently contains between 12 and 15 per cent. of it, but cakes taken from the same case are apt to vary considerably. Egyptian opium usually contains a smaller amount of morphine, varying from 6 to 12 per cent. Persian opium varies to a still greater extent, but much of that found in commerce is equal to the ordinary qualities of Turkey opium. East Indian opium, as a rule, is weak in morphine. It is sometimes as low as 2.5 per cent., more frequently perhaps between 3.5 and 5 per cent., but occasionally as high as 8 or 9 per cent. Most of the opium made in Europe has been of good and even of excellent quality. French opium yielded 14.4 to 22.8 (Guibourt), German opium 16.5 to 20, and from white poppy 6.8 per cent. (Biltz) of morphine. Opium made in Algiers from red poppy yielded 10.4 to 17.8 per cent., and from white poppy 1.5 to 8.5 per cent. of morphine. Several morphiometric assays of opium grown in the United States have been recorded; the lowest percentage of morphine, 4, was observed by Grahame; Procter obtained from other samples 7.4 and 9.15, Flint 9.34, and Wayne 10.2 per cent.

The other alkaloids have been observed in the following proportions:

Narcotine, 1.3 to 10.9 per cent.
Pseudomorphine, 0.02 per cent.
Narceine, 0.02 to 0.1 (0.7) per cent.
Rhœadine, minute.
Lanthopine, 0.005 per cent.
Codamine, 0.003 per cent.
Codeine, 0.2 to 0.4 per cent.
Thebaine, 0.15 (to 1.0) per cent.
Papaverine, 1.0 per cent.
Cryptopine, minute.
Laudanine, 0.005 per cent.

Meconic Acid (**Acidum meconicum**, *Br.*), $C_7H_4O_7$, discovered by Sertürner, is obtained by precipitating the concentrated infusion of opium with calcium chloride, and treating the calcium meconate repeatedly with warm diluted hydrochloric acid. It crystallizes in micaceous scales or rhombic prisms containing $3H_2O$, dissolves in 4 parts of boiling water, and is also soluble in alcohol. Opium yields 3 to 4 per cent. of it. It is a tribasic acid, and imparts to ferric salts a deep-red color, which does not disappear on the addition of dilute hydrochloric acid (difference from formic and acetic acids) or by the chlorides of gold or of mercury (difference from sulphocyanides). When boiled with water, or more rapidly when boiled with dilute hydrochloric acid, meconic acid is decomposed into carbonic acid gas and crystallizable *comenic acid*, $C_6H_4O_5$, which on being heated yields a sublimate of *pyrocomenic acid*, $C_5H_4O_3$. The two derivative acids likewise redden ferric salts, the last less deeply than the former.

T. and H. Smith (1862) exhibited *thebolactic acid* as one of the constituents of opium. This acid has the composition and physical properties of lactic acid, and, according to Buchanan (1870), is identical with the latter. It is present to the extent of about 1¼ per cent., and is probably the decomposition-product of another constituent of poppy-juice. The same may also be said of the free acetic and traces of butyric acid announced by David Brown in 1876.

MECONIN is obtained from narcotine (see above), exists also in opium, and forms colorless shining prisms, which are inodorous, bitter, soluble in alcohol, ether, and slightly soluble in water. It was discovered by Dublanc (1832), and is also known as *opianyl*. It melts in water at 77° C., and in the air at 110° C. (230° F.), and when evaporated with slightly diluted sulphuric acid gives a green color.

MECONOIOSIN, $C_8H_{10}O_2$, was obtained by T. and H. Smith (1878) from the mother-liquors left on the isolation of meconin, from which it separates in an impure state as brown leaf-like crystalline masses. When pure it is colorless, is freely soluble in alcohol, ether, and hot water, fuses at 88° C. (190.4° F.), and on evaporation with dilute sulphuric acid yields a red color, changing to purple.

Morphiometry.—In view of the variable quality of opium and of its liability to adulteration, the determination of the amount of morphine in it is frequently necessary, and must not be neglected if uniformity of strength of the pharmaceutical opium preparations is desired. The U. S. and British Pharmacopœias have adopted the method of Thibounery and Mohr, and give the following directions:

"Opium, in any condition to be valued, 7 Gm.; lime, freshly slaked, 3 Gm.; chloride of ammonium 3 Gm.; alcohol, stronger ether, distilled water, each a sufficient quantity. Triturate together the opium, lime, and 20 Ccm. of distilled water in a mortar until a uniform mixture results; then add 50 Ccm. of distilled water, and stir occasinally during half an hour. Filter the mixture through a plaited filter 3 to 3½ inches (75 to 90 Mm.) in diameter into a wide-mouthed bottle or stoppered flask (having the capacity of about 120 Ccm., and marked at exactly 50 Ccm.), until the filtrate reaches this mark. To the filtered liquid (representing 5 Gm. of opium) add 5 Ccm. of alcohol and 25 Ccm. of stronger ether, and shake the mixture; then add the chloride of ammonium, shake well and frequently during half an hour, and set it aside for 12 hours. Counterbalance two small filters; place one within the other in a small funnel, and decant the ethereal layer as completely as practicable upon the filter. Add 10 Ccm. of stronger ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterward wash the latter with 5 Ccm. of stronger ether, added slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle in portions, in such a way as to transfer the greater portion of the crystals to the filter. Wash the bottle, and transfer the remaining crystals to the filter, with several small portions of distilled water, using not much more than 10 Ccm. in all, and distributing the portions evenly upon the filter. Allow the filter to drain, and dry it, first by pressing it between sheets of bibulous paper, and afterward at a temperature between 55° and 60° C. (131° to 140° F.). Weigh the crystals in the inner filter, counterbalancing by the outer filter. The weight of the crystals in Gm., multiplied by 20, equals the percentage of morphine in the opium taken."—*U. S.* The present *Br. P.* has adopted the same process.

"Take of opium 100 grains; slaked lime 100 grains; distilled water 4 ounces. Break down the opium, and steep it in an ounce of the water for 24 hours, stirring the mixture frequently. Transfer it to a displacement apparatus, and pour on the remainder of the water in successive portions, so as to exhaust the opium by percolation. To the infusion thus obtained, placed in a flask, add the lime, boil for 10 minutes, place the undissolved matter on a filter, and wash it with an ounce of boiling water. Acidulate the filtered fluid slightly with diluted hydrochloric acid, evaporate it to the bulk of half an ounce, and let it cool. Neutralize cautiously with solution of ammonia, carefully avoiding an excess; remove by filtration the brown matter which separates, wash it with an ounce of hot water, mix the washings with the filtrate, concentrate the whole to the bulk of half an ounce, and add now solution of ammonia in slight excess. After 24 hours collect the precipitated morphine on a weighed filter, wash it with cold water, and dry it at 212° F. It ought to weigh at least from 6 to 8 grains."—*Br.*, 1867.

Mayer (1863) recommended a similar method, but substituted baryta for lime, and, instead of weighing the morphine, estimated it by his test solution.

Prollius (1877) devised a process which is also recommended by Flückiger (*Pharma-*

cographia, 2d ed., p. 63): A tincture is made from 10 Gm. of opium and sufficient alcohol spec. grav. .950 to obtain 100 Gm. of filtrate; add to this 50 Gm. of ether and 2 Gm. of ammonia-water spec. grav. .960; collect the crystals of morphine after a day or two, and dry them at 100° C. (212° F.).

The following is a modification of this process: "Agitate 8 Gm. of powdered opium with 80 Gm. of water, and after half a day filter. Mix 42.5 Gm. (equal to one-half of the total) liquid with 12 Gm. alcohol, 10 Gm. ether, and 1 Gm. ammonia-water, and set aside for 12 hours in a closed vessel at a temperature of 10° to 15° C. (50°–59° F.); then transfer to a well-dried and tared filter of 80 Mm. (about 3¼ inches) diameter, wash the morphine crystals twice with a mixture composed of 2 Gm. each of alcohol sp. gr. .894, water, and ether, and dry them upon the filter at 100° C. (212° F.); their weight should not be less than 0.4 Gm. (= 10 per cent.)."—*P. G.*

Numerous other processes and modifications have been recommended. The principal difficulties encountered in most of them are (1) the large quantity of water required for extracting the morphine, frequently rendering the concentration of the solution necessary, which should always be accomplished at a moderate heat; and (2) the impurities which are always precipitated with the morphine, and which consist of coloring matter with or without narcotine; the latter may be removed by ether, but in decolorizing the precipitate, either by alcohol or with the aid of animal charcoal, there ensues inevitable loss.

Pharmaceutical Preparations.—Opium denarcotisatum, Denarcotized opium. Powdered opium, containing 14 per cent. of morphine, 100 parts (1 oz. av.); stronger ether 1000 parts (10 oz. av. or 13¼ fluidounces); sugar of milk, in fine powder, a sufficient quantity; to make 100 parts. Macerate the powdered opium with 500 parts of stronger ether in a well-closed flask for 24 hours, agitating from time to time. Pour off the clear ethereal solution, and repeat the maceration with 2 other portions of the ether, each of 250 parts, first for 12 hours, and the last time for 2 hours. Collect the residue in a weighed dish, dry it, first by a very gentle heat, and finally at a temperature not above 85° C. (185° F.), and mix it thoroughly, by trituration, with enough sugar of milk to make the product weigh 100 parts (1 oz. av.). Instead of taking 100 parts of powdered opium, containing 14 per cent. of morphine, a proportionately smaller quantity of powdered opium of any higher percentage of morphine may be taken. The proper quantity, in parts by weight, for the above formula is ascertained by dividing 1400 by the percentage of morphine in the powdered opium selected.—*U. S.*

Liquor morphinæ bimeconatis, *Br.*, Solution of bimeconate of morphine.—Dissolve morphine hydrochlorate 9 grains in 2 or 3 drachms of warm distilled water; add solution of ammonia sufficient to precipitate the morphine; cool, filter, wash the precipitate well with distilled water; drain; mix with sufficient water to produce 1½ oz.; then add rectified spirit ½ fluidounce and meconic acid 6 grains; dissolve.—*Br.*

This is a colorless or nearly colorless liquid, in which potassa produces a white precipitate soluble in excess, nitric acid an orange-red color, and ferric chloride a blood-red color, which is not changed by diluted hydrochloric acid. The solution contains about 1¼ per cent. of morphine bimeconate ($C_{17}H_{19}NO_3.C_7H_4O_7$), and is of about the same morphine strength as tincture of opium. Procter (1867) precipitated, from an infusion of 5 troyounces of dry opium, the meconic acid by lead acetate and the morphine by ammonia, decomposed the lead precipitate by H_2S, dissolved in this liquid the morphine, diluted with water to 3 pints, and added alcohol 1 pint. This process yields a reddish brown solution.

Aqua opii, Opium-water. From a mixture of 1 part of bruised opium and 10 parts of water distil 5 parts. It is colorless and has a slight narcotic odor.

Off. Prep.—Containing opium, extract or tincture of opium: Acetum opii, *U. S.*; Emplast. opii, *U. S.*, *Br.*; Enema opii, *Br.*; Extract. opii, *U. S.*, *Br.*; Extract. opii liquid., Liniment. opii, *Br.*; Pilulæ opii, *U. S.*; Pil. ipecacuanhæ cum scilla, Pil. plumbi cum opio, Pil. saponis comp., Pulv. cretæ arom. cum opio, *Br.*; Pulv. ipecacuanhæ comp., *U. S.*, *Br.*; Pulv. kino comp., Pulv. opii comp., Suppos. plumbi comp., *Br.*; Tinct. opii, Tinct. opii camphorata (camphoræ comp.), *U. S.*, *Br.*; Tinct. opii ammoniata, *Br.*; Tinct. opii deodorata, Trochisci glycyrrhizæ et opii, *U. S.*; Troch. opii, Unguent. gallæ cum opio, *Br.*; Vinum opii, *U. S.*, *Br.*

Physiological Action.—*On Animals:* In the lower animals opium affects the spinal marrow more than the brain, and the latter organ in proportion to the rank of the animal among organized beings. Experiments upon frogs prove that opium throws these animals into tetanic spasms, however it may be introduced and whether the brain is detached or not. The same effects are produced in lizards. Birds will bear enormous doses of opium in comparison with those which may be given to man; but its effects are by no means uniform, for in individual cases the narcotic exceeds the tetanizing or paralyzing influence of the drug. Not infrequently a pigeon, for example, will survive the ingestion of 20 grains of opium—a dose far exceeding that which would be fatal to the strongest man—yet the same bird will, under the influence of the hypodermic injection of a relatively small dose of morphine, succumb, and usually with a predominance of spinal phenomena. A similar illustration is presented by herbivorous quadrupeds; for while even 30 grains of opium produce no effect when introduced into a rabbit's stomach, sleep and contracted pupils are produced by throwing laudanum into the pleural cavity or a solution of morphine into the connective tissue. Unless we suppose that the active constituents of opium are decomposed in the stomach of these animals, such opposite results appear to be quite inexplicable.

On Man: In doses varying from a ¼ grain to 1 grain, opium produces usually a soothing and luxurious calm of mind and body, followed, in the course of 40 or 50 minutes, by a disposition to sleep; or, if sleep does not take place, the body and mind enjoy a sense of repose from external impressions, while the mind is filled with dreamy and generally pleasant ideas. The pulse at first is quickened, but gradually becomes slower, the mouth grows dry, and the skin moist. Excited consciousness is followed by sleep, which is natural in its phenomena, and from which one awakes refreshed. Larger doses, as from 1 to 3 grains, occasion turgor and redness of the face, heat and fulness of the head, flashes of light before the eyes, and contraction of the pupils. The mind is excited, even to delirium; the pulse is full, tense, and frequent; the skin is hot and dry, and often there is vomiting. Depression follows, with a slow and sometimes irregular pulse; dulness oppresses all the functions of relation, and the mind is torpid; the muscles lose their co-ordinating action, and the gait is sluggish and staggering. Deep sleep, or rather coma, succeeds; the breathing is stertorous, the skin pale and damp, and the hands and feet cold. The return to consciousness is attended with depression of mind and body, headache, thirst, nausea, and constipation. In narcotism by opium, when an excessive dose has been taken, no stage of excitement occurs; giddiness is speedily followed by insensibility and immobility, the respiration is slow and stertorous, and then scarcely perceptible; deglutition is suspended; the pupils are extremely contracted; the face is pale and cadaverous; the muscles of the limbs are relaxed. Vomiting sometimes occurs, but more usually in fatal cases coma continues until death, which is sometimes preceded by convulsions. After death from opium-poisoning the convolutions of the brain are flattened, the vessels of the cerebro-spinal axis are gorged with black blood, and the capillaries of the brain on section give out minute drops of the same fluid. A serous liquid is usually found in the ventricles and beneath the cerebral surface of the arachnoid. The lungs, heart, liver, and spleen are in most cases distended with dark and fluid blood. It is worthy of notice that some persons who have recovered from the immediate effects of a poisonous dose of opium have afterward died of congestion or consolidation of the lung, doubtless induced by the narcotic effects of the poison (Shapleigh).

To render more intelligible the operation of opium, it is necessary to point out the details of its action upon several of the organs. Contraction of the pupil is attributed, on the one hand, to its sedative action upon the sympathetic nervous system, in consequence of which the capillary blood-vessels of the iris become dilated and distended, and the pupil consequently contracted; on the other hand, it is ascribed to a stimulation of the oculo-motor centres. The former opinion seems the more probable of the two. Opium affects the digestive function by blunting the gastric sensation to which we give the name of hunger, and diminishing the demand for food by checking all the tissue-changes which create that demand. At the same time it increases thirst, probably by rendering the gastric mucous membrane dry, as well as by accumulating solid effete matters in the blood. In the same manner it impedes digestion and retards absorption. The vomiting which it sometimes occasions, even when administered by the rectum or when morphine is given hypodermically, appears to be of cerebral origin. Opium tends to constipate the bowels by benumbing their muscles, as well as by diminishing their proper secretions and those of the liver and pancreas. When the drug is habitually used these effects become less marked. As already mentioned, the primary effect of a medicinal dose of opium is to render the pulse fuller and more frequent, but as the soporific operation is developed the pulse becomes slower without losing its fulness. The ultimate narcotic effects upon the pulse are to render it small, weak, and irregular. That these phenomena arise through the action of opium upon that portion of the nervous system which regulates the movements of the heart and arteries must be taken for granted; but the attempts made to explain it by defining the special nervous centres upon which it depends, and its mode of action, are more ingenious than satisfactory. The same remark is measurably applicable to the action of opium upon the respiration. Respiratory movements are rendered progressively slower, until in complete narcotism they become scarcely perceptible. Hence the blood is but partially oxygenated, and, being unfit for returning to the heart, it stagnates in the lungs. Hence, too, the blood of those who perish in opium-narcosis is intensely black, and death occurs by gradual asphyxia. Hence, moreover, the most direct remedy for this condition is the introduction of oxygen into the lungs. Upon the kidneys, as upon all other glands, the action of opium is to check secretion, and at the same time to prevent the discharge of what is secreted by paralyzing the bladder. Its power of lessening renal secretion is strikingly exhibited in diabetes and hydruria. While diminishing glandular and mucous secretions, opium greatly augments the perspiration, so that a conspicuous symptom among its toxical effects is profuse sweating, and it may be used as one of the surest and most perfect of all diaphoretic medicines. It is very apt to excite itching of the skin, and often produces an erythematous eruption.

The attempts to explain the operation of opium have not been much more satisfactory than in the case of other really efficient medicines. Its local anæsthetic action, and that which its internal use manifests when less than soporific doses are administered, are absolutely unintelligible. Its hypnotic action, it can scarcely be doubted, depends in part upon the same anæsthetic virtue exercised upon the brain-tissue. In part, also, it seems to be explicable by the power, several times above referred to, which opium exerts in contracting the capillary blood-vessels, and thereby diminishing the supply of the natural stimulant of the organ, arterial blood. This view is rendered more probable by the consideration that belladonna, which prevents sleep, dilates the capillary blood-vessels as much as opium contracts them. It is further supported by the fact that poisonous doses of opium, producing not sleep but narcotism, dilate the capillaries by paralyzing them. Yet, after all, nothing known of the action of opium can dispense with that innate quality of the drug, our ignorance of whose nature used to be concealed under the delusive phrase "vis dormitiva."

It must be constantly borne in mind that the action of opium, like that of all agents which especially influence the nervous system, is greatly modified by numerous causes besides its mere dose. Thus it acts with extreme energy in the very young, because their nervous systems are highly susceptible; and ordinary doses are unsafe in the old, because, their eliminating functions being feeble, the medicine remains in their blood. For the former reason, probably, females are, as a rule, more readily affected than males by opium. All nervous, susceptible persons feel its influence speedily, and often in an abnormal manner, being unduly excited by ordinary doses. On the other hand, as in the case of alcohol, there are persons who can take with impunity doses of opium which to others would be distressing or even fatal. There are those, also, in whom the habit of using opiates has created a relative insensibility to the action of medicinal doses. In other cases extreme pain, like that of tetanus or biliary and nephritic colic, may neutralize the narcotic operation of the largest medicinal doses.

In a work like the present a detailed account of the morbid effects produced by the habitual use of opium would be out of place. They have been briefly summarized under MORPHINA, and need not be repeated here. An elaborate discussion of the subject is contained in a work of one of the present authors (*Therapeutics and Materia Medica*), where the opium habit is illustrated by many examples, and its influence on health and life considered. To the cases there cited, and which prove that the slavery of this habit may be as prolonged as it is terrible, may here be added one of more recent publication. It is that of a former officer in the English army, who at the alleged age of one hundred and eleven was still living in New York. "He had been an opium habituate for seventy years," and at one time his daily consumption of the drug was 90 grains (Mattison, *New York Med. Record*, xii. 239). His extreme longevity makes any detail of its morbid effects superfluous. Indeed, the chief disorders it produced consisted of obstinate constipation when the dose of opium was very large, and diarrhœa when it was suspended or greatly diminished. (Respecting the opium habit, the following are a few of the articles that may be consulted: Mattison, *Phila. Jour. of Phar.*, Apr. 1879, p. 209, and *N. Y. Med. Record*, xxiii. 621; Kane, *Med. Record*, Nov. 1881, p. 511; Francis, *Lond. Med. Times and Gaz.*, Jan. 1882, pp. 87, 116; Myers, *Ibid.*, June, 1882, p. 672; Moore, *Edinb. Med. Jour.*, xxviii. 958.)

The several constituents of opium which have been isolated by chemical analysis manifest various modes of action, which differ more or less widely from that of opium itself. While *morphine*, as we have shown elsewhere, very nearly represents the crude drug, and codeine, meconine, papaverine, cryptopine, and narceine share with it a certain soporific virtue, the remaining elements, narcotine, thebaine, etc., are almost if not entirely destitute of this quality. The following statements represent the ambiguous condition of existing knowledge on these subjects:

Narcotine was first introduced as an anti-periodic, and, although freely given, was not suspected of possessing narcotic properties. Experiments upon animals prove it to be eminently a tetanizing agent, and productive at the same time of great depression; yet some observers report its possession of a slight narcotic power. According to others, this power is distinctly manifested in man by doses of from 10 to 20 or 30 grains (Gm. 0.60–2), yet it is certain that it has been administered as a tonic and anti-periodic in 30-grain (Gm. 2) doses without producing any narcotic effects. The conclusion almost necessarily is, that the alkaloid was not pure in the former case, but contaminated with morphine. *Papaverine* is, on the one hand, alleged to be hypnotic, even the "prime hypnotic element of opium," an arterial and nervous sedative; and, on the other, it is by turns pronounced inert, tetanizing, relaxing, and a heightener of reflex action. Physiological experimenters have demonstrated that *thebaine* is eminently a convulsifying agent, the "most potent of all the poisonous constituents of opium." In man it is anodyne and soporific in the hypodermic dose of 1½ grains (Gm. 0.10), and is nearly equivalent to ¼ grain of a salt of morphia, while it does not occasion headache and nausea. *Cryptopine* appears to be closely analogous in its action to thebaine, tetanizing some of the lower animals, convulsing others. In man it acts like morphine, but without the unpleasant consequences due to the latter alkaloid. It is stated to be about one-fourth as strong as morphine. *Meconine*, when administered even in large doses hypodermically to large animals, and by the mouth to man, appears to be quite inert; but hypodermically, in doses of from ½ grain to 1½ grains (Gm. 0.03–0.10), it produces in man a moderately hypnotic effect. The action of *codeine*, which is now officinal, is discussed elsewhere. *Narceine* was once proclaimed to possess all of the virtues, without any of the defects, of morphine, and as being operative in an equal dose. The usual contraindications of physiological experiment and therapeutical observation have only left the fact to survive that it is soporific for cold-blooded animals, and for man a feeble though pure hypnotic in the dose of 5 grains and upward, but, being at the same time rare and costly, it is practically useless as a medicine. The peculiar action of *apomorphine* has been fully described elsewhere (p. 222); it may suffice in this place to say that it is an emetic and general depressant. According to Ott, *chlorocodide* is a tetanizing agent; *apocodeine* produces vomiting, coma, and death; *cotarnine* is soporific, and paralyzes the motor nerves; *hydrocotarnine* is narcotic and convulsivant; *laudanosine* and *laudanine* are tetanic agents. In 1878, Bardet undertook a course of experiments to determine, if possible, the relative value of the principal constituents of opium, and reached the following conclusions: Codeine in small doses is null, in large doses a fruitless and distressing agent; narceine has either no real existence or is totally inert as a narcotic; and morphine "is the sole useful and narcotic alkaloid of opium" (*Bull. de thérap.*, c. 78).

In 1883, Von Schroeder pursued this investigation much more thoroughly and minutely (*Archiv f. exp. Pathol, etc.*, xvii. 96). Space is wanting to describe in detail even his results, but they proved that morphine is the only true narcotic element of opium, and that codeine, papaverine, narcotine, and thebaine are mainly tetanizing agents and but slightly narcotic. Narceine he held to be wholly inoperative. Thus the most recent results as substantially agree as the early ones were at variance with one another.

Medical Uses.—The different modes of action of opium, according to its dose, upon the two great vivifying elements of the animal economy, its stimulant and sedative operations upon the nervous and circulatory systems, and its directly anæsthetic influence in all doses, render it the most useful of all medicines, as well as the most multifarious in its applications. It relieves pain, allays agitation, delirium, and spasm, restrains tissue-change, secretion, and hæmorrhage, and both directly and indirectly supports the powers of the system. By the possession of these manifold virtues it becomes the most fitting associate of numerous other medicines, the operation of which it moderates, exalts, or directs.

Fevers: It is an old precept, which all judicious experience has confirmed, that opium ought not to be prescribed at the onset nor at the climax of a continued fever, but during the augment to appease its violence, and during the decline to support the strength and calm the nervous symptoms which denote exhaustion. In *typhus* its greatest usefulness is not when the strongest tendency to stupor exists, but when muttering delirium, jactitation, tremor, and spasm denote exhausted nervous power; but even then it must be used in such doses only as revive, and not in such as tend to oppress, the brain. In the rarer cases of this disease presenting violent delirium, a furious aspect, suffusion of the eyes, constant raving and muttering, and perfect sleeplessness, moderate doses of a liquid preparation of opium, associated with tartar emetic, according to a former practice, or with veratrum viride or digitalis, as more recently employed, will often render the patient tranquil and induce refreshing sleep. These remarks are equally applicable to all forms of disease when the *typhoid state*, characterized by the above phenomena, is present, and especially to *typhoid fever*, and to *small-pox* as it occurs in adults. But opiates in the diseases of children, and especially in their eruptive fevers, are seldom useful, and often involve serious risk. Another object of employing opium in the exanthematous fevers is to hasten the development of the eruption when it is tardy and imperfect. Under such circumstances the medicine should be given in small and repeated doses, and associated with external heat and rubefacients and internal diffusible stimulants. Before the introduction of cinchona, opium was generally used to abort the paroxysms of *periodical fevers*, which it did by creating a vascular excitement opposed to the formation of the chill, and inducing artificially a diaphoresis which also prevented that stage of the attack. In the same manner it is often now associated with quinine, whose specific operation it favors. Another mode of using opium in intermittent fever is to administer it in so large a dose as to hold the nervous system in a state of immobility, and so prevent the formation of the paroxysm.

Inflammation is less directly under the control of opium than idiopathic fever, yet its judicious employment, by lessening pain, tends to prevent an aggravation of the disorder and to allow the natural recuperative powers their full operation. In chronic inflammations, also, attended with constitutional irritation and hectic fever, opium exerts a salutary restraining influence. After severe operations it tends to prevent the irritative fever which the shock of pain and loss of blood, and the consequent reaction, are apt to excite. As a rule, the dose required is large and sedative. In *hæmorrhage*, even of the active sort, opium is sometimes of service by diminishing the agitation upon which its continuance depends, and especially by allaying the excitability of the nervous system of the heart; but its greater utility is in cases of passive hæmorrhage accompanied by a similar excitability. Possibly, also, it may directly contract the capillaries. In senile *gangrene* it is generally employed, probably on account of its analgesic and stimulant operation.

All forms of *pain* are palliated by opiates, but the more independent pain is of material lesions, as in pure *neuralgia*, the more efficient are these remedies, unless, perhaps, when the narcotic operation suspends the action of the physical cause of pain. All forms of *spasmodic pain*, of the bowels, bladder, uterus, gall, and urinary ducts, etc., are lessened by suspending the spasm in which the pain arises. Pain due to movements of the affected part is directly palliated by opium, and indirectly by promoting rest. In nearly all painful disorders the dose of opium must be proportioned to the degree of pain. The tolerance of large doses of the drug during severe pain, and also in prolonged spasmodic attacks like tetanus, is a remarkable fact. Opium is seldom appropriate for pain within the head; it may dangerously mask this symptom in other cases where pain is the chief indication of the disease. Of the latter, strangulated *hernia* is an example.

Sleeplessness is relieved by the direct action of opium, and also indirectly, in so far as opium removes the cause that prevents sleep, whether it be pain, mental excitement, or exhaustion, etc.; but very often it fails of its effect, although given in large doses, in such excessive excitement as occurs in *mania a potu*, acute *insanity*, *meningeal inflammation* in some of its forms, etc. Moreover, if long continued, its utility as a hypnotic is more than counterbalanced by the derangement of digestion, secretion, etc. which it induces, particularly as its original effects can only be maintained by largely increased doses of the drug. In *puerperal insanity* it is more beneficial than in other forms of mental disorder, particularly when morphine is used hypodermically. The treatment of *delirium tremens* by large doses of opium, which at one time prevailed, was most unfavorable in its results; and if the drug is used at all in this disorder, its doses should be small and repeated, so as to produce a primary stimulant and not a narcotic operation. We have observed with intense regret a tendency to revive the practice of administering large doses of opiates in this disease. In one case 5 grains of morphine were given subcutaneously in 2 doses, and in another no less than 8 grains within 4 hours (*Med. Times and Gaz.*, March 11 and 18, 1876). The mortality of delirium tremens under the opium treatment, as formerly practised, was enormous, and is remembered by the present writer as one of the most painful features of his hospital life. Since that time, with an expectant and rational treatment, he has rarely had occasion to witness a death from this disease. In *epidemic cerebro-spinal meningitis* opium is probably the most efficient of all the remedies that have been employed. But its utility is most conspicuous in those cases of the disease in which spasm (*i. e.* spinal irritation) predominates over septic phenomena, and when it is administered steadily from the commencement of the attack. *Sunstroke* marked by nervous symptoms, such as convulsions, twitchings, delirium, and general excitement, is greatly benefited by the hypodermic injection of morphine. This medicine may be used as a palliative in *epilepsy*, *hysteria*, *eclampsia*, and *spasm of the glottis;* and although it is contraindicated in obstruction of the kidneys, as in Bright's disease, it is nevertheless of great value in *uræmic convulsions*, especially in the form of hypodermic injections.

In obstinate cases of *chorea* the sustained use of opium has sometimes been followed by a great reduction of the spasmodic movements, and even by cure. Hardly any remedy has effected as much good in *traumatic tetanus* as opium, even when given by the mouth, although a large portion of the drug is wasted by this mode of administration. The liquid preparations are preferable, and superior to these again is the hypodermic injection of morphine. Neither method should exclude the due employment at the same time of other remedies, and especially of counter-irritation of the spine and the use of alcohol. In this disease larger doses of opiates are required than in any other. In the somewhat analogous affection produced by *strychnine-poisoning* subcutaneous injections of morphine have proved curative. The use of opiates in *neuralgia* is most efficient when the salts of morphine are injected hypodermically, as is elsewhere at greater length described. (See MORPHINA.) This statement applies to internal as well as external neuralgia.

In diseases of the respiratory organs *pain* and *cough* are the symptoms which especially call for the use of opiate preparations, which relieve the former directly as well as diminish the violent movements accompanying the latter symptom. So far as the pain caused by coughing depends upon pleural inflammation or upon the action of muscles affected with rheumatism, opium affords certain relief, while it palliates also the painful sensations accompanying acute bronchitis. But as coughing is largely a conservative act, tending to prevent the accumulation of secretions in the bronchia, opium must not be employed in such doses as tend to prevent this salutary operation; hence it must be cautiously used, if at all, when the bronchia are filled with their secretions. In the forming stage of *pulmonary catarrh* or *bronchitis*, when the air-tubes are dry and irritable and coughing painful, opium, especially with ipecacuanha, as in Dover's powder, will sometimes mitigate, or even terminate, the attack by promoting the pulmonary and cutaneous secretions. Opium has been used in the form of morphine, hypodermically, with reported advantage in arresting the development of *autumnal catarrh*. In *pneumonia* and *pleurisy* its use should be restricted to moderating cough and pain: and the same may be said of chronic *phthisis*. In the latter, if habitually used, it is very apt to impair digestion and hasten the patient's decline, but is nevertheless almost indispensable when the cough is harassing. It may sometimes be given in an atomized solution more efficiently than when otherwise administered. In *asthma* hypodermic injections of morphine are efficient palliatives. In the various affections of the heart, of which *angina pectoris* is a more or less frequent symptom, opium, but still more morphine, is an invaluable palliative, and that without too closely regarding the special lesion upon which the pain and the disordered action of the heart depend. Of heart lesions which accompany such attacks those of the mitral valve are the most frequent. For the relief by opium of all symptoms depending upon a positive or relative debility of the heart the medicine must be given so as to stimulate; that is to say, in small and repeated doses.

Among diseases of the digestive organs the symptoms most appropriately treated by opium are *vomiting*, *pain*, and *diarrhœa*. All forms of vomiting are more or less under its control, as that of *sea-sickness*, of *pregnancy*, of *reflex irritation* generally, and of diseases affecting the stomach itself. In the last opium is often given in the form of an old or hard pill, but the hypodermic injection of morphine is usually more efficient. *Simple ulcer* of the stomach as a cause of vomiting is sometimes treated with opium and its preparations, but they are unnecessary when the diet is properly regulated and bismuth or lime-water is employed. In pure *gastralgia* these medicines are often extremely valuable as palliatives, but other means are required to cure the disease through the removal of its cause. When used, they should be administered 10 or 15 minutes before meals, and also when a paroxysm is imminent.

Of the use of opiates in *diarrhœa*, it may be remarked that the less this symptom depends upon material lesions or upon irritating crude ingesta, the more efficient are opium and its preparations as remedies. Indeed, they only hasten somewhat the natural cure by moderating the peristaltic action and diminishing the secretions of the intestine. Otherwise, they act only as aids to absorbents and astringents, such as chalk, tannin, etc. In *dysentery* opium is of less value for its curative properties than as a palliative of the tormina and tenesmus which belong to the active forms of this disease; but even these symptoms are more successfully relieved by the evacuant method, either alone or in alternation with the administration of opium by the mouth and by the rectum in enemata or suppositories. When once the violence of the disease is subdued, moderate doses of opium greatly hasten its termination. In the chronic form of dysentery the main reliance must be upon diet, especially upon a milk diet, but opium with astringents is the best medicinal remedy. In *lientery* opium, with or without astringents, is almost indispensable. It is by far the best remedy in *cholera morbus*. No evacuant medicines need be first administered. A grain of opium should be given every half hour in severe cases, the patient refraining from the use of liquids as much as possible. Enemata of laudanum should also be employed, or the treatment may be confided to the hypodermic use of morphine. Care should be taken not to exceed the needful quantity of the drug administered, on account of the depression which is apt to follow the use of large doses. In *epidemic cholera*, depending as it does upon a specific poison, opium cannot be as confidently relied upon; indeed, the records of its use in this disease are extremely discouraging. But in the forming stage, or that of premonitory diarrhœa when that stage exists, opium with chalk and vegetable astringents is invaluable. The tender age and great susceptibility to the influence of opium of the ordinary subjects of *cholera infantum* render opium an unsafe remedy for that affection, notwithstanding the apparently clear indications for its use in the nature of the disease. If used at all, it should be in the form of Dover's powder alone or along with gray powder or calomel.

The symptom *colic*, as a form of pain, is of course amenable to a treatment by opiates, but it is a symptom connected with very numerous and dissimilar conditions. In the ordinary form, due to flatulent dyspepsia of the bowel, opium with diffusible or carminative stimulants affords prompt relief. In *painter's colic*, which is attended with intestinal contraction and spasm, opium is the best remedy, especially in alternation with purgatives. *Biliary* and *nephritic colic* are most efficiently treated by opium; and when pain arises from any of the various acute forms of intestinal displacement (*invagination*, *hernia*), the moderate but sustained use of opiates is infinitely preferable to the too common method of attempting to force an evacuation by means of purgatives. In all of these cases the hypodermic use of morphine is preferable to opium internally. (Compare Post, *New York Med. Record*, xxi. 431.) Of the several forms of *peritonitis*, those only which are due to traumatic causes, such as external violence and perforation or irritation of the peritoneum by diseases of the organs which it covers, are favorably influenced by opium; but in these it is indispensable, for by its means alone can that repose of the abdominal organs be secured which is necessary to control the degree and extent of the inflammation. In *puerperal peritonitis*, although it has been employed in heroic doses and emphatically praised, it has not been generally recognized as appropriate.

Among diseases of the genito-urinary organs opium is an efficient palliative in *nephritic colic*, already referred to, and in all the spasmodic affections of the *ureters*, *bladder*, and *urethra*, such as arise during calculous disorders and inflammation of these several parts. Thus it is a usual remedy for *chordee*, although generally associated with camphor. In all of these cases it is best administered by the rectum. It should never be used in *Bright's disease*. Opium is superior to any other single medicine in diminishing the quantity and the saccharine quality of the urine in *diabetes* when administered in full and progressively increasing doses until a partial tolerance of the drug is induced. At the same time it lessens the thirst and hunger, renders the skin softer, and the mind less despondent. Its most efficient coadjutors are exercise and appropriate food. (See case, *Boston Med. and Surg. Jour.*, Sept. 1881, p. 277.) It is an efficient palliative of the *grinding pains* which precede actual labor, and for those uterine contractions which so often lead to *abortion* or premature labor. Hypodermic morphine injections are more efficient than opium in such cases. The same means are frequently employed in *dysmenorrhœa*. In these various affections, and in all others within the pelvis for which opium is appropriate, suppositories containing this drug or its derivatives, and enemata with laudanum, are especially indicated. In constitutional *syphilis* opium has been erroneously represented as a means of cure. It only allays constitutional irritability and procures rest from nocturnal pains. In the primary forms of the disease it is useful as a dressing for irritable sores.

Muscular rheumatism may generally be relieved by opium, used so as to produce free diaphoresis, and especially in the form of Dover's powder. It is much more efficient in the forming stage of the attack than later. In *articular rheumatism* it has sometimes been used as an exclusive treatment, but with very unfavorable results, in that it augments the frequency and the gravity of the cardiac complications. It is, however, valuable as an anodyne and soporific, thereby husbanding the patient's strength while the disease is removed by eliminative medicines. In the same manner it is useful in *gout*, and particularly its liquid preparations. When this disease becomes *retrocedent*, and especially when it attacks the stomach, opiates associated with diffusible stimulants are the most reliable remedies. Wine of opium or laudanum should then be administered in doses of from 40 to 60 drops (Gm. 2–3) every hour by the mouth or rectum, or morphine may be employed hypodermically.

The use of opium in poisoning by BELLADONNA, ATROPINA, STRYCHNINA, and PHYSOSTIGMA will be found described under those several titles.

As a *local remedy* opium has already been noticed in connection with various painful affections; the uses of morphine in this respect are even more numerous. But the liquid preparations of opium in liniments, epithems, poultices, etc. as topical anodynes are more habitually employed. A watery solution is used as a dressing for irritable *ulcers;* the wine of opium is an admirable anodyne and stimulant in granular *conjunctivitis* and *ulcers of the cornea;* in *earache* laudanum and sweet oil are applied on cotton to the auditory canal; in *toothache* a small piece of opium may be introduced into the hollow of a carious tooth, or, still better, a solution of morphine in chloroform, saturating a plug of cotton, may be similarly applied, or in rheumatic toothache the gums may be bathed with laudanum. In *paronychia* and numerous other forms of painful local inflammation the anodyne operation of opium and its preparations lessens the inflammation by assuaging the pain.

The rational and habitual method of treating *poisoning by opium* consists in emptying the stomach of whatever portion it still contains of the poison, and in keeping the nervous system stimulated and the respiratory apparatus active, and so preventing or diminishing narcotism until the poison is eliminated from the system. For the first purpose emetics are indicated; *e. g.* large draughts of warm salt and water, mustard-water, or water containing ipecacuanha, sulphate of zinc, or sulphate of copper. Tartar emetic should never be prescribed, unless other evacuants fail. It has been successfully employed by the rectum and also by the veins. Vomiting should be favored by tickling the fauces. If these means are not promptly and completely efficient, the stomach-pump should be resorted to. When solid opium has been taken—which, however, is rarely the case—the stomach-pump is of secondary importance. To counteract narcotism, stimulants of the general nervous system and of the respiratory apparatus are employed, both internally and externally. One of the best, as well as the most accessible, is a strong infusion of coffee, given without sugar or cream, but with a small proportion of brandy or whiskey. A strong infusion of green tea is nearly as efficient. The mydriatics (belladonna and stramonium) have been employed as direct antidotes. Their value is estimated in the articles devoted to those medicines. A single illustration of the efficacy of the former may be mentioned here: A man had taken 2¼ ounces of laudanum, none of which was rejected or removed, and no remedies were applied until 2 hours had elapsed. Then ¼ grain of atropine was given hypodermically in 4 hours and in six doses. The man recovered (Bryant, *Med. Record*, xviii. 648). Of external means for stimulating the nervous system, one of the best is to cause the patient to walk, as long as he is able, supported between two assistants, while his attention is kept aroused by conversation or by flagellating the back with a whip of fine cords or a bundle of birch-twigs. Unless the impression made is sharp it is almost useless. Hence the electrical brush answers remarkably well for this purpose. Cold, or alternate hot and cold, affusions, made to the upper part of the body, produce a powerful impression and excite the respiratory act. The partial restoration of consciousness by these means is sometimes accompanied by a renewal of the susceptibility of the stomach, and the emetics it may contain excite vomiting. Ammonia may be held to the nostrils occasionally, and mustard applied over the epigastrium and heart; but the irritation produced by these agents makes it necessary to watch their action. Artificial respiration, although inferior to the other means described, has occasionally been used with success. In infants the natural resiliency of the ribs renders this agency especially useful.

The cure of *opium-eating* consists either in gradually diminishing the quantity of the drug consumed, and the substitution for it of aromatic and stimulant tonics, such as ginger, black pepper, columbo, quassia, etc., or in the abrupt cessation of the practice. Both methods count a few successful cases, but the latter, while the more efficient, is the more arduous. In certain inveterate cases it is claimed that a cure has been effected by prescribing 40 minims of dilute phosphoric acid and 80 minims of tincture of lupulin an hour before meals in a wine-glassful of water. At night sleep may be promoted by tincture of cannabis and Hoffmann's anodyne. The exhausted digestive function should be allowed to revive under simple food, such as milk and rich broths, in small quantities at a time. Exercise and bathing should be insisted upon, and zinc, quinine, and iron may be cautiously administered.

Administration.—The average *dose* of opium for an adult is 1 grain (Gm. 0.06). This is usually an objectionable form of its administration when the medicine must be repeated. In that case a liquid preparation should always be preferred. When a gradual operation is intended an old opium pill is the best, since its slow solution prolongs its action and extends its local influence over a larger surface. It is also much less apt than freshly-made opium pills to occasion nausea. The after-effects of opium are supposed to be mitigated by bromide of potassium in a full dose administered along with the opiate. This apparent operation is rather due to the fact that with a full dose of the bromide a smaller one of opium is necessary. Owing to the extreme susceptibility of children to opium, it should rarely be prescribed for them in the solid form. Suppositories of opium for the rectum and vagina are very useful in local disorders of the pelvic organs, and the rectal forms may also be used when for any reason the drug cannot be administered by the mouth. But they are less prompt in action than enemata of liquid opiates.

Denarcotized opium is supposed to be free from narcotine, and, according to some, from thebaine also, and therefore that it is less apt than opium to excite those distressing nervous symptoms which the whole drug sometimes occasions. Its *dose* is the same as that of opium.

Opium-smoking has been recommended by Thudicum as one of the most effectual remedies for commencing *coryza*, *hay fever*, *bronchitis*, obstinate *coughs*, various *neuralgia*, and *hyperæsthesiæ* generally. The watery extract is alone suitable for the purpose. (For the mode of using opium in this manner see Kerr, *Med. News*, xliii. 402.)

OPOPANAX.—Opopanax.

A gum-resin obtained from Opopanax Chironium, *Koch*, s. Pastinaca Opopanax, *Linné*. *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin.—The opopanax-plant is a perennial herb, with a long, thick, and fleshy root, a tall stem, large pinnately decompound leaves, yellow flowers, and dorsally flattened fruit containing many oil-tubes. It is indigenous to Southern Europe. On wounding the root or lower part of the stem a yellowish milk-juice exudes, which after hardening constitutes opopanax.

Description.—The best quality of opopanax is in irregular angular or subglobular pieces from the size of a pea to that of a walnut, red-brown or yellowish-brown, friable, breaking with a flat somewhat waxy fracture, and frequently with vegetable fragments adhering. It has a strong, unpleasant odor, a balsamic bitter taste, yields with water a yellowish emulsion, and when heated softens and exhales a rather alliaceous odor. An inferior quality comes in larger irregular masses, which contain many impurities and are of a less bitter taste.

Composition.—According to Pelletier, opopanax contains 42 per cent. resin, 33.4 per cent. gum, besides volatile oil, a little wax, starch, etc.

Allied Gum-Resins.—Sagapenum, obtained from a Persian species of Ferula, is met with in yellowish-brown somewhat translucent small tears, and is frequently agglutinated to larger pieces, of a bitter acrid taste and a faint alliaceous odor, which becomes prominent on heating. Cake sagapenum is soft, adhesive, brown, nearly free from tears, mixed with foreign matters. A mixture of galbanum and asafetida is sometimes sold in place of sagapenum. Pelletier and Brandes found in sagapenum 50 to 54 per cent. of resin, 32 per cent. gum, with small quantities of volatile oil, bassorin, etc.

Gummiresina hederæ, *Ivy gum*, is in the Levant and Southern Europe obtained from the common ivy, Hedera Helix, *Linné* (nat. ord. Araliaceæ). It is in irregular yellowish or reddish-brown pieces, translucent on the edges, with a garnet-red color, of a slightly bitter and somewhat acrid taste, and when heated of an agreeable balsamic odor. Pelletier found in a sample nearly 70 per cent. of wood-fibre.

Medical Action and Uses.—Opopanax ("the all-healing juice") is one of the numerous gum-resins, including galbanum and ammoniac, which were anciently most esteemed. Galen speaks of it and of the root-bark of the plant as stimulating and cleansing when applied to ulcers, and of the seeds as diuretic. Dioscorides describes its internal uses in fever and ague, pleurisy, cough, dysury, and amenorrhœa, and its topical applications in sprains, headache, gout, toothache, and carbuncle. Arabian writers advise it in nervous exhaustion, for promoting the expulsion of the dead fœtus, for paralysis, and for inflammation of the eyes. In modern times it has been used, like ammoniac, for *chronic bronchitis* with profuse secretion, and externally in stimulating plasters, but is now very seldom employed. The *dose* may be stated at from 20 to 30 grains (Gm. 1.30–2).

Sagapenum was anciently used for the purposes to which asafetida and galbanum were also applied—*i. e.* to the cure of chronic bronchitis and other chronic catarrhs, menstrual disorders, hysteria, etc. The gum of *Hedera helix* was held to be acrid and astringent, and was employed topically for the relief of local pains and the moderation of profluvia, the healing of ulcers, etc. Griffiths states that some species of Silphium afford a fragrant bitter gum which is stimulant and aromatic; and Porcher refers to S. laciniatum, s. gummiferum, as having been used for asthma in horses, and to S. perfoliatum as tonic, diaphoretic, etc. In France a species of Silphium has been credited with the cure of phthisis, but doubtless the disease which it benefited was chronic bronchitis.

ORIGANUM, *U. S.*—ORIGANUM.

Origan, Marjolaine sauvage, Fr.; *Dosten, Wilder Majoran* (*Meiran*), G.

Origanum vulgare, *Linné.* Bentley and Trimen, *Med. Plants*, 204.
Nat. Ord.—Labiatæ, Satureieæ.

Origin and Description.—Origanum, or *wild marjoram*, is a perennial herb growing in dry soil throughout a large portion of Asia, Europe, and Northern Africa. It has been introduced into the United States, where in some places it is now quite common. The stem is about 2 feet (60 Cm.) high, quadrangular, often purplish, branched above. The leaves are opposite, petiolate, roundish ovate, obtuse, entire, or slightly toothed, hairy on the veins beneath, and pellucid punctate. The flowers are terminal on the branches, forming a corymbose panicle, have a purple, ovate bell-shaped and five-toothed calyx, a purplish somewhat two-lipped corolla, and four didynamous exserted stamens. The herb has a strong aromatic, marjoram-like odor and a warm aromatic and bitterish taste.

Constituents.—The herb contains volatile oil, a little tannin, bitter principle, etc.

OLEUM ORIGANI, *U. S.* 1870.—Oil of origanum, *E.*; Essence d'origan, *Fr.*; Dostenöl, *G.*—Raybaud obtained only 0.024 to 0.03 per cent. from the fresh plant, and Redtel 2 per cent. from the recently-dried herb. Red oil of thyme (see OLEUM THYMI) is often sold in its place. It is pale-yellow and limpid, becoming thicker and brown-yellow on exposure, has a strong aromatic odor, and a warm, pungent, and slightly bitter taste. Its specific gravity varies between 0.87 and 0.91. It yields a turbid solution with 12 parts of alcohol specific gravity 0.85, fulminates when brought into contact with powdered iodine, acquires with sulphuric acid a dark blood-red color, and a deep-brown one with potassium bichromate and sulphuric acid (Zeller). The oil consists of a liquid and a solid portion, which have not been fully investigated. Kane (1838) ascribed to it the composition $(C_{10}H_{16})_5O$. According to Jahns (1881), it is left-rotating, and contains 0.1 per cent. of phenols.

Allied Plants.—ORIGANUM MAJORANA, *Linné*, s. Majorana hortensis, *Mœnch*; Herba majoranæ.—Sweet marjoram, *E.*; Marjolaine, *Fr.*; Meiran, *G.*—It is an annual herb, frequently cultivated for culinary purposes, and is indigenous to Western Asia and South-eastern Europe. The leaves are spatulate or oval, very obtuse, entire, gray-green, soft-hairy, and pellucid punctate. The flowers are aggregated in small heads and have a small whitish corolla. The plant is agreeably and pungently aromatic.

The volatile oil (*Oleum majoranæ*) is thin, yellowish, of the specific gravity 0.89, boils above 163° C., is readily soluble in alcohol, has the aromatic odor of the herb, and, according to Beilstein and E. Wiegand (1882), contains a terpene boiling at 178° C. (352.4° F.) and forming a liquid compound with HCl; the fraction boiling between 200° and 220° C. (392° and 428° F.) has the composition $C_{15}H_{26}O$, and is not affected by metallic sodium.

An ointment of marjoram, *Unguentum majoranæ*, is occasionally employed; it is prepared by softening 2 parts of the cut herb with 1 part of alcohol, then digesting with 10 parts of lard until the alcohol has evaporated, straining, and cooling.

Orig. creticum, *Linné*, indigenous to Southern Europe, has hairy ovate or nearly cordate and somewhat five-nerved, pungently aromatic leaves, and whitish flowers. In Europe the volatile oil is distilled from it, and is used like allied oils. The volatile oil of Orig. hirtum, *Link*, which is often sold in place of it, consists, according to Jahns (1879), of 50 to 60 per cent. of *carvacrol* and of several terpenes, besides a volatile acid and a small quantity of a phenol which becomes violet-colored with ferric chloride.

Orig. Dictamnus, *Linné*, is found in the Levant, has woolly-tomentose, obtusely quadrangular branches, roundish-ovate tomentose leaves, partly purple-colored bracts, and a dark-purplish corolla. It is pungently aromatic.

Medical Action and Uses.— *Wild marjoram* has been applied in fomentations and poultices for the relief of local pains in the same manner as numerous other plants containing an aromatic volatile oil. *Sweet marjoram* is chiefly used as a condiment in cooking, to diminish, by its excitant qualities, the indigestibility of pork, goose, and other fatty food. It is sometimes employed in warm infusion to promote the eruption in exanthematous fevers, allay *colic*, *dysmenorrhœal pains*, etc., and the fresh bruised herb is applied as a cataplasm to assuage local pains. The infusion may be made with an ounce of the herb to a pint of water (Gm. 30 to Gm. 500). Oil of origanum is applied locally as an anæsthetic to relieve the pain of *carious teeth*, *neuralgia*, etc. It forms an efficient ingredient of liniments for *muscular rheumatism*, *contusions*, etc. It may be prescribed internally in doses of from 5 to 10 drops (Gm. 0.30–0.60).

OS.—Bone.

Os, Fr.; *Knochen*, G.

Description.—Bones form the skeleton of the vertebrate animals, and consist of a dense organic tissue which is filled with a calcareous deposit. They are white, externally smooth, insoluble in water, partly soluble in acids, leaving a gelatinous mass behind, and when heated are partly decomposed, an empyreumatic animal odor being given off and a porous charcoal left. (See Carbo Animalis, p. 383.) On continuing the heat in contact with air, the organic matter is entirely consumed and a white earthy residue remains.

Composition.—The organic portion of bones, which is left undissolved on treatment with hydrochloric acid, has been called *ossein*, and on continued boiling with water is converted into gelatin (see page 724). The inorganic portion varies in different bones of the same individual, in the bones of different species, and in different layers of the same bone; it is smaller in the inner layers, amounting sometimes to 40 per cent., and in the outer layers it may reach 67 per cent. The ash contains phosphate (usually about 57 per cent. of the bones) and carbonate (about 5 to 10 per cent.) of calcium, phosphate of magnesium (1.1 to 2.7 per cent.), fluoride of calcium (nearly 1 per cent.), and traces of silica, iron, manganese, and probably also sodium chloride. Æby (1874) considers the principal inorganic constituents of bones to be united to a chemical compound having the formula $3(Ca_32PO_4).CaCO_3$, probably united with water and mixed with calcium carbonate. *Ivory*, including the fossil kind, has the composition $6(Ca_32PO_4).Ca2HO.CaCO_3.4H_2O$. When old bones free from organic matter are dried at 200° C. (392° F.), the residue on being moistened with water becomes warm and increases to its original weight again. Above 250° C. (482° F.) more water and carbonic acid are given off.

When ground bones are treated with about 50 per cent. of their weight of sulphuric acid a mixture is obtained which is largely used as manure under the name of *superphosphate of lime*, containing, besides the organic matter of the bones, about 50 per cent. of calcium sulphate, 22 or 23 per cent. of acid calcium phosphate, and small quantities of magnesium compounds. On exposing such a mixture in thin layers to a current of crude illuminating gas the latter is deprived of ammonia, which combines with the superphosphate to the extent of about 10 per cent., forming phosphate and sulphate of ammonium. The product of this *dry ammonia process* for gas purification is considered to be more valuable as a fertilizer than the superphosphate of lime.

Pharmaceutical Uses.—Os ustum, *Br.* Bone-ash is the inorganic residue left on burning bones to whiteness, and consists principally of phosphate of calcium, with about 10 per cent. of carbonate of calcium and a little calcium fluoride and magnesium phosphate. It is used in the manufacture of glacial phosphoric acid and in preparing Calc. phosphas and Sod. phosphas, *U. S.*, *Br.*

OXALIS.—Wood-Sorrel.

Alléluia, Surelle, Pain de coucou, Fr.; *Sauerklee, Hasenklee*, G.

Nat. Ord.—Geraniaceæ, Oxalideæ.

Description.—The following species indigenous to North America and Europe have been used:

O. Acetosella, *Linné.* The plant has a thin, thread-like rhizome, which near the ascending apex is furnished with a number of crowded reddish fleshy scales and fine brown radicles. The leaves rise upon petioles about 2½ inches (38 Mm.) long, and have three triangular-obcordate entire leaflets ½ inch (12 Mm.) long. The scapes are longer than the petioles, and bear a single white, red-veined flower with ten alternately short stamens. The capsule is five-angled and five-celled, each cell containing two seeds.

O. stricta, *Linné.* This is an annual herb with a stem 6 to 12 inches (15 to 30 Cm.) high, producing subterranean shoots which survive the winter. The leaves are petiolate, with three obcordate leaflets, and the flowers yellow, forming a small umbel on peduncles longer than the petioles.

Several species, mostly acaulescent and bulbous, and bearing white, purple, or yellow flowers, are seen in cultivation. All are inodorous or nearly so, and have a pleasant acidulous taste.

Constituents.—Besides the principles common to most herbs, these plants contain acid potassium oxalate (see p. 79).

Medical Action and Uses.—Wood-sorrel and yellow wood-sorrel depend for their medicinal virtues upon the oxalate of potassium they contain. They have been long considered anti-scorbutic, diuretic, and sedative in febrile conditions. In the last case an infusion of the plant forms an agreeable acidulous drink. Sorrel may be eaten as a salad mixed with lettuce, water-cress, etc. In *scurvy, purpura*, and some cases of vernal *intermittent fever* it is reported to have been curative. In Europe it is commonly eaten as a dressing for insipid meats, such as veal and sweetbread, and it is stated that its habitual use in this way has led to the formation of urinary calculi of oxalate of lime. Externally, the bruised leaves are sometimes applied to cleanse and stimulate foul *ulcers.*

OXYGENIUM.—Oxygen.

Oxygène, Fr.; *Oxygen, Sauerstoff*, G.

Symbol O. Atomicity bivalent. Atomic weight 16.

Oxygen was discovered by Priestley (1774) and Scheele (1775). It constitutes about one-fifth of the volume of atmospheric air, the remainder being nitrogen, with a small proportion of carbonic acid gas. Eight-ninths of the weight of water and one-half the weight of many minerals consist of oxygen, and it is estimated that at least one-third the weight of the solid crust of the earth is made up of this element, which is the most abundant of all.

Preparation.—Oxygen may be obtained by exposing binoxide of manganese, oxide of mercury, or some other metallic oxide to a strong heat, but it is most conveniently prepared by heating a mixture of 4 or 5 parts of chlorate of potassium with 1 part of binoxide of manganese. At a low red heat the chlorate is completely decomposed into oxygen and potassium chloride, which remains mixed with the manganese; the latter, not being altered, may be recovered by dissolving the potassium chloride in water; $KClO_3$ yields $KCl + O_3$. Care should be taken that black sulphide of antimony be not used in place of binoxide of manganese, and that the mixture be free from organic compounds, since a violent explosion would take place on the application of heat.

Properties.—Oxygen is a colorless and inodorous gas having the density 1.1056 as compared with air; 1 liter of it at 0° C. (32° F.) and a barometric pressure of 0.76 meter weighs 1.43 Gm. L. Cailletet and R. Pictet (December, 1877) succeeded in reducing it to the liquid state, when it has the density 1.0. It is slightly soluble in water and alcohol, and combines with all other elements, perhaps with the sole exception of fluorine. These compounds are called *oxides*, and the act of combination *oxidation*, and when attended with heat and light it is termed *combustion.*

By the action of electricity upon oxygen, or by the slow oxidation of phosphorus in moist air, and under various other circumstances, oxygen is converted into *ozone*, which is a gas as usually obtained colorless, but, according to Hautefeuille and Chappuis (1880), of a deep-blue color if sufficiently concentrated, and under a pressure of 125 atmospheres forms indigo-blue drops, which after the removal of pressure evaporate slowly. It has a peculiar odor, somewhat resembling that of chlorine, is a powerful oxidizing agent, bleaches indigo solution, and liberates iodine from potassium iodide; paper dipped in thin starch-paste containing potassium iodide is turned blue by ozonized air, and is a delicate test for the presence of ozone. This body has not been obtained free from oxygen; it is regarded simply as a modification of oxygen, its formula being O_2O, indicating that 3 vols. have been condensed into 2; its spec. gravity is one-half greater than that of oxygen. It is nearly insoluble in water (see also page 799).

Physiological Action.—It was taken for granted that oxygen could be introduced by the lungs as readily as food is carried into the system through the stomach, and that by its means all the organic operations of the economy could be aroused to an increased activity. Experimenters graphically described the enlivening influence of this increased supply of "vital air" upon the sensations and the organic functions, and were apt at explaining how it not only must, but actually did, cure some of the gravest of diseases. But it was pointed out by Dr. A. H. Smith, and then by Dr. B. W. Richardson, that no more than a certain proportion of oxygen, such as exists in the atmosphere, can be absorbed by the lungs. Their results were subsequently (1875) confirmed by Buchheim, who concluded that "henceforth we must abandon the notion that the course of diseases can be modified by increasing the amount of oxygen in the blood." It should be remembered that Richardson and others have shown (*Lancet*, Nov. 1878, p. 749) that oxygen inhaled in large quantities is so far from being a stimulant that it relaxes and debilitates the system, and, in fact, induces narcotism. According to Hayem, on the other hand, the inhalation of from 50 to 100 quarts a day of oxygen, more or less diluted with atmospheric air, stimulates the appetite, raises the temperature slightly, quickens the pulse, and increases the weight. It temporarily augments "the hæmatoblasts and the red corpuscles," and the proportion of hæmoglobin in the latter, but it restores neither their normal size nor form (*Archives gén.*, June, 1881, p. 745).

Medical Uses.—A critical examination of the reports of *pulmonary consumption* treated by oxygen proves that no ground exists for the belief that the disease is either curable or benefited by this gas; the same may be said of *diabetes*, in which it transiently diminishes the diuresis and the proportion of sugar; of *albuminuria*, in which it similarly reduces the albumen; and also of *hydrophobia*, in spite of some cases which are alleged to have recovered under its use. In chronic *bronchitis* and other affections of the respiratory organs attended with symptoms of *asphyxia* the inhalation of oxygen has certainly appeared to prolong, and even to save, life. This has been demonstrated in *asphyxia* from emphysema with bronchitis, in laryngitis of various forms, in compression of the lungs by the gravid uterus, in *opiate narcotism*, in poisoning by *charcoal fumes* or by *illuminating* or *privy gas*, and in similar conditions. A case is recorded in which it seems to have saved the life of a child poisoned by a very large dose of carbolic acid (*Bull. de thérap.*, cv. 417). Its most striking benefits are observed when the gas is inhaled by *dyspeptic chlorotic* patients. It revives the appetite, quickens the digestion, and arrests vomiting if present, and consequently increases the excretion of urea. But this improvement is not permanent unless iron is used as supplementary to the oxygen (*Bull de thér.*, xcviii. 427). In traumatic *tetanus* the inhalation of oxygen is said to have caused profuse diaphoresis and muscular relaxation (Richardson). In some cases of *vomiting* during pregnancy this treatment has arrested the symptom when all other measures had failed. (For a detailed account of oxygen as a medicine see STILLE, *Therapeutics*, etc., 4th ed., i. 703.) If possible, the oxygen should be inhaled from a reservoir or bag containing it through a tube with a suitable stopcock and valves, in the same manner as nitrous oxide gas.

OXYMEL, *Br.*—OXYMEL.

Oxymel simplex, Mel acetatum.—Oxymel (Oxymellite) simple, Acétomel, Fr.; *Sauerhonig*, G.

Preparation.—Take of Clarified Honey 40 ounces; Acetic Acid and Distilled Water, each 5 fluidounces. Liquefy the honey by heat, and mix with it the acetic acid and water.—*Br.*

The French Codex orders 1 part of white wine vinegar to be mixed with 4 parts of virgin honey, and the mixture to be concentrated and clarified with paper pulp. The German Pharmacopœia of 1872 directed the mixing of 40 parts of clarified honey with 1 part of acetic acid spec. grav. 1.040; this is certainly the simplest process.

Medical Action and Uses.—This is an officinal form of the popular mixture of honey and vinegar, which is generally used as a gargle in *sore throat*. It may be prescribed as an excipient for various expectorant medicines, and particularly for squill and ipecacuanha in the form of syrup.

OXYMEL SCILLÆ, *Br., P. G.*—Oxymel of Squill.

Oxymel scilliticum.—*Oxymel scillitique*, Fr.; *Meerzwiebelhonig*, G.

Preparation.—Take of Vinegar of Squill 1 pint; Clarified Honey 2 pounds. Mix and evaporate by a water-bath until the product when cold shall have the specific gravity 1.32.—*Br.* The process of the P. G. is practically identical with this. Vinegar of squill 1 part, honey 4 parts; clarify with paper pulp and evaporate to the density 1.26.—*F. Cod.*

Medical Action and Uses.—Oxymel of squill has the medicinal virtues of syrup of squill, neither more nor less. Honey is superior to syrup as a local application to the throat, but there is no known difference between them in their action upon the air-passages. Like the syrup of squill, the oxymel may be prescribed in *catarrhal affections* of the respiratory mucous membrane, and in young children as an emetic in spasmodic *croup*. The *dose*, as an expectorant, is for adults a teaspoonful (Gm. 4); for infants, from 5 to 20 drops (Gm. 0.30–1.30). As an emetic for children a teaspoonful (Gm. 4) may be given at short intervals.

PÆONIA.—Peony.

Pivoine, Fr.; *Gichtrose*, *Pfingstrose*, G.

Pæonia officinalis, *Linné.*
Nat. Ord.—Ranunculaceæ, Pæonieæ.

Description.—Peony is a perennial herb from Southern Europe, which is frequently cultivated for ornament. It has an oblique many-headed root-stock 6 or 9 inches (15–23 Cm.) in length, with numerous at first fibrous *roots*, which afterward enlarge and become fusiform, dark-brown, internally white and mealy, resembling elongated tubers, about 2 or 3 inches (5–8 Cm.) long, and ½ inch (12 Mm.) thick. In commerce these are generally peeled, are whitish or purplish, and have near the circumference narrow yellow wood-wedges. The branched stem is about 2 feet (60 Cm.) high, smooth, with large, twice or thrice pinnately dissected and cleft green smooth leaves, and large terminal flowers, having five sepals, five to eight petals, numerous stamens, and two to five ovaries. The *petals* are obovate, entire or crenate, 1½ inches (18 Mm.) long, dark-red, purple or rose-red, after drying inodorous, and have a sweetish astringent taste. The *seeds* are nearly globular, ⅛ to ⅙ inch (3–4 Mm.) in diameter, black, glossy, and smooth, inodorous, and contain a yellowish oily albumen and a small embryo. The tuberous roots, petals, and seeds have been used.

Constituents.—Wiggers obtained from the fresh root a distillate having the odor of bitter almonds and acquiring a blood-red color by ferric chloride; separated by means of ether, the volatile oil had a pale-yellow color. The analysis of the fresh root by Morin proved the presence of starch, sugar, fat, malates, oxalates, and phosphates, a little tannin, etc. The root of Pæonia peregrina, *Miller*, yielded to Dragendorff and Mandelin (1879) 4.1 to 5.4 per cent. of ash, some sugar, starch, gummy matter, and small quantities of tannin, resin, fat, etc., while the seeds contain 23.6 per cent. of fixed oil, various coloring matters, etc., and a crystalline body which in the ripe seeds appears to be changed to an indifferent and an acid resin. The root of the Japanese species, Pæonia Moutan, *Simson*, according to Jagi (1878), contains a crystalline substance closely related to caprinic acid; it melts at 45° C. (113° F), sublimes at a higher temperature, and is easily soluble in ether and alcohol.

Medical Action and Uses.—In the ages of medical faith the virtues of this plant were highly esteemed. Galen described its acrid qualities and emmenagogue virtues, and its astringency also, which rendered it useful in diarrhœa. A superstition prevailed in his time that peony-root enclosed in a bag and hung around a child's neck both prevented epileptic attacks and cured them, and this belief is not yet extinct among the peasantry of Europe. They also believe that the same amulet, or rather one made with the seeds, worn on the arm, will prevent the dangers of dentition and promote menstruation. That the plant is not inert is abundantly proved; its very odor has caused syncope; in one case an infusion of it brought on an attack of convulsions, and in another it produced headache, ringing in the ears, confusion of sight, violent colic, and vomiting. Modern observation has neither confirmed nor condemned the ancient opinions concerning it; and although some have reported favorably of it in *epilepsy*, *chorea*, and *whooping cough*, the evidence in favor of its efficacy is very slender indeed. The powdered root may be prescribed in doses of from 15 to 60 grains (Gm. 1–4), or an infusion made with from half an ounce to an ounce of the bruised root in a pint of water (Gm. 16–32 in Gm. 500).

PANAX.—GINSENG.

The root of Panax quinquefolium, *Linné*, s. Aralia quinquefolia, *Gray*.

Nat. Ord.—Araliaceæ.

Origin.—North American ginseng is a perennial herb growing in rich and cool woods. The stem is a foot (30 Cm.) high, and bears at the summit three large palmately five-foliate leaves, with long-stalked, obovate-oblong, pointed, doubly serrate leaflets. The greenish-white flowers are in a terminal subglobular umbel, and produce globular scarlet-red two-celled and two-seeded berries.

Description.—The root is fusiform, 2 to 3 inches (5–8 Cm.) long, with a rounded head, closely annulate, and with few wrinkles above, dividing below into two, or occasionally three, branches of even size. The branches are not, or are but slightly, annulate, and are longitudinally wrinkled. The root is externally of a light brownish-yellow color, internally white, breaks with a short and mealy fracture, and has a faint sweetish odor and a sweet slightly aromatic taste. The transverse section shows a thick bark, with numerous scattered brown-red resin-cells, and in older roots is radially striate from the bast-wedges; it is separated by a brown cambium-line from the central portion, which consists of linear wedge-shaped yellowish wood-bundles and broad medullary rays.

Panax Schinseng, *Nees*, the *Chinese ginseng*, has a larger root, 4 to 6 inches (10–15 Cm.) long, darker in color, and near the head usually with two lateral branches, otherwise resembling the preceding.

Constituents.—Besides starch, gum, albumen, and resin, S. S. Garrigues (1854) isolated a sweet principle, *panaquilon*, $C_{12}H_{25}O_9$, by adding to the syrupy infusion a concentrated solution of sodium sulphate and dissolving the precipitate in alcohol. It is yellow, amorphous, sweet, insoluble in ether, and precipitated by tannin. Concentrated sulphuric acid dissolves it with a purple-red color, converting it at the same time into *panacon*, $C_{11}H_{19}O_4$, which is white, tasteless, and insoluble in water and ether, but soluble in alcohol.

Medical Action and Uses.—It is unsettled whether or not the American and Chinese species of ginseng are identical. It is at least certain that while the former is only agreeable in taste, and perhaps useful as a mild stomachic, the latter enjoys in its native country the reputation of a panacea, and especially of being aphrodisiac. The affections for whose cure it is most esteemed are such as are usually treated by aromatic stimulants, including *dyspepsia*, *vomiting*, and *nervous disorder*. It is used as a masticatory, and also in infusion.

PANCREATINUM.—PANCREATIN.

Origin.—The *pancreas* is a gland which is deeply seated in the abdomen and secretes the *pancreatic juice*, containing the proteid *pancreatin*, to which it owes the property of emulsifying and decomposing fats into glycerin and acid and of converting starch into sugar. The pancreatic juice is a colorless, clear, somewhat viscid liquid, of an alkaline reaction, without odor and of an insipid somewhat saline taste; it contains, besides the ferment, nearly 1 per cent. of mineral salts, a trace of fat and of organic matters soluble in water.

Preparation.—Prof. Scheffer (1875) recommended the following process: Fresh and finely-chopped beef pancreas is macerated for a day in water acidulated with a little hydrochloric acid; the maceration is repeated with water; the strained liquids are filtered, neutralized with calcium carbonate, again filtered, and mixed with an equal volume of 95 per cent. alcohol; the precipitate is washed with dilute alcohol, pressed between bibulous paper, and dried at the ordinary temperature.

Properties.—Thus prepared, it is a transparent, brittle, yellow mass, which dissolves in water slowly, but almost entirely, leaving, when prepared in cold weather, only a trace of insoluble matter. The solution is clear, pale-yellowish, neutral, and produces white precipitates on heating and on being mixed with alcohol. Hydrochloric acid likewise precipitates it, but not a saturated neutral solution of table-salt.

Composition.—Like other proteids, pancreatin consists of C, H, N, O, and a little S (see VITELLUS), and belongs to the soluble ferments, designated by Kuehne as *enzymes.* Bernard assumed the presence in the pancreatic liquid of two ferments, and in 1878 Defresne announced the isolation of even three—namely, *myopsin*, which digests albumen; *amylopsin*, which saccharifies starch; and *steapsin*, which decomposes fats. The first of these, or proteolytic enzyme, has been termed *trypsin*, and the second, or amylolytic enzyme, as *pancreatic diastase*, by W. Roberts (1881), who found the diastatic value of pancreatic extracts to be uniform between 30° and 45° C., to be less below and above these temperatures, and to cease between 65° and 70° C. On the other hand, the proteolytic activity gradually increases in energy up to 60° C., then falls rapidly, and is finally arrested between 75° and 80° C. It may be valued by determining how many cubic centimeters of milk, after digestion with 1 Ccm. of pancreatic extract at 40° C. for 5 minutes, will be changed so as to be distinctly curdled on boiling (the onset point); on prolonged digestion the property of curdling by heat will abruptly disappear (the vanishing point). Quantity and time are inversely related as far as the onset point is concerned, only provided the time does not exceed 8 or 10 minutes; if the test be performed at 20° C., sufficiently accurate results are obtained by multiplying with 3.5. The proteolytic value of the pancreatic juice of the pig was found to vary between 64 and 83; of the ox, between 42 and 83; and of the sheep, between 28 and 125.

The amylolytic action is measured by determining the number of cubic centimeters of standard mucilage of starch, containing 1 per cent of the latter, which can be brought to the achromic point (of not being colored blue by iodine) by 1 Ccm. of pancreatic extract at 40° C. in 5 minutes. In testing, 10 Ccm. of starch solution are diluted with 90 Ccm. of water, and from .02 to .20 Ccm. of the pancreatic liquid may be employed; in the action of the ferment quantity and time are in inverse proportion, unless largely diluted. The diastatic value of the pancreatic liquid of the pig is 100; of the ox, 11; of the sheep, 10; of filtered human saliva, 10 to 17; and of malt diastase, 4 to 5, increasing to 10 at 60° C.

Medical Action and Uses.—Pancreatic juice has an alkaline reaction, converts starch into sugar, and decomposes fat into fatty acids and glycerin. It also forms with albumen an alkaline solution. The latter action, which is ascribed to pancreatine, and forms the ground of its utility in disease, is not interfered with by the presence of the acid secretions of the stomach. During the first years of life, when the food consists chiefly of milk and farinacea, a state of *dyspepsia* frequently arises which often leads to marasmus, and which is not traceable to any organic lesions of the stomach or auxiliary viscera. In this it is claimed that pancreatic emulsion speedily restores the digestive function to its normal condition, and, through improved nutrition, renews the health. "Defresne has recommended pancreatine in *phthisical* cases where the patient is unable to digest or assimilate cod-liver oil; in cases of *jaundice* in which fat is badly digested; in cases of *dyspepsia* in which the patient experiences abdominal pains, vomiting, diarrhœa, and flatulence several hours after meals; and, speaking generally, in those cases of disturbances of digestion in which fats and starches are badly assimilated and where pepsine is found to be useless" (*Practitioner*, xx. 454). Hence it is reported to be serviceable in such diseases as are more or less maintained by the imperfect digestion of albuminous food, including *rachitis*, *scrofula*, *diabetes*, and *fatty diarrhœa*, *anæmia*, *chlorosis*, *leukæmia*, *pernicious anæmia*, and the early stage of *tuberculosis*. It has also been profitably employed during *convalescence* from acute wasting diseases (Loebisch). In all of these cases it may be administered by the mouth. It was, however, originally introduced into medicine by Leube in 1874 as an efficient means of nourishing by the rectum when the stomach could not retain or digest food. Such were cases of *gastric atony* produced by protracted illness; of *gastric irritability* caused by disease of the stomach itself or by disorders of its nervous system leading to the rejection of food; of cases also of *stricture of the œsophagus* or compression of it by tumors; and, finally, cases of *gastric hæmorrhage* in which the introduction of food into the organ might be attended with danger. All other forms of nutritive enemata had failed of their purpose, both because they were, or soon became, mechanically irritating, and because they were not of such a nature as to be absorbed, or to subserve the purposes of nutrition had their absorption been practicable. The first of these objections does not apply to pancreatic emulsions, probably because their reaction, like that of the rectum, is alkaline.

Leube's directions for preparing the enemata are as follows: Take a piece of lean beef and scrape or grate it until it is reduced to a fine pulp. For one injection from 5 to 10 ounces (Gm. 150–300) of it should be mixed with an equal quantity of finely-hashed pancreas and thoroughly pounded in a mortar or crushed in a bowel with a spoon, with the gradual addition of about 5 ounces (Gm. 150) of lukewarm water until the mixture is of the consistence of pap. If it is desired to administer fat, it may be added in the proportion of about one-sixth of the meat. To inject this mixture a syringe with a much larger nozzle than usual is required. If the enema is judiciously introduced, the whole of it will be retained, and, according to Leube, will penetrate even to the transverse colon. He refers to cases in which, after from 12 to 36 hours, the stool was feculent, without any trace of the emulsion. He further advises that, as the pancreas readily becomes stale in warm weather, it should be preserved by mixing its pulp thoroughly with glycerin.

A number of cases have been published in which pancreatic enemata were either the means of saving life permanently, or in which, owing to the incurable nature of the disease, they prolonged life far beyond the term when it must otherwise have terminated. To the latter category necessarily belong all cases of organic stricture of the digestive canal; to the former, cases of simple ulcer of the stomach and nervous vomiting.

The preparation of the pancreas for administration by the mouth differs from that just described. According to Engesser, the pancreas of the hog, sheep, or ox should be used, that of the hog being preferable. After being finely minced it is forced through a hair sieve. The semi-liquid product may then be directly mixed with the food, or may, after the addition of a little salt, be preserved in a cool place in a properly-covered jar. For immediate use the watery infusion of pancreas may be employed, although it is less efficient than the gland substance. It is also less repulsive in appearance than the emulsion, and its taste is not unlike the cold prepared extract of beef. Pancreatic pulp may be given in bolus, in wafers, or mixed with the food, and in the dose of about a dessertspoonful at each meal. Care must be taken not to mix it with hot food (113° F. = 45° C.). Various expedients have been suggested for concealing the unpleasant taste and smell of the emulsion, and for securing its thorough and equable mixture with the food, but they must generally be left to the ingenuity of the physician or patient. It need only be added that the food should not be taken very hot, especially in the form of soup, nor very highly seasoned, nor with much or strong wine. On the whole, it must be admitted that pancreatic emulsions given by the mouth are less valuable than was anticipated, probably because their active constituents are neutralized by the acid contents of the stomach.

PAPAVERIS CAPSULÆ, *Br.*—Poppy-Capsules.

Fructus s. Capita papaveris immaturi, P. G.; *Papaver*, U. S. 1870.—*Capsules* (*Têtes*) *de pavots*, Fr.; *Mohnkapseln*, *Mohnköpfe*, G.

The nearly-ripe capsules of Papaver somniferum, *Linné.* Bentley and Trimen, *Med. Plants*, 18.

Nat. Ord.—Papaveraceæ.

Origin.—The poppy is an annual herb, and is most likely indigenous to Western Asia and South-eastern Europe, where it is found wild in fields and waste places. It is frequently cultivated in gardens for ornament, and very extensively in several countries for the production of opium (see Opium). The stem is 3 to 5 feet (0.9–1.5 M.) high;

Fig. 202.

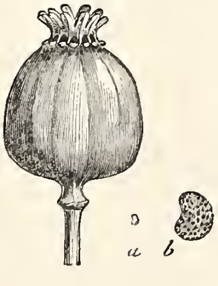


Fig. 203.

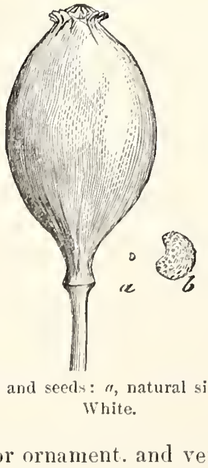
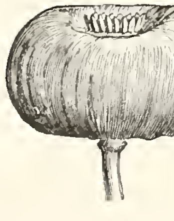


Fig. 204.



Poppy-capsules and seeds: *a*, natural size: *b*, magnified.

Black. White. Depressed.

the leaves are alternate, 5 to 10 inches (12–25 Cm.) long, oval-oblong, sessile, and the upper ones clasping, irregularly dentate, frequently cleft or nearly pinnatifid, rather thick, smooth, and glaucous. The flowers terminate the branches, are about 4 inches (10 Cm.) broad, and have two oval blunt caducous sepals, and four broad roundish petals varying in color from white to violet and dark-purple, with a darker spot near the base. The stamens are numerous, and inserted beneath the subglobular ovary, which is crowned by the peltate radiating stigma. The wild form, Papaver setigerum, *De Candolle*, has acute teeth, prolonged into a stiff bristle. The white flowering variety, Pap. officinale, *Gmelin*, has white seeds, and its capsules are alone recognized by pharmacopœias.

Description.—Poppy-capsules vary in shape and size according to the variety of the plant from which they have been obtained. The black poppy usually has rather small capsules, which are globular-ovate, about 1½ inches (37 Mm.) in diameter, broadest near the base, and dehiscent by small apertures forming underneath the stigma. The capsules of the white poppy are mostly larger, indehiscent, and more variable, occasionally depressed and much broader than high, but usually oblong, or in some varieties much elongated and narrowed toward the base. The sessile and peltate stigma is formed of from eight to twenty rays, and a similar number of longitudinal striæ, marking the sutures, are observed upon the immature capsule, which is smooth, and underneath the epidermis consists of loose parenchyma with a circle of thin fibro-vascular bundles and larger laticiferous vessels. The capsule is one-celled, but internally is furnished with placentas equal in number to the lobes of the stigma and projecting into the interior, forming incomplete partitions. In the fresh state it has a narcotic odor; after drying it is nearly inodorous; its taste is bitter.

Semen papaveris, *P. G.*—Poppy-seed, Maw-seed, *E.;* Semences (Grains) de pavot, *Fr.;* Mohnsamen, Magsamen, *G.*—The seeds are very numerous, quite small, about $\frac{1}{20}$ inch (1.2 Mm.) long, reniform in shape, white, blackish, or bluish, finely netted-veined, and contain an oily albumen enclosing a curved embyro. They are inodorous, and have a bland oily and scarcely bitterish taste. Only white poppy-seeds are medicinally employed. About 700 pounds of poppy-capsules and 425,000 pounds of poppy-seed were imported in 1882.

Constituents.—1. The Capsules. Winckler (1837), Merck, and others have demonstrated the presence of *morphine* in ripe poppy-capsules; the former chemist obtained as much as 2 per cent. of this alkaloid, and likewise *narcotine* and *narceine*. Groves (1854) found also another alkaloid, which was probably *codeine*. A. Buchner obtained an alkaloid which differed from morphine, and other chemists were unable to find the latter. Deschamps (1864) isolated an alkaloid, and silky needles of a nitrogenous body called *papaverin*, which is said to have an acid reaction; the alkaloid *papaverosine* forms colorless, nearly tasteless prisms, is soluble in alcohol, ether, chloroform, and benzol, has a slight alkaline reaction, and with sulphuric acid assumes a violet color, which on warming becomes red, and with nitric acid orange-red. Hesse (1866) obtained *rhœadine* from ripe poppy-capsules. Besides meconic acid, which could not be detected by several chemists, citric and tartaric acids were found by Deschamps. The capsules contain considerable mucilage. The waxy coating of the epidermis is scraped off in the preparation of opium, and forms a constituent of the latter. Examined by Hesse (1870), it yielded a colorless compound insoluble in chloroform, crystallizing in prisms, and melting above 100° C. (212° F.); the portion soluble in boiling chloroform consists of *cerylcerotate*, $C_{27}H_{55}.C_{27}H_{53}O_2$, which crystallizes in silky scales, melts at 82.5° C. (180.5° F.), and congeals in crystals at 80° C. (176° F.); and of *cerylpalmitate*, $C_{27}H_{55}.C_{16}H_{31}O_2$, which forms crystalline warts melting at 76° C. (168.8° F.)

2. The Seeds. Sace (1849) obtained from white poppy-seeds nearly 55 per cent. of fixed oil, 23 pectin, and 12.6 per cent. protein compounds. Accarie (1833) announced that he isolated 30 grains of morphine from 6 pounds of white seeds. The fixed oil (Oleum papaveris, *P. G.*—Poppy-seed oil, *E.;* Huile de pavots, Huile d'œillette, *Fr.;* Mohnöl, *G.*) is pale-yellow, bland, limpid, of the density 0.92, congeals near −18° C. (0° F.), and on exposure becomes thick and hard. It is soluble in 25 parts of alcohol, freely soluble in ether, and yields when saponified 9.5 per cent. of glycerin.

Off. Prep.—Of the capsules: Decoct. papaveris, Extract. papaveris, Syrupus papaveris, *Br.*

Medical Uses.—Formerly decoctions of poppy-heads were much used internally, but such is no longer the case since preparations of opium of definite strength have become multiplied. Even for external use such decoctions have been almost entirely supplanted by liquid opiates and plasters containing opium. The officinal retention of papaver seems unnecessary, unless for pharmaceutical purposes.

PARAFFINUM.—Paraffin.

Paraffinum durum and Par. molle, Br.; *Paraffinum liquidum and Par. solidum*, P. G.; *Ceresinum.—Paraffine*, Fr.; *Paraffin*, G.

Origin.—The paraffins are produced under various circumstances from fats and other organic compounds, but are chiefly obtained among the products resulting from the destructive distillation of many organic substances, especially cannel and boghead coal, and from bituminous shale. They are a natural constituent in varying proportions of the different kinds of petroleum, and solid paraffins are found native in Austria, Great Britain, the United States (Utah), and some other countries, constituting the minerals known as *earth-wax*, *fossil* (*mineral*) *wax*, and *ozokerite*.

Properties.—"Liquid paraffin is a clear oily liquid having a specific gravity of not less than 0.840, and boiling not below 360° C. (680° F.). Solid paraffin is a white micro-crystalline, inodorous mass, melting between 74° and 80° C. (165° and 176° F.). Both paraffins should be free from colored, fluorescing, and odorous compounds. When heated for a day with sulphuric acid by means of a water-bath, the paraffins should not become dark-colored, and the sulphuric acid should become only slightly brownish. Metallic sodium, treated in a similar manner, should retain its metallic lustre. Alcohol boiled with paraffin should not have an acid reaction."—*P. G.*

Paraffin is insoluble in water, alkalies, and cold alcohols, but dissolves in volatile and fixed oils, ether, chloroform, benzol, and carbon bisulphide; the solubility is, however, influenced by the composition. The melting-point of commercial paraffin varies much. Obtained from the residuum of petroleum distillation, it is usually about 43° C. (109.4° F.), or somewhat higher; from peat, about 47° C. (116.6° F.); from ozokerite, about 60° C. (140° F.); from *Rangoon tar* of Burmah, about 62° C. (143.6° F.); and the mineral wax of Moldavia, known as *zietrisikite*, melts between 85° and 90° C. (185°–194° F.), and is insoluble in ether. Hard paraffin, *Br.*, should melt between 43.3° and 62.8° C. (110°–145° F.).

Composition and Characters.—The general formula of the paraffins is the same as that of the lighter coal oils, C_nH_{2n+2}, but in their physical properties they differ from the latter in being at the ordinary temperature either solid, and frequently crystalline, or of a butyraceous consistence or liquid. Those which are liquid at the ordinary temperature are known in commerce as *paraffin oils*, while the name *paraffin* is retained for the solid products. They can be separated from one another only with great difficulty, but it is known that the different members of this homologous series increase in density, viscidity, and in boiling-point, and the solid paraffins also in melting-point and hardness, as the molecular weight increases. The paraffins, obtained in as pure a state as possible, show the following differences:

Nonane (Nonylhydride),	C_9H_{20},	boils near	138° C.	= 280.4° F.,	spec. grav.	.741
Decane (Decatylhydride),	$C_{10}H_{22}$,	"	160	= 320	"	.757
Endecane (Undecylhydride),	$C_{11}H_{24}$,	"	180	= 356	"	.766
Dodecane (Laurylhydride),	$C_{12}H_{26}$,	"	200	= 392	"	.778
Tridecane (Cocinylhydride),	$C_{13}H_{28}$,	"	220	= 428	"	.796
Tetradecane (Myristylhydride),	$C_{14}H_{30}$,	"	240	= 464	"	.809
Pentadecane (Benylhydride),	$C_{15}H_{32}$,	"	260	= 500	"	.825

Galletly (1871) ascertained for paraffins—

Fusing at 32.0°	39.0°	40.5°	53.3°	58.0°	59.0°	80.0° C.,
the spec. grav. .8236	.8480	.8520	.9100	.9243	.9248	.9400

The solubility of paraffins in benzol decreases as the melting-point rises, the last one of the table being nearly insoluble therein.

Paraffins are not easily acted on by chemicals. By continued boiling with nitric acid the higher paraffins yield nitro-compounds and various acids. Boiling hydrochloric acid or contact with chlorine gas, ammonia, or potassa has no effect upon paraffin, but the lowest members of the series, which are gaseous at the ordinary temperature, yield substitution-products with chlorine.

In distilling paraffin, the heat to which the vapors are exposed influences the melting-point, and consequently the composition; at a red heat *naphthalin* is produced, and when paraffin is heated for some time in a sealed tube it is split into an olefin and a paraffin of a lower boiling-point.

Olefins are present among the products of dry distillation of organic substances, in rock oils, mineral tars, etc. They have the formula C_nH_{2n}, and the so-called paraffin oils usually consist principally of olefins, particularly of *heptilene*, C_7H_{14}, which boils at 96° C. (205° F.). The olefins are readily polymerized by the action of sulphuric acid, zinc chloride, and other chemicals, and unite with the halogens, their hydro-acids, and with hypochlorous acid; by nascent hydrogen they are converted into paraffins.

J. L. Lemberger and A. W. Miller ascertained (1875) that crude paraffin oils may be deprived of their odor by filtering them through granulated animal charcoal. *Cosmoline*, *vaseline*, and other copyrighted preparations are paraffins containing olefins of the consistence of ointments. (See PETROLATUM.) The liquid paraffins are extensively employed for lubricating purposes, and are known in commerce as *lubricating oils* and *neutral oils*.

Medical Action and Uses.—A case of death in a boy from swallowing paraffin oil is reported (*Med. Times and Gaz.*, Nov. 1878, p. 631), but the symptoms are not detailed. A child two years old drank some of the oil, and fell into a state of collapse with drowsiness. There was neither vomiting nor diarrhœa. On the morrow the child was well (*Lancet*, 1880, vol. ii. p. 730). Soft paraffin and paraffin oils are much used in a pure state and in ointments as a dressing for *chilblains*, *excoriations*, *bruises*, *indolent ulcers*, and in some diseases of the skin, especially *eczema*, *psoriasis*, and *scabies*. As a substitute for various fatty substances, oils, lard, glycerin, and glycerite of starch, which are more or less irritating in cutaneous affections, Kaposi prefers petroleum or vaseline jelly, as being unirritating and having no tendency to become rancid, and employs an ointment composed of equal parts of lead plaster and vaseline, thoroughly incorporated by the aid of heat and scented with oil of bergamot. Galezowski recommends vaseline as the best excipient for yellow oxide of mercury, nitrate of silver, etc. in the treatment of *scrofulous affections of the eye*, chiefly *keratitis* and *conjunctivitis*. The lead plaster spoken of above is *Unguentum diachylon Hebræ*, and consists of simple litharge ointment melted with an equal quantity of olive or linseed oil. Solid paraffin, when mixed with glycerin or linseed oil, has been used with advantage in the same diseases (Purdon). Dubois is of the opinion that vaseline scented with otto of roses, when applied to the vagina during parturition, facilitates labor by relaxing the tissues; that it may be used with advantage to protect the hands of the obstetrician in vaginal explorations; and that it answers better than oil or soap to remove the smegma from the new-born child. It is said that vaseline used as an excipient for carbolic acid impairs or destroys the antiseptic qualities of the latter. But when the mixture is applied to a moist tissue the acid is dissolved out by the water of the part and exerts its special action. Mixed with an equal weight of honey and 10 grains of borax or of chlorate of potassium to the ounce, it is a useful application in *thrush*. Mixed with 10 grains of quinia to the ounce (Gm. 0.60 to Gm. 32), it quickly removes *ascarides of the rectum*; it is beneficial in the *ophthalmia* of the newborn child; cures the *coryza* of suckling children when applied with a brush to the interior of the nostrils; and effects a rapid healing of *intertrigo*.

PAREIRA, *U. S.*—PAREIRA.

Pareiræ radix, Br.—*Pareira brava*, E., Fr., G.; *Racine de butua*, Fr.; *Grieswurzel*, G.

The root of Chondodendron tomentosum, *Ruiz et Pavon*, s. Cocculus Chondodendron, *De Candolle*, s. Cissampelos Abutua, *Vellozo*, s. Botryopsis platyphylla, *Miers*. Bentley and Trimen, *Med. Plants*, 11.

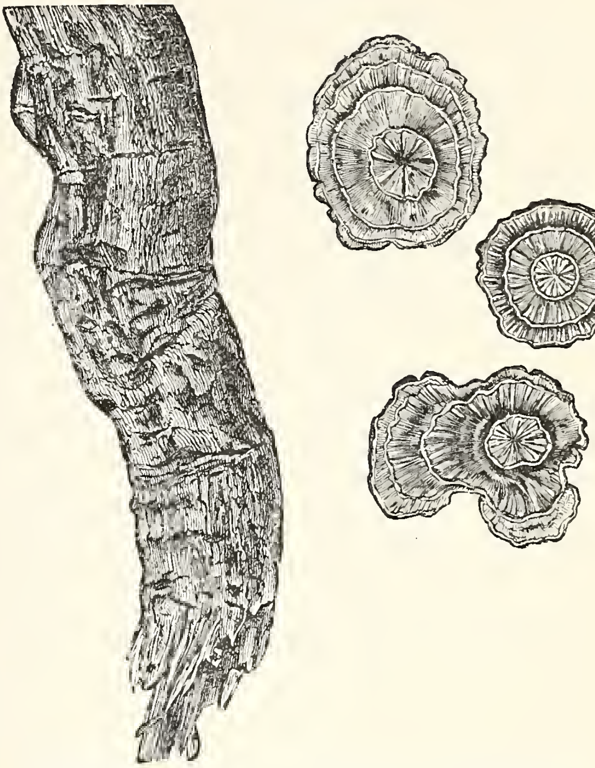
Nat. Ord.—Menispermaceæ.

Origin.—Pareira brava was formerly referred to Cissampelos Pareira, *Linné*, s. Ciss. microcarpa, *De Candolle* (Bentley and Trimen, *Med. Plants*, 15), which is a woody climber indigenous to the West Indies and Central America, and probably to other tropical countries. It is medicinally employed there, but is not exported. The root as well as the stem rarely reaches an inch (25 Mm.) in diameter, and is often not thicker than a goose-quill; both show no concentric rings in transverse section, the wood consisting of about twenty porous wedges, separated by narrower medullary rays and covered by a gray-brown suberous bark.

The true origin of pareira brava was established by Hanbury (1873), and is the species mentioned above, which, according to Peckolt, is known in Brazil as *abutua*. This is a tall woody climber of Brazil and Peru, having large cordate or ovate-cordate, somewhat five-nerved leaves, very small unisexual flowers and purplish-black ovoid one-seeded drupaceous fruits, which form thick bunches resembling grapes in appearance.

Description.—Pareira brava comes to us in pieces 3 to 6 inches (7–15 Cm.) long, or even longer, and from about 1 to 4 inches (2–10 Cm.) in diameter, more or less tortuous, dark-brown or blackish-gray externally, and marked with transverse ridges and fissures and with irregular longitudinal furrows. Internally it is of a pale-brown color, when cut exhibits a somewhat waxy lustre, and on breaking shows a fibrous fracture. On transverse section are seen, under a thin bark, two or more concentric zones separated by wavy circles of a waxy tissue of parenchyma, resembling that of the medullary rays; in each zone are found a varying number of harder porous wood-wedges. Each one of the different zones is mostly nearly uniform in width, so that the axis is nearly in the centre of the root. Pareira brava is nearly inodorous and has a bitter taste.

Fig. 205.



Pareira brava: portion of a root, and transverse sections of the same.

Admixtures and Substitutions.—The *stem* of chondodendron is sometimes found mixed with the commercial root, which it closely resembles. It is distinguished by being rather more woody, but more particularly by the distinct central pith.

Several drugs derived from menispermaceous plants have been sold in place of pareira brava; these consisted of roots, or more frequently of sections of the stem. The one which was most commonly met with some years ago consisted of woody, more or less flattened pieces, with a thin brown-gray bark, often covered with patches of lichens, and upon transverse section showed numerous woody zones in more or less eccentric layers, so that the axis was removed to one side. This variety of *false pareira brava* is not readily cut with the knife, does not present a waxy appearance of the internal tissue, and, though possessed of a bitter taste, is much less so than the root of chondodendron. A second variety of false pareira was usually in thinner pieces, of a brown color, very woody and nearly concentrically arranged in the interior, and almost tasteless.

A *yellow pareira brava* has also been met with in commerce, and was imported from Brazil. It consists of the flat, often twisted stems, which Bentley and Trimen presume to be obtained from Abuta amara, *Aublet.* This kind is easily recognized by the eccentric arrangement of its woody zones and by its bright-yellow color internally. C. Morrison (1878) isolated from it an alkaloid which closely resembles berberine, but appears to be distinct from it, since with iodine it gave a reddish-brown crystalline precipitate instead of green spangles.

Hanbury mentions also a *white pareira brava*, derived from Abuta rufescens, *Aublet*, which has numerous concentric layers traversed by very distinct dark medullary rays, the interradial spaces being white and rich in starch. It is known in Brazil as *butua* (Martius, Peckolt), and is not an article of commerce.

Constituents.—Wiggers (1838) obtained an alkaloid from pareira brava which was named *pelosine* or *cissampeline*, and was found by Flückiger to be identical with beberine, paricine, and buxine (see pp. 302 and 1014), and to exist also in the stem and root of Cissampelos Pareira, *Linné*, to the extent of about ½ per cent. Pareira brava contains it in the same proportion. The pure alkaloid is amorphous, nearly insoluble in water, somewhat soluble in ether and carbon disulphide, but freely soluble in chloroform and acetone, also in alcohol and benzol; its nitrate is sparingly soluble, and its acetate is precipitated by sodium phosphate, by the group reagents for alkaloids, and by iodide, ferrocyanide, ferricyanide, and chromate of potassium; the precipitate with phosphomolybdic acid dissolves in ammonia with a blue color. Feneulle (1821) examined a pareira brava, and obtained a yellow bitter principle soluble in alcohol and ether, a soft resin soluble in alcohol, and brown extractive soluble in alcohol and water.

Off. Prep.—Decoctum pareiræ, Extract. pareiræ, *Br.;* Extract. pareiræ fluidum (liquidum), *U. S.*, *Br.*

Infusum pareiræ, *U. S.* 1870.—Infusion of pareira brava, *E.;* Tisane de pareira, *Fr.;* Pareira-Infusion, *G.*—Pareira brava, bruised, a troyounce; boiling water a pint; macerate for 2 hours in a covered vessel and strain.

Medical Action and Uses.—Pareira appears to be analogous in its virtues to uva ursi and chimaphila, since they are chiefly manifested in diseases of the mucous membrane of the urinary organs, and especially in those attended with muco-purulent deposits in the urine. In chronic *pyelitis* and *cystitis* it may be advantageously administered in the form of infusion, decoction, or the officinal fluid extract. The solid extract is less efficient. The former officinal infusion was made with an ounce of pareira to a pint of boiling water. The *dose* is represented by 30, and from that to 60, grains (Gm. 2–4) of the root.

PARIETARIA.—Parietaria.

Pellitory, *Wall pellitory*, E.; *Pariétaire*, *Perce-muraille*, Fr.; *Glaskraut*, G.

Nat. Ord.—Urticaceæ, Urticeæ.

Description.—The following perennial European species has been used:

Par. officinalis, *Linné.* The stem is diffusely branched, reddish, rough-hairy; the leaves are petiolate, alternate, about an inch (25 Mm.) long, short-hairy, elliptic, entire, and acute; the polygamous flowers are in cymose axillary clusters with an involucre of short bracts, which are united at the base. The plant is perennial, and grows on walls and along roadsides. A variety with a nearly simple stem is Par. erecta, *Koch.*

Par. pennsylvanica, *Muhlenberg*, indigenous to the United States, probably possesses similar properties. It is an annual, has thin oblong-lanceolate, rather obtuse and opaquely-dotted leaves, and an involucre which is longer than the flowers. It grows on shaded rocky banks.

These plants are inodorous, and have a mucilaginous, saline, and slightly bitter taste.

Constituents.—No complete analysis of these plants has been made. Among the saline constituents of the European species nitrate of potassium is named.

Pharmaceutical Uses.—The *infusion* and *syrup of parietaria* are used in France. *Tisane de pariétaire* is made from 1 part of the leaves and 100 parts of boiling water. *Sirop de pariétaire* is prepared by dissolving 19 parts of sugar in 10 parts of the expressed and clarified juice of the herb.

Medical Action and Uses.—Anciently, common wall pellitory was held to be astringent, cleansing, and cooling, and hence was applied in the first stage of *abscesses* and other local inflammations, including *burns*, erysipelas, inflamed hæmorrhoids, gouty joints, and scaly eruptions. Its expressed juice was used as a *gargle*, and in modern times was taken internally, in the dose of 1 or 2 fluidounces (Gm. 32–64), as a diuretic and lithontriptic.

PARTHENIUM.—Feverfew.

Herba matricariæ.—*Featherfew*, E.; *Matricaire*, Fr.; *Mutterkraut*, G.

The flowering herb of Pyrethrum (Matricaria, *Linné*, Chrysanthemum, *Persoon*, Tanacetum, *C. H. Schultz*) Parthenium, *Smith.*

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Feverfew is a perennial herb growing in waste places in Europe and cultivated in gardens, where it is often seen with double flowers.

Description.—The stem is about 2 feet (60 Cm.) high, furrowed, and has alternate, petiolate, ovate, twice pinnately-cleft leaves about 3 inches (75 Mm.) long, and with obovate or oblong mostly toothed lobes, the teeth terminating with a white point. The flower-heads are in small cymes at the end of the branches, have an involucre composed of linear scales in two rows, a naked hemispherical receptacle, white ligulate obovate and three-toothed ray-florets, and tubular yellow disk-florets. The herb has a peculiar odor resembling that of chamomile, but less agreeable, and a bitter, somewhat acrid taste.

Constituents.—The bitter principle of feverfew has not been isolated; the tannin is of that variety which produces dark-green precipitates with iron salts. The volatile oil contains, according to Dessaignes and Chatard (1848), a stearopten which has the composition of camphor, $C_{10}H_{16}O$, fuses at 170° C. (338° F.), and turns polarized light to the left; also another oxygenated but liquid portion, and probably a hydrocarbon.

Allied Plants.—Parthenium integrifolium, *Linné*, is a North American perennial growing in dry soil in the Southern and Western States. It is about 2 feet (60 Cm.) high, and has oblong or ovate leaves, of which the lower ones are sometimes lobed, and the upper ones merely crenately toothed, and small corymbose flower-heads, with a conical chaffy receptacle, five inconspicuous white pistillate ray-florets, and sterile disk-florets. It has a bitter taste.

Parth. Hysterophorus, *Linné*, indigenous to the West Indies, Florida, and Louisiana, resembles the preceding, but has bipinnatifid leaves and numerous small flower-heads. It is employed like feverfew.

Silphium laciniatum, *Linné*, is indigenous to the Western and South-western United States, and attains a height of 5 to 10 feet (1.5–3 M.). The root is 2 or 3 feet (60–90 Cm.) long, and contains a circle of resin-ducts in the bark and one near the centre. The flowers are 2 or 3 inches (50 to 75 Mm.) broad, have a cup-shaped involucre composed of imbricated ovate pointed and squarrous scales, and contain numerous yellow tubular sterile disk-florets and many pistillate yellow ray-florets, with compressed, broadly winged, and notched akenes. On the open prairies the lower leaves point north and south, hence the names *compass-plant* and *polar-plant*. The leaves are about 2 feet (60 Cm.) long, the stem-leaves smaller; they are rough and bristly, ovate in outline, pinnately divided, the segments lanceolate, toothed or lobed. All parts of the plant are rich in resin, hence the name *rosin-weed*. The exudation of the stem and leaves forms translucent or transparent tears resembling mastic in appearance, having an agreeable terebinthinate odor and taste, and readily becoming plastic when masticated. It is only partly soluble in the different simple solvents, and, according to L. I. Morris (1881), contains nearly 20 per cent. of volatile oil consisting of a hydrocarbon, and 37 per cent of acid resin, which, on being fused with potassa, does not yield protocatechuic acid: the other constituents are wax, a little sugar, ½ per cent. of inorganic salts, and a whitish tasteless powder insoluble in alcohol, but soluble in chloroform and carbon disulphide.

Silphium terebinthinaceum, *Linné*, Prairie burdock. It has a smooth stem and smaller flower-heads than the preceding, with smooth and obtuse involucral scales. The leaves are thick, rough, cordately ovate, and toothed or pinnatifid. The plant likewise yields a resinous exudation.

Medical Action and Uses.—The medicinal properties of Matricaria parthenium may be referred to the bitter principle associated with the essential oil which it contains. It has been much used in the treatment of flatulent or atonic *dyspepsia*, in *amenorrhœa*, *dysmenorrhœa*, and simple *intermittent fever*, as well as in conditions of *nervous debility* with hysterical symptoms.

The expressed juice has been administered, and also a decoction and an infusion of the herb. The last is sometimes applied, like chamomile, in fomentations, to allay the pain of local inflammations (*toothache, abscesses, rheumatism*) and to promote suppuration.

The flowering-tops of Parthenium integrifolium are extremely bitter. Many years ago an infusion made from them was reported to be remarkably efficacious in curing *intermittent fever*. 2 ounces (Gm. 64) of the dried flowering-tops in an infusion were thought to be equal to 20 grains (Gm. 1.33) of sulphate of quinine. As no further testimony has been published in confirmation of this statement, it may fairly be assumed to have been exaggerated, and that the alleged cures were only such as occasionally follow the use of various vegetable bitters. The species of Silphium above mentioned are more allied by their medicinal virtues to the gum-resins than to the aromatic bitters. They are noticed under Opopanax.

PASSIFLORA.—Passion-Flower.

Grandille, Fr.; *Passionsblume*, G.

Nat. Ord.—Passifloraceæ.

Origin and Description.—This genus is chiefly confined to tropical America, and consists of climbing shrubs or herbs with alternate undivided or palmately lobed stipulate leaves and perfect flowers. The calyx has five sepals, united below to a short cup-shaped tube, which is fringed in the throat with two or three rows of filaments. The five petals are inserted on the throat of the calyx; the five stamens are united with their filaments, forming a tube from which the long-stalked ovary projects, bearing three somewhat club-shaped styles; the fruit is often edible, berry-like, one-celled, and contains numerous seeds, which are invested with a pulpy covering.

P. lutea, *Linné*. It is indigenous to the United States as far north as Southern Pennsylvania and Illinois; has obtusely three-lobed leaves with the lobes entire, and greenish-yellow flowers.

P. INCARNATA, *Linné.* It is found as far north as Virginia and Kentucky; has three-lobed serrated leaves, and large whitish flowers with a flesh-colored crown. The berry is orange-yellow, oval, of the size of a hen's egg, and is known as *May-pops.*

P. CŒRULEA, *Linné.* The leaves are five-lobed, the lobes entire; the flowers are greenish, and the fringes blue above; the oval berry is orange-colored.

P. LYRÆFOLIA, *Tussac.* The ovate leaves are divided at the end into three unequal lobes; the flowers are large and red; the berries are globular, and of the size of a cherry.

P. RUBRA, *Linné.* The leaves are two-lobed, the flowers whitish and pale-red, and the berries nearly globular and scarlet-red.

P. MALIFORMIS, *Linné.* The leaves are ovate, pointed, somewhat heart-shaped, entire. The large flowers are white with blue fringes. The fruit resembles an apple in size, shape, and color.

P. QUADRANGULARIS, *Linné.* The branches are quadrangular and winged; the leaves are ovate-cordate, pointed, and entire; the flowers are whitish, and rose-red with a mottled crown; the berry is yellowish, of the size and shape of a goose-egg.

P. FŒTIDA, *Cavanilles,* with three-lobed leaves, and whitish flowers having a purple crown, is characterized by its strong disagreeable odor.

The fruits of the allied Paropsis edulis, *Petit-Thouars,* Tacsonia tripartita, *Jussieu,* T. molissima, *Kunth,* T. speciosa, *Kunth,* and others, are edible.

The constituents of these plants are unknown.

Medical Action and Uses.—Several species of Passiflora are endowed with active qualities. P. quadrangularis, a West Indian plant, was long ago (1824) stated to cause in animals spasms, paralysis, and a cataleptic condition, and its root was said to be emetic. In Jamaica, P. rubra was regarded as narcotic; P. fœtida, as "pectoral, anti-spasmodic, and emmenagogue;" P. laurifolia, as anthelmintic; and P. lyræfolia, as diuretic. According to Phares, P. lutea and incarnata, the passion-flower indigenous to our Southern States, was used by him "with extraordinary success in all cases of *tetanus neonatorum,*" in "all sorts of *neuralgic* affections," and in the form of an extract of the root as "an application to *chancres,* irritable *piles, erysipelas,* and recent *burns.*" An extract prepared by evaporating to dryness the expressed juice of the leaves gathered in May was given in the form of powder, and in the dose of from 1 to 4 teaspoonfuls. For external use an inspissated decoction of the whole plant was used.

PEPO, *U. S.*—PUMPKIN-SEED.

Semen Peponis.—*Semences de potirons,* Fr.; *Kürbissamen,* G.

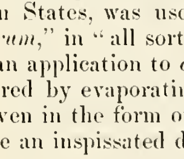
The seed of Cucurbita Pepo, *Linné.*

Nat. Ord.—Cucurbitaceæ.

Origin.—The plant is probably indigenous to tropical Asia and America, and is often cultivated. It has a rough hollow stem, large five-lobed, serrate leaves, five-branched tendrils, yellow bell-shaped monœcious flowers, and usually large globular or oblong fruits.

Description.—The seeds are ¾ to 1 inch (19–25 Mm.) long, flat, broadly ovate, somewhat oblique at the pointed end, white or pale-yellowish, nearly smooth or finely granular on the surface, near the edge and parallel with it marked with a shallow groove, and frequently covered with fragments of a white membraneous tissue. The embryo consists of two flat cotyledons of the shape of the seed, and of a short conical radicle. It is inodorous, and has a bland oily taste.

FIG. 206.



Pumpkin-seed: entire, and longitudinally divided.

The seeds of Cuc. melopepo, *Linné,* the *squash,* are very similar, rather more obtuse, and less plainly margined. (See also p. 523.)

Constituents.—Dorner and Wolkowich (1870) obtained from pumpkin-seeds 44.5 per cent. of slowly-drying fixed oil, 32.75 starch, and traces of volatile oil, resin, and sugar. They also announced the discovery of an alkaloid, *cucurbitine;* this, however, could not be found by Kopylow (1876), who was also unable to establish the presence of a glucoside. He proved the seeds to contain free fatty acids, and the bland oil to consist of the glycerides of palmitic, myristic, and oleic acids. Heckel (1875) attributes the tænifuge properties to a resin contained in the tegmen (perisperm?) of the seed, but Vigier (1876) found the embryo to possess the activity. Dr. L. Wolff (1882) extracted the fixed oil by petroleum benzin, and treated the seeds afterward with alcohol, ether, or chloroform, obtaining a greenish-brown soft resin of an acrid bitter taste. Cadenberg (1881) obtained from the seed of Cucurbita maxima, *Duchesne*, by pressure, 20 to 25 per cent. of bland yellow fixed oil, an aromatic principle, emulsin, gum, sugar, and an acid soluble in alcohol and water. When triturated with water the seeds yield a white and bland emulsion; the emulsionizing principle is probably a protein compound.

Pharmaceutical Preparation.—Extractum peponis fluidum.—Fluid extract of pumpkin-seed, *E.*—It was recommended by Dr. L. Wolff (1882) to be prepared with alcohol, like other fluid extracts.

Medical Uses.—Pumpkin-seeds are among the most efficient remedies for *tapeworm*. Originally referred to as a vermifuge in the last century, it is only within a comparatively few years that their efficiency has been established by numerous and trustworthy witnesses, notwithstanding their neglect by most writers on helminthology. It was stated in 1878 that the people in Northern Italy are in the habit of using them to expel tæniæ (Bröking). The remedy has the advantage of being free from any unpleasant taste or harsh mode of action. According to Heckel, the tænifuge virtues reside in the perisperm. According to Bérenger-Féraud, who made comparative trials of numerous vermifuges, pumpkin-seed is one of the least reliable for expelling unarmed tæniæ (*Bull. de thérap.*, xcix. 57; ciii. 104). The fixed oil of the seeds, extracted by ether, has also been used successfully for the same purpose in the dose of ½ ounce (Gm. 16) repeated in two hours, and followed in two hours more by a dose of castor oil. For administration, from 2 to 4 ounces (Gm. 64–128) of fresh pumpkin-seeds should be beaten into a paste with finely-powdered sugar and diluted with water or milk. The night before using the emulsion, and early the following morning also, it has been recommended to administer a large saline purgative for the purpose of washing away the mucus and other intestinal contents that protect the tænia. The emulsion, to the amount of a pint, should be taken in three doses at intervals of about two hours, beginning at ten o'clock, the patient remaining very still in bed to prevent vomiting (Squibb, *Ephemeris*, i. 172). Three or four hours later 1 or 2 tablespoonfuls of castor oil should be administered. Before taking the medicine the patient should fast for 24 hours. A fluid extract has also been used. The same treatment has been recommended for *lumbricoid* worms.

PEPSINUM SACCHARATUM, *U. S.*—Saccharated Pepsin.

Pepsinum, P. G.; *Pepsin*, Br.; *Pepsina*, F. Cod.—*Pepsine*, Fr.; *Pepsin*, G.

Pepsin, the digestive principle of the gastric juice, obtained from the mucous membrane of the stomach of the hog, and mixed with powdered sugar of milk.—*U. S.* A preparation of the mucous lining of a fresh and healthy stomach of the pig, sheep, or calf.—*Br.*

Preparation.—The stomach of one of these animals recently killed having been cut open and laid on a board with the inner surface upward, any adhering portions of food, dirt, or other impurity are to be removed and the exposed surface slightly washed with cold water; the cleansed mucous membrane is then to be scraped with a blunt knife or other suitable instrument, and the viscid pulp thus obtained is to be immediately spread over the surface of glass or glazed earthenware and quickly dried at a temperature not exceeding 100° F. The dried residue is to be reduced to powder and preserved in a stoppered bottle.—*Br.*

This product, it will be observed, consists merely of the carefully-dried mucous membrane of the stomach. The U. S. and German Pharmacopœias do not give a process for the preparation of pepsin, but from the descriptions it is evident that a product is intended as obtained by the process of Prof. E. Scheffer, published in 1872, and which is as follows: The mucous membrane of the well-cleaned, fresh stomach of the hog is dissected off, chopped finely, and macerated in water acidulated with hydrochloric acid. After several days the liquid is strained, clarified by rest and decantation, and mixed with an equal bulk of a saturated solution of sodium chloride. The pepsin is separated floating upon the surface, drained upon muslin, and strongly pressed to remove the solution of salt. If permitted to dry, it becomes very tough, parchment-like, or leathery. Obtained in this way, it still contains mucus, phosphate of calcium, and table-salt, from the two former of which it is freed by resolution in water, filtering, again precipitating by sodium chloride, and expressing; the table-salt which now remains with it is best removed by allowing the pressed pepsin to dry, when the salt will effloresce upon the surface and will dissolve on short immersion in water. It then constitutes Scheffer's *purified pepsin*, which dissolves in acidulated water to a clear and colorless solution.

To obtain *saccharated pepsin*, the expressed residue, while still damp, is thoroughly mixed with milk-sugar, and when the mixture has become air-dry its digestive power is ascertained, and the remainder is then diluted by the addition of milk-sugar, so that it will digest the proportion of coagulated albumen indicated below (see *Tests*).

Various other processes for obtaining pepsin have been recommended. Kuehne triturated the mucous membrane of the stomach with clean sand and filtered the liquid, which, after being dried in thin layers at a temperature of 40° C. (104° F.), was obtained by J. Lamatsch in the form of a brownish-yellow somewhat hygroscopic powder. The French Codex directs pepsin to be prepared from the stomach of the sheep; the mucous membrane is macerated for 2 hours in water at 15° C. (59° F.), the strained liquid precipitated with lead acetate, the precipitate washed, then diffused in water, and decomposed by hydrosulphuric acid; the liquid is rapidly filtered, and evaporated below 45° C. (113° F.) in very shallow vessels. Thus prepared, it forms a brownish-yellow firm mass. Instead of evaporating the solution, Hottot recommended the precipitation of the pepsin by sodium sulphate, and its drying so as to form pale-brown scales.

Selldén (1873) observed that the mucous membrane is not deprived of pepsin by maceration in acidulated water, but that by digestion at 37° C. (98.6° F.) about double the amount of pepsin is obtained; the mother-liquor from the precipitated pepsin, after having been deprived of salt by dialysis, possesses only very slight digestive properties. That pepsin exists partly in the stomach in an insoluble form has also been demonstrated by Béchamp and by Gautier (1882); the insoluble granules, termed *microzymes*, gradually dissolve in water on digestion.

Properties.—The British Pharmacopœia describes pepsin as being a light yellowish-brown powder, having a faint but not disagreeable odor, and a slightly saline taste, without any indication of putrescence. It is soluble to a very small degree in water or spirit.

Saccharated pepsin is a white or pale-yellowish powder, which is not hygroscopic, has but a slight odor, a sweetish taste, and a slight acid reaction. It is not completely soluble in water, floccules of *syntonin* remaining behind, which, however, are dissolved by diluted hydrochloric acid. The solution, slightly acidulated with hydrochloric acid, furnishes precipitates on the addition of alcohol, tannin, and sodium carbonate or bicarbonate, an excess of the last two precipitants yielding again a clear solution. Except in minute quantities, chloride of sodium impairs the digestive power of pepsin; the same is true of alcohol. When a solution of pepsin is rendered alkaline, and afterward again acidulated, it has lost its power of dissolving fresh coagulated albumen. An aqueous solution of pepsin will decompose in a short time; after the addition of sufficient hydrochloric acid it remains clear, but gradually loses its effects on albumen. Glycerin, on the other hand, preserves its virtues. (See LIQUOR PEPSINI.) Pepsin, particularly after it has been slightly acidulated, coagulates milk; 80,000 parts of the latter were found by Scheffer to be curdled by 1 part of purified pepsin.

Tests.—The solution of pepsin in water acidulated with hydrochloric acid should be clear or only slightly opalescent, showing the absence of an undue proportion of mucus, which would gradually impart a disagreeable, finally an ammoniacal, odor. 1 part of pepsin dissolved in 500 (218 *Br.*, 1500 *P. G.*) parts of water, acidulated with 7.5 (2.5 *Br.*, *P. G.*) parts of hydrochloric acid, and mixed with 50 (100 *P. G.*) parts of hard-boiled egg-albumen in thin shavings, form a mixture which on being kept at a temperature of 38° to 40° C. (100° to 104° F.) should become a slightly opalescent solution (in 30 minutes at 54.4° C.= 130° F., *Br.*) in 5 or 6 hours.—*U. S.*

Composition.—Absolutely pure pepsin is unknown; it probably contains the same elements present in other protein compounds. Syntonin has a similar composition, but is insoluble in water and neutral saline solutions; its presence in pepsin made by Scheffer's process was shown by Selldén (1873).

Allied Substances and Products.—GASTRIC JUICE. As taken from the stomach and filtered from the undigested food, this forms a clear, transparent, limpid liquid of a pale-yellow or brownish color, of a slight peculiar odor, and of a somewhat saline and acidulous taste. It is but slightly heavier than water, and has a strongly acid reaction, which has been attributed to free lactic and hydrochloric acids, to acid phosphates, and to acid hippurates. The gastric juice retains its digestive power for a long time, even after it has become mouldy. Lehmann obtained from it between 0.1 and 0.132 per cent. of free hydrochloric, and between 0.32 and 0.585 per cent. of lactic, acid. The latter was observed by Richet (1878) to be identical with *sarcolactic acid* of horseflesh. The total percentage of all solids contained in gastric juice is between 1 and 1.5 per cent., but varies in different animals, and is invariably increased by admixture with saliva. The chlorides amount to nearly ½ per cent., among them small quantities of ammonium and calcium chlorides. Phosphates of calcium, magnesium, and iron amount to ⅕ or ¼ per cent., but alkali sulphates and phosphates cannot ordinarily be detected.

Papain, Papayotin, is obtained from the milk-juice of the *melon tree* or *papaw*, Carica Papaya, *Linné*, s. Papaya vulgaris, *De Candolle;* nat. ord. Papayaceæ. The tree is indigenous to tropical America, but now is cultivated and wild in most tropical countries. The trunk is mostly undivided, 20 to 25 feet (6 to 7.5 M.) high, has a crown of long-petioled, large, palmately-lobed leaves, and bears as fruit fleshy berries which under cultivation attain a length of 12 inches (30 Cm.) and a thickness of 6 inches (15 Cm.). Peckolt (1879) found the fruit to contain albuminoids, resin, sugar, fat, tartrates, citrates, malates, etc.: the milk-juice of the unripe fruit, dissolved in water, yields with alcohol *papayotin* as a snow-white, inodorous, and nearly tasteless powder, which is very soluble in water and glycerin, but insoluble in other solvents. Wurtz and Bouchut (1879) named it *papaïn*. Wittmack (1878) showed that the filtered milk-juice is not coagulated by heat. The residue from dialysis, precipitated by alcohol, gave to Wurtz (1880) a product containing only 1 to 3 per cent. of ash, and having a composition closely resembling that of albuminoids. The aqueous solution foams when agitated, and is not precipitated by acetic or orthophosphoric acid, but nitric or hydrochloric acid yields a precipitate soluble in excess of acid. Precipitates are also obtained with tannin, picric acid, platinic chloride, corrosive sublimate (on boiling), copper sulphate (violet), and Millon's reagent (yellowish-white, on heating brick-red).

Bouchut (1880) found the milk-juice of the *fig tree* to contain a similar digestive ferment.

Peptone. This is the product of the digestion of albuminoid substances. Peptones are readily soluble in water, and this solution is not disturbed by boiling nor by the addition of acids or alkalies. Neutral solutions of peptone are precipitated by alcohol, tannin, and by various salts. Acid solutions yield precipitates with potassio-mercuric iodide, bromine-water, and other group reagents for alkaloids, but these precipitates are soluble in excess of peptone (Tanret, 1881). Brieger (1883) extracted from some peptones by boiling alcohol an amorphous poisonous alkaloid resembling the ptomaïnes in behavior. Peptone is colored yellow by nitric acid, and gives with Millon's reagent, on warming, a red precipitate, and with Fehling's solution violet-red color.

Peptone is readily assimilated by the intestinal mucous membrane. Poehl (1882) states that peptones may be again converted into albuminoids by the influence of alcohol, various alkali salts, and other agents having much affinity for water. *Peptonized meat* has been recommended as a nutritive medicine. The liquid resulting from the artificial digestion of lean meat is strained, neutralized with sodium bicarbonate, and the filtrate evaporated until it has the density 1.208, when it is stated to contain 50 per cent. of peptone (Petit, 1881), and may be preserved by the addition of glycerin and combined with ferric chloride, mercuric chloride, and other salts. By desiccating its concentrated solution upon oiled plates peptone may be obtained in scales resembling gelatin, which are hygroscopic, but not deliquescent on exposure.

Pharmaceutical Preparations.—Vinum pepsini, s. Vinum pepticum, s. Essentia pepsini, *P. G.;* Wine of pepsin.—Macerate for 6 days 50 parts of pepsin with 50 parts each of glycerin and distilled water, 1845 parts of good white wine, and 5 parts of hydrochloric acid, and filter. The liquid is of a clear yellowish color and has a vinous odor and slightly acid taste.

Liquor seriparus.—Rennet wine, Liquid rennet. *E.;* Laabessenz, *G.*—3 parts of the mucous membrane of calves' rennet are macerated for 3 days with 26 parts of sherry wine and 1 part of chloride of sodium. After filtration liquid rennet is a clear yellowish liquid.

Off. Prep.—Liquor pepsini, *U. S.*

Medical Action and Uses.—According to Albertoni, the injection into a dog's veins of an aqueous faintly acid solution of pepsin in water (1 in 1000) renders the coagulation of the blood very slow and imperfect and diminishes the amount of fibrin produced. He inclined to regard pepsin as normally exercising "a by no means unimportant function in connection with the processes of tissue-change." These results, if real, relate to quite a different operation from that which has heretofore been attributed to pepsin, and which entirely concerns its action upon the food during gastric digestion.

On the admission of pepsin into medical practice it soon acquired a brilliant reputation as a remedy for numberless dyspeptic ailments indirectly engendered by the wear and tear of civilized life, as well as for those directly produced by certain affections of the structural elements of the stomach itself. The introduction into this organ from without of a substance necessary to the solution of the food, but which it was incompetent to furnish by its own power, was a happy thought of the rational therapeutist, and which has been repeated less rationally in the case of pancreatin. The practical results of its application were apparently, and at first, as flattering as possible; but confidence in the remedy began to decline when it became certain that nearly all of the numerous preparations of pepsin were absolutely inert intrinsically, or had become so from the changes induced by time or by the various substances associated with the pepsin they originally contained. It is unnecessary to describe in detail the various *dyspeptic disorders* which might be profitably treated by a really active preparation of pepsin; it will suffice to say that, besides those already referred to, there is the common gastric derangement of infants and of children during the period of dentition, induced usually by the pain and irritation of this process, which being duly corrected, the patients are enabled to bear with comparatively slight disorder of function the continued action of the disturbing cause. Other causes beside teething may occasion the same condition, such as unwholesome air and food. Under the use of pepsin sometimes the vomiting and diarrhœa cease, the abdominal distension subsides, and the increased flesh and improved complexion testify to the more complete assimilation of the food. In numerous cases occurring during convalescence from exhausting acute diseases and in the course of chronic affections, more or less of the same effect may be hoped for from the administration of pepsin in a really active condition. Still, we believe that general clinical experience will support the deduction of Dana from his experiments, "that *good* pepsin has a *real* though not a *great* medicinal value" (*Amer. Jour. of Med. Sci.*, Oct. 1882, p. 347). It seems probable that pepsin prepares albuminous compounds for absorption, for Catillon fed a dog by the rectum with eggs prepared with pepsin, and the animal retained its weight and temperature during the two months that the experiment continued. As soon as the pepsin was omitted it began to lose flesh and heat (*Bull. de thérap.*, c. 233). It is unnecessary to do more than mention that pepsin has been applied locally to dissolve diphtheritic membrane, and also coagulated blood retained in the urinary bladder.

Perfectly fresh pepsin may be prescribed in *doses* of about 10 grains (Gm. 0.60) immediately before or after each meal. It should be mixed with arrowroot and given in a little sweetened water. Liebreich has found that to preserve the ferment of pepsin in the liquid state glycerin is the only reliable agent.

The ripe fruit of *Carica papaya* is eaten when fresh, and is also preserved as food; the unripe fruit is pickled. A syrup is made of the expressed juice, which is also used as "a sedative and expectorant." The fresh milky juice is a drastic cathartic, and is employed as a vermifuge, as are also the seeds. Cases of severe, and even fatal, poisoning, with symptoms of gastro-enteritis, have arisen from the use of this juice (*Bull. de thérap.*, xcviii. 279). It has been alleged that the sap of the tree acts as a caustic on the gastro-intestinal mucous membrane of animals, even perforating the walls of the digestive canal (*Bull. et Mém. Soc. thérap.*, 1880, p. 78). Diluted, it has been used as a cosmetic to remove freckles and other cutaneous affections. The bruised seeds are applied as poultices (*Amer. Jour. Phar.*, l. 559).

It is said that finely-chopped meat macerated in a 10 per cent. watery solution of the juice for 24 hours becomes completely dissolved, and exhales a strong and ammoniacal smell. The solution is quickened by heat (*Med. Record*, xvii. 147). Except in regard to the putrefactive smell this statement has been confirmed (*Bull. de thérap.*, xcviii. 279); and it is added that the "digestion" of the meat is more perfect than that caused by ordinary pepsin. Wurtz compares papayotin to a solution of pancreatin (*Ibid.*, xcix. 32, 464), and others have found it superior both to pepsin and to pancreatin in the power of digesting either cooked meat or hard-boiled white of egg. It is added that the fruit of the papaw tree has long been used in the West Indies to render beefsteaks tender (*Practitioner*, xxv. 301).

Rossbach claims that papayotin is a good solvent for the exudation in *diphtheria* and *croup*. He used a 12 per cent. watery solution, and applied it with a soft brush (*Practitioner*, xxvii. 289). Koths and Ascher, on the other hand, refuse to this agent any specific action in the case, and state that while the hourly application of a 5 per cent. solution is efficient in dissolving overlying membranes, it exerts no action upon diphtherial "infiltration" (*Centralblatt f. Therapie*, i. 250).

INGLUVIN is obtained from the gizzard of the domestic fowl, and is supposed to promote digestion in the same manner as pepsin. But Dr. Edes and Dr. Ellis both failed to discover that it displayed any such action upon albumen as pepsin exerts (*Boston Med. and Surg. Jour.*, April. 1883, p. 381). It has long been a popular domestic medicine. In 1877 the attention of physicians was called to it by Dr. Shelley (*Phila. Med. and Surg. Reporter*, June, 1877) as a remedy for *nausea* and *dyspepsia* associated with debility (Kennedy, *Phila. Med. Times*, x. 104). In doses of 15 grains before meals it has suspended the *vomiting* of pregnancy (*Med. Record*, xii. 664; *Practitioner*, xxvi. 43). Dr. Dobbs advises that it be given very early in the morning in the dose of 10 grains, at 8 or 9 o'clock 15 grains more, and that an hour later a light breakfast be taken, and that this administration be continued for several days, while the dose is increased to 20 grains (*Brit. Med. Jour.*, 1881, i. 86). Sawyer recommends that in atonic dyspepsia it be given in doses of 10 grains thrice daily, in powder sprinkled on bread, immediately *after* meals (*Practitioner*, xxvi. 43).

PERSICA.—Peach.

Pêcher, Fr.; *Pfirsich*, G.

Persica vulgaris, *De Candolle*, Amygdalus Persica, *Linné*.
Nat. Ord.—Rosaceæ, Amygdaleæ.

Description.—The peach tree is indigenous to South-western Asia, and is at present extensively cultivated in most temperate countries. It is of medium size, and has a nearly smooth brown bark and spreading branches. The *leaves* are alternate, short-petiolate, about 4 inches (10 Cm.) long, lanceolate, pointed, closely serrate, green, and smooth on both sides. The *flowers* appear in April, are axillary, have a bell-shaped and five-cleft calyx, five ovate, reddish petals, about twenty-five stamens, and a single ovary developing into a subglobular drupe, with a hard and furrowed putamen and containing a seed resembling the almond. The leaves, flowers, and seeds when bruised exhale a bitter-almond odor and have a bitter taste.

Constituents.—The young branches, leaves, flowers, and seeds, after maceration in water and distillation, yield a volatile oil which is chemically identical with oil of bitter almond. Geiseler (1840) proved the presence of about 3 per cent. of crystallizable amygdalin in the seeds. The fixed oil of the latter is bland, and resembles expressed oil of almond (see p. 1044).

Physiological Action and Medical Uses.—The bark, the leaves, the kernels, and even the flowers, are endowed with active properties, which they owe in part to hydrocyanic acid. The flowers are chiefly laxative, and the leaves are not destitute of this quality. Indeed, they have been used as a substitute for manna, and especially for their *vermifuge* effect; they have also been reputed to cure *intermittent fevers* and to allay the pain of *nephritic colic*, as well as to promote the discharge of calculi by causing diuresis. Bruised and applied to the abdomen, they are said to relieve colic produced by indigestion. They are also reported to have cured *whooping cough*. They have been applied to arrest slight *hæmorrhages*. Peach-kernels have frequently produced poisonous effects. A child three years old who had eaten a quantity of them became insensible, with slow, deep, sobbing respiration, slight twitching of the mouth, icy-cold extremities, lividity of the finger-nails, and dilated pupils. It was restored by an emetic (Keating). In other cases active vomiting and purging, with convulsions, have been observed. The possibility of these effects having resulted from the indigestibility of the kernels should not be overlooked. The leaves, and also the flowers, may be prescribed in an infusion, and a syrup prepared from them or from the bark has also been used.

PETROLATUM, *U. S.*—Petrolatum.

Paraffinum molle, Br.; *Unguentum paraffini*, P. G.; *Paraffinum unguinosum*, *Adeps petrolei.*—*Petroleum ointment*, *Soft paraffin*, *Paraffin jelly*, E.; *Paraffinbutter*, G.

A semi-solid substance consisting of hydrocarbons, chiefly of the marsh-gas series ($C_{16}H_{34}$, etc.), obtained by distilling off the lighter and more volatile portions from American petroleum and purifying the residue. Melting-point about 40° C. to 51° C. (104° F. to 125° F.), the first constituting the softer (*Petrolatum molle*), and the second the firmer (*Petrolatum spissum*) variety. When petroleum ointment is prescribed by the physician without specification of the melting-point, the low-melting variety, liquefying at about 40° C. (104° F.), is to be dispensed.—*U. S.*

Preparation.—When in the distillation of crude petroleum by means of superheated steam the heavier hydrocarbons begin to come over, the receiver is changed, and the butyraceous distillate is filtered through a long column of well-dried granular boneblack, the temperature being kept at 45° C. (113° F.) or higher, so as to keep the product in a melted condition while percolating through the charcoal. The first portion of the percolate is colorless or nearly so; the subsequent portions pass more colored The boneblack retains nearly its own weight of the soft paraffin. The crude paraffin which settles in the storing-tanks of coal oil is first deprived of the adhering lighter hydrocarbons by distillation, and is afterward filtered through boneblack as stated. (See also Paraffinum.) In Europe sulphuric acid is used for the purification of paraffins.

Properties.—Petrolatum is "a yellowish or yellow fat-like mass, transparent in thin layers, more or less fluorescent, especially when melted, completely amorphous, tasteless, and odorless, or giving off, at most, only a faint petroleum odor when heated, and having a neutral reaction. When gently heated until the mass is almost entirely melted, the liquid portion has a sp. gr. varying from 0.835 to 0.860. It is insoluble in water, scarcely soluble in alcohol or in cold absolute alcohol, but soluble in 64 parts of boiling absolute alcohol, and readily soluble in ether, chloroform, disulphide of carbon, oil of turpentine, benzin, benzol, and in fixed or volatile oils. When heated on platinum-foil it is completely volatilized without emitting the acrid vapors of burning fat or resin."—*U. S.*

UNGUENTUM PARAFFINI, *P. G.*, Paraffin ointment. Melt together solid paraffin 1 part and liquid paraffin 4 parts. This is somewhat crystalline, and on exposure becomes hard from the slow evaporation of the liquid portion. It is not a suitable substitute for petrolatum. Soft paraffin, *Br.*, melts not below 35° C. (95° F.), and has the sp. gr. .840–.870.

Tests.—"If 5 Gm. of petroleum ointment are digested for half an hour with 5 Gm. of soda and 25 Gm. of water, the aqueous layer separated, and supersaturated with diluted sulphuric acid, no oily substance should separate (absence of fixed oils or fats of vegetable or animal origin, or of resin). Liquefied petroleum ointment agitated with sulphuric acid of sp. gr. 1.540 should not acquire a dark color within 2 hours (absence of readily carbonized organic impurities)."—*U. S.*

Allied Drug.—ICHTHYOL is the name of a substance obtained by the distillation of a peculiar bituminous earth. It is of the consistence of petrolatum, of a greenish color, and of an unpleasant cabbage-like odor. It contains 2.5 to 10 per cent. of sulphur, is soluble in spirit of ether, and forms a milk-white mixture with water.

Action and Uses.—This preparation is intended to be used as a substitute for lard in making many ointments, and for oil as a protecting and lubricating substance. It is absolutely unirritating, and has the advantage of not becoming rancid by keeping.

Ichthyol has been used by Unna in the treatment of papular and moist *eczema*. It was incorporated with lard or vaseline in the proportion of from 10 to 50 per cent., the former being applied to the moist and the latter to the dry eruption. The same physician recommends it as a local application in acute and also in chronic articular *rheumatism*, both as a liniment and as the spray of a 10 per cent. spirituous solution. He also found it a useful palliative of various acute and chronic affections of the *air-passages*, when its vapors, given off by gentle heat, were inhaled. For such purposes a tablespoonful in one or two quarts of water was employed. It has been applied with alleged advantage in congestive forms of *pharyngitis* and as a cure for *scabies* (*Edinb. Med. Jour.*, xxviii. 1042; *Centralblatt f. d. g. Thérap.*, i. 363).

PETROLEUM.—PETROLEUM.

Oleum petræ.—Rock oil, *Coal oil*, E.; *Pétrole*, *Huile minéral*, Fr.; *Steinöl*, *Bergöl*, G.

Origin.—Petroleum is met with in several parts of North America, on the west coast of the Caspian Sea, and to a limited extent in most European countries. It oozes from the ground, frequently mixed with water, but is obtained in largest quantities from wells sunk in the ground. Its formation in the soil has been the subject of much speculation. H. Byasson (1876) explains its origin from salt water penetrating into cavities of the terrestrial crust and carrying with it lime salts and other materials; if these reach a depth where the temperature is sufficiently high, and come in contact with metallic substances, such as iron or its sulphurets, hydrocarbons are formed, the properties of which are modified by causes acting after their formation, such as partial distillation, etc.

Properties.—As naturally obtained, petroleum varies in consistence from thin limpidity to the thickness of molasses or tar, and in color from pale-yellow to blackish-brown, usually showing a distinct fluorescence. Its specific gravity is generally between 0.8 and 0.9, but some varieties slightly exceed water in density. The heavier and dark-colored kinds yield, on rectification, light and limpid oils, and leave a residue consisting of *paraffin* and solid *bitumen*, a variety of which is found native as *asphaltum*. The latter is black, glossy, and brittle, while the bituminous residues from coal-oil distillation are less glossy and scarcely brittle at the ordinary temperature. The solid as well as the liquid fractions of petroleum are inflammable and burn with a bright sooty flame; the vapors of the more volatile kinds, mixed with atmospheric air, are highly explosive.

Barbadoes tar and *Seneca oil* are two varieties of petroleum which were formerly employed; they are viscid and dark-colored, the last named lighter, thinner, and of a less disagreeable odor than the former.

Constituents.—Petroleum consists of a large number of hydrocarbons, belonging to two homologous series—namely, that of *marsh gas*, of the general formula C_nH_{2n+2} (see PARAFFINUM), and of *olefiant gas* (olefin or ethylene series), having the formula C_nH_{2n}. On treating petroleum with strong sulphuric acid the olefins, coloring matter, and some other constituents are removed, and the hydrocarbons of the paraffin series left. The hydrocarbons of both series exist also in isomeric modifications which differ from the normal compounds in volatility and some other properties. Those containing C_4 and less are gases at the ordinary temperatures; the relation of the others is shown by the following table (see also PARAFFINUM):

	Normal.	Iso.		Normal.	Iso.
Pentane, C_5H_{12}, boils at	38° C.	30° C.	Pentene, C_5H_{10}, boils at	37° C.	35° C.
Hexane, C_6H_{14}, "	70° C.	62° C.	Hexene, C_6H_{12}, "	70° C.	65° C.
Heptane, C_7H_{16}, "	98° C.	90° C.	Heptene, C_7H_{14}, "	100° C.	——
Octane, C_8H_{18}, "	124° C.	118° C.	Octene, C_8H_{16}, "	125° C.	——

These compounds are to some extent separated by fractional distillation. The portion boiling below 50° C. (122° F.), being collected by itself, constitutes *naphtha* or *gasolene*, and consists almost exclusively of pentane and pentene; but if the vapors are well refrigerated the product contains also *butane*, C_4H_{10}, boiling at 1° C. (33.8° F.), and constitutes *rhigolene*, which requires to be kept in strong and well-corked bottles and in a cool place, since it evaporates rapidly at the common temperature. The naphtha freed from the low-boiling hydrocarbons is commercially known as *benzin* or *petroleum benzin* (see page 310); its specific gravity is about .67. The portion boiling at a higher temperature is separately collected and furnishes *kerosene*, *photogene*, or *coal oil*, which is largely employed for illuminating purposes; its safety for that use depends upon the absence of the low-boiling hydrocarbons. At a still higher temperature paraffin oils, paraffin jelly, and paraffin wax (see PARAFFINUM) pass over, and the residue left in the still at a temperature of about 300° C. (572° F.) constitutes the ordinary *asphaltum* or *bitumen*. Heptane was ascertained by Thorpe (1879) to be a constituent of the volatile oil of Pinus Sabiana (see page 1091).

OLEUM PETRÆ ITALICUM, s. Petroleum crudum. Yellowish or reddish, limpid, iridescent, of a peculiar bituminous odor, soluble in fixed and volatile oils, in ether and absolute alcohol, with difficulty soluble in alcohol; specific gravity 0.75 to 0.85. This is sometimes employed in Europe.

Physiological Action.—Taken internally in excessive doses, it has caused oppression, giddiness, palpitation, faintness, and headache, but no tendency to stupor, or even sleep. In one case frightful tonic and clonic convulsions occurred; in another the pulse fell from 82 to 48, the pupils were contracted, the skin hot, the respiration hurried, and the voice weak. It is remarkable that it does not produce vomiting, nor, usually, diarrhœa. In only one case is death said to have resulted from it, with symptoms of gastro-enteritis, on the twentieth day after the oil was taken. The urine has a peculiar aromatic odor.

Medical Uses.—Petroleum was used by the Egyptians for embalming dead bodies, as is well known. Dioscorides and Pliny refer to it as being either liquid or solid. The first of these writers speaks of its application in opacity of the cornea; the Arabians refer to its emmenagogue and diuretic qualities, to its use in (humid) asthma and for cough, to its vulnerary and anthelmintic powers, and especially to its being used in suppositories to remove ascarides of the rectum. They speak particularly of its use by friction to relieve rheumatic pains, assuage colic, and expel flatus, and of its efficacy in bringing on uterine contractions and expelling the dead fœtus. In more recent times it was highly esteemed in the cure of *tapeworm* and other verminous affections, and for overcoming *retention of urine* caused by atony of the bladder. It was also credited with singular virtues as an embrocation in *paralysis*, *contraction*, and *stiffness* of the *joints*, atonic *rheumatism* and *tumors*, *chilblains*, etc. Still more recently the popular use of it as a remedy for *itch* has been imitated by physicians, and many cures by its means have been reported. It is said to be one of the promptest of the remedies for this affection, but it is also stated by eminent authorities not only to fail in a majority of cases, but in some to be a painful application, and to produce sleeplessness, intoxication, and eczematous eruptions of the skin. It has been found curative in *prurigo*. Dr. Frayer used petroleum in the treatment of *wounds*, and regarded it as possessing "some, if not all, of the advantages assigned to carbolic acid for this purpose." The ancient use of this substance for the cure of chronic *bronchitis* has been revived with such advantage as attends the administration of various terebinthinate and balsamic medicines (*Practitioner*, xxiv. 375). The crude oil is greatly to be preferred to the refined, and wherever petroleum is manufactured it is considered a sovereign remedy not only for bronchitis, but for all other mucous profluvia, as well as for internal lesions of every sort (Blache, *Bull. de thér.*, xcv. 489; Campardon, *ibid.*, xcvii. 463). It has been applied with alleged success to the removal of *dipththeritic* false membranes (*Bull. et Mém. Soc. thérap.*, Juin. 1882, p. 135; *Phila. Med. News*, xli. 509), and suggested as a remedy for *favus* (*Boston Med. and Surg. Jour.*, Nov. 1882, p. 453).

Petroleum may be given internally in doses of from 5 to 10 drops (Gm. 0.30–0.60) in the same way as oil of turpentine. For the cure of tapeworm larger doses, such as ½ fluidrachm (Gm. 2), may be used. In liniments its odor may be partially masked by that of some agreeable essential oil. It is sometimes united with cosmoline as an excipient, which renders it easy of application in all the diseases mentioned above. Its operation and advantages are nearly identical with those of paraffin and vaseline. Petroleum may be administered in capsules, but as this method allows the pure oil to irritate the stomach, it is preferably given in an emulsion made with white of egg, sugar, and tragacanth, so as to form a semi-liquid mixture.

RHIGOLENE. Used with an ordinary hand spray-producer, furnished with metal tubes, it readily produces a temperature of 15° below zero F. It is therefore more reliable than ether for this purpose, although, if its application be too long contined, it may cause frost-bite, and even mortification. It was used in a great variety of cases in which local anæsthesia was required to render certain surgical operations painless, but it does not seem to have commended itself to general adoption, on account probably of its explosiveness.

PETROSELINUM.—Parsley.

Persil, Fr.; *Petersilie*, G.

The root of Petroselinum sativum, *Hoffmann*, s. Apium Petroselinum, *Linné*.

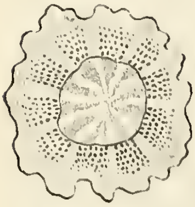
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Parsley is indigenous to Southern Europe, and is much cultivated for culinary purposes. It is a biennial 2 or 3 feet (60–90 Cm.) high, and has bi- or tri-pinnate smooth and shining leaves, with ovate wedge-shaped three-cleft toothed or crisp leaflets.

Description.—RADIX PETROSELINI. The root is 6 or 8 inches (15–20 Cm.) long, ½ to 1 inch (12–25 Mm.) thick, when dry pale brown-yellow externally, annulate above, longitudinally wrinkled below, and marked with transverse corky ridges; it breaks with a short and mealy fracture, upon which is seen a thick white and in the inner layer radially striate bark, a fine dark-colored cambium-line, and a yellow, soft meditullium with irregular medullary rays. The bark and medullary rays contain scattered brown resin-cells. The root is faintly aromatic and has a sweetish taste.

FRUCTUS PETROSELINI. The fruit is $\frac{1}{16}$ to $\frac{1}{12}$ inch (1.5–2 Mm.) long, ovate, laterally flattened, greenish-brown, each mericarp with five light brown-gray filiform ribs and six oil-tubes, and has a strong aromatic odor and a warm taste.

FIG. 207.



Parsley-root: transverse section, magnified 3 diameters

Constituents.—The root contains starch, mucilage, sugar, volatile oil, and *apiin*, $C_{24}H_{28}O_{13}$. The latter is best obtained from the fresh herb by boiling with water, expressing while hot, and purifying the green gelatinous precipitate which forms on standing by dissolving it in hot water. It was discovered by Braconnot (1843), and is a white, inodorous, and tasteless powder, perhaps a glucoside, soluble in boiling water and alcohol, separating on cooling jelly-like; the hot aqueous solution acquires a blood-red color on the addition of ferrous sulphate.

The fruit was examined by C. Rump (1836), and found to contain 1.4 per cent. of volatile oil and 22 per cent. of fixed oil, besides mucilage and other common principles. *Oil of parsley* is colorless or yellowish, has the specific gravity 1.01 to 1.14, dissolves in 2½ parts of 80 per cent. alcohol, commences to boil near 170° C. (338° F.), and consists of a hydrocarbon, $C_{10}H_{16}$, and a stearopten, $C_{12}H_{14}O_4$. This *parsley camphor* crystallizes in silky needles or prisms which fuse at 30° C. (86° F.) and are partly sublimable; it is readily soluble in strong alcohol, ether, and fixed and volatile oils, and has a faint odor of parsley and a camphoraceous, pungent taste.

Joret and Homolle (1855) separated from parsley-fruit *apiol*, by exhausting with alcohol, treating the tincture with animal charcoal, distilling off three-fourths of the alcohol, dissolving in ether, evaporating the ethereal solution, macerating the residue with levigated litharge, and filtering through charcoal. A simpler process was recommended by L. Wolff (1877). The fruit is exhausted with petroleum benzin, the solvent evaporated, and the residue treated with strong alcohol, on the evaporation of which apiol is left. It is a colorless oil of spec. grav. 1.07, becomes turbid without congealing at − 12° C. (10.4° F.), has an acid reaction, the odor of parsley, and a pungent taste, forms a kind of emulsion with alkalies, and is easily soluble in alcohol, ether, chloroform, and in glacial acetic acid.

Allied Plant.—Apium graveolens, *Linné.*—Celery, *E.;* Ache, Céleri, *Fr.;* Sellerie, Eppich, *G.*—A biennial plant indigenous to Europe, where it grows wild in ditches and meadows. It has a spindle-shaped whitish root, which, like the dark-green glossy pinnate or ternate lobed and coarsely serrate leaves, has a disagreeable odor, an acrid bitter taste, and is regarded as poisonous. Under cultivation the root becomes short, thick, tuberous, juicy, and of an agreeable flavor, and with the blanched stalks is much used as a salad. The fruit (Fructus apii, *celery-seed*) is about $\frac{1}{25}$ to $\frac{1}{16}$ inch (1–1.5 Mm.) long, roundish-ovate, laterally flattened, brown, with lighter-colored ribs, and smooth; the mericarps are usually separate, somewhat curved, flat on the face, and contain about twelve thin oil-tubes; odor and taste are agreeably aromatic. All parts of the cultivated plant contain volatile oil, sugar, mucilage, and fat; the root and leaves also mannit. The United States imported 73,683 pounds of celery-seed in 1881.

Physiological Action.—In modern as in ancient times parsley has been used as a carminative, discutient, and diuretic. The root is said to be more actively diuretic than the rest of the plant; its fruit resembles in its action those of fennel, anise, etc., and its peculiar oil, apiol, acts in part after the manner of essential oils. Half an ounce of this oil given to a rabbit produced laborious breathing, frequent pulse, muscular debility and twitching, insensibility, coldness, and death. Given to man in doses of from 7 to 15 grains, it creates a sense of warmth at the epigastrium and of general well-being. 30, and from that to 60, grains produce a state of intoxication, with scintillations before the eyes, deafness and buzzing in the ears, staggering movements, and severe headache.

Medical Uses.—Freshly-bruised parsley-leaves are a popular remedy for the "weed," or the engorgement of the mammæ at the commencement of lactation, and for threatening abscess of these and other external *glands.* In like manner they are employed to dry up the milk. A decoction of parsley-root is useful in relieving *strangury* from cantharides and turpentine, and the painful micturition attending attacks of *gravel.* An infusion of the dried leaves and the juice have been used to cure *gonorrhœa*, and also *periodical fevers* and *neuralgia;* but the seeds are said to be superior to either in the treatment of intermittent fever when given in the form of a recently-prepared and strong decoction. It repulsive smell and taste render it a very ineligible remedy, and it is now supplanted by apiol, to which identical therapeutic powers are ascribed. The value of this agent as an anti-periodic is no better established than that of the almost innumerable medicines which are reported to cure periodical affections. The case is different in regard to *amenorrhœa*, *scanty menstruation*, and *dysmenorrhœa*, in which its efficacy is demonstrated, whenever these affections appear to be owing to a want of activity and power in the ovarian nisus; in a word, in all those cases for which direct emmenagogues are considered appropriate. It must not be forgotten, however, that the state in question is often subordinate to or associated with a general atony of the system, which requires for its cure tonics, hæmatics, and hygienic agents. Apiol has been used successfully in cases of *fetid menstruation* (*Boston Med. and Surg. Jour.*, Nov. 1880, p. 482).

Powdered parsley-seeds may be given in doses of from 10 to 15 grains (Gm. 0.60–1.00). The root should be employed in the recent state, and generally in strong infusion. Apiol may be administered two or three times a day in doses of 5 or 6 drops (Gm. 0.30) enclosed in gelatin capsules. In the uterine disorders above referred to the use of the medicine should be commenced four or five days before the menstrual period.

PHALARIS.—Canary-Seed.

Fructus (Semen) canariense.—*Semence de canarie*, Fr.; *Kanariensamen*, G.

The fruit of Phalaris canariensis, *Linné.*
Nat. Ord.—Graminaceæ.

Origin.—This annual grass is indigenous to the basin of the Mediterranean, and is cultivated for its fruit, which is much used as food for canaries and other birds. 131,423 bushels of canary-seed were imported into the United States during the year 1876–77; in 1881 only 50,627 bushels.

Description.—The fruit is about $\frac{1}{6}$ inch (4 Mm.) long, ovate or elliptic, flattened, enclosed by glossy, yellowish-gray paleæ, after the removal of which the fruit is smooth and brownish and internally white. It is inodorous and has a slightly bitter taste.

Constituents.—Like other graminaceous fruits, canary-seed contains starch, gluten, a little sugar, and fat; Dubuc ascertained also the presence in it of notable quantities of calcium chloride and of a brown bitter coloring matter.

Medical Action and Uses.—Canary-seed is to be ranked with other amylaceous seeds as nutritious and emollient. It is familiar as a food for birds, and has been used by man for the same purpose, alone or mixed with wheat or rye flour. In medicine poultices have sometimes been made of it.

PHELLANDRIUM.—Phellandrium.

Fructus phellandrii, P. G.—*Five-leaved water-hemlock*, E.; *Phellandrie, Fenouil d'eau*, Fr.; *Wasserfenchel*, G.

The fruit of Œnanthe Phellandrium, *Lamarck*, s. Phellandrium aquaticum, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This biennial plant grows in swampy places and on river-banks in Europe and Northern Asia. It has pale-green pinnately dissected leaves, with ovate lobed or pinnately cleft leaflets, the submersed ones narrow and thread-like. The flowers are white, in compound umbels, with short linear involucral leaves. (See also page 451.)

Description.—The fruit is $\frac{1}{8}$ to $\frac{1}{5}$ inch (3–5 Mm.) long, ovate-oblong in shape, scarcely compressed, and narrowed above. The three dorsal ribs are broad and obtuse, the two lateral ones larger, the four grooves narrow, each with a single oil-tube, and two additional oil-tubes on the face of each mericarp. It is of a brown, and when collected in an unripe state of a blackish-brown, color, and has an unpleasant odor, recalling that of caraway, and a bitterish somewhat acrid taste.

Constituents.—Berthold (1818) obtained 1.5 per cent. of volatile oil, 7.8 of fat and wax, 4.9 of resin and other unimportant principles. Smaller quantities, .5 to .8 per cent., of volatile oil were obtained by others. According to Pesci (1883), the greater portion of the volatile oil consists of *phellandrene*, which is a levogyrate terpene boiling at 171° C. (340° F.) and polymerized by heat. Frickhinger (1839) describes the volatile oil as being brownish-yellow, limpid, of spec. grav. .86, of neutral reaction, fulminating with iodine, and possessing the odor and taste of the fruit. Distilled with potassa, the alkaline distillate contained ammonia, but no other alkaloid; 186 ounces of the recently-dried fruit yielded over 12 drachms of ammonium sulphate. The supposed alkaloid obtained by C. Froncfield (1860) was probably identical with Devay and Guillermond's (1852) *phellandrin*, which appears to be merely volatile oil; it is volatile, liquid, neutral, and soluble in alcohol, ether, and fixed oils.

Medical Action and Uses.—Five-leaved water-hemlock has been compared in its action to conium, for it is said that some animals upon eating the fresh herb lose their muscular power, and that this effect is not produced by the dried herb. The essential oil prepared from it injected into a dog's veins in the dose of 10 grains caused dyspnœa, trembling, and anxiety for several hours. The fruit appears to be stimulant, diaphoretic, diuretic, and expectorant, and without a direct or exclusive action upon the nervous system. Although recommended sometimes as a remedy for dropsy, whooping cough, intermittent fever, etc., it is chiefly in chronic *bronchitis* that the virtues of the medicine are displayed. At a time when this affection was considered a form of consumption, phellandrium was reputed to be a remedy for the latter disease; but it is now certain that it could be useful in tubercular phthisis in so far only as it might diminish the bronchial secretion, as it does in simple bronchitis. It shares this virtue with numerous plants whose activity is due to their essential oil, but neither it nor they can be compared in efficiency with the terebinthinate and balsamic preparations. The *dose* of the powdered fruit is from 30 to 60 grains (Gm. 2–4). An infusion, made with $\frac{1}{2}$ ounce of the bruised fruit in $\frac{1}{2}$ pint of hot water (Gm. 16 in Gm. 250), may be given in doses of 1 or 2 tablespoonfuls several times a day.

PHLORIZINUM.—Phlorizin.

Phloridzin, *Phlorrhizin*.
Formula $C_{21}H_{24}O_{10}$. Molecular weight 436.

Preparation.—This principle has been obtained from the bark of the apple, pear, cherry, and plum tree—more abundantly in that of the root than in that of the stem. It is prepared from the concentrated decoction by setting it aside and recrystallizing with the aid of animal charcoal. It was discovered by De Koninck and Stas (1835).

Properties.—It crystallizes in fine silky prisms containing $2H_2O$, becomes anhydrous at 100° C. (212° F.), fuses at about 108° C. (226.4° F.), congeals at 130° C. (266° F.), and fuses again near 160° C. (320° F.), being then converted into an isomeric modification which is less freely soluble and crystallizable than the normal compound. Phlorizin is inodorous, bitter, neutral, colored yellow and red by sulphuric acid, and yields with ammonia, in the presence of moisture, red amorphous *phlorizein*, $C_{21}H_{30}N_2O_{13}$. Phlorizin requires about 1000 parts of cold water for solution, but is freely soluble in hot water and in 2 parts of cold alcohol; it is nearly insoluble in ether, and dissolves in alkalies, the solutions becoming yellow in contact with air. On being boiled with potassa, *phloretic acid*, $C_9H_{10}O_3$, a crystalline homologue of salicylic and anisic acids, is obtained, together with *phloroglucin*, $C_6H_6O_3$; the solution of phloretic acid is colored green by ferric chloride.

Composition.—The empirical formula of phlorizin has been given above. According to Rochleder (1869), it belongs to the salicylic series, while *isophlorizin*, an isomeric principle of apple-leaves, is classed with the benzoylic compounds. Phlorizin is a glucoside, and when continuously heated with dilute mineral acids is resolved into glucose and *phloretin*, $C_{15}H_{14}O_5$, which is nearly insoluble in water, has a sweet taste, and by hot alkalies is decomposed into phloretic acid and *phloroglucin*. The latter is a sweet crystallizing compound, which is also produced from quercetin, dragon's blood, gamboge, kino, and other compounds by heating them with hydrate of potassium; Wiesner (1878) regards it as a very delicate test for ligneous tissue, with which 1 drop of its dilute solution produces a beautiful red color after the addition of a drop of hydrochloric acid.

Medical Action and Uses.—In 1862, De Ricci called attention to this substance as a substitute for quinia, and a number of physicians testified to its efficacy; but soon it became apparent that the new succedaneum was neither more nor less valuable than the numerous bitter vegetable products which act as stomachic tonics and sometimes cure cases of mild *intermittent fever*. Among these medicines it is most comparable to salicin. Phlorizin was formerly given in doses of from 10 to 20 grains (Gm. 0.60–1.30), but is now quite disused.

PHOSPHORUS, *U. S.*, *Br.*, *P. G.*—Phosphorus.

Phosphore, Fr.; *Phosphor*, G.
Symbol P. Atomicity trivalent and quinquivalent. Atomic weight 31.

Phosphorus should be carefully kept under water in a secure and moderately cool place, protected from light.—*U. S.*

Origin and Preparation.—Phosphorus exists, mostly as phosphates, in many minerals and in all plants and animals; the bones of the higher animals contain much phosphate of calcium. Phosphorus was discovered by Brandt (1669) of Hamburg among the products of the dry distillation of urine, and about 1769 Gahn and Scheele detected the presence of phosphoric acid in bones, and the latter succeeded in isolating it in 1771. Phosphorus is made by treating calcined bones with sulphuric acid, decanting from the calcium sulphate, evaporating the liquid, after mixing it with powdered charcoal, to complete dryness, and distilling the residue in a stoneware retort. In case the organic matter of bones is to be utilized in the manufacture of glue, the bones are treated with hydrochloric acid and the liquid treated as stated. The retort is connected with a wide bent tube which dips into water; a number of retorts are placed in each furnace, and after the distillation is completed the melted phosphorus is strained under water and run into tubes of suitable size, where it congeals. Phosphorus is manufactured in the United States, but much of it is still imported, the importation in 1882 amounting to 146,410 pounds.

Properties.—Phosphorus is seen in commerce in the form of cylindrical sticks, which are nearly colorless or pale-yellow, transparent or translucent, of a waxy lustre, and about as hard as beeswax, and flexible at ordinary but brittle at low temperatures.

It is inodorous and tasteless, but in contact with air it has an alliaceous odor and taste, and emits white vapors, which are luminous in the dark (phosphorescence). It is very easily inflammable in the air, burning with a brilliant white flame and giving off dense white vapors of phosphoric anhydride, and must be preserved and cut under water, in which it is insoluble. Its density, according to H. Kopp (1855), is 1.826 at 10° C. (50° F.), and when fused at 44° C. is 1.743, but after purification with alcoholic potassa was found by Böttger to be 2.089 at 17° C. (62.6° F.). It melts at 44° C. (111.2° F.), and may be cooled to 40° C. (104° F.) before it congeals again—under certain circumstances even to 4° C. (39.2° F.), as observed by Bellani (1813). Grotthuss (1810) obtained phosphorus in an oily condition after boiling it with alcoholic solution of potassa, and Kalhofert (1850) by slowly evaporating a solution of phosphorus in carbon bisulphide from under water. Houston and Thompson (1874) made similar observations with phosphorus treated with hot potassa solution, and regard this oil as a modification of ordinary phosphorus. The boiling-point of phosphorus is 288° C. (550° F.), according to Dalton; Mitscherlich found it at 260° C. (500° F.); but it volatilizes slowly with the vapors of boiling water; the density of its vapor is 4.3. According to Joubert, phosphorus is not luminous in pure oxygen below 14° C. (57° F.) unless the pressure be diminished or the oxygen is mixed with an indifferent gas; the luminosity is prevented in the presence of sulphuretted hydrogen, of vapors of alcohol, ether, and other compounds. Phosphorus is sparingly soluble in alcohol, ether, fixed and volatile oils; it dissolves "in 350 parts of absolute alcohol at 15° C. (59° F.), in 240 parts of boiling absolute alcohol, in 80 parts of absolute ether, in about 50 parts of any fatty oil."—*U. S.* It is more freely soluble in sulphur chloride, chloroform, benzol, and abundantly so in carbon disulphide, the latter solution being extremely inflammable. Phosphorus crystallizes after fusion when slowly cooled, and from its solutions in volatile oils and carbon disulphide. It unites directly with oxygen, sulphur, chlorine, iodine, bromine, and with many metals, and precipitates some of the latter from their solutions. When kept in water and exposed to light and air it is superficially corroded, and becomes white and opaque (Baudrimont, 1865), while phosphorous acid is found in the water; the change does not take place in water which is free from air, nor does phosphorus lose its transparency when kept in the dark. Under certain conditions phosphorus, when melted and suddenly cooled, becomes black, according to Blondlot (1869). This is due to the presence of a black body which is rather more volatile than ordinary phosphorus. Commercial phosphorus frequently contains a little arsenic, from which it cannot be freed by distillation.

Amorphous or Red Phosphorus. This was discovered by Schrötter (1848) by heating ordinary or vitreous phosphorus for a long time to near its boiling-point (about 240° C. = 464° F.) in an atmosphere in which it cannot burn. It is an amorphous dark-red mass or powder, becomes nearly black on being boiled with potassa solution, is insoluble in simple solvents, remains unaltered in dry air, and enters into chemical combinations less readily than the ordinary variety. According to Hittorf (1865), it has the specific gravity 2.19, is infusible, volatilizes slowly above 260° C. (500° F.), and, according to Lemoine (1867), is best converted into ordinary or vitreous phosphorus by heating to near 450° C. (842° F.) in an atmosphere of nitrogen. At the temperature stated Hittorf observed it to be converted into another modification, which forms black laminæ of a metallic lustre, is less volatile even than amorphous phosphorus, but, like the latter, is gradually converted by heat into ordinary vitreous phosphorus.

Tests.—The impurities likely to be present in phosphorus are derived from the sulphuric acid used in its preparation, and are mainly arsenic and sulphur; a small proportion of the latter renders phosphorus hard and rather brittle at ordinary temperatures. "If 3 Gm. of phosphorus are digested with 24 Gm. of nitric acid and 18 Gm. of distilled water until it is completely dissolved, the solution evaporated until no more nitrous vapors are given off, then diluted with distilled water, so as to weigh about 36 Gm., and hydrosulphuric acid gas be passed through the larger portion of the liquid, heated for half an hour to about 70° C. (158° F.), and afterward until the liquid cools, there should not appear more than a trifling quantity of a lemon-yellow precipitate after the lapse of 24 hours (limit of arsenic). On adding test solution of chloride of barium to the remainder of the liquid, not more than a slight opalescence should make its appearance (limit of sulphur)."—*U. S.*

Compounds of Phosphorus.—Hypophosphorous acid, H_3PO_2 (molecular weight 66), is formed by boiling phosphorus with milk of lime (see page 352) and under other circumstances. In its purest state it forms a thick uncrystallizable liquid; for medicinal purposes Procter (1858) suggested decomposing 480 grains of calcium hypophosphite dissolved in 6 ounces of water by a solution of 350 grains of crystallized oxalic acid in 3 ounces of water, filtering from the calcium oxalate, and evaporating to 8½ fluidounces, when it contains 10 per cent. of the acid.

PHOSPHOROUS ACID, H_3PO_3 (molecular weight 82), is formed on the slow oxidation of phosphorus in moist air, and forms a crystalline deliquescent mass. If phosphorus is slowly burned with a very limited supply of dry air, *phosphorous oxide* or anhydride, P_2O_3, is formed as a voluminous flocculent powder, which liquefies in the air by the absorption of moisture, and is gradually oxidized to phosphoric acid, or, heated in a close vessel, is decomposed into phosphoric acid and phosphoretted hydrogen.

PHOSPHORIC OXIDE, P_2O_5 (molecular weight 142), and phosphoric acid are described on page 81.

Phosphorous acid and phosphites are rarely, if ever, employed in medicine. The phosphates and hypophosphites, which are sometimes used, are described under their appropriate heads. Of other chemical compounds only phosphide of zinc has been employed.

Off. Prep.—Acidum phosphoricum (dilutum), Oleum phosphoratum, Pil. phosphori, *U. S.*, *Br.*

Medical History.—The first employment of phosphorus in medicine is ascribed by some to Kinkel in 1721, and by others to Mentz in 1751. After them it was advocated from time to time during the last and the early part of the present century, and the most extravagant statements were published of its life-giving powers; but the numerous, and generally unforeseen, accidents that sometimes followed its administration caused it to be abandoned as a medicine, and to retain its interest for physicians chiefly through its operation as a poison. Within the last few years it has once more risen into notice—in a great measure, we must believe, through the influence of those chemico-physiological doctrines which still prevail and the predominant part which the nervous system holds in the medical theories of the day, and possibly also to the increased number of nervous diseases chargeable to the augmented luxury and wear and tear of modern life.

Physiological Action.—*On Animals:* Applied in substance or solution to the sound skin, phosphorus does not usually occasion other symptoms than a superficial irritation, but if the integument be broken, painful ulcers follow which are extremely difficult to heal, and the phenomena of constitutional poisoning are rapidly developed. It is a very striking fact that when phosphorus in bulk is introduced beneath the skin of animals it causes neither pain nor inflammation, and, although it gives rise to toxical symptoms, the phosphorus itself retains its transparency and does not visibly diminish in bulk. Administered internally in moderate doses to various birds and mammals, such as ducks, rabbits, dogs, pigs, etc., it plainly acts as a stimulant of the nervous system, exciting the animals to unusual activity, and in some instances developing an exaggerated sexual excitement. Continuous administration of small doses of phosphorus to dogs produces the following effects: After two or three days the animal becomes dejected, the eyes congested, the urine is passed scantily and with straining, and contains an increased proportion of urea, phosphoric and sulphuric acids, and iron (Cazeneuve); the pulse and the respiration are slower, and the temperature is higher. Subsequently the pulse and respiration grow much quicker, and the temperature rises even to 5° above the normal point. Death occurs without convulsions at the end of a week. On examination of the body the gastric mucous membrane is found ecchymosed; the liver is soft and dark, with bloody spots on the surface, and its glandular elements are in a state of fatty degeneration; the gall-bladder is distended with bile containing urea and albumen; the kidneys are in a state of fatty degeneration (acute Bright's disease), which accounts for the abnormal ingredients of the bile. One-twelfth of a grain of phosphorus being given three times a day to a dog, the animal survived 17 days. After its death a vast ecchymosis occupied the left side of the thorax, extending to the costal pleura, and even to the pulmonary in a limited space. In the right lung and in the heart were also ecchymosed spots; the pulmonary tissue was dense, dirty in color, and quite oily to the touch, and demonstrably so by microscopic examination. The liver also was slightly ecchymosed, and totally disintegrated by oily infiltration. The urine was oily and albuminous, the kidneys softened and doughy, and broken down by oily infiltration (Percy). The same lesions and symptoms essentially have been found in other animals poisoned with phosphorus. According to E. Rousseau (*Inaugural Thesis*, Univ. of Penna., 1880), fatty degeneration of the liver from phosphorus is due to the conversion of the protoplasm of the hepatic cells into granular fat, and the subsequent breaking down of those cells. The change seems to begin in the region of the hepatic veins and advance toward the periphery of the lobules; and in each cell the nucleus is removed from its central position to the periphery of the cell. Long-continued non-poisonous doses of phosphorus occasion chronic gastritis and fatty degeneration of the stomach, liver, kidneys, heart, and other muscles, both voluntary and involuntary, and hæmorrhages in various parts of the body. It at the same time, however, appears to increase the deposit of osseous matter in the bones.

On Man: In the dose of from one-sixtieth to one-tenth of a grain phosphorus quickens the pulse, raises the temperature, promotes perspiration and urination, increases both mental and physical activity, and sometimes excites the sexual organs. But it may also soon afterward derange the digestion, causing flatulent distension, alliaceous eructations, a coated tongue, anorexia, colic, diarrhœa, vomiting, and jaundice. The experiments of Cutler and Bradford show that doses of $\frac{1}{64}$ gr. (Gm. 0.001), gradually increased to $\frac{1}{10}$ gr. (Gm. 0.006) and given three times a day, caused diarrhœa and vomiting. After an interval of three days it was resumed in the original dose. Twenty-five days after the medicine was first taken an examination of the blood showed a marked decrease in the red and an increase in the white corpuscles. While the proportion of white to red corpuscles before the experiment was 1 : 690, it subsequently changed to 1 : 433. No clearer demonstration could be made of the chief cause of the constitutional effects of phosphorus. Sometimes the functional disturbances above described appear suddenly when the treatment has been steadily continued or when a larger and poisonous dose—of 2 or 3 grains, for instance—has been taken. But in such cases the toxical phenomena may not appear for 36 hours. The first is usually a burning pain in the stomach and vomiting of matters which are more or less luminous in the dark. The heat extends to the whole abdomen, which may be tender under pressure; the stools are loose, dark, bloody, and sometimes phosphorescent, and are voided with pain. The pulse and temperature are generally raised at first, but subsequently fall below the normal standard. Usually, there is general nervous excitement, sometimes headache, giddiness, fainting, sleeplessness, delirium, spasms, convulsions, followed by collapse, coma, coldness of the extremities, strabismus, and dilatation of the pupils. In other instances death is owing to exhaustion, the mind remaining clear. Meanwhile, from the second to the fourth day there is pain in the liver, with dark jaundice, and blood is passed by stool and in the urine, and may exhale from the gums or appear in ecchymoses of the skin. The urine is albuminous. After death the interior of the body is everywhere phosphorescent in the dark; the stomach is seldom widely inflamed, but chiefly in the pyloric extremity, where there may also be some ulceration, and the organ is apt to contain a bloody liquid. Sanguineous effusions are also found in other organs. The blood is dark and thick, but, according to most authorities, not easily disintegrated, and it contains an undue proportion of tissue-waste in the form of uric acid, creatine, etc. The liver is of a light-yellow color, and it, as well as the heart, capillary vessels, and kidneys, shows more or less distinct signs of fatty degeneration. In many cases death has been caused by swallowing the tops of lucifer matches, and in one instance a lad of sixteen had a number of these introduced into his rectum. He died within a few hours in very severe pain with inflammation of the bowel (*Med. News*, xl. 544). A case is recorded in which this cause of death probably existed, although unsuspected during the patient's life (*Phila. Med. Times*, xii. 866). In it blood-dissolution, ending in apoplexy, was the principal symptom. After death general fatty degeneration was discovered. According to Daniello, the spinal marrow undergoes a similar change, resulting from inflammation. The symptoms of chronic phosphorus-poisoning—as they occur, for instance, among lucifer-match makers—are briefly these: Bronchial irritation and dyspepsia; a straw-colored or grayish tint of the skin; extreme sensitiveness to cold; formication; stiffness and numbness of the limbs; softening, abscess, and ulceration of the gums; loss, and sometimes decay, of the teeth, with caries and necrosis of the jaw-bones. Usually there is hectic fever, and if the patient continue to work in phosphorus until its effects are fully developed, he is worn out by them or dies of consumption of the lungs. In a case of poisoning with lucifer matches phosphorus was found in the body three months after death (*Virchow's Archiv*, lxxxiii. 501).

These symptoms are, in their various degrees, produced by phosphorus alone, and not by any of its alkaline compounds; its oxygen compounds occasion totally different effects, and even these are not poisonous. Phosphorus is absorbed mainly without change, and a very minute proportion of it is oxidized in the system. Its administration occasions a very small increase, if any, in the urinary phosphates; and when we remember that of these a man daily excretes not less than 54 grains, it is inconceivable that the minute quantity in which alone it is possible to administer free phosphorus can have any marked influence upon the proportion of phosphorus compounds in the tissues. Whatever action it possesses seems fairly attributable to a molecular irritation, which, if carried too far, results in tissue-transformation and physiological death. This interpretation appears to be justified by the seemingly successful treatment of certain paralyses by extremely minute doses of phosphorus. The confident anticipations that the physical and chemical constitution of bodies would enable us to predict their therapeutic effects have found no support in the medical history of this substance, and, least of all, the notion that it supplies a deficiency of phosphorus compounds in the system.

Medical Uses.—Phosphorus has been employed chiefly in the treatment of diseases of the nervous system. It is useless, if not mischievous, in *epilepsy*. In *paralysis* following cerebral hæmorrhage or embolism, or their frequent consequence, softening, improvement may be attributed to phosphorus in the first case alone. But its value becomes more than doubtful when the tendency to spontaneous cure after this accident is borne in mind. Possibly its stimulant influence may quicken the operations of repair, but not without the risk of increasing the mischief. The same statement is essentially true of *spinal* paralysis; but as this affection is not, like the other, always associated with a substantial lesion, the cases of paraplegia benefited by phosphorus are numerous enough to deserve a certain consideration. The same statement is applicable to *locomotor ataxia*. The persistent but moderate and interrupted use of phosphorus has unquestionably in a few instances temporarily improved the power of locomotion in this disease, but it has not, any more than other remedies, effected a cure. In regard to this class of diseases it may well be said: "Phosphorus is a rapid stimulant, but it acts by causing waste, and not by increasing power; it impoverishes, and does not enrich. It momentarily galvanizes, as it were, the torpid functions, but is incapable of renewing a dilapidated constitution, or even a nervous system exhausted by chronic disease" (Gubler). Although in former years phosphorus was alleged to have cured *neuralgia*, it is only of late that it has been asserted to operate "with a rapidity, a certainty, and a permanency unequalled by the action of any other medicine in this or any other disorder" (Thompson). It is said to exhibit its virtues most conspicuously—indeed to be "apparently specific"—in neuralgia attended with extreme debility produced by hæmorrhage, lactation, etc. when the pain follows on exposure to cold, and especially when it affects the fifth nerve. Doses less than one-twelfth of a grain (Gm. 0.005) of phosphorus every four hours are said to be inefficient, and it is added that if relief does not ensue in twenty-four hours, it is useless to persevere in this treatment. It is singular that if the medicine possesses such remarkable powers, they should not have been recognized and described by other observers. But notwithstanding the extreme frequency and intractability of this disease, phosphorus is not usually employed by physicians who have had the largest experience in its treatment. In certain cases of neuralgia of the heart, or simple *angina pectoris*, it is alleged to have entirely suspended the attacks. It has been used with probable advantage in chronic *psoriasis*, *lepra*, *lupus*, etc., but can seldom be necessary unless after the failure of more usual remedies. It was also credited with the cure of *pernicious anæmia* and splenic *leucocythæmia*, but a more extended and critical inquiry proved it to be useless.

There is some reason to believe that this medicine may be serviceable in functional asthenic *amaurosis*, but in no other form of that defect of vision. In *melancholia*, and even in *dementia*, it is alleged to be useful; and still more so in that state of *nervous exhaustion* and depression which follows excessive mental or even physical fatigue. In the latter case there is a rational as well as an empirical ground for supposing that it may occasionally do good. In regard to the reputed *aphrodisiac* action of phosphorus authorities differ; for while one of its most moderate expositors (Lemaire) declares that if any power belongs to the drug it is certainly this, the most extravagant of its eulogists (Thompson) concludes that phosphorus is not an aphrodisiac, unless given in a larger dose than it is safe to employ for remedial purposes. In poisonous doses it certainly exerts this power upon man and animals, but only as a transient influence which is soon succeeded by general insensibility.

Kassowitz claims (*Zeitsch. f. klin. Med.*, vii. 36, 193) to have found in phosphorus a more efficient remedy for *rachitis* than any that has been hitherto employed; and yet he administered it in the minute dose of $\frac{1}{2}$ Mgm. (gr. $\frac{1}{128}$) a day.

In *poisoning* by phosphorus it has been usual to administer lime-water, magnesia, or charcoal, with the intention of producing a chemical combination with the two first-mentioned substances, and a mechanical mixture with the last. It should be borne in mind, however, that phosphorus does not act primarily as a corrosive poison, like several acids.

and that its local gastric lesions are quite disproportioned to those which are due to its absorption. It may also be remarked that, under ordinary circumstances, the contents of the stomach do not favor the combustion of phosphorus. Oil of turpentine has been proved by numerous experiments, and by some clinical observations, to be capable of arresting the poisonous phenomena (*Guy's Hosp. Rep.*, xli. 13). It should be administered in doses of from 15 to 30 drops every half hour for several hours, and meanwhile all albuminous and oily substances should be withheld. An agent the very opposite in its chemical properties to this hydrocarbon has recently been recommended by Percy, who claims that oxygenated water by the stomach and the inhalation of oxygen gas are the true antidotes to phosphorus, by converting it into hypophosphorous and phosphoric acids, which are comparatively innocuous. This conclusion is supported by experiments on animals. Still more recently chlorate of potassium has appeared to have an antidotal and curative effect (*Amer. Jour. of Med. Sci.*, Oct. 1882, p. 575).

The dose of phosphorus is variously stated as between $\frac{1}{30}$ and $\frac{1}{4}$ grain (Gm. 0.002–0.016). Those who have most advocated its use recommend that a first dose of $\frac{1}{18}$ grain (Gm. 0.003) should be repeated every four hours until six doses are taken. If then no improvement have occurred, the dose should be increased to $\frac{1}{12}$ grain (Gm. 0.005), and repeated in the same manner as before. Of the authorities in this matter some recommend that the medicine should be given before and some after meals. Phosphorus was originally administered in ether or alcohol, and more recently dissolved in almond oil, olive oil, cod-liver oil, glycerin, chloroform, etc., or mixed with cocoa butter, wax, soap, spermaceti, and formed into pills coated with gelatin; or, finally, in capsules containing phosphorized oil (1 : 100). Each capsule should contain 1 Mgm. ($\frac{1}{65}$ gr.) of phosphorus. The following formula has been recommended: ℞. Phosphori gr. ij; Carbon. bisulphid. q. s.; solve; Saponis, Guaiaci resinæ, āā gr. xxxv; Glycerinæ gtt. xij; Pulv. rad. glycyrrhiz. gr. xij.—M. ft. mass. Divide into pills of the required strength and coat with gelatin or varnish.

PHYSOSTIGMA, *U. S.*—PHYSOSTIGMA.

Physostigmatis semen, Br.; *Faba calabarica.*—*Calabar bean*, *Ordeal bean*, E.; *Fève de Calabar*, Fr.; *Kalabarbohne*, G.

The seed of Physostigma venenosum, *Balfour.* *Trans. Roy. Soc. Edinb.*, xxii. tt. 16, 17; Bentley and Trimen, *Med. Plants*, 80.

Nat. Ord.—Leguminosæ, Papilionaceæ.

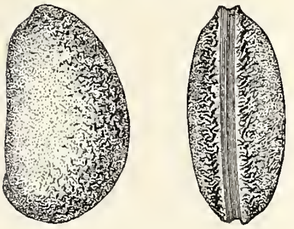
Origin.—This plant is a woody climber growing near the mouths of the Niger and of Old Calabar River in Western Africa, and attaining a length of 40 or 50 feet (12 or 15 M.). It somewhat resembles the scarlet runner or Spanish bean of our gardens. The purple flowers are in pendulous racemes, originating from tubercular knots to the number of two or three. The curved style bears at its apex a triangular fleshy reflexed appendage. The pale-brown, reticulately-veined legumes contain two or three seeds. The plant was described by Balfour in 1861, and has been introduced into India and Brazil.

Description.—The seeds are 1 to 1¼ inches (25–31 Mm.) long, about ⅝ inch (16 Mm.) broad, and ½ inch (12 Mm.) thick, oblong and more or less reniform in shape. A well-marked black furrow, the hilum, with a ridged border, extends along the convex edge from one extremity of the seed to the other, and contains in the centre the thread-like raphe. The seed has a brittle, somewhat polished, granular testa of a chocolate-brown color, two white cotyledons adhering to the testa and concave upon the inner surface, thus enclosing a rather large cavity; along the hilum each cotyledon is marked with a long shallow groove. The short radicle is situated at one end, and its position is externally indicated by the small depressed micropyle. Calabar beans are inodorous, but on the evaporation of the tincture an odor resembling that of cantharides is given off. Their taste is nearly like that of the ordinary bean. On being moistened with potassa solution the cotyledons become pale-yellow.

The seed of another species was observed by Holmes (1879) among the commercial drug. The plant was described by Oliver as Mucuna cylindrosperma, *Welwitsch*, but should evidently be called Physostigma cylindrosperma. The seeds are about 1¾ inches (44 Mm.) long, nearly cylindrical, of a dark reddish-brown color, and have a shorter hilum, not extending quite to the end where the micropyle is visible. The cotyledons acquire with alkalies a deep-yellow color.

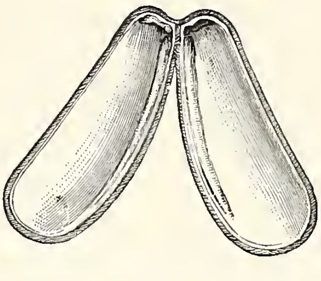
Constituents.—The poisonous principle of Calabar bean is the alkaloid *physostigmine*, which was isolated by Jobst and Hesse (1864), and by the latter (1867) ascertained to have the composition $C_{15}H_{21}N_3O_2$. Vée (1865) proposed to call the alkaloid *eserine.* It is obtained by mixing powdered Calabar bean with 1 per cent. of tartaric acid, exhausting with alcohol, evaporating the solvent, treating the residue with water, agitating the filtrate with ether as long as the latter becomes colored, then supersaturating with potassium or sodium bicarbonate, and again agitating with ether; on evaporating the ether, physostigmine is left behind in a colorless, amorphous condition. The crystals obtained by Vée were isolated by Hesse (1877) and found to be *physosterin*, an indifferent body resembling cholesterin, and crystallizing from ether, chloroform, and petroleum benzin in silky needles, and from hot alcohol in scales. Physostigmine becomes soft at 40° C. (104° F.), and is liquid at 45° C. (113° F.); it is readily soluble in alcohol, ether, benzol, carbon bisulphide, and chloroform, less freely so in water, and neutralizes acids completely; it even precipitates ferric hydrate from a solution of ferric chloride. The pure alkaloid and its salts are tasteless; their solutions yield with Mayer's reagent a white precipitate which is readily soluble in ether and alcohol and crystallizes from the latter in prisms. Physostigmine is colored red by chlorinated lime, and becomes colorless again by more of the reagent. Nitric acid dissolves the alkaloid with a yellow color, sulphuric acid with yellow, turning olive-green. On adding excess of ammonia to the solution of a salt and heating the mixture upon a water-bath, the liquid turns successively red, orange-red, yellow, green, and blue. Alkalies color solutions of physostigmine red, producing the *rubreserine* of Duquesnel, and if now agitated with ether the ethereal solution will become blue or red on the addition of dilute sulphuric acid, the color depending on the degree of decomposition undergone by the alkaloid. Rubreserine crystallizes from its solution in chloroform, and, according to Harnack and Witkowski (1880), is insoluble in pure ether: its red color disappears in presence of sulphurous acid, but reappears on the evaporation of the latter. PHYSOSTIGMINA is officinal in *Br. P.*

FIG. 208.



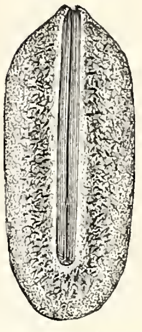
Calabar Bean: view from the side and edge, showing length of hilum.

FIG. 209.



Calabar Bean, split, showing cotyledons.

FIG. 210.



Phys. cylindrospermum seed.

Harnack and Witkowski (1876) succeeded in isolating a second alkaloid, *calabarine*, which produces tetanic effects in cold-blooded animals. It is obtained from the liquid from which physostigmine has been separated by precipitating it with subacetate of lead and ammonia, evaporating the filtrate, treating the residue with alcohol, precipitating with phosphotungstic acid, and decomposing with baryta. This alkaloid is soluble in alcohol and water, insoluble in ether, and its mercuric double iodide is insoluble in water and alcohol. Subsequently (1880) the same authors ascertained that calabarine is formed in solutions of physostigmine; for instance, under the long-continued influence of hydriodic acid.

According to Teich (1867), Calabar bean contains 48 per cent. of starch, 3.65 of nitrogen, indicating about 23 per cent. of proteids, and 3 per cent. of ash, chiefly phosphate of potassium. Mucilage and a small quantity of fat are likewise present. The alkaloids appear to exist mainly in the cotyledons, but the testa likewise possesses medicinal activity.

Adulterations of Calabar bean have not been observed by us. The seeds of a Mucuna (cylindrosperma?) and of the oil palm have been mentioned, but bear no resemblance to the officinal article.

Off. Prep.—Extractum physostigmatis, *U. S., Br.;* Tinct. physostigmatis, *U. S.*

Physiological Action.—*On Animals:* After a small but fatal dose a slight tremor seizes the animal, beginning in the posterior region and advancing forward; paralysis follows in the same order of parts; the bowels are apt to be evacuated and the pupils contract. Respiration becomes stertorous during inspiration and expiration, as well as slow and irregular. Slight muscular twitches appear and reflex action is annihilated, but while the sense of pain is lost tactile sensibility and the muscular sense are unimpaired. The rate of the heart-beat declines, but the power of the systole increases until the approach of death, when it also subsides. Death does not take place by the heart unless the dose of the poison have been very great, but is brought about by muscular paralysis of the respiratory apparatus, destroying life by an accumulation of blood in the lungs and asphyxia. Immediately after death the pupils dilate; muscular contractility is retained for some time longer; the heart may continue to act for an hour or more, and the intestines may exhibit their peristaltic movements. The large veins of the thorax are distended, as are also those upon the surface of the brain; the vascular system of the spinal cord appears natural. When a large fatal dose is given the right and left sides of the heart and the arteries and veins, which everywhere remain well filled, present their characteristic differences of color. The peculiar tremor above referred to may be produced in dogs by the hypodermic injection of $\frac{1}{5}$ grain of eserine. It may be exaggerated into distinct spasmodic movements, and even general convulsions. Vomiting is usual, and salivation also, with a frothy bronchial secretion, frequent urination, and fecal discharges, which become more and more liquid. When the poison is applied directly to a part concerned in the function of motility, it occasions paralysis of the organ. On the brain itself it exerts no action, but through the spinal cord it first occasions a few twitches in the limbs, followed by their paralysis. In direct contact with an insulated nerve-trunk, it paralyzes the afferent fibres first, and then the efferent. On or in the heart, it arrests the action of the organ, and applied to the capillary blood-vessels it causes their dilatation. Hiller observed the action of physostigma upon the exposed intestines of animals. The most characteristic effect was a circular tetanic contraction of the bowel, while its peristaltic motion was impaired, and then suspended, and the tissues grew pale. It never caused fecal evacuations unless the rectum were filled with feces (*Centralblatt f. Therap.*, i. 188).

On Man (for a fuller account of this substance as an "ordeal bean" see STILLE, *Therapeutics, etc.*, 4th ed., ii. 320): In excessive but not fatal doses physostigma causes pallor of the skin, giddiness, weakness and faintness, indistinctness of vision, contraction of the pupils, nausea or vomiting, an accumulation of liquid in the mouth, a feeble but rapid and tumultuous action of the heart, and a total inability to perform voluntary muscular acts. The muscles twitch, but there is a complete absence of pain in them and elsewhere. The contraction of the sphincters caused by it has induced retention of urine. In a few fatal cases of poisoning by this substance the following characteristic effects have been observed: Extreme muscular relaxation and debility, salivation, urgent nausea and vomiting; a slow, feeble, and almost insensible pulse, with coldness of the extremities and of the skin, which is covered with a cholera-like sweat. Some colic may be felt at first, but generally no pain is experienced, although a distressing oppression of the chest is complained of. The pupils are not usually contracted. There is much vomiting and purging, the respiration is rattling, and the face livid. Consciousness remains until death, which occurs without a struggle. On dissection the body presents no characteristic lesions, unless it be a fluid condition of the blood, which also distends the heart, a flaccid state of the muscles, and some pale injection of the gastric mucous membrane. Investigations post-mortem, taken together with the action of physostigma when applied locally, seem to render it probable that the whole chain of toxical phenomena occasioned by this substance is more readily explained by its immediate action upon the muscles or upon the nervous branches supplying them than by its operation upon the spinal axis. This conclusion is supported by the results of its direct application to the eye. It then produces a marked contraction of the pupil, which may last in a high degree for twelve or fourteen hours, and less conspicuously for several days. But the effect is confined to one eye if the application is limited to one; and if it be made also to the corresponding eyelids, they become paralyzed, but no general symptoms are exhibited. It seems probable that pupillary contraction by this substance is due to its dilating the blood-vessels of the iris, just as dilatation of the pupil by atropine is caused by its power of contracting the same blood-vessels. It is true that Falck states as the inevitable inference from experiments that physostigmine (eserine) acts as a stimulant upon the sphincter muscle of the iris (*Antagonismus der Gifte*, 1879). It is also true that neither of these antagonistic explanations affects the fact that eserine contracts the pupil.

The toxical action of physostigma is sometimes induced by very small doses of the drug. Hiller speaks of cases in which it occasioned retention of the urine while it promoted defecation. Contraction of the pupil, with a sense of tension in the eyeballs and heaviness of the head, was usual. In a feeble, anæmic woman, after using one-fortieth of a grain (Gm. 0.0015) of the extract in the course of two days threatening symptoms arose, comprising violent palpitation of the heart, præcordial distress, and irregular and rapid pulse; there was also gasping for breath, shallow respiration, and an earthy hue and slight cyanosis of the face (*Zeitschrift f. k. Med.*, vi. 490).

Medical Uses.—Physostigma is frequently employed to contract the pupil; for example: "In *mydriasis* dependent upon the over-action of belladonna or as a symptom of amaurosis; in *iritis* and inflammation of the neighboring structures, where the prevention of adhesions may be more successfully secured by an alternation of contraction and dilatation than by dilatation alone; in injuries of the eyeball with displacement of the iris, etc." It favors the healing of *corneal ulcers*, such as so frequently occur in strumous children, and are accompanied with extreme photophobia that maintains a constant irritation of the eye; and when perforation of the cornea occurs it also prevents *prolapse of the iris.* Even when this accident takes place, eserine is the best agent for extricating the hernia of the iris. Sometimes the alternate action of atropine and eserine is better than that of either alone. In *photophobia* depending upon asthenia, and therefore on irritability of the nerves of the eye, eserine is very useful, and may render the employment of shades, dark rooms, etc. superfluous. It is equally so in *paralysis of accommodation* of the *iris*, such as follows diphtheria and other debilitating disorders. In the opinion of ophthamologists eserine is a valuable palliative of *glaucoma.* It combats "the particular displacement of the iris which is often the cause of the tension" (Priestley Smith), but is not in any sense a substitute for the operation of iridectomy. The operation of *iridectomy* is facilitated by the tension and increase of surface which the iris, under the use of this medicine, presents. *Night blindness* has been successfully treated by instillations of a solution of eserine, which is supposed to act by augmenting the vascularity of the retina. When the sight is impaired by paralytic dilatation of the iris this medicine is a useful palliative of the defect. Of all the medicines which have cured *tetanus*, physostigma certainly holds the first place. In 1874 an analysis of published cases showed that out of sixty-three cases of traumatic tetanus treated by this medicine thirty-three recovered. Since then this unusual proportion of cures of a disease which was before nearly always fatal has been considerably increased. When the treatment has failed, as has often happened, the failure has been mainly attributable to an inefficient use of the remedy, but sometimes also to its employment having been too long delayed. The more recent experience of its use in tetanus fully confirms the judgment here expressed (1884). The minimum dose of extract of physostigma which should first be administered is ⅓ grain (Gm. 0.02). It should be repeated every quarter of an hour until its specific operation is developed and the spasms are completely overcome. This effect should be steadily maintained, and then reproduced as often as spasms recur. It is usually necessary to increase the dose in order to maintain the original impression. Several German physicians have used this agent to overcome passive dilatation of the intestine, especially in cases of fecal accumulation. Subbotin used for this purpose the following: ℞. Ext. physostigmat. Gm. 0.10 (gr. ⅓); Glycerin, Gm. 20.0 (fl℥v). *Dose*, 10 drops. An objection to the medicine is, that its action is likely to continue longer than necessary, and also that it leaves the bowel more confined than at first. Hiller has suggested that in epidemic *cholera* this spastic action of the drug might be utilized to prevent the colliquative discharges, or rather the profuse secretion that produces them. But the method seems too mechanical. Moreover, it could only have a chance of acting in the early stage of the attack. In a tetanoid disease known as *tonic convulsion* the medicine has also been successfully employed. Its efficacy in *strychnine-poisoning* is not so well established, and in *chorea* it so generally fails that its use is hardly warrantable unless in very prolonged and obstinate cases.

The physiological antagonism between physostigma and belladonna has been illustrated by the neutralization of the poisonous effects of the latter by the former medicine. But as fatal *poisoning by belladonna* is exceedingly rare, the practical value of the antidote is very small. That poisoning by physostigma is neutralized by the hypodermic injection of atropine has been abundantly demonstrated by experiments upon man. The antagonism is not so evident in similar experiments upon rabbits.

Physostigma has been found useful internally as a palliative of *gastralgia*, and topically its tincture is distinctly anodyne in *neuralgia* and *muscular rheumatism* and in cases of painful malignant *tumors*.

As antidotes to the *poisonous effects of physostigma*, atropine should be used hypodermically, while coffee and alcoholic and other diffusible stimulants are internally administered. If the patient is unable to swallow, artificial respiration should be maintained, mechanically as well as by means of induced electricity, and the use of atropine persisted in. The hypodermic dose of the latter should not be less than $\frac{1}{30}$ grain (Gm. 0.002).

Administration.—The commencing dose of the powdered bean is about 1 grain; of the officinal extract, about $\frac{1}{10}$ grain (Gm. 0.006); of the officinal tincture, about 10 minims. For external use a solution of 1 part of the alcoholic extract in 5 parts of glycerin has been employed. For application to the eye this solution is applied on little disks of gelatin or of paper that have been soaked in it. Eserine may be applied to the eye in its original state or as a hydrochlorate in a solution containing 1 part to 1000. Internally, it may be given in the dose of from $\frac{1}{65}$ to $\frac{1}{12}$ grain (Gm. 0.001–0.005).

Doundaké (said to be a shrub of the Rubiaceæ family, and found on the western coast of Africa), and its organic base *doundakine*, given to frogs hypodermically, produce either a paralytic or a cataleptic condition, and kill by suspending the respiration without affecting the heart (*Med. News*, xliii. 265). The bark has a very bitter taste, and is employed by the natives as a febrifuge.

In 1880, Tanret described the effects of cedrine and valdivine, the active principles of the fruits of *Simaba cedron* and *Picrolemma valdivia*, products of Colombia, S. A. *Valdivine* has been found by Dujardin-Beaumetz and Restrepo to be a mortal poison to rabbits and dogs. It is peculiar in the slowness with which its symptoms are developed even when used in fatal doses. In dogs it causes violent and persistent vomiting, and in rabbits a deep torpor, which continues until death, and is not attended with convulsions. In man doses of $\frac{1}{16}$ grain (Gm. 0.004) occasion vomiting at the end of half an hour. It was found useless in counteracting the effects of poisonous *serpent-bites*, but in *hydrophobia* it prevented the convulsions that usually precede death. It does not seem to influence the course of intermittent fever. *Cedrine* is much less poisonous than valdivine. It has "unquestionable *anti-periodic* virtues, although they are feebler and slower than those of quinine" (*Bull. de thérap.*, c. 328).

PHYSOSTIGMINÆ SALICYLAS, *U. S.*—Salicylate of Physostigmine.

Physostigminum (Eserinum) salicylicum, P. G.—*Salicylate of eserine*, E.; *Salicylate d'ésérine*, Fr.; *Physostigmin-Salicylat*, G.

Formula $C_{15}H_{21}N_3O_2C_7H_6O_3$. Molecular weight 413.

The salt should be kept in small, well-stopped vials in a dark place.—*U. S.*

Preparation.—Dissolve 2 parts of physostigmine and 1 part of pure salicylic acid in 35 parts of boiling distilled water; strain if necessary, and set aside to crystallize (Hager).

Properties.—The salt forms colorless glossy needles or prismatic crystals, which in the dry state remain unaltered for a long time even on exposure to light, but ultimately turn reddish; which change is hastened by the presence of ammoniacal vapors; its aqueous and alcoholic solutions, however, become reddish in the course of several hours after exposure to diffused daylight, though the change occurs less rapidly than with other salts of physostigmine. The salicylate is neutral, and dissolves at 15° C. (59° F.) in 12 parts of alcohol and in 130 (Hager, *U. S. P.*) or 150 (*P. G.*) parts of water, and at the boiling temperature in about 30 parts of water, and in much less alcohol. The aqueous solution of the salt acquires a violet color on the addition of a little ferric chloride, and if sufficiently concentrated produces with sulphuric acid a white precipitate of salicylic acid. The alkaloid is recognized by decomposing the aqueous solution with sodium bicarbonate and agitating with ether; the amorphous residue left on evaporating the ethereal solution should show the reactions described under Physostigma.

Tests.—The salt should have the properties described above, and on being heated on platinum-foil should burn, without leaving any residue. The solution in strong sulphuric acid is at first colorless, but becomes yellow.

Other Salts.—Physostigminæ sulphas, Sulphate of physostigmine, $(C_{15}H_{21}N_3O_2)_2H_2SO_4.7H_2O$. It is with difficulty obtained in crystals, is usually an amorphous mass, and, being rapidly colored on exposure and very deliquescent, is not adapted for medicinal use.

Physostigminæ hydrobromas, Hydrobromate of physostigmine. It is crystalline, more stable than the preceding salt, but inferior in this respect to the salicylate.

Action and Uses.—The salicylate is said to be less liable to decomposition than the other salts of physostigmine. If it is intended especially for hypodermic use, its difficult solubility in water and its changes under the action of light render it of doubtful value in a permanent solution. It is probably better adapted for solution in alcohol and water for instillation into the eye. It may be given hypodermically in *doses* of from one sixty-fifth to one-twelfth of a grain (Gm. 0.001–0.005). But Lewin gives Gm. 0.001 as the maximum dose.

PHYTOLACCÆ BACCA, *U. S.*—PHYTOLACCA-BERRY.

Pokeberry, E.; *Raisin d'Amérique*, Fr.; *Amerikanische Kermesbeere*, G.

The fruit of Phytolacca decandra, *Linné.*

PHYTOLACCÆ RADIX, *U. S.*—PHYTOLACCA-ROOT.

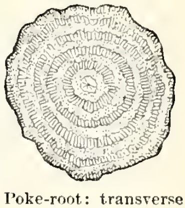
Poke-root, E.; *Racine de phytolaque*, Fr.; *Kermesbeerenwurzel*, G.

The root of Phytolacca decandra, *Linné.*
Nat. Ord.—Phytolaccaceæ.

Origin.—Poke or garget is a perennial herb indigenous to North America and naturalized in the West Indies and Southern Europe. It grows in waste places, and has a smooth stem 4 to 8 feet (1.2–2.4 M.) high, alternate petiolate, ovate-oblong acute leaves, and white decandrous flowers in elongated racemes, which are usually opposite the leaves. The young shoots collected in early spring are sometimes eaten as a substitute for asparagus. It commences to flower in June, and ripens its fruits in August, when the root and berries should be collected. The young shoots of Phyt. octandra, *Linné*, indigenous to Central and South America, and Phyt. acinoso, *Roxburgh*, a native of Northern India, are likewise eaten.

Description.—1. THE ROOT. In the fresh state the root is large, conical, branched, and fleshy. In commerce it is seen in transverse or longitudinal slices, from 1 to 4 inches (2–10 Cm.) in diameter, longitudinally wrinkled, yellowish brown-gray externally, hard, and breaking with a fibrous fracture. It is of a dingy white color internally, and exhibits upon transverse section a number of circles composed of wood-tissue radially divided by numerous medullary rays and concentrically approximate, being separated from one another by shrunken parenchyma, which in the fresh state is fleshy and of about the width of the wood-circles. The root is inodorous; its taste is at first sweetish, afterward somewhat acrid.

FIG. 211.



Poke-root: transverse section.

2. THE FRUIT is a flattened globular compound berry, about ⅓ inch (8 Mm.) in diameter, and composed of ten carpels, which are concentrically arranged around a short axis, are laterally confluent, and contain each one lenticular black and shining seed, with the embryo curved around a mealy albumen. The fruit is of a dark-purple color, has a thin pericarp, and contains a purplish-red juice which is inodorous and has a sweet and slightly acrid taste. When the berries are dried on their common peduncles they have a slight resemblance to raisins.

Constituents.—The root was analyzed by E. Donnelly (1843) and W. F. Pape (1881), who found starch, tannin, resin, and other common constituents of plants, but did not succeed in isolating the active principle. Pape's observation renders the presence of an alkaloid probable; he obtained 10.7 per cent. of ash, two-thirds of which was soluble in water. Terreil (1881) obtained amorphous *phytolaccic acid*, which is soluble in water and alcohol, reduces silver salts, and yields with earths and alkalies soluble salts, from which boiling hydrochloric acid separates the acid as a jelly. Reichel's analysis (1836) of the root of Phytolacca (Pircunia, *Betero*) drastica, *Pöppig*, yielded similar results; among the salts was found 6.6 per cent. of calcium malate. The fruit was examined by Braconnot (1804); its coloring matter is bleached by sunlight and turned yellow by alkalies. W. Cramer (1881) showed the presence of sugar, gum, and malic acid, and found the fresh fruit to contain 70 per cent. of moisture and the dried fruit to yield 5 per cent. of ash, of which 62 per cent. was soluble in water. E. Classon (1879) obtained from the seed *phytolaccin*, which is soluble in alcohol, ether, and chloroform, slightly so in benzin, and insoluble in water; it crystallizes in colorless needles, is tasteless, and dissolves in sulphuric acid with a brown-yellow, and in warm nitric acid with a yellow, color. The fruit of most other species of Phytolacca contains a similar coloring matter. According to Landerer (1836), the juice is employed in Turkey for coloring sweetmeats.

Physiological Action.—Although long known to possess certain acrid and narcotic properties, phytolacca has never been generally employed as a medicine. The juice or a strong decoction of the root applied to the skin when abraded or tender causes a smarting or burning pain, and it is reported that a person engaged in powdering the root suffered from coryza, headache, purging, and prostration. Vomiting and purging are said to have followed eating the flesh of pigeons that had fed upon the berries, but it is well known that pigeons and other birds which feed on these berries are eaten without harm. The young shoots are eaten boiled, like asparagus and cabbage-sprouts. The powdered root is emetic and purgative in the dose of 1 or 2 drachms, and 2 teaspoonfuls of the juice of the root have produced similar effects. It is remarkable that the evidences of gastro-intestinal irritation do not arise until an hour or two after the medicine has been taken. In an overdose, besides vomiting and purging and intense thirst, with epigastric distress, it affects the nervous system, causing great prostration, coldness of the skin, and even a cyanotic discoloration, feebleness of the pulse, drowsiness, vertigo, dimness of vision, coma, and sometimes convulsions. In the case of a child six years old they assumed the tetanic form. This patient recovered, but the death of an adult female from eating the berries is recorded. None of these effects are produced even by 30-grain doses of the powdered root. According to Rutherford, the resin of phytolacca is "a mild intestinal but a powerful hepatic stimulant"—a conclusion the first part of which does not apply to the root of the plant.

Medical Uses.—The most probable evidence in favor of the medicinal powers of this plant relate to its use in *rheumatism* and in *diseases of the skin*. In the former, and especially in *syphilitic* rheumatism, it has been employed as a tincture either of the root or of the berries and as a decoction of the former, and is reputed to have displayed anodyne and sudorific powers. The decoction, the tincture, the juice of the leaves, etc. have been used extensively and with reputed advantage, both internally and locally, in the treatment of sanious *ulcers*, *scabies*, *tinea capitis*, *sycosis*, and *favus*, and of the *mange* in dogs. An ointment made with the roots or leaves (℥ij to lb. j lard) has been applied in the same affections. All of these preparations have been much employed in the treatment of *hæmorrhoids*, and the infusion and decoction both internally and by injection. The decoction has been administered with alleged benefit in *scrofula*, as well as used locally in treating the ulcers peculiar to that disease. It has been alleged to prevent and also relieve mammary inflammation after delivery, and to cure "irritation of the ovaries with uterine complications," but the statements are too vague for acceptance.

In the action and medicinal uses of phytolacca it is difficult to avoid observing a certain analogy between it and dulcamara on the one hand and white hellebore on the other. The *dose* of the powdered root as an emetic is from 10 to 30 grains (Gm. 0.60–2). Of a saturated tincture about a fluidrachm (Gm. 4) may be given two or three times a day. An ointment may be made by mixing with an ounce of lard the extract produced by evaporating an ounce of the tincture.

PICHURIM.—Pichurim Beans.

Fèves pichurim, *Noix de sassafras*, Fr.; *Pichurimbohnen*, *Sassafrasnüsse*, G.

The cotyledons of Nectandra (Ocotea, *Martius*) Puchury major and N. Puchury minor, *Nees*.

Nat. Ord.—Lauraceæ.

Origin.—Both species are Brazilian trees, with ovate smooth leaves and elliptical drupaceous one-seeded fruits, which are surrounded at the base by the hardened involucre. The embryo only is used, and is dried by artificial heat.

Description.—The so-called pichurim beans consist of the cotyledons, which are rarely united. They are oblong or roundish ovate, convex and blackish-brown on one side, nearly flat or concave and lighter colored on the other side, and near one end with a depressed scar left by the detached radicle. The large pichurim beans are from 1½ to nearly 2 inches (4–5 Cm.) long; the small rarely exceed ¾ inch (18 Mm.), and are often covered on the convex side with the pale-brown finely-wrinkled integuments. Both have internally a light-brown color, with yellowish oil-cells, and have an aromatic odor and taste, resembling that of nutmeg with an admixture of sassafras.

Constituents.—Kobes (1800) obtained from the large variety 2.1, and Bonastre (1821) from the small variety 3, per cent. of pale-yellow volatile oil; the latter also 10 per cent. of a brown butyraceous and 22 per cent. of a solid fat. Sthamer (1845) extracted the soft fat by cold alcohol, and the solid kind by boiling with alcohol and expressing; the latter is laurin. Alex. Müller (1853) separated the volatile oil by fractional distillation into a colorless pungent oil, boiling at 150° C. (302° F.); a colorless oil of an orange-like odor, boiling near 170° C. (338° F.); a yellowish-green portion, having the odor of pichurim, and boiling near 240° C. (464° F.); and a considerable quantity of a dark-blue oil, boiling near 260° C. (500° F.) and containing a little lauric acid. All the fractions contain oxygen. Pichurim contains also starch, gum, and other common vegetable principles.

Medical Action and Uses.—Introduced a century ago into Europe by the Portuguese, pichurim beans were for a long time regarded as possessing a great medicinal value, and even very recently were included in the officinal lists of the German, Spanish, and Portuguese Pharmacopœias. They appear to depend for their virtues upon a concrete volatile oil, and are sometimes used as substitutes for nutmeg. They have been chiefly used as stimulants and tonics in mild, subacute, and chronic *diarrhœa* and *dysentery*, and in habitual debility of the intestinal canal tending to produce flatulence and diarrhœa. Pichurim-bark, which has an aromatic smell resembling that of nutmegs and an astringent taste, is employed in Panama in the treatment of *typhoid states* of the system, in atonic *dyspepsia*, *chronic vomiting*, *intermittent fever*, and *menstrual disorders*. The beans are given in powder in doses of from 10 to 20 grains (Gm. 0.60–1.30), or else in an infusion; the bark is used in the same manner and in doses twice as great as these.

PICROTOXINUM, *U. S.*—PICROTOXIN.

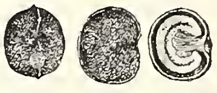
Picrotoxine, Fr.; *Pikrotoxin*, G.
Formula $C_9H_{10}O_4$. Molecular weight 182.

A neutral principle prepared from the seeds of Anamirta paniculata, *Colebrooke*, s. Anam. (Menispermum, *Linné*) Cocculus, *Wight et Arnott*, s. Cocc. suberosus, *De Candolle*. Bentley and Trimen, *Med. Plants*, 14.

Nat. Ord.—Menispermaceæ.

Origin.—Anam. paniculata is a tall climbing shrub, with broad heart-shaped leaves and long drooping racemes of small greenish diœcious flowers, indigenous to India and some of the East Indian islands. The fruit, which is an article of commerce, and of which 327 pounds were imported in 1867, is known as

FIG. 212.



Cocculus indicus: fruit and longitudinal section.

COCCULUS INDICUS, s. Fructus cocculi.—Fishberries, *E.*; Coque du Levant, *Fr.*; Kokkelskörner, Fischkörner, *G.*—It is globular, kidney-shaped, about $\frac{1}{4}$ inch (6 Mm.) in diameter and $\frac{2}{5}$ inch (10 Mm.) in length, blackish-brown and wrinkled. The base and apex of the fruit are close together on one side of the fruit, separated from each other by a shallow sinus and connected by an obscure ridge running around the convex side. The endocarp or shell is whitish, thin, and on the narrow concave side folded inward, forming a double projection into the interior of the fruit, and causing the embryo to assume a semilunar shape upon longitudinal section. The fruit is inodorous and almost tasteless, with the exception of the shrivelled oily embryo, which is disagreeably bitter. Cocculus differs in the characters described from all other fruits usually met with in drug-stores. According to Schmidt and Rolmer (1883), the fruit contains 23.6 per cent of fat, over one-third of which is free stearic acid. Pelletier and Couërbe (1833) isolated from the integuments of the fruit the crystalline and tasteless alkaloid *menispermine*, $C_{18}H_{24}N_2O_2$, and *paramenispermine*, which has the same composition, but differs from the former in being insoluble in ether, sublimable, and in failing to neutralize acids. These bodies are associated with the amorphous brown *hypopicrotoxic acid*, which is insoluble in ether and water. The poisonous principle picrotoxin is contained in the kernel, and was first isolated by Boullay in 1819.

Preparation.—Bruised cocculus indicus is exhausted by boiling alcohol sp. gr. .85; the tincture is concentrated by distillation to about one-third the weight of the fruit; after cooling, the fat is removed and the residue boiled with one-half its weight of water; the decoction is filtered while hot, the filtrate slightly acidulated and crystallized; the crystals require to be purified from hot alcohol. The portion insoluble in water contains menispermine, paramenispermine, and hypopicrotoxic acid.

Properties.—Picrotoxin is in "colorless, flexible, shining, prismatic crystals, permanent in the air, odorless, having a very bitter taste and a neutral reaction; soluble in 150 parts of water and in 10 parts of alcohol at 15° C. (59° F.), in 25 parts of boiling water, and in 3 parts of boiling alcohol; also soluble in acids and in solutions of the alkalies. When heated to about 200° C. (392° F.) the crystals melt, forming a yellow liquid; when heated on platinum-foil they char, and are finally completely dissipated. Concentrated sulphuric acid dissolves picrotoxin with a golden-yellow color, which turns violet-red on the addition of a trace of bichromate of potassium. When mixed with three times its weight of nitrate of potassium, moistened with sulphuric acid, and then treated with strong solution of soda in excess, picrotoxin assumes a brick-red color of short duration. The aqueous solution should remain unaffected by solutions of salts of mercury or platinum, tannic acid, iodide of mercury and potassium, or other reagents for alkaloids (absence of and difference from alkaloids)."—*U. S.*

The reaction with sulphuric acid and a trace of potassium bichromate was described by H. Koehler (1867) as giving a violet-blue color, changing to violet-brown, brown-green, and finally apple-green; excess of bichromate causes a red-brown, then dark-brown, color (W. Schmidt, 1862). The yellow color produced by sulphuric acid disappears on the addition of nitric acid. Picrotoxin dissolves in strong nitric acid to a colorless liquid, which becomes mahogany-brown with a little potassium bichromate. Heated with Fehling's solution, picrotoxin yields a precipitate of cuprous oxide (Ludwig), but is not a glucoside. Warm alkaline solutions occasion also a reduction of silver and gold salts. The reaction with potassium nitrate, sulphuric acid, and soda was suggested as a characteristic one by J. W. Langley (1862).

Diluted acids do not increase the solubility of picrotoxin in water (Pelletier, Koehler), but caustic alkalies render it much more soluble; hence Pelletier and Couërbe regarded it as *picrotoxic acid;* the alkaline solutions are, however, precipitated by carbonic and other acids. Picrotoxin is soluble in strong acetic acid, also in amylic alcohol, benzol, chloroform, ether, and in fixed oils (Koehler).

The above formula is that of Paterno and Oglialora (1877). By fractional crystallization from benzol Barth and Kretschy (1880) separated picrotoxin into three bodies. One, for which the name picrotoxin was retained, melts at 201° C. (394° F.), answers in the main to the above description, and has the composition $C_{15}H_{16}O_6 + H_2O$. The second, *picrotin*, $C_{25}H_{30}O_{12}$, has similar properties, but melts at 250° C. (482° F.), is less freely soluble in benzol, and is not poisonous. The third compound, *anamirtin*, $C_{19}H_{24}O_{10}$, remains in the mother-liquor on recrystallizing picrotoxin from water; it is but slightly bitter, is not poisonous, and its alkaline solutions do not reduce metallic salts.

Physiological Action.—*On Animals:* Cocculus is familiarly used for catching fish by mixing the bruised fruit with dough and scattering it on the water. The animals, after whirling round, lie motionless upon the surface of the water. In dogs and other quadrupeds it occasions dulness, muscular tremor, convulsion, and tetanic spasms by turns, the body being strongly bent in opisthotonos. After death no distinctive lesions are found. The poisonous effects of picrotoxin on vertebrate animals are described as exhibiting the phenomena of the epileptic paroxysm. They may be ushered in by a cry, and begin by tremor of the muscles of the head and face, which extends to those of the remainder of the body. There is unconsciousness, with tonic and clonic convulsions, discharge of urine, rotation of the eyeballs, projection of the tongue, arrest of breathing and of the heart. Invertebrate animals do not become convulsed by its use (*Bull. de thérap.*, ci. 137; *Med. Record*, xxiii. 650). Picrotoxin appears to differ from strychnine in its effects by producing alternate clonic and tonic spasms and by occasioning vomiting. They agree in exerting their power chiefly, if not exclusively, upon the spinal motor functions. It appears, however, that picrotoxin does not exalt the reflex irritability of the spinal cord as strychnine does. The minimum fatal dose for a rabbit weighing 3 pounds was found to be $\frac{1}{20}$ grain (Gm. 0.003), and its lethal effects were preventable by chloral (Browne). (Compare Roeber, *Glasgow Med. Jour.*, i. 361.)

On Man: Its chief effects in excessive doses appear to be slight giddiness and lightness of the head and partial loss of power in the lower limbs. In one case the symptoms of active poisoning by cocculus have been described as including gastro-intestinal irritation, congestion of the brain, strabismus, sweating, exhaustion, and death. The absence of any spasmodic phenomena throws doubt upon the alleged nature of the attack (STILLÉ, *Therapeutics*, 4th ed., ii. 353). A case is reported by Sosinsky in which several ounces of whiskey impregnated with cocculus were taken by a male adult. Within an hour he became unconscious, and was seized with epileptiform convulsions. The pupils were contracted and the respiration was slow, and there was also profuse sweating, with diarrhœa.

Death occurred in 3 hours, "and was apparently due to failure of respiration and exhaustion" (*Med. News*, xliii. 485).

Medical Uses.—The resemblance between the actions of picrotoxin and of strychnine led to the use of the former in *paralysis* of the extremities and of the sphincters of the bladder and rectum, but the degree of its success does not appear to have been very great. Its virtues in curing *epilepsy* have been confidently set forth by Planat, who recognizes, as the sole exceptions to its curative power in this affection, inveterate cases, whether idiopathic or symptomatic. This physician reports no less than sixteen cases of the disease cured by a saturated tincture of cocculus, of which the primary dose was 2 drops twice a day, and on each subsequent day every dose was increased by 1 drop until 30 drops a day were given. It was then gradually reduced until the original dose was reached, when the medicine was suspended for a fortnight, after which it was renewed and intermitted alternately during 6 months. If the results above related could be relied upon, then cocculus would be a remedy for epilepsy of far higher curative power than any one before used in the same disease. This is far from being the case, for the observations of Gowers and Ramskill render it probable that picrotoxin aggravates the paroxysms in epileptic patients (*Times and Gaz.*, Apr. 1880, p. 448). Planat attributes to the medicine a striking curative power in infantile *eclampsia*, in chronic *spasm of the limbs*, and in *chorea*. A case of labio-glosso-pharyngeal *paralysis* is stated to have been greatly benefited by the hypodermic injection of 1-Mgm. (Gr. $\frac{1}{64}$) doses of picrotoxin (Gubler). Much more positive are the effects of picrotoxin in controlling *night sweats*, as illustrated by Murrell (*Practitioner*, xxiii. 241; xxv. 93). He made use of a solution of 1 part in 240, as follows: Picrotoxin 8 gr.; Glacial acetic acid flʒiv; distilled water, to fl℥iv. Mix and filter. Of this solution 4 minims contain $\frac{1}{60}$ gr. of picrotoxin, which is the average dose. From 1 to 4 teaspoonfuls of the solution seldom failed to diminish, and then arrest, the sweating, without leaving the skin dry. It did not disagree with the stomach. Picrotoxin may also be given in pills, each containing one-sixteenth of a grain. Cocculus indicus is employed in decoction or in ointment to destroy *lice*, and in the latter form to cure *ringworm of the scalp*. The skin should in this disease be thoroughly cleansed with soap and water before applying the ointment. *Porrigo* has been cured by an ointment made with 10 grains (Gm. 0.60) of picrotoxin to an ounce of lard. Cocculus indicus is said to prevent the secondary fermentation of liquors, and for this purpose it is sometimes added to malt liquors at the risk of poisoning those who drink them. The average hypodermic dose of picrotoxin is 1 Mgm. or $\frac{1}{64}$ of a troygrain.

PILOCARPINÆ HYDROCHLORAS, *U. S.*—HYDROCHLORATE OF PILOCARPINE.

Pilocarpinum hydrochloricum, P. G.; *Hydrochlorate de pilocarpine*, Fr.; *Pilocarpinhydrochlorid*, G.

Formula $C_{11}H_{16}N_2O_2HCl$. Molecular weight 244.4.

Preparation.—Diluted hydrochloric acid is neutralized with pilocarpine, and the solution concentrated and set aside over sulphuric acid to crystallize.

Properties.—This salt forms long colorless needles or is obtained in small white needle-shaped or scaly crystals. It is inodorous, and has a slightly bitter taste and a neutral reaction to test-paper. It is deliquescent on exposure, and dissolves, according to Schuchardt (1881), in $1\frac{1}{2}$ parts of water at 15° and at 100° C. (59° and 212° F.) in 7 parts of alcohol at 15° C. (59° F.), and in about $\frac{2}{5}$ part of boiling alcohol. According to Poehl, it is insoluble or nearly so in ether, chloroform, benzol, and carbon bisulphide, but, according to Gerrard (1876), chloroform dissolves the salt. This melts on the application of heat, and at a higher heat is decomposed without leaving any fixed residue. The aqueous solution remains clear for many weeks, and yields with silver nitrate a white curdy precipitate insoluble in nitric acid, but soluble in ammonia. Only concentrated solutions are precipitated by soda (whitish cloudiness) or by platinic chloride (yellowish, crystalline), but diluted aqueous solutions are precipitated by mercuric chloride (white, soluble in hydrochloric acid), iodine (brown-red, crystallizable), phosphomolybdic acid (yellow, curdy), and other group reagents for alkaloids. Pure sulphuric acid dissolves the salt nearly colorless; in the presence of a little potassium bichromate the solution is at first brownish-green, but soon changes to a lasting bright-green color (Poehl, 1879). Fuming nitric acid dissolves the salt with a pale greenish color (*P. G.*); it gives with nitric acid sp. gr. 1.400 a faintly greenish-violet tint (*U. S.*).

Composition.—The formula given above is that of Harnack and Meyer, but Kingzett maintains that the correct formula of the salt is $C_{23}H_{34}N_4O_4(HCl)_2$.

Allied Salt.—PILOCARPINÆ NITRAS, *Br.*, $C_{11}H_{16}N_2O_2HNO_3$. White crystalline powder or needles, soluble in 8 or 9 parts of water, or freely soluble in hot alcohol.

DOSE. Hydrochlorate of pilocarpine may be administered by the mouth in doses of ½ to ⅘ gr. (Gm. 0.03–0.05), and hypodermically ¼ gr. (Gm. 0.02) may be given. (See PILOCARPUS.)

PILOCARPUS, *U. S.*—PILOCARPUS.

Jaborandi, Br., F. Cod.; *Folia jaborandi*, P. G.—*Jaborandi*, *Pernambuco jaborandi.*

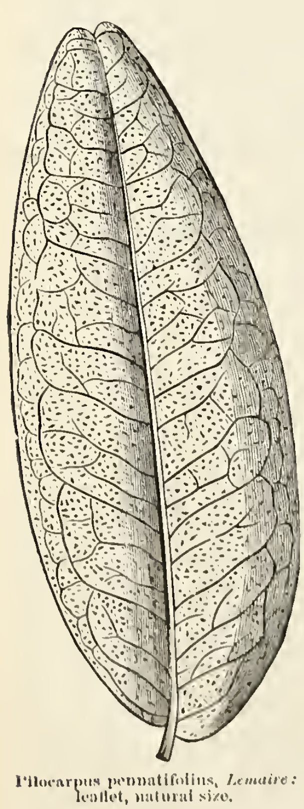
The leaflets of Pilocarpus pennatifolius, *Lemaire.* s. P. pinnatus, *Martius.* Bentley and Trimen, *Med. Plants*, 48.

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Jaborandi is a kind of generic name used in South America for several plants possessing diaphoretic properties. The Pilocarpus jaborandi is a shrub growing in Brazil in the neighborhood of Pernambuco, perhaps also in the southern provinces of that empire. E. M. Holmes (1875) determined the origin of jaborandi. There appear to be several more or less distinct forms of Pilocarpus in Brazil, which are regarded as distinct species by some botanists, while others regard them as mere varieties. Of these may be mentioned—Pil. Selloanus, *Engler*, Pil. heterophyllus, *A. Gray*, and Pil. pauciflorus, *St. Hilaire.* From the anatomical structure of the leaves constituting the drug Poehl (1879) regards it to be obtained from an undescribed species, Pil. officinalis, *Poehl.*

Description.—The leaves are imparipinnate, and are composed of four to ten short-stalked leaflets with an unequal base, and a terminal one which has a longer stalk and is more tapering and nearly equal at base. The leaflets are about 4 inches (10 Cm.) long, oval or ovate-oblong, entire and slightly revolute at the margin, rather rounded below and obtuse and usually emarginate above. They are of a coriaceous texture, green and shining above, and on the under side paler and smooth or somewhat hairy, and with a prominent midrib; the veins branch from the midrib at nearly right angles, and anastomose near the margin, forming on each side one or two distinct wavy lines. The entire blade is marked with numerous pellucid glands. The leaves are nearly inodorous, but when bruised exhale a slight aromatic odor; the taste is herbaceous, afterward aromatic, warm, and somewhat bitter.

FIG. 213.



Pilocarpus pennatifolius, *Lemaire*: leaflet, natural size.

Constituents.—Byasson (1875) obtained from jaborandi leaves a volatile oil, and a volatile alkaloid which he named *jaborandine.* But both Gerrard and Hardy (1875) showed that the alkaloid is not volatile, and named it *pilocarpine.* It is obtained from the aqueous solution of the alcoholic extract by adding an alkali, agitating with chloroform, and extracting it from the latter by agitation with water acidulated by hydrochloric acid. It is best purified by crystallizing the nitrate from boiling alcohol, which, according to Schuchardt, dissolves 2.5 per cent. of the salt, while at 15° C. (59° F.) only .77 per cent. remains in solution. The alkaloid is uncrystallizable, but A. W. Gerrard (1875) crystallized from alcohol a number of its salts, of which the sulphate and acetate are very deliquescent; the latter is also soluble in ether, chloroform, and benzol, in which the nitrate and phosphate are insoluble, while the chlorhydrate and bromhydrate dissolve besides in water and alcohol, also in chloroform. Kingzett (1876) gives to the alkaloid the formula $C_{23}H_{34}N_4O_4$, and states that on distillation with caustic potassa it yields trimethylamine, and that jaborandi contains only one alkaloid. These observations have been corroborated by Gerrard (1880). But Harnack and Meyer (1880) give to pilocarpine the formula $C_{11}H_{16}N_2O_2$. Chastaing (1881) found the same composition, and states that on treating the alkaloid with a large excess of fuming nitric acid *nitrate of jaborandine*, $C_{10}H_{12}N_2O_3.HNO_3$, is obtained, together with traces of another alkaloid, probably jaborine. Poehl (1879) agrees with Kingzett's formula; he also found but one alkaloid, but on distilling this with caustic soda obtained *coniine.* The latter alkaloid was also obtained by Harnack and Meyer, but only from impure pilocarpine, and they believe it to be a decomposition-product of a second alkaloid, *jaborine,* which could not be prepared in the pure state, and is probably produced by the alteration of pilocarpine; it is yellow, amorphous, more soluble in ether and less in water than pilocarpine, and resembles atropine in its action.

Hardy (1876) obtained from the leaves 0.56 per cent. volatile oil, consisting of *pilocarpene,* $C_{10}H_{16}$ (sp. gr. .85; boiling-point 178° C.), and two hydrocarbons of higher boiling-points.

Other Jaborandis.—Peckolt (1875) enumerated the following Brazilian drugs which are known in some of the provinces as jaborandi, and belong either to the natural order of Piperaceæ or to that of Rutaceæ (Xanthoxylaceæ):

1, Serronia (Piper, *Vellozo,* Ottonia, *Kunth*) Jaborandi, *Guillemin;* 2, Piper reticulatum, *Linné;* 3, P. nodulosum, *Link;* 4, Artanthe Mollicoma, *Miquel;* 5, Aubletia (Monniera, *Linné*) trifolia, *Richard;* and 6, Xanthoxylum elegans, *Engler.* Herpestes gratioloides, *Kunth* (nat. ord. Scrophulariaceæ), is also stated to yield a jaborandi; and to these must probably be added Piper citrifolium, *Lamarck,* and perhaps other species. (See paper by Dr. F. V. Greene in *Phila. Med. Times,* 1877, p. 537.)

Piper Jaborandi, *Vellozo,* is, according to Peckolt, the true jaborandi of Brazil, and, according to Parodi (1875), the true *yaguarundi* of Paraguay. The latter isolated from it a volatile oil of an acrid and biting taste and a crystalline alkaloid, *jaborandine,* $C_{10}H_{12}N_2O_3$, which is slightly soluble in ether and has but a weak affinity for acids.

Off. Prep.—Extractum pilocarpi fluid., *U. S.,* and Extr. jaborandi, *Br.* (See p. 654.)

INFUSUM JABORANDI, *Br.*—Jaborandi ½ ounce, boiling water 10 fluidounces; infuse for half an hour and strain.

TINCTURA JABORANDI, *Br.*, *F. Cod.*—Jaborandi 5 ounces, proof spirit 20 fluidounces (*Br.*). Jaborandi 100 Gm.; alcohol (sp. gr. .912) 500 Gm. (*F. Cod.*).

Substitutions.—The leaves of one or more species of Piper have occasionally been in the market and sold as jaborandi; they are thin or subcoriaceous, ovate, acuminate, and so finely glandular that on being held up to the light and examined with the naked eye they do not appear to be pellucid punctate.

We have seen the leaves of Laurus nobilis, *Linné,* offered as jaborandi; they are easily distinguished by the characters described on page 874.

Physiological Action.—*On Animals:* Jaborandi and its preparations given to guinea-pigs and dogs do not occasion sweating, but in the latter animals induce salivation and diarrhœa, and when they are sacrificed extreme congestion of the gastro-intestinal mucous membrane is found, and sometimes hæmorrhage. In horses pilocarpine injected hypodermically caused profuse sweating, commencing near the point of puncture, as well as salivation. Injected into the veins, it causes primarily an increased, followed by a diminished, blood-pressure and a fuller volume of the pulse-wave. Luchsinger, on administering hypodermically to cats ⅙ grain (Gm. 0.01) of muriate of pilocarpine, found that in 2 minutes salivation began, and very soon afterward sweating of the paws, which lasted for several hours. Vulpian observed that by such administration the secretions of the liver and pancreas were increased. Thus, pilocarpine appears to be the opposite of atropine in its action.

On Man: When a jaborandi-leaf is chewed it causes an acrid sensation in the fauces, and the powder by prolonged contact with the skin irritates it. In doses of from 30 to 90 grains (Gm. 2–6) infused in boiling water, the water and grounds being swallowed together, it produces within ten or fifteen minutes its characteristic effects. Very similar, if not identical, effects are produced by the hypodermic injection of muriate of pilocarpine in the dose of ⅙ to ⅓ gr. (Gm. 0.01–0.02). Pilocarpine acts more promptly than jaborandi, especially when used hypodermically. In the dose just indicated it produces, in the course of two or three minutes, a flushing of the face and breast, and in from three to six minutes drops of sweat appear upon the forehead and moisture is felt in the axillæ and groins, and then upon the trunk and limbs. In a case of glaucoma the patient by mistake received a hypodermic injection of 6 grains instead of ¾ gr. of pilocarpine. Hardly had the needle been withdrawn before the saliva began to dribble from the patient's mouth (*Med. Record,* xx. 599). The amount and duration of the sweating are increased by the patient's remaining covered in bed, and also depend in part upon individual peculiarities. The secretion of tears and of nasal and bronchial mucus is commonly augmented. These abundant losses of liquid necessarily reduce the patient's weight, often to the extent of from 2 to 6 pounds, and occasionally as much as 8 pounds. It sometimes also increases the bronchial secretion, or causes diarrhœa, or produces swelling of the submaxillary glands. During the sweating the temperature is apt to fall about 1° F., the pulse grows fuller and tenser, and its rate is at the same time increased, sometimes by as much as 40 or 50 beats a minute. The face becomes flushed at first, but grows pale when the perspiration is most profuse. These phenomena are attributed to the action of the medicine upon the heart and arteries, whereby their walls are dilated and their capacity increased. Meanwhile, at the time when the sweat breaks out the patient feels his mouth begin to water, and the flow of saliva is so rapid, and often so copious, that he is unable to speak. During the hour and a half, on an average, that the secretion lasts, it may amount to 1 or 2 pints. The saliva is usually ropy. During these operations some drowsiness is apt to occur, which seems to be owing to exhaustion rather than to any narcotic virtue in the drug, and in some cases the sight is so clouded that only very near objects can be distinctly seen. In rare instances sweating fails to occur, and salivation is much less usual than sweating. The fall of temperature noticed above seems usually to be due to the diaphoresis, but it sometimes is observed independently of the latter symptom. Vomiting is an ordinary effect caused in part by the irritation of the medicine when given by the stomach, but in part also by the large amount of saliva swallowed. Hiccough is not uncommon. It is noteworthy that the usual promoters of diaphoresis are quite unnecessary when this medicine has been given. It is the only direct and essential diaphoretic in the materia medica. During the sweating and salivation produced by jaborandi the quantity of urine excreted is diminished, and it is voided with pain. Nearly all observers agree that it contains less than the normal proportion of urea, but some have found it to be increased. Urea is, however, largely eliminated with the saliva and the sweat. Sphygmographic observations denote a dilatation and diminished tension of the whole vascular system during the action of jaborandi, and in experiments upon frogs the heart becomes gradually distended, and finally ceases to beat in diastole. The imperfect vision sometimes produced by the internal use of this drug has already been alluded to. It is attributed to a defect of accommodation. When the extract of jaborandi or pilocarpine dissolved in glycerin is introduced into the eye, it in most cases contracts the pupil, but when taken internally it produces this effect much less uniformly, if at all. Instead of diminishing the secretion of milk, as might reasonably be expected from its causing such profuse discharges elsewhere, it appears to be a true galactagogue. It is said to exhibit this virtue even when directly applied to the mammæ (*Practitioner*, xvii. 443). Children are but little affected by doses which would produce the full operation of the medicine in adults.

A remarkable effect of pilocarpine given hypodermically is described by Strauss, who states that it produces a local sudation confined to the neighborhood of the puncture, provided that the dose be duly proportioned—not exceeding, *e. g.*, $\frac{1}{32}$ to $\frac{1}{16}$ grain. He also found that when copious sweating was produced by one or two milligrams ($\frac{1}{64}$ to $\frac{1}{32}$ grain) of pilocarpine, a very minute injection, such as a hundredth, or even a thousandth, of a grain of atropine will arrest the secretion within a greater or less area (*Bull. de thérap.*, xcviii. 478). The experiments of Van der Mey (*Archives gén.*, 7ème sér., iv. 621) of Müller (*Practitioner*, xxvi. 55), of Hyernaux and others (*Monthly Abst.*, Nov. 1879, p. 483) render it certain that pilocarpine is useless if not mischievous as an oxytocic. The small advantage derived from its dilating the os uteri is greatly outweighed by the prostration and annoyance it occasions.

There can be no doubt that these medicines, especially muriate of pilocarpine, sometimes occasion distressing and even alarming symptoms, such as nausea, vomiting, diarrhœa, tenesmus, collapse, tremor, indistinct vision, sighing respiration, rapid pulse, palpitation of the heart, and vertigo, for which the appropriate remedy is a hypodermic injection of atropine; the inhalation of nitrite of amyl has also been used for the same purpose.

Jaborandi resembles atropine in quickening the pulse and flushing the face, and in acting more powerfully upon adults than upon children; but it is antagonistic to atropine in its action upon the salivary, sudoral, and mammary secretions, upon the pupils also, and the minute arteries. Moreover, the tendency of belladonna to excite delirium contrasts with that of jaborandi to cause prostration and drowsiness, and the sweats and salivation produced by the latter are checked by the hypodermic injection of atropine. The dryness of the mouth and skin which this alkaloid or belladonna occasions is relieved by the administration of jaborandi or pilocarpine. The mammary secretion is diminished by the one and increased by the other. In this connection it may be mentioned that in experiments upon frogs the dilatation of the heart produced by the one agent has been overcome by the operation of the other. Nevertheless, it has happened in cases of poisoning by belladonna or its alkaloid that no mitigation of the symptoms followed the administration of jaborandi or of pilocarpine.

Pilocarpine or its muriate, when injected hypodermically in the dose of about $\frac{1}{5}$ grain, gives rise to effects which in their nature are almost indentical with those of jaborandi taken internally, but they are more promptly produced, as well as more certainly, and are more lasting. Sweating especially, which sometimes fails to occur under the operation of jaborandi, is invariably excited by pilocarpine, which is also, when thus administered, less apt to cause vomiting, probably because it does not irritate the stomach.

Medical Uses.—The utility of jaborandi in medicine is chiefly shown by its power of lessening the amount of liquid in the system. Hence it is often of service in removing effusions due to cardiac or renal obstruction, and even to inflammation. The last effect has been illustrated in some cases of chronic as well as acute *pleurisy*, probably, however, with serous rather than purulent effusion. The relief afforded by the medicine is sometimes wonderfully prompt, and is all the more so if the patient refuses to yield to his thirst and abstains, as far as possible, from using liquids. In children the relief is more apt to be afforded by profuse salivation than by sweating. In *hydrothorax* the benefit is even more speedy and complete, although its duration must depend upon the cardiac or renal disease during which it occurred. When *dropsy* arises in connection with desquamative *tubular nephritis* (especially scarlatinous), or even with *interstitial nephritis*, the medicine is very efficient; in the former disease often leading to a cure, and in the latter to a prolongation of life. But it can be of no service unless its sialagogue or its diaphoretic action is fully developed. A danger, however, which, perhaps, attends this treatment of acute renal dropsy is that the discharge of water by the skin diminishes the excretion of the kidneys, and if carried too far may cause them to become obstructed and uræmic symptoms to arise. In regard to the dropsy of pregnancy and the usually associated *puerperal albuminuria* and *convulsions* the efficacy of the medicine does not yet appear to be determined. In some cases its administration has been followed by its physiological effects and the dissipation of threatening symptoms; but some physicians (Bidder, Fordyce Barker) regard its utility as more than doubtful, and the latter states that after puerperal convulsions its depressing influence, which is continuous and exhausting, prevents sleep and the repose of the nervous system, and thus renders it in these cases a dangerous remedy. On the whole, however, there is no speedier relief to be obtained than by this medicine, which undoubtedly acts precisely as another and now neglected remedy did under similar circumstances. Venesection is the remedy referred to. Serous evacuation is almost as prompt in giving relief, and does not waste the vital and nutritive constituents of the blood. The special indication for jaborandi is the necessity of prompt action; and it is perhaps wiser not to persist in prescribing it after safety has been secured, lest perchance the case may become embarrassed by secretion into the air passages, and also because the prolonged diaphoresis may aggravate the renal obstruction. In *dropsy* caused by *disease of the heart* it is a temporary palliative which may appropriately be used from time to time during a treatment by digitalis, etc. Indeed, it simply serves as a substitute for the ancient practice of purging, or sweating by heat, etc., and may be used alternately with them. Its action in lessening the contractile power of the heart and arteries, and retaining them in diastole, should be borne in mind, since it tends to favor the accumulation of blood in them and to obstruct instead of relieving the circulation and respiration. In all cases in which the rhythm of the heart is disordered by valvular or muscular degeneration this medicine should be cautiously used, lest during the prostration it cause the action of the heart to be suspended. Used in certain cases of pulmonary *emphysema*, it has embarrassed respiration and threatened to produce asphyxia. But when dropsy of whatever form (hydrothorax, ascites, anasarca) due to Bright's disease is associated, not with obstructive lesions of the heart, but with hypertrophy of the left ventricle, the relief obtained from jaborandi is immediate and striking. Yet the rule must not be too absolutely followed. In cases of obstructive diseases of the heart from valvular or muscular degeneration, with emphysema, and even disease of the arteries, the action of pilocarpine may sometimes be so adjusted as to afford relief without embarrassing the circulation. In a case of *œdema of the larynx* the hypodermic use of pilocarpine seems to have saved life (*Bull. et Mém. Soc. de thérap.*, 1881, p. 146). In 1880 and for several subsequent years marvellous success was announced from the use of pilocarpine in *diphtheria*, on the ground, apparently, of the salivation induced by it causing the separation of the false membranes. As usual, the "rational" anticipation resulted in disappointment, and it was found that the medicine added to the disease a new element of weakness, and therefore of danger. A caution has been given to beware of the possible uræmic symptoms that may follow the diminished urination, but as urea is eliminated by the saliva and sweat the advice is perhaps not very important. The utility of pilocarpine in all forms of dropsy is precisely like that which has long been derived from hot-air and steam-baths and other powerful diaphoretics, but is greater, inasmuch as it excites profuse salivation as well as sweating. It must be borne in mind also that some clinical observers have found it injurious by causing distressing nausea and vomiting, and so exhausting the strength that its repeated use was not tolerated.

Pilocarpine is alleged by some practitioners to bring on *labor* in pregnancy at term, and to hasten and facilitate it when once begun. Its influence in these respects is not, however, determined. According to Galezowski, pilocarpine equals eserine in its power of *contracting the pupil*, and has the advantage of not irritating the conjunctiva. He prefers a solution of 20 Cgm. of the nitrate in 10 Gm. of cherry-laurel water, or of 10 Cgm. of the sulphate in 6 Gm. of the same solvent. Dr. H. W. Williams has confirmed this judgment, adding that it produces less supraorbital pain than the eserine sulphate, and less spasm of the accommodative power. It is used chiefly in cases of corneal lesions in which it is desirable to withdraw the iris from the danger of prolapsing or of adhering to the cornea. It was observed by Schmitz that the administration of muriate of pilocarpine hypodermically caused a growth of downy hair on the scalp of two men affected with *alopecia*. A like effect has been reported by André (*Bull. de thérap.*, ci. 139), and others belonging to diseases of the scalp by Pick (*Phila. Med. Times*, x. 451). A case is reported of a "change of color of the hair from light blond to nearly jet black in a patient while under treatment by pilocarpine" (Prentiss, *Phila. Med. Times*, xi. 609).

Jaborandi has been employed to diminish the discharge of urine in watery and also in saccharine *diabetes*, but it only changes the outlet of the liquid without reducing the loss. The morbid conditions producing *polyuria* are so various that the excessive flow of urine cannot in all cases be under the control of the same agent. In the present case it is doubtful whether the simple functional (?) affection, or the excessive urination that attends the first stage of interstitial Bright's disease, or chronic poisoning by lead, is most benefited by the vicarious discharge of liquid under the influence of pilocarpine. Upon "scientific principles" jaborandi should be a specific for acute articular *rheumatism*, but clinically it is so far from curing the disease that it does not even modify its symptoms or its course. In syphilitic rheumatism its sudorific action is said to have removed the nocturnal pains, and it has been efficacious in muscular rheumatism and *sciatica*. In scaly *skin diseases* it is useless. In *prurigo* it is a palliative. Some published cases render it probable that the sudorific power of pilocarpine may take the place of the sweating by means of the "decoction of the woods" which was once considered essential to the cure of constitutional *syphilis* (*Practitioner*, xxvi. 55; *St. Bart.'s Hosp. Reports*, xvi. 280). In *mumps* it is reported to have been curative both of the parotid swelling and of the metastatic engorgement of the testicles. In a case of unilateral *sweating* the hypodermic injection of pilocarpine is reported to have cured the affection after having at first increased it. In *asthma* with bronchitis (humid asthma) it sometimes affords surprising relief. A case of persistent *hiccough* from disease of the brain, and which had resisted various other remedies, yielded at once to the hypodermic injection of ½ grain (Gm. 0.03) of pilocarpine. A case of reputed *hydrophobia* treated by means of pilocarpine is said to have recovered, but the Academy of Medicine of Paris did not regard the case as being accurately designated (*Bull. de thérap.*, ciii. 39). In several cases pilocarpine has served as an antidote to the poisonous effects of *atropine* and *belladonna*. Its effects appear to be prompt and decided (*Phila. Med. Times*, x. 415; *ibid.*, xi. 637; *Med. Record*, xx. 41; *Edinb. Med. Jour.*, xxviii. 1048). Hypodermic injections of nitrate of pilocarpine are said to have cured *fetid sweating* (*Bull. de thérap.*, c. 135).

Jaborandi may be administered in an infusion made with 90 grains of the medicine and 4 fluidounces (Gm. 6 in Gm. 128) of water, and taken in three or four equal portions at intervals of 10 minutes. To avoid nausea it may be given by enema. A concentrated tincture containing the virtues of 30 grains in a fluidrachm (Gm. 2 in Gm. 4) of the preparation, and a fluid extract made with 50 per cent. alcohol, a fluidrachm (Gm. 4) of which represents 60 grains (Gm. 4) of jaborandi, have both been employed. Pilocarpine or its nitrate may be prescribed by the mouth in doses of from ½ to ¾ grain (Gm. 0.03–0.05), and hypodermically ¼ grain (Gm. 0.02) may be given. Squire recommends muriate of pilocarpine in solution as the best form to use—1 grain to 15 minims of water for hypodermic injections, 1 grain to 4 ounces of water for internal use, one-third of a grain being the largest, and one-fifteenth of a grain the smallest, dose needed.

PILULÆ.—PILLS.

Pilules, Fr.; *Pillen*, G.

Pills are medicaments which have been formed into spherical, or sometimes slightly elongated or more or less lenticular, bodies, intended to be swallowed without being previously masticated. Their weight ranges from less than 1 grain to about 5 grains (0.3 Gm.) for vegetable substances, or about 8 or 10 grains (0.5 or 0.6 Gm.) for heavy mineral compounds; if a pill exceeds this weight it is called a *bolus*. Boluses are occasionally made weighing 20 or 30 grains (1.3 or 2.0 Gm.) each, and are often of a softer consistence than pills. Very small pills coated with sugar have been called *granules*.

Excipients.—All drugs and chemicals may be worked into pills, but few only are adapted for this purpose without the addition of some other liquid or solid material, called the excipient, to impart to them the necessary plasticity. Soap, gum-resins, some resins, and several extracts do not require any addition except a few drops of water or alcohol, with which they may be triturated into plastic masses, and then serve as excellent excipients for many non-adhesive drugs. Treated in the same manner with ether, lupulin will furnish a mass suitable for pills. That the majority of extracts are unfit for the preparation of pills without the addition of an absorbent powder is explained at page 611. Absorbent powders, like powdered marshmallow, liquorice-root, bread-crumb, etc., are likewise required for liquids, such as *fixed* and *volatile oils*, *oleoresins*, *balsams*, etc., but such mixtures, if containing more than minute quantities of the oily liquid, cannot conveniently be formed into a pill mass by the addition of mucilage or syrup. The substances named are best combined with a solid fat, like butter of cacao or expressed oil of nutmeg, or with wax in sufficient quantity to form a plastic mass; however, it is preferable in such cases to use also some absorbent powder, and for volatile oils the wax is better replaced by a resin, like mastic. The proportion in which such excipients are to be used may be stated as being, for every 5 parts of the medicine 10 parts of the two excipients, of which not less than 2 parts should be wax, resin, or solid fat. Very limpid oils require a somewhat larger proportion of the excipients, and the absorbent powder need not necessarily be inert. Powdered marshmallow-root is capable of absorbing a larger amount of liquids than most other vegetable powders, but it has the disadvantage of rendering the pill mass more or less elastic, and the pills if kept on hand for a prolonged time are apt to become mouldy. Powdered liquorice-root is nearly free from these objections, and is therefore more largely employed than the former; prepared from peeled Russian liquorice-root, it is of a light-buff color and does not materially darken most pill masses.

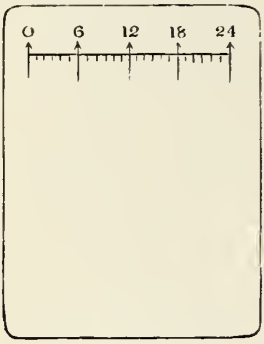
Ethers, *chloroform*, and similar liquids are not adapted for use in pill form, owing to their great volatility; and *tinctures*, unless added only in very small quantities, in which case they are triturated with the absorbent powder, are best reduced by evaporation to the consistence of a soft extract.

It is also advisable to avoid prescribing very *deliquescent compounds* in the form of pills unless these are immediately covered with a substance impervious to moisture; or the pill mass may be formed with a mixture of 1 part of wax and 3 parts of Canada balsam, as proposed by Dannecy (1877).

Many vegetable powders contain an amount of gum or similar principle sufficient to form, by trituration with a little *water*, *honey*, *syrup*, or *glycerin*, an adhesive mass suitable for making pills. Saline and mineral substances, as a rule, require a firmer excipient, but in the presence of a small quantity of an extract the addition of a minute proportion of glycerin will often produce a plastic mass.

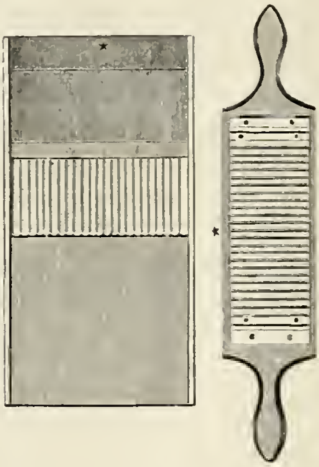
It is obvious, from the foregoing, that there cannot be an excipient which would be alike serviceable for all medicinal substances, or even for all drugs capable of being reduced to powder. The choice of the excipient is very frequently left to the pharmacist, and involves a knowledge not only of the constituents of the drugs, but also of the reactions which may take place between the different ingredients in the presence of moisture. *Mucilage of acacia* or of *tragacanth* serves a good purpose if the pills are to be used in a short time, but if kept on hand they become hard and dissolve very slowly. This may be prevented by replacing about one-half or more of the water with *glycerin*. The *glycerite of starch* (see p. 739) and various combinations of it with gum-arabic, tragacanth, and sugar have been used for the same purpose. Some very soluble salts, like boro-tartrate of potassium, have been recommended as excipients, but are scarcely required. Commercial syrupy *glucose*, *manna*, the officinal *pill masses*, most of the officinal *confections*, and more particularly that of rose, of hip, and of senna, will render powders adhesive, and if *extracts* are not inadmissible they will be found to yield good pill masses with a comparatively large amount of powder; a rather soft extract is capable of serving as an excipient for its own weight of vegetable powder and three or four times its weight of resins and insoluble salts, and with the addition of a little syrup or honey twice the weights indicated may be incorporated.

FIG. 214.



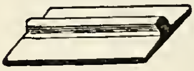
Pill-tile, graduated.

FIG. 215.



Pill-machine.

FIG. 216.



Pill-roller.

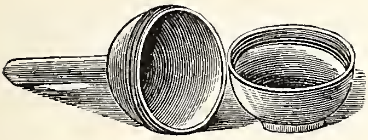
As a rule, it will be found desirable for the physician to order some adhesive material, like extracts, together with the other ingredients of pills, but the former should not be in excessive quantities, so as not to require the addition of inert absorbent powder. When no excipient is directed, the pharmacist should select one which is simple in composition, does not increase the bulk of the mass, and is not liable to become very hard. When resinous extracts and similar materials are ordered, an excipient is not often required, but the powders may be triturated together in a warm mortar and the plastic mass rolled out into pills while still warm. The compound cathartic pills furnish an example of this kind.

Preparation.—After the mass has been uniformly mixed and properly prepared in the mortar, or for a small number of pills upon a glazed slab, it is rolled out either by means of a spatula or a flat piece of hard wood, or when the mass is tough or voluminous the flat back of the cutter of a pill-machine is used. A cylinder of uniform thickness and the desired length having been obtained, it is cut into the requisite number of pieces upon a graduated tile or by means of a pill-machine. Several sizes of the latter are usually kept in the shops for preparing pills of different sizes, and serve not only for dividing, but likewise for shaping, the pills by placing the cylindrical roll upon the cutting surface and moving the cutter forward and backward with a gradually increased pressure. Those pieces which have not become spherical or which have been cut by hand are rolled between the fingers until they are nearly globular, after which they are placed upon a smooth surface and completely rounded by means of a slight pressure of the fingers, or by rotating them under the blade of a pallet-knife or under a flat piece of hard wood similar to the pill-roller. Various implements have been constructed for giving the pills a uniform finish; they usually consist of a circular, smooth, rolling surface with a projecting margin adjustable to pills of different size.

Pill-dusting.—The pill mass, being plastic and adhesive, is apt to adhere to the slab and the fingers while being rolled out and shaped into pills. This is prevented by the use of a fine powder, which should be strictly inert unless otherwise directed by the physician. Among the most suitable powders are liquorice-root, marshmallow-root, and lycopodium. The fineness and uniformity of the latter, its slight adhesive qualities, and its tastelessness render it particularly desirable for this purpose. Powdered starch is usually too slippery, but when mixed with finely-powdered sugar and gum-arabic is sometimes preferable on account of its white color. Magnesia and magnesium carbonate should be used with due care, on account of the possible chemical effect upon the ingredients of the pills. Powdered talc (soapstone), with or without sugar and gum-arabic, is likewise serviceable, and has the advantage of imparting a very thin opaque and tasteless coating to the pills without impairing their solubility in the stomach. When asafetida or other substances of a nauseous odor are given in the form of pill, the odor may either be entirely covered or considerably modified by the use of powdered cinnamon, aromatic powder, ginger, or a similar powder.

Pill-coating.—If the pill mass be not too soft, the amount of powder adhering to the surface of the finished pill is quite small, though generally sufficient, if quickly swallowed, to cover the taste of bitter and nauseous ingredients. More perfect coverings may be obtained in various ways, an ordinary rather deep pill-box being used, or preferably an apparatus made of hard wood consisting of two hollow hemispheres, to one of which a short handle is attached. For *silvering* or *gilding* the pills are made firm, if possible rolled out and shaped without using any powder, and after a perfectly smooth surface has been obtained they are slightly dampened and introduced into the apparatus, together with the requisite quantity of gold- or silver-leaf; after a rapid rotary motion for a few seconds the pills will be found uniformly coated with the thin metal. Glycerin should not be used as an excipient or only in very small quantity, as it lessens the brightness of this kind of coating.

Fig. 217.



Apparatus for coating pills.

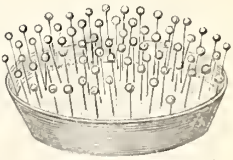
The same apparatus may likewise be employed for *sugar-coating* pills extemporaneously. To accomplish this, the pills receive first a thin coating of a thick mucilage, syrup of acacia or albumen, by rotating them upon a moistened slab or in a saucer, after which they are introduced into the apparatus with not too large a quantity of very finely-powdered sugar. The smoothness of the surface of the sugar depends altogether upon the mutual attrition of the pills, and consequently upon the absence of too large an excess of sugar and upon the rapidity of motion during the operation. A coating of *French chalk* may be applied in the same manner. Pills are now extensively coated with sugar on the large scale, hemispherical copper pans being used to which a somewhat eccentric rotary motion is given; these pans may be moderately heated either by steam or otherwise. To obtain a uniform and compact coating the powdered sugar is added gradually as required. In France sugar-coated pills are called *dragées*, and when of very small size *granules*.

The practice of sugar-coating pills was approved by the Pharmacopœia of 1870 in reference to pills which are expected to be slow in their operation, but was stated to be of doubtful propriety in regard to those intended to act quickly, as the coating retards the solution of the pill matter in the liquids of the stomach; and the same remark holds good, with at least equal force, for nearly every other kind of coating.

Pills are occasionally coated with *tolu* or *collodion*. The operation is in both cases alike, the tolu balsam, which should for this purpose be hard at the ordinary temperature, being dissolved in ether or in chloroform; the pills are rapidly rotated, with the liquid gradually added, a flat dish being used, and afterward exposed upon a tile, and occasionally stirred until the coating is dry.

For coating pills with gelatin a different manipulation from those described is required. A solution of pure gelatin in one-half or one-third its weight of water is made, and the solution kept at a temperature just high enough to keep it liquid. The pill, fastened upon the end of a pin, is dipped into the liquid, quickly withdrawn, and, after some rotary motions to promote the uniform diffusion of the gelatin solution and its superficial hardening, the pins are fixed in a tray, where the coating is allowed to become sufficiently firm, when a second, and sometimes a third, coat is applied in the same manner. If many pills are to be thus coated, a number of pins may be fastened to a flat cork or piece of wood, and an equal number of pills dipped together. Various serviceable apparatus have been constructed to facilitate this operation. The coating of gelatin may be applied to pills while still plastic, but they should be sufficiently firm not to lose their shape while temporarily exposed to a somewhat elevated temperature. Most bitter principles being soluble in aqueous liquids, the taste of the pill mass will to some extent be communicated to the first layer of gelatin. After a sufficiently thick coating of gelatin has been applied, the pills are withdrawn

Fig. 218.

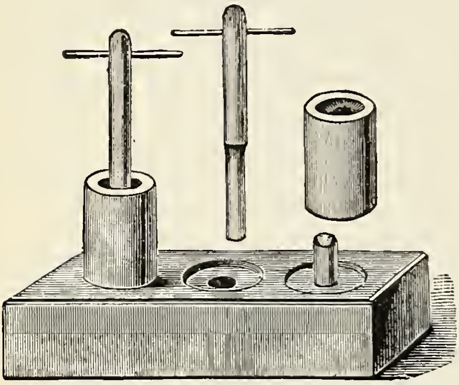


Tray with gelatin-coated pills.

after heating the pins in the flame of an alcohol or gas lamp, whereby the adjacent gelatin is melted and the orifice closed. Instead of operating in the manner described, Deschamps proposed to roll the pills in a little of the gelatin solution, previously mixed with a small quantity of alcohol, and to dry them afterward in a tray made of sheet iron or covered with oiled paper.

Compressed Pills.—These pills, which have been recently introduced, are usually lenticular in shape, and are made without any excipient, simply by subjecting the powdered material to pressure, the process being essentially that which was patented in England in 1843. Prof. Remington (1876) constructed an apparatus which is made of cast steel, the mould being on a rod which fits in a movable cylinder into which the weighed material is introduced; the compression is effected by striking the rod with a wooden mallet a quick blow. A more uniform pressure is obtained by acting with a lever upon the compressing rod, the compressed material being then less liable to break. Powders which are readily soluble in water without being deliquescent appear to be best adapted for this kind of pills.

Fig. 219.



Apparatus for making compressed pills.

Preservation.—Uncoated pills are best preserved in lycopodium or other powder, and in a vessel which does not prevent the change of air. Moist pills kept in well-closed vessels are apt to become mouldy.

It should be mentioned that the British Pharmacopœia directs only *pill masses*, leaving the final division to be specially ordered by the physician. The U. S. Pharmacopœia, on the other hand, besides recognizing three pill masses (see page 960), directs *pills* of a certain weight; for convenience of dispensing, however, the mass of some of these is sometimes kept on hand undivided.

PILULÆ ALOES, *U. S.*—Pills of Aloes.

Pilula aloes Socotrinæ, Br.—*Pilules d'aloès et de savon*, Fr.; *Aloepillen*, G.

Preparation.—Purified Aloes, in fine powder, 200 grains (13 Gm.); Soap, in fine powder, 200 grains (13 Gm.); to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes and soap, of each 24 grains (1.56 Gm).

The formula of the French Codex is identical with this, except that Cape aloes is used, and that 100 pills contain 10 Gm. of each of the ingredients.

Take of Socotrine aloes, in powder, 2 ounces; hard soap, in powder, 1 ounce; volatile oil of nutmeg 1 fluidrachm; confection of roses 1 ounce. Beat all together until thoroughly mixed.—*Br.*

Pilula aloes Barbadensis, *Br.*, is made in precisely the same manner, except that Barbadoes aloes is substituted for Socotrine aloes, and oil of caraway for oil of nutmeg, both in the same proportion as in the preceding formula.

Pilulæ aloeticæ, Pilules d'aloès, *F. Cod.* Cape aloes 154 grains (10 Gm.); confection of rose 77 grains (5 Gm.); make 100 pills.

Medical Action and Uses.—The soap in this pill serves to divide the aloes and render it more soluble, whereby, it is thought, the tendency of the medicine to irritate the rectum is diminished. In the British pill the oil of nutmeg is intended to lessen the tendency of the medicine to gripe. Pill of aloes is convenient as a laxative in habitual *constipation*, and may be taken at bedtime or after dinner. A single pill repeated daily forms the ordinary dose. It may be used as a purgative in the *dose* of five or more pills, but is less suited for this purpose than other aloetic preparations.

The *Pilula aloes Barbadensis*, Br., is nearly identical as a purgative with that of the United States Pharmacopœia, but the oil of caraway it contains gives it the advantage. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60).

The only difference between *Pilula aloes Socotrinæ*, Br., and that made with Barbadoes aloes, besides the source of the aloes itself, is that the former contains oil of nutmeg and the latter oil of caraway. It would seem more convenient, as well as reasonable, that the one or the other oil should be added, as it may be according to the United States Pharmacopœia, according to the nature of the case. The *dose* of the Socotrine aloes pill is from 5 to 10 grains (Gm. 0.30–0.60), or two or three pills.

PILULÆ ALOES ET ASAFŒTIDÆ, *U. S., Br.*—PILLS OF ALOES AND ASAFETIDA.

Pilules d'aloès et asefétide, Fr.; *Aloe- und Asafœtida-Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 400 grains (26 Gm.); Asafetida 400 grains (26 Gm.); Soap, in fine powder, 400 grains (26 Gm.); to make 300 pills. Beat them together with water so as to form a mass, and divide it into 300 pills.—*U. S.* For 12 pills use aloes, asafetida, and soap, of each 16 grains (1.04 Gm.).

Take of Socotrine aloes, in powder, asafetida, hard soap, in powder, confection of roses, each 1 ounce. Beat all together until thoroughly mixed.—*Br.*

Medical Action and Uses.—These pills may take the place of the simple aloetic pill in cases of constipation attended with flatulence, and especially in nervous or hysterical persons. *Dose*, from two to five pills.

PILULÆ ALOES ET FERRI, *U. S., Br.*—PILLS OF ALOES AND IRON.

Pilulæ aloeticæ ferratæ, s. Pilulæ Italicæ nigræ, P. G., F. Cod.—*Pilules d'aloès et de fer*, Fr.; *Aloe- und Eisenpillen, Italienische Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 100 grains (6.50 Gm.); Dried Sulphate of Iron 100 grains (6.50 Gm.); Aromatic Powder 100 grains (6.50 Gm.); Confection of Rose; to make 100 pills. Beat the powders together with confection of rose so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes, exsiccated sulphate of iron, and aromatic powder, of each 12 grains (0.78 Gm.).

Take of sulphate of iron 1½ ounces; Barbadoes aloes, in powder, 2 ounces; compound powder of cinnamon 3 ounces; confection of roses 4 ounces. Reduce the sulphate of iron to powder, rub it with the aloes and compound powder of cinnamon, and, adding the confection, make the whole into a uniform mass.—*Br.*

Exsiccated sulphate of iron and powdered aloes equal parts; mix, form a mass with alcohol, and divide into pills each weighing 0.10 Gm. Moisten the pills with tincture of aloes to make the surface black and glossy.—*P. G.*

Medical Action and Uses.—This is an old and efficient combination used in the treatment of *amenorrhœa* associated with anæmia and constipation. Like other analogous compounds, it should be used habitually in moderate doses, and in larger ones at the menstrual epochs. *Dose* from 5 to 10 grains (Gm. 0.30–0.60), or two or three pills.

PILULÆ ALOES ET MASTICHES, *U. S.*—PILLS OF ALOES AND MASTIC.

Lady Webster's dinner pills, E.; *Pilules d'aloès et de mastic*, Fr.; *Aloe- und Mastix-Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 200 grains (13 Gm.); Mastic, in fine powder, 50 grains (3.25 Gm.); Red Rose, in fine powder, 50 grains (3.25 Gm.); to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes 24 grains (1.56 Gm.), mastic and red rose, of each 6 grains (0.39 Gm.).

Medical Action and Uses.—The association of mastic with aloes in a purgative pill can hardly have any other effect than to retard the solution of the latter, and thereby cause it to act upon the large rather than upon the small intestine. These pills are used to quicken defecation, and are generally taken with or immediately before or after the principal meal. Hence they have been called *Pil. ante cibum*, *Pilules des gourmands*, etc. Under the latter title, however, pills are used containing extract of cinchona and absinth, as well as aloes. Each pill contains about 2 grains of aloes.

PILULÆ ALOES ET MYRRHÆ, *U. S., Br.*—PILLS OF ALOES AND MYRRH.

Rufus's pills, E.; *Pilules d'aloès et myrrhe, Pilules de Rufus*, Fr.; *Rufus'sche Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 200 grains (13 Gm.); Myrrh, in fine powder, 100 grains (6.50 Gm.); Aromatic Powder 50 grains (3.25 Gm.); Syrup a sufficient quantity; to make 100 pills. Beat them together so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes 24 grains (1.56 Gm.), myrrh 12 grains (0.78 Gm.), and aromatic powder 6 grains (0.39 Gm.).

Triturate together Socotrine aloes 2 ounces, myrrh 1 oz., dried saffron ½ ounce; then add treacle 1 ounce and sufficient glycerin, and beat them together into a uniform mass.—*Br.*

Medical Action and Uses.—The proportion of myrrh in this compound is too small to exert much influence, but, owing to its supposed action upon the uterine system, it is believed to increase the virtue of the aloes in the treatment of *amenorrhœa, uterine catarrh*, etc. The still smaller proportion of saffron can scarcely add much to its virtues. As a purgative, from three to six pills may be given, or from 10 to 20 grains (Gm. 0.60–1.30) of the mass in a bolus. As a laxative, taken at bedtime for a week or more, one or two pills will generally suffice, and will be found the most efficient mode of administration in the uterine disorders referred to.

PILULÆ ANTIMONII COMPOSITÆ, *U. S.*—COMPOUND PILLS OF ANTIMONY.

Pilula hydrargyri subchloridi composita, Br.; *Pil. calomelanos composita.—Compound pills of subchloride of mercury, Plummer's pills*, E.; *Pilules altérantes composées, P. antidartreuses, P. de Plummer*, Fr.; *Plummer'sche Pillen*, G.

Preparation.—Sulphurated Antimony 50 grains (3.25 Gm.); Mild Chloride of Mercury 50 grains (3.25 Gm.); Guaiac, in fine powder, 100 grains (6.50 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 100 pills. Mix the powders, beat them together with mucilage of tragacanth so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use sulphurated antimony and calomel, each 6 grains (0.39 Gm.), guaiac resin 12 grains (0.78 Gm.).

Take of subchloride of mercury, sulphurated antimony, each 1 ounce; guaiacum resin, in powder, 2 ounces; castor oil 1 fluidounce or a sufficiency. Triturate the subchloride of mercury with the antimony, then add the guaiacum resin and castor oil, and beat the whole into a uniform mass.—*Br.*

Medical Action and Uses.—Plummer's pills—or compound calomel pills, as they might properly be called—probably owe their virtues to the mercury they contain, since various other mercurial preparations are equally efficacious in the diseases for the cure of which these pills are in greatest repute—viz. *chronic rheumatism* and *diseases of the skin*, so far as they are due to a syphilitic taint—and since the proportion of guaiac they contain can have no efficiency. The *dose* is one or two pills twice a day.

PILULÆ ASAFŒTIDÆ, *U. S.*—PILLS OF ASAFETIDA.

Pilule d'asafétide, Fr.; *Asafœtida-Pillen*, G.

Preparation.—Asafetida 300 grains (19.50 Gm.); Soap, in fine powder, 100 grains (6.50 Gm.); to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use asafetida 36 grains (2.34 Gm.) and soap 12 grains (0.78 Gm.).

Medical Action and Uses.—These pills, especially when sugar-coated, are a convenient form for the administration of asafetida, of which each one contains 3 grains. *Dose*, from one to three pills.

PILULA CAMBOGIÆ COMPOSITA, *Br.*—COMPOUND PILL OF GAMBOGE.

Preparation.—Take of Gamboge, in powder, Barbadoes Aloes, in powder, Compound Powder of Cinnamon, each 1 ounce; Hard Soap, in powder, 2 ounces; Syrup a sufficiency. Mix the powders together, add the syrup, and beat the whole into a uniform mass.

Medical Action and Uses.—As an efficient purgative in constipation and in congested states of the portal circulation this pill may be recommended. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60).

PILULÆ CATHARTICÆ COMPOSITÆ, *U. S.*—COMPOUND CATHARTIC PILLS.

Antibilious pills, E.; *Pilules cathartiques composées*, Fr.; *Abführpillen*, G.

Preparation.—Compound Extract of Colocynth 130 grains (8.40 Gm.); Abstract of Jalap 100 grains (6.50 Gm.); Mild Chloride of Mercury 100 grains (6.50 Gm.); Gamboge, in fine powder, 25 grains (1.62 Gm.); to make 100 pills. Mix the powders intimately; then with water form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use compound extract of colocynth 15.6 grains (1.008 Gm.); abstract of jalap and calomel, of each 12 grains (0.78 Gm.); gamboge 3 grains (0.195 Gm.).

In making this pill mass it is advisable to use a warm mortar and add very little water; while still warm it may be formed into pills which will better retain their shape than if made with more water at the ordinary temperature. The composition of these pills is almost exactly the same as in the previous Pharmacopœia, the abstract of jalap being of about the same strength as the extract which was formerly used (see page 7.)

Medical Action and Uses.—Whether or not the calomel in these pills acts upon the liver, as was once fully believed, there can be no question that in all cases requiring thorough purgation, in which the *gastric digestion* is *disordered*, the liver tumid and tender, the skin and the conjunctiva muddy, and the urine dark and sedimentary, these symptoms are promptly relieved by a full purgative dose of them. Hence, they are much used in malarial localities at seasons when periodical diseases prevail, and in other places for the relief of similar symptoms produced by the habit of eating excessively of animal food and using alcohol beyond the needs of the economy. There is much reason for believing that the compound cathartic pill operates as a purgative upon the entire intestinal tract.

The *dose* of this preparation as a laxative is about 3 grains (Gm. 0.20), or one pill; as an active cathartic, about three pills. It is not adapted for habitual use, on account of its tendency to produce salivation when often repeated.

PILULA COLOCYNTHIDIS COMPOSITA, *Br.*—COMPOUND PILL OF COLOCYNTH.

Pilules de coloquinte composées, Pil. cochés mineures, Fr.; *Coloquinten-Pillen*, G.

Preparation.—Take of Powdered Colocynth-Pulp 1 ounce; Barbadoes Aloes 2 ounces; Resin of Scammony 2 ounces; Sulphate of Potassium ¼ ounce; Oil of Cloves 2 fluidrachms; Distilled Water a sufficiency. Mix the powders, add the oil of cloves, and beat into a mass with the aid of the water.—*Br.*

The formula of the French Codex directs colocynth, Barbadoes aloes, and scammony, of each 10 Gm., honey 30 Gm., oil of cloves 0.05 Gm., to be divided into 200 pills, which are to be coated with silver.

Medical Action and Uses.—This pill is appropriate in the same cases as the compound pill of gamboge. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60), or two or three pills.

PILULA COLOCYNTHIDIS ET HYOSCYAMI, *Br.*—PILL OF COLOCYNTH AND HYOSCYAMUS.

Preparation.—Take of Compound Pill of Colocynth 2 ounces; Extract of Hyoscyamus 1 ounce. Beat them into a uniform mass.—*Br.*

Medical Action and Uses.—The operation of the compound extract of colocynth in this pill is mitigated by its association with extract of hyoscyamus, but an officinal formula is hardly necessary for such a combination. It is better to add the narcotic extract to whatever purgative pill has a tendency to gripe, in a magistral prescription. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60), or two or three pills.

PILULA CONII COMPOSITA, *Br.*—COMPOUND PILL OF HEMLOCK.

Preparation.—Take of Extract of Hemlock 2½ ounces; Ipecacuanha ½ ounce; Treacle a sufficiency. Mix the extract of hemlock and ipecacuanha, and add sufficient treacle to form a pill mass.

Medical Action and Uses.—This combination is intended to act as a sedative and expectorant, but the extract of conium contained in it can exert but little influence in either way. A pill of Dover's powder is much more efficient. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60), or two or three pills.

PILULÆ FERRI COMPOSITÆ, *U. S.*—COMPOUND PILLS OF IRON.

Pilulæ ferri cum myrrha, F. Cod.; *Pilules de Griffith*, *P. de fer et de myrrhe composée*, Fr.; *Griffith'sche Pillen*, G.

Preparation.—Myrrh, in fine powder, 150 grains (9.75 Gm.); Carbonate of Sodium 75 grains (4.85 Gm.); Sulphate of Iron 75 grains (4.85 Gm.); Syrup a sufficient quantity; to make 100 pills. Rub the myrrh first with the carbonate of sodium and afterward with the sulphate of iron, until they are thoroughly mixed; then beat them with syrup so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use myrrh 18 grains (1.17 Gm.), sodium carbonate and ferrous sulphate, of each 9 grains (0.585 Gm.).

By the reaction between the iron and sodium salts ferrous carbonate is formed, which, though an unstable compound when in contact with the air, is prevented to a considerable extent from becoming oxidized, except on the surface of the pills.

Pills of similar composition, but without myrrh, are used in Europe under the name of *Blaud's ferruginous pills.* Made according to the French Codex, twenty pills contain 3 Gm. each of exsiccated ferrous sulphate and carbonate of potassium. The ingredients may be triturated with 0.5 Gm. of powdered tragacanth, and with a little honey beaten into a good pill mass. Some formulas direct equal quantities of crystallized ferrous sulphate and potassium carbonate, and a good mass is obtained by using the granulated sulphate, beating it together with the carbonate, and adding to 16 Gm. of the mixed salts 2 Gm. of powdered tragacanth and 5 or 6 drops of syrup.

Medical Action and Uses.—These pills, each of which contains less than a grain of oxide of iron and a grain and a half of myrrh, are supposed to be peculiarly adapted to the treatment of *amenorrhœa* and of other conditions requiring the use of a reconstituent and stimulant medicine. They are intended to represent in a more convenient form the compound iron mixture, but clinical observation does not show their equality with that efficient medicine. From two to six pills may be given at a *dose*, two or three times a day.

PILULÆ FERRI IODIDI, *U. S., Br.*—PILLS OF IODIDE OF IRON.

Pilules d'iodure de fer, P. de Blancard, Fr.; *Eisenjodür-Pillen,* G.

Preparation.—Reduced Iron 60 grains (4.00 Gm.); Iodine 80 grains (5.20 Gm.); Glycyrrhiza, in No. 60 powder, 50 grains (3.25 Gm.); Sugar, in fine powder, 50 grains (3.25 Gm.); Extract of Glycyrrhiza, in fine powder, 12 grains (0.75 Gm.); Acacia, in fine powder, 12 grains (0.75 Gm.); Water, Balsam of Tolu, Stronger Ether, each a sufficient quantity; to make 100 pills. To the reduced iron, contained in a porcelain capsule, add about 120 grains or about 8 Gm. of water, and gradually add the iodine, constantly triturating, until the mixture ceases to have a reddish tint. Then add the remaining powders, previously mixed, and evaporate the excess of moisture on the water-bath, constantly stirring, until the mass has acquired a pilular consistence. Lastly, divide it into 100 pills. Dissolve 1 part of balsam of Tolu in 1 part of stronger ether; shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Keep the pills in a well-stopped bottle.—*U. S.*

Take of fine iron wire 40 grains; iodine 80 grains; refined sugar, in powder, 70 grains; liquorice-root, in powder, 140 grains; distilled water 50 minims. Agitate the iron with the iodine and the water in a strong stoppered ounce phial until the froth becomes white. Pour the fluid upon the sugar in a mortar, triturate briskly, and gradually add the liquorice.—*Br.*

The first process, as compared with that of the former Pharmacopœia, has been modified in several particulars, though the strength of the pills remains unaltered. In directing a large excess of reduced iron, of which, if pure, 17 grains would suffice for combining with the iodine, filtration of the solution of ferrous iodide is rendered unnecessary; but owing to the heat produced by the reaction the iodine should be cautiously added in small quantities, to avoid loss by vaporization. Due precaution being exercised, the quantity of water directed in this part of the process may well be reduced to one-half or less, as has been done by the British Pharmacopœia, whereby subsequent evaporation may be avoided or materially lessened; if evaporation be necessary, the ferrous iodide is sufficiently protected by the excess of iron and by sugar, and without the presence of the other vegetable powders, which may be easily incorporated with the syrupy liquid. Owing to the gradual oxidation when exposed to the air, the pill mass should not be kept on hand, but should be at once made into pills. To protect these against the influence of the air, they are directed to be coated with a thin layer of Tolu balsam, or, according to the French Codex, with Tolu balsam and mastic, used in ethereal solution. The latter authority, whose process has, in the main, been adopted by the U. S. P., with several improvements, does not require an excess of iron to be incorporated with the pill mass, but directs the freshly-made pills to be rolled in finely-powdered iron, and afterward to be coated as stated, thus affording an additional protection to the surface of the pill.

If properly made and preserved, these pills will keep for years without acquiring the smell of iodine or tarnishing a strip of bright metal suspended in the vial. Should oxidation take place to the extent of liberating iodine, distilled water on being triturated with a few of the pills will yield a filtrate which, on the addition of gelatinized starch, will acquire a more or less distinct green tint, resulting from the brown-yellow color of the extractive matter and the blue color of iodide of starch.

Each pill contains very nearly 1 grain (0.063 Gm.), *U. S. P.*, or about ¾ grains (0.05 Gm.), *F. Cod.*, of ferrous iodide. 1 grain of the same compound is contained in 3½ grains of the pill mass.—*Br.*

Medical Action and Uses.—Each of these pills contains about a grain of iodide of iron and one-fifth of a grain of reduced iron, and may be used for the purposes to which iodide of iron in other forms is applied. They are reported to be useful in *anæmia* and the *scrofulous* or *tuberculous* diathesis, but the opinion is founded rather on hypothetical notions than upon clinical experience. In point of fact, glandular scrofula and pulmonary tuberculosis are neither identical nor closely allied, and while iodine and iron are both useful in the former, they are usually injurious in the latter, except when iron is demanded by the anæmic state of the system; but neither of them touches the root of the disease. *Dose*, from 3 to 8 grains (Gm. 0.20–0.40).

PILULÆ GALBANI COMPOSITÆ, *U. S.*—COMPOUND PILLS OF GALBANUM.

Pilula asafœtidæ composita, Br.; *Compound pill of asafetida*, E.; *Pilules de galbanum composées*, Fr.; *Galbanum-Pillen*, G.

Preparation.—Galbanum 150 grains (9.75 Gm.); Myrrh 150 grains (9.75 Gm.); Asafetida 50 grains (3.25 Gm.); Syrup a sufficient quantity; to make 100 pills. Beat them together so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use galbanum and myrrh, of each 18 grains (1.17 Gm.), asafetida 6 grains (0.39 Gm.).

Take of asafetida, galbanum, myrrh, each 2 ounces; treacle, by weight, 1 ounce. Heat all together by means of a water-bath, and stir the mass until it assumes a uniform consistence.—*Br.*

A similar pill was formerly officinal in France as *Pilules antihystériques.*

Medical Action and Uses.—The ingredients of this compound render it more or less stimulant to the mucous membrane, and especially appropiate in chronic *pulmonary catarrh* and *uterine leucorrhœa.* It is also used in functional nervous disorders, especially of an hysterical nature. *Dose*, from 5 to 20 grains (Gm. 0.30–1.30) or from 2 to 4 pills.

PILULA IPECACUANHÆ CUM SCILLA, *Br.*—PILL OF IPECACUANHA AND SQUILL.

Preparation.—Take of Compound Powder of Ipecacuanha 3 ounces; Squill, in powder, Ammoniacum, in powder, each 1 ounce; Treacle a sufficiency. Mix the powders, and beat into a mass with the treacle.—*Br.*

Medical Action and Uses.—The presumed effect of this pill is to mitigate *bronchitis* in its chronic, and especially its senile forms, by a combined sedative and stimulant action. There can be no question of its utility in many cases for which the balsams and terebinthinates are too stimulating. *Dose*, from 5 to 10 grains (Gm. 0.30–0.60).

PILULÆ OPII, *U. S.*—PILLS OF OPIUM.

Pilules d'opium, Fr.; *Opiumpillen*, G.

Preparation.—Powdered Opium 100 grains (6.50 Gm.); Soap, in fine powder, 25 grains (1.62 Gm.); to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use powdered opium 12 grains (0.78 Gm.) and soap 3 grains (0.195 Gm.).

Medical Action and Uses.—Very often opium in substance is more suitable than any of its liquid preparations or than the salts of morphine. This is especially the case when it is desirable to limit the action of the medicine, as far as possible, to the *stomach* and *bowels* in painful affections of those viscera, and in cases of *vomiting* and *purging*, such as occur in *cholera morbus*, *ulcer of the stomach*, *gastralgia*, *typhoid fever*, etc. In most of these diseases the efficiency of the medicine is increased by its slow solution, and hence in them an old opium pill is greatly preferable to a freshly-made one. One pill may be given for a dose, and repeated if necessary.

PILULÆ PHOSPHORI, *U. S., Br.*—PHOSPHORUS PILLS.

Pilules au phosphore, Pilules phosphorées, Fr.; *Phosphorpillen*, G.

Preparation.—Phosphorus 1 grain (0.06 Gm.); Althæa, in No. 60 powder, 80 grains (5.20 Gm.); Acacia, in fine powder, 20 grains (1.30 Gm.); Glycerin 40 grains (2.60 Gm.); Water 20 grains (1.30 Gm.); Purified Chloroform 50 grains (3.20 Gm.); Balsam of Tolu, Stronger Ether, each a sufficient quantity; to make 100 pills. Dissolve the phosphorus in the chloroform in a test-tube. Mix the althæa and the acacia in a mortar with the pestle, add the solution of phosphorus, then the glycerin and the water, and quickly form a mass, to be divided into 100 pills. Dissolve 1 part of balsam of Tolu in 1 part of stronger ether, shake the pills with a sufficient quantity of the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring until the drying is completed. Keep the pills in a well-stopped bottle.—*U. S.*

Take of phosphorus 3 grains; balsam of Tolu 120 grains; yellow wax 57 grains. Put the phosphorus and balsam of Tolu into a Wedgewood mortar about half full of hot water, and, when the phosphorus has melted and the balsam has become sufficiently soft, rub them together beneath the surface of the water until no particles of phosphorus are visible, the temperature of the water being maintained at or near to 140° F.; add now the wax, and as it softens mix it thoroughly with the other ingredients. Allow the mass to cool without being exposed to the air, and keep it immersed in cold water in a bottle. When dispensed, incorporate 2 grs. of the mass with curd soap 1 gr.; if necessary, soften with spirit.—*Br.*

Phosphorus requires to be kept under water and to be weighed out under a liquid in which it is not oxidized, either water or chloroform. By melting a small quantity of phosphorus under warm water contained in a vial, and then agitating it well until the phosphorus has solidified, this is obtained in small granules, which are conveniently handled, and after having been rapidly dried with filtering-paper are at once dropped into the previously tared liquid until the desired quantity has been obtained.

Tolu as a vehicle for phosphorus in pills was proposed by A. C. Abraham (1874), who observed that it will retain 4 per cent. of the latter if combined with it in the melted condition. A. W. Gerrard (1873) had previously made a similar observation with regard to rosin, and this preparation became known at the time as *phosphoretted resin*; it is prepared by melting the resin in a wide-mouthed vial, adding the requisite quantity of phosphorus, and when it has melted agitating the stoppered vial until the phosphorus is dissolved. Like resin, it may be powdered, and, like the pill mass of the British Pharmacopœia, it should be kept under water to prevent oxidation. W. H. Walling (1875) found cacao butter very serviceable; 300 grains of it are melted in a vial, 25 grains of phosphorus are added, the vial is corked and well agitated until solution has been effected, and afterward with 200 grains of powdered soap until a uniform mixture is obtained. E. Lilly (1876) suggested fusing 6 parts of phosphorus under 260 parts of syrup, agitating well to effect its fine division, and incorporating with 340 parts of flour; formulas similar to this one are often followed in Europe. W. B. Addington (1875) proposed to dissolve the phosphorus in sufficient bisulphide of carbon, and to incorporate the solution in a mortar with a suitable extract, continuing the trituration until the solvent has evaporated; the extract may be replaced by soap, resin, or other suitable material. This process has been adopted by the U. S. Pharmacopœia, which, however, uses the far preferable chloroform as a solvent, which, aside from its odor, has the advantage of not being inflammable, while its vapor prevents the oxidation of the phosphorus. (See PHOSPHORUS.)

Medical Action and Uses.—This is one of the forms in which phosphorus may be prescribed internally. *Dose*, from 3 to 6 grains (Gm. 0.20–0.40), or one or two pills.

PILULA PLUMBI CUM OPIO, *Br.*—PILL OF LEAD AND OPIUM.

Preparation.—Take of Acetate of Lead, in fine powder, 36 grains; Opium, in powder, 6 grains; Confection of Roses, 6 grains. Beat them into a uniform mass.—*Br.*

Medical Action and Uses.—2¼ grains of acetate of lead and ⅜ grain of opium are contained in every 3 grains of this mass. The association of the two medicines is of great benefit in chronic *diarrhœa*, *dysentery*, and *bronchitis*, but as the proportion in which they ought to be employed should vary in almost every case, a fixed formula for their union appears superfluous. *Dose*, from 3 to 5 grains (Gm. 0.20–0.30).

PILULA QUINIÆ.—Pill of Quinia.

Pilules de quinine, Fr.; *Chininpillen*, G.

Preparation.—Take of Sulphate of Quinia 60 grains; Confection of Hips 20 grains. Mix them to a uniform mass.—*Br.* 1867.

The quinine pills (U. S. P. 1870) contained 1 grain of the sulphate, and, like those of the French Codex, were made with clarified honey; the pills of the latter authority contain 1½ grains (0.10 Gm.) of the salt. The Pharmacopœia of 1880 has very properly dismissed the old formula. Since these pills are usually desired white, the mass is often made with simple syrup or glycerin, using at the same time a minute quantity of powdered acacia or tragacanth; or glycerite of starch is employed as an excipient. Sulphate of quinine may also be made into pills by the aid of aromatic sulphuric acid, of which 12 to 15 drops are required for 20 grains of the salt, as proposed by Parrish (1853). The mixture is at first quite soft, but soon becomes plastic, and may then be rapidly rolled out and divided; the previous addition of 1 or 2 drops of syrup will keep it soft for a short time. Other dilute acids, except acetic acid, may be substituted for the sulphuric acid, or, if solid, like citric and tartaric acids, may be incorporated with about five or ten times their weight of the salt in the dry state, and formed into a mass by the addition of a liquid.

Medical Action and Uses.—Pills of sulphate of quinine are not, generally, as efficient as liquid preparations of the salt, particularly if they have become hardened by age. The use of the disulphate obviates this objection partially, and the lenticular or compressed pills made with it are very efficient. These pills are better adapted for securing the tonic than the anti-periodic or febrifuge operation of quinine. They should be taken either immediately before or after a meal, especially when the stomach is irritable. The ordinary *dose* is one pill, containing 1 grain (Gm. 0.06) of the sulphate.

PILULÆ RHEI, *U. S.*—Pills of Rhubarb.

Pilules de rhubarbe, Fr.: *Rhabarberpillen*, G.

Preparation.—Rhubarb, in fine powder, 300 grains (19.50 Gm.); Soap, in fine powder, 100 grains (6.50 Gm.); to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use rhubarb 36 grains (2.34 Gm.), soap 12 grains (0.78 Gm.).

Soap is an excellent excipient for rhubarb and many other powders.

Medical Action and Uses.—One of these pills, containing 3 grains of rhubarb, acts as a mild laxative, especially when taken after a meal or at bedtime, unless the constipation be very decided. They are generally prescribed to relieve slowness of defecation rather than actual constipation. *Dose*, from one to three pills.

PILULÆ RHEI COMPOSITÆ, *U. S., Br.*—Compound Pills of Rhubarb.

Compound rhubarb pill, E.; *Pilules de rhubarbe composées*, Fr.; *Rhabarber und Aloepillen*, G.

Preparation.—Rhubarb, in No. 60 powder, 200 grains (13.00 Gm.), Purified Aloes, in fine powder, 150 grains (9.75 Gm.); Myrrh, in fine powder, 100 grains (6.50 Gm.); Oil of Peppermint 10 grains (.65 Gm.); to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use rhubarb 24 grains (1.56 Gm.); aloes 18 grains (1.17 Gm.); myrrh 12 grains (0.78 Gm.); oil of peppermint 1 grain (about 2 drops).

Take of rhubarb-root, in powder, 3 ounces; Socotrine aloes, in powder, 2¼ ounces; myrrh, in powder, hard soap, in powder, each 1½ ounces; oil of peppermint 1½ fluidrachms; glycerin 1 ounce; treacle about 3 ounces. Mix the powders with the oil, then add the glycerin and sufficient treacle, and beat the whole into a uniform mass.—*Br.*

Medical Action and Uses.—Compound pills of rhubarb are among the best medicines for the relief of habitual *costiveness* depending upon atony of the large intestine and flatulent dyspepsia. *Flatulence*, whether gastric or intestinal, is a serious hindrance to the proper movements of the muscular walls of the digestive canal, tending to hinder the progress of the alimentary or fecal mass and increase its fermentation, with the production of gas or of the acrid and irritating products of its decomposition. Such results are more or less prevented by the stimulating operation of medicines of which these pills are an example. *Dose*, from one to four pills.

PILULA SAPONIS COMPOSITA, *Br.*—COMPOUND PILL OF SOAP.

Pilula opii, Br. 1864.

Preparation.—Take of Opium, in powder, ½ ounce; Hard Soap, in powder, 2 ounces; Glycerin a sufficiency. Mix the opium and soap, and beat into a mass with the glycerin.—*Br.*

Compound soap pill (*U. S. P.* 1870) was identical with this, but was prepared with water in the place of glycerin.

Medical Action and Uses.—This preparation contains 1 grain of opium in 5 of the mass. Its merit is supposed to consist in its ready solubility in the gastric juices and in its being a convenient vehicle for prescribing opium under another name. *Dose*, from 3 to 5 grains (Gm. 0.20–0.30), or one or two pills.

PILULA SCAMMONII COMPOSITA, *Br.*—COMPOUND SCAMMONY PILL.

Piloles de scammonée composées, Fr.; *Scammoniumpillen*, G.

Preparation.—Take of Resin of Scammony, Resin of Jalap, Curd Soap, in powder, each 1 ounce; Strong Tincture of Ginger 1 fluidounce; Rectified Spirit 2 fluidounces. Add the spirit and tincture to the soap and resins, and dissolve with the aid of a gentle heat; then evaporate the spirit by the heat of a water-bath until the mass has acquired a suitable consistence for forming pills.—*Br.*

The process adopted furnishes a very good pill mass, in which the resins are uniformly divided through the agency of the soap, which also keeps them in suspension when the mass is macerated with water. A similar preparation, which does not contain scammony, has been in use for a long time in continental Europe. (See RESINA JALAPÆ.)

Medical Action and Uses.—In this preparation the compound powder of scammony assumes a pilular form. It may be prescribed when drastic purgation is required in *dropsy, congestion of the brain* or *liver*, etc. *Dose*, from 5 to 15 grains (Gm. 0.30–1).

PILULA SCILLÆ COMPOSITA, *Br.*—COMPOUND SQUILL PILL.

Pilules de scille composées, Fr.; *Meerzwiebelpillen*, G.

Preparation.—Take of Squill, in powder, 1¼ ounces; Ginger, in powder, Ammoniac, in powder, Hard Soap, in powder, each 1 ounce; Treacle, by weight, 2 ounces or a sufficiency. Mix the powders, add the treacle, and beat into a uniform mass.—*Br.*

Compound pills of squill (*U. S. P.* 1870) contained each squill ½ grain, ginger 1 grain, ammoniac 1 grain, and soap 1½ grains.

Medical Action and Uses.—The stimulant action of these pills upon the bronchial mucous membrane makes them appropriate in the treatment of *chronic bronchitis* when it is attended with excessive secretion. The ginger in the compound probably renders it less hurtful to the stomach than it would be without that ingredient. *Dose*, two pills two or three times a day.

PIMENTA, *U. S., Br.*—PIMENTO.

Semen amomi, Piper jamaicense.—Allspice, E.; *Piment de la Jamaique, Toute-épice.* Fr.; *Nelkenpfeffer, Englisches Gewürz, Neugewürz*, G.

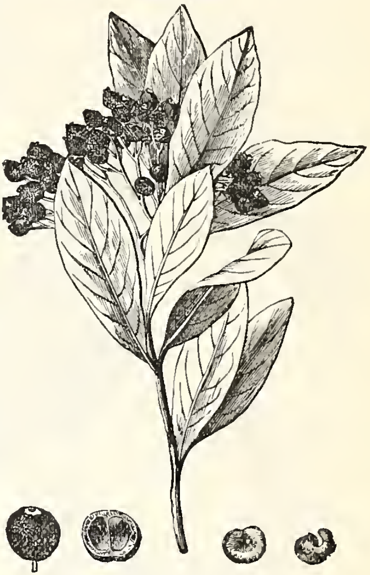
The nearly ripe fruit of Eugenia Pimenta, *De Candolle*, s. Myrtus Pimenta, *Linné*, s. Pimenta officinalis, *Lindley*, s. P. vulgaris, *Wight et Arnott.* Bentley and Trimen, *Med. Plants*, 111.

Nat. Ord.—Myrtaceæ.

Origin.—The allspice tree is indigenous to the West Indies, Central America, and the northern part of South America, and has been introduced into other tropical countries.

It is slender, 30 to 40 feet (9–12 M.) high, has opposite, entire, oblong or oval oblong, obtuse, and pellucid punctate leaves, and small white racemose flowers, the terminal ones being sessile and the lateral ones peduncled. The fruit is collected before it is ripe, but after it has attained its full size. 1,774,344 pounds of allspice were imported into the United States in 1881.

Fig. 220.



Pimenta officinalis, *Lindley.*

Description.—Allspice is nearly globular, ¼ inch (6 Mm.) or less in diameter, and crowned above with the short four-parted calyx limb, or marked by its remnants, which surround a shallow depression containing a short style. The pericarp is of a reddish-brown or brown-gray color, and a granular appearance externally, lighter internally, woody, but thin and fragile, and contains numerous oil-cells. The berry has two cells, each with a single brown, plano-convex, roundish-reniform seed enclosing the spirally-curved, dark purplish-brown embryo. Allspice has an agreeable pungently aromatic odor and taste, with a flavor resembling that of cloves.

Constituents.—The most important constituent is the volatile oil (see Oleum Pimentæ), of which the fruit yields 3 to 4 per cent. Bonastre (1826) examined the fruit deprived of the seeds, and the latter separately, and obtained from them 10 to 5 per cent., respectively, of volatile oil; they also contain resin, tannin, fixed oil, sugar, mucilage, etc.

Off. Prep.—Aqua pimentæ, Syrupus rhamni, *Br.*

Medical Action and Uses.—Pimento is an aromatic stimulant, and, like other agents of its class containing an essential oil, is used as a condiment to stimulate the digestive organs when they are suffering from exhaustion, and particularly from the debility caused by the prolonged heat of summer in tropical regions. In medical practice it is chiefly employed to relieve *flatulence*, to augment the effect of vegetable tonics, and to correct the tendency of purgatives to produce griping, or to cover the nauseous taste of certain medicines. It may be given in infusion, but the oil is more generally used. Like capsicum, pimento may be incorporated with Burgundy pitch or lead plaster to produce local stimulant, anodyne, and revulsive effects in *neuralgia* and *rheumatism*, or the extract itself may be spread upon cloth. Its application rapidly produces a sense of warmth in the part to which it is applied, followed by smarting and redness.

PIPER, *U. S.*—Black Pepper.

Piper nigrum, Br.—*Poivre noir (commun)*, Fr.; *Schwarzer Pfeffer*, G.

The unripe berries of Piper nigrum, *Linné.* Bentley and Trimen, *Med. Plants*, 245.

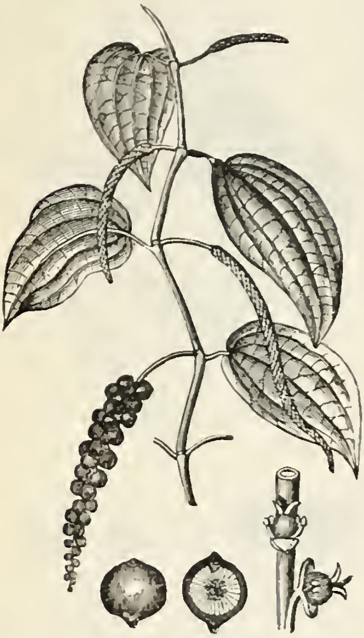
Nat. Ord.—Piperaceæ.

Origin.—Black pepper is a climbing shrub about 20 feet (6 M.) high, indigenous to India, and at present cultivated in most of the East Indian and Philippine and some of the West Indian islands. It has smooth, alternate, petiolate, ovate acute, and entire, five- or seven-nerved leaves, opposite to which elongated spikes of monœcious or diœcious flowers are produced, followed by sessile, berry-like fruits, which change from green to red, and finally yellow. The spikes are gathered as soon as some of the fruits begin to turn red; the next day the berries are rubbed off with the hands, and dried either near a fire or in the sun. About 9,000,000 pounds of black and white pepper and about 5000 pounds of ground pepper are annually imported into the United States; in 1883 the importation of the former was nearly 7,000,000 pounds.

Description.—Black pepper is globular, about ⅙ inch (4 Mm.) in diameter, reticulately wrinkled on the surface from the dried and contracted thin sarcocarp, blackish-brown or grayish-black externally, lighter colored internally, and encloses a single globular seed, which is whitish, mealy, and contains an undeveloped embryo in a central cavity. Pepper has a peculiar aromatic odor and a hot and pungent taste. Piper trioicum, *Roxburgh*, of India, yields a very similar fruit.

Constituents.—Black pepper was examined by Oersted (1819), who announced the discovery of *piperine*, and by Pelletier and Poutet (1820), who recognized the presence of volatile oil, acrid resin, starch, gum, etc. Willert (1817) ascribed the acrid taste to the soft resin, which conclusion was corroborated by Pelletier. According to Buchheim (1876), pepper contains a second alkaloid, *chavicine*, which may be obtained from the ethereal solution of the alcoholic extract by agitating it with potassa solution to remove chlorophyll, resin, and fat acids, and evaporating; fat is removed by treatment with benzin, and piperine is left behind by repeated solution in a little ether. Thus obtained, chavicine is yellowish-brown, of the consistence of turpentine, has a strongly acrid taste, and when in alcoholic solution, boiled with potassa, is said to yield *piperidine* (see below) and amorphous *chavicic acid*. Lecanu obtained 1.17 per cent. of volatile oil from black and 1.04 per cent. from white pepper. *Oil of pepper* is colorless, lighter than water, commences to boil at 167.5° C. (333.5° F.), and was found by Dumas (1835) to be isomeric with oil of turpentine. It has the odor of pepper, but is destitute of its pungent taste, and yields with dry hydrochloric acid gas a liquid compound.

FIG. 221.



Piper nigrum, *Linné.*

The *pungent resin* is dark-green, soluble in alcohol, ether, and alkalies, and, in connection with other constituents of pepper, also in water. Pepper yields about 5 per cent. of ash.

Adulterations.—Ground pepper is frequently adulterated with various farinaceous substances, the press-cake of flaxseed, capsicum, and other materials. The adulterations are best detected by the microscope. With the view of determining the presence of adulterations in ground pepper, A. W. Blyth (1874) examined black pepper from five different localities, with the following results: Loss by the heat of a water-bath (moisture and volatile oil), 9.531 to 12.908, mean 10.95 per cent.; ash (for dried pepper), total, 4.189 to 5.770, mean 4.845 per cent., and soluble in water, 2.212 to 3.453, mean 2.84 per cent.; alcoholic extract, dried, 6.30 to 7.836, mean 6.922 per cent.; hot-water extract, 16.50 to 20.375, mean 18.177 per cent.

Other Peppers.—Piper album, *White pepper*, consists of the ripe fruit of black pepper, which is immersed in water and with the hands deprived of the epicarp and sarcocarp. It consists of the seed, which is composed of a large white mealy perisperm united at the apex with a small endosperm, in which the embryo is enclosed, the whole being enclosed in the reddish-brown testa, and this is covered with the white, soft, inner tissue of the fruit, in which about ten light lines are observable running from the base toward the apex. White pepper is rather larger and less pungent than black pepper, but contains the same constituents. A factitious white pepper is said to have been sometimes put into the market, made from black pepper by rubbing off the outer layers; it is easily recognized by its smaller size and large central cavity. White pepper yielded to Blyth 7.650 per cent. of alcoholic extract, but only 1.120 per cent. of ash, one-half of which was soluble in water.

Piper longum, *Long pepper*, consists of the spikes of Piper (Chavica, *Miquel*) officinarum, *De Candolle*, which is indigenous to Java. The nearly-allied Piper longum, *Linné*, s. Chavica Roxburghii, *Miquel* (Bentley and Trimen, *Med. Plants*, 244), is likewise a shrub, but is found in India, Ceylon, and the Philippines. The spikes of the full-grown but still immature fruits are collected; they are 1 to 1½ inches (25–38 Mm.) long, nearly cylindrical, covered with the closely-packed, coalesced fruits, and agree with black pepper in odor, taste, and composition. In the amount of hygroscopic moisture and hot-water extract long pepper gives results agreeing with those mentioned above; but Blyth obtained 2.60 per cent. of alcoholic extract and 8.308 per cent. (4.472 soluble in water) of ash.

Piper (Macropiper, *Miquel*) methysticum, *Forster*. (See page 964.)

Piper reticulatum, *Linné*, has a pungently aromatic root, which is employed in Brazil for its stimulating properties.

Piper (Chavica, *Miquel*) betle, *Linné*. (See page 964.)

Piper (Chavica, *Miquel*) Siriboa, *Linné*, has leaves which are used like the preceding, and are of a similar appearance, but less distinctly heart-shaped.

Piper (Artanthe, *Miquel*) crocatum, *Ruiz et Pavon*. It is indigenous to Peru; the leaves and berries have a peppery taste; the ripe spikes are employed for dyeing yellow.

Piper anisatum, *Kunth*. It is found in the northern part of South America; the leaves and berries have an anise-like taste.

Off. Prep.—Confectio piperis, *Br.;* Oleores. piperis, *U. S.*, *Br.;* Pulv. opii comp. *Br.*

Medical Action and Uses.—Pepper is a powerful local and general stimulant, a quality which it owes to its concrete and volatile oils, and it also probably exerts a special and more sustained influence upon the nervous system through its peculiar principle, piperine. Applied to the skin, powdered pepper occasions severe pain and redness; in the mouth and throat in large quantities it excites intense burning, and in the stomach a sense of diffusive warmth with some acceleration of the pulse. In very large doses it excites a burning heat throughout the abdomen, thirst and vomiting, sometimes fever, and occasionally convulsions. In some cases heat and tingling are felt in the palms of the hands and in the soles of the feet, followed by a sense of coolness in these parts. It augments the urine and irritates the bladder and urethra, and it may produce a transient eruption of urticaria upon the skin.

Black pepper is, of all condiments except salt, the most extensively used to facilitate the digestion of soups and watery vegetables. Anciently, it was one of the most approved remedies for *intermittent fever*, and in modern times a large number of examples attest its efficacy, both in the form of the crude drug and as piperine. There can be no doubt that in many cases it has effected complete cures, but it is more generally employed in connection with quinine when the latter alone has failed, and often with advantage. Whether its efficiency is due to its own anti-periodic properties, or to its rendering the system more susceptible to the action of quinine, is undecided. Pepper is sometimes used in poultices to promote the resolution of enlarged *lymphatic glands;* in gargles to stimulate the *throat* and *gums* in flaccid conditions of these parts; and in plasters for the relief of *muscular rheumatism* and to assuage *headache*, *colic*, and other local pains. In powder it has been used to destroy *head lice.* Anciently, it was employed as a topical application to *hæmorrhoids*, and in recent times the confection of pepper has been given internally for a like purpose. In some cases of *fistula in ano*, of *gleet*, and of *leucorrhœa* it has been found very serviceable.

Powdered pepper may be given as a stomachic stimulant in *doses* of from 5 to 20 grains (Gm. 0.30–1.30), or as a condiment mixed with food. As an anti-periodic eight or ten pepper-corns may be taken two or three times a day.

PIPERINA, *U. S.*—PIPERINE.

Piperinum.—*Pipérine*, Fr.; *Piperin*, G.
Formula $C_{17}H_{19}NO_3$. Molecular weight 285.

Origin.—Piperine was discovered by Oerstedt (1819), and obtained pure by Pelletier and Poutet (1820). It has been prepared from black, white, and long pepper, and by Stenhouse (1855) from the fruit of Cubeba Clusii, *Miquel.*

Preparation.—It is most readily prepared from the alcoholic extract of white pepper by treating it with potassa solution, which dissolves the resin, washing the residue with water, and purifying it by repeated crystillization from alcohol. On neutralizing the potassa solution with an acid the pungent resin is obtained. Wittstein's process is as follows: 16 parts of black pepper are exhausted with cold water, and afterward with alcohol; the alcoholic extract is washed with water, digested with alcohol and 1 part of slaked lime, and the solution concentrated; the crystals are purified by recrystallization and treatment with animal charcoal. The yield varies between 5 and 9 per cent.

Properties.—Pure piperine crystallizes in colorless flat, four-sided prisms of a glassy lustre and almost tasteless. As usually met with, it is of a yellowish color, inodorous, and has at first a slight, but on continued mastication or in alcoholic solution a sharp, peppery taste. It remains unaltered on exposure, has a neutral reaction to test-paper, is nearly insoluble in water, and dissolves in volatile oils, in 60 parts of cold ether (Merck), in 30 parts of cold and in 1 part of boiling 80 per cent. alcohol (Wittstein), and freely in acetic acid; the last two solutions are precipitated on the addition of water. It is likewise soluble in chloroform, benzol, and benzin. At 129° C. (264.2° F.) it melts like wax to a yellowish oily liquid, which on cooling congeals to a mass of resinous appearance; when fused it may be ignited and burns with a bright flame, leaving a light charcoal, which is readily consumed by heating it in the air. Sulphuric acid colors it blood-red, the color disappearing on the addition of water, leaving the piperine unaltered if the action of the acid had not been prolonged (Pelletier). The solution of piperine in sulphuric acid is yellow, becoming dark-brown, and finally green-brown (Dragendorff). Nitric acid colors piperine successively greenish-yellow, orange, and red, and dissolves it with a yellow color, the solution separating yellow floccules on the addition of water; by prolonging the action of the acid oxalic acid and a yellow bitter compound are produced (Pelletier). The resin resulting from this reaction becomes blood-red on the addition of potassa, and on heating the mixture piperidine is given off (Anderson, 1850). Piperine is a very weak base, and its salts are decomposed by water; crystallizable double salts, soluble in alcohol, may be obtained with the chlorides of mercury, platinum, and cadmium. By dry distillation with soda-lime piperidine is obtained. Boiled with alcoholic solution of potassa, piperine was found by Babo and Keller (1856) to be resolved into *piperic acid*, $C_{12}H_{10}O_6$, and *piperidine*, $C_5H_{11}N$. Piperic acid is in hair-like yellowish needles which fuse at 150° C. (302° F.), and at a higher temperature volatilize partly unaltered, at the same time giving off a coumarin-like odor. Piperidine is a colorless liquid of an ammoniacal and pepper-like odor, and when largely diluted of a bitter taste. It boils at 106° C. (222.8° F.), has a strong alkaline reaction, dissolves freely in water and alcohol, and yields with acids crystallizable salts; the piperate of piperidine crystallizes in silky scales, which, on being heated, give off a part of the alkaloid. Ladenburg (1884) obtained a small quantity of piperidine synthetically by treating an alcoholic solution of pyridine with sodium.

Dose. Piperine may be given in *doses* of from 1 to 10 grains (Gm. 0.06–0.60).

PISCIDIA.—Piscidia.

Jamaica dogwood, E.; *Piscidie*, Fr., G.

The bark of the root of Piscidia Erythrina, *Jacquin.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a West Indian tree, about 20 feet (6 M.) high. It has imparipinnate leaves, with about seven ovate entire leaflets, and paniculate racemes of whitish and deep-red flowers, producing linear four-winged racemes. The wood of the trunk is heavy, brown, coarse-grained, and very durable.

Description.—Piscidia-bark comes in quills about ½ inch (12 Mm.) in diameter, or in flat or curved sections 1 or 2 inches (25 or 50 Mm.) broad, 4 or 6 inches (10 or 15 Cm.) long, and from $\frac{1}{12}$ to $\frac{1}{6}$, rarely ¼ inch (2 to 4 or 6 Mm.), thick. It is covered with a corky layer having a bright orange-brown, or occasionally a whitish, color, and a roughish wrinkled or somewhat fissured appearance. When the cork is detached the outer surface of the bark is of a dark ash-gray color, with a brown or blackish tint, and has slight wavy longitudinal wrinkles and thin transverse ridges. The inner surface is brownish and smooth, or from the bared bast-bundles more or less fibrous. In the interior the tissue is of a brownish-green or blue-green color, apparently due to chlorophyll contained in the parenchyma. The bark consists mainly of the liber, in which the transverly elongated bast-bundles are arranged in irregular circles separated by parenchyma, and in radial rows between the rather broad medullary rays. It breaks with a tough fibrous fracture, the bast-bundles adhering in bands. When broken, the bark has a narcotic odor, resembling that of opium; the taste is at first slight, afterward bitter and acrid.

Constituents.—The active principle, according to E. Hart (1883), is a neutral compound, *piscidin*, $C_{29}H_{24}O_8$, which may be obtained from the concentrated tincture by treating it with lime, filtering, adding a little water, and crystallizing; after recrystallization from alcohol it forms colorless prisms, which melt at 192° C. (377.6° F.), are insoluble in water, slightly soluble in ether and in cold alcohol, and easily soluble in benzol and chloroform. It is not a gluscoside. The other constituents have not been investigated. Resinous and oily compounds are present, and crystals of calcium oxalate are observed in the tissue.

Pharmaceutical Uses.—Extractum piscidiæ fluidum, Fluid extract of piscidia, may be prepared in the same manner as fluid extract of serpentaria, using a menstruum composed of 3 parts of alcohol and 1 part of water.

Medical Action and Uses.—The bark of *Piscidia erythrina* was first known in Europe as having been used in the West Indies to catch fish by benumbing them (Wibmer, *Wirkung d. Arzneimittel*, iv. 222). Many years ago (1844), in England, Dr. Hamilton took a drachm of the tincture of this bark while suffering from a severe toothache. It caused a burning sensation in the stomach and copious perspiration, followed by deep sleep. He also applied it with success to aching carious teeth (*Jour. Phil. Coll. Phar.*, v. 159). It appears to have been lost sight of until 1880, when it was stated to be a powerful anodyne, relaxing the system, producing salivation and sweating, and affording marked relief in neuralgia of the face (*Phila. Med. Times*, xi. 57). In 1881 the experiments of Dr. Isaac Ott led him to conclude that piscidia contains a narcotic principle which does not affect the motor nerves, but acts on the sensory ganglia of the spinal cord, producing convulsions, partly by stimulating the cord and partly by heightening the excitability of the muscles. He also found that it reduces the frequency of the pulse by a direct action upon the heart, first increasing and then diminishing the arterial tension, and that it first contracts and then dilates the pupils (*Medical News, etc.*, xxxix. 212). It has had the credit of curing or relieving *neuralgia* (*Louisville Med. News*, June 5, 1880), but sufficient proof of its virtues is wanting. It should be remembered that of all affections neuralgia is perhaps the one most frequently relieved—for the time—by faith. Seifert used an extract of piscidia which, when given in the dose of from 4 to 8 grains (Gm. 0.20–0.40) to relatively healthy persons, caused sound sleep, after which some lightness of the head was felt, as after a dose of morphine; but it did not affect the pulse or temperature. In two cases of phthisis in which morphine had ceased to allay the cough this medicine palliated it, and in others in which no morphine had been used it acted in a similar manner, but in one instance it occasioned sweats which were checked by atropine. In several other affections its utility was less evident (*Centralbl. f. d. ges. Therapie*, i. 427). In trials made by Berger the results were entirely negative (*Ibid.*, ii. 121).

PIX BURGUNDICA, *U. S., Br.*—Burgundy Pitch.

Poix de Bourgogne, *Poix blanche*, Fr.; *Burgunder Harz* (*Pech*), G.

The prepared resinous exudation from the spruce fir, Abies (Pinus, *Lamarck*, Picea, *Link*) excelsa, *De Candolle*, s. Pinus Abies, *Linné*, s. Pinus Picea, *Du Roi.* Woodv., *Med. Bot.*, pl. 208; Bentley and Trimen, *Med. Plants*, 261.

Nat. Ord.—Coniferæ.

Origin.—The *spruce fir*, or *Norway spruce fir*, is a stately tree attaining a height of 150 to 180 feet (50–60 M.), and growing in Northern Asia and Northern Europe, and in the latter continent southward in mountainous regions to the Pyrenees and Alps; it is frequently cultivated in the United States. It has spreading, nearly horizontal branches, pendulous branchlets, scattered, somewhat four-angled leaves, about ¾ inch (19 Mm.) long, and pendulous, light-brown, nearly cylindrical cones, which are from 6 to 7 inches (15–17 Cm.) in length. The Siberian variety, Picea (Pinus, *Antoine*) obovata, *Ledebour*, differs mainly in having smaller and more slender ovate cones.

Collection.—The oleoresinous exudation of the spruce fir, which flows from incisions, is collected in Finland, South-western Germany, Austria, and Switzerland, and is melted in water and strained; but the manufacture is on the decline, at least in Germany. That collected in some districts of the Bernese Jura is known in commerce as *poix blanche* (*Pharmacographia*). During the year 1881–82, 147,053 pounds, and in the following year 35,356 pounds, of Burgundy pitch entered the United States.

Description.—Burgundy pitch is thus described by the British Pharmacopœia: "Hard and brittle, yet gradually taking the form of the vessel in which it is kept; opaque, varying in color, but generally dull reddish-brown; of a peculiar, somewhat empyreumatic perfumed odor and aromatic taste, without bitterness; free from vesicles: gives off no water when heated." The following additional characters of true Burgundy pitch were ascertained by Hanbury (1867): "Fracture shining, conchoidal, translucent; some samples contain much water and are opaque and of a dull-gray color, and require straining to free them from impurities; not wholly soluble in alcohol of .838, but leaves a small amount of white flocculent matter; placed in contact with double its weight of glacial acetic acid in a vial, it is dissolved, with the exception of a small amount of flocculent matter." The description of the U. S. Pharmacopœia agrees with the above.

Constituents.—Burgundy pitch contains *volatile oil*, which is most likely isomeric with oil of turpentine, and *resin*, which probably consists mainly of Maly's *abietic acid.* (See Terebinthina.)

Adulterations and Substitutions.—The German Pharmacopœia has very properly dismissed Burgundy pitch; that of 1872 recognized the product of *various* species of Abies, which were not enumerated, under the designations *Resina pini*, *Resina pini burgundica*, and *Pix alba*, and gave the following description: "It is a yellow or yellowish-brown, opaque, or diaphanous, fragile resin, having a glossy fracture, becoming soft when held in the hand, of a terebinthinate odor, and almost completely soluble in alcohol."

The substance commonly sold in England is made by melting together colophony with palm oil or some other fat, water being stirred in to render the mixture opaque (*Phar-*

macographia). Hanbury described artificial Burgundy pitch as varying in color between tawny-yellow, orange-yellow, and orange-brown. The fracture is wax-like or shining or conchoidal, always opaque, but becoming gradually transparent on the surface by the loss of water; the odor is weak, terebinthinous, and hardly aromatic; it is less soluble in alcohol of .838, and with glacial acetic acid forms a turbid mixture which separates into two layers—a thick oily liquid above and a bright solution below.

Off. Prep.—Empl. ferri, *U. S.*, *Br.;* Empl. galbani. Empl. opii, *U. S.;* Empl. picis, *Br.;* Empl. picis burgundicæ, Empl. picis c. cantharide, *U. S.*

Medical Action and Uses.—Applied to the skin as a plaster, it produces itching, redness, and a papular eruption, and upon a delicate integument may occasion a vesicular, and even a pustular, eruption, with superficial ulcers. This eruption has been attributed to the retention by the impermeable plaster of the cutaneous secretions, but the better opinion is that it depends upon the inherent properties of the resin.

In the form of a plaster Burgundy pitch is in general use to protect, sustain, or stimulate the part to which it is applied. In most cases these several objects are attained together. Thus, in the popular use of it as a remedy for *lumbago* particularly, but of other forms also of *muscular rheumatism*, it supports the part mechanically, protects it from external impressions, and stimulates it to the production of perspiration, or even to the formation of an eruption, as already mentioned. In the latter way it acts revulsively upon the deeper-seated parts, and is habitually used to relieve internal congestions and diminish secretions, as in *chronic bronchitis* and chronic *pulmonary tuberculosis.* In chronic and in subacute *pleurisy* its counter-irritant action is resorted to for promoting absorption of the effusion. In these several affections it also, if applied in a plaster of proper dimensions, gives to the chest a greatly-needed mechanical support during the act of coughing. Some obstinate cases of *sciatica* have been cured by enveloping the buttock and thigh in a Burgundy pitch plaster, and leaving it permanently in place. In like manner, this plaster has been used to relieve chronic *diarrhœa* following dysentery, etc., but this cannot conveniently be done when the abdomen is prominent or flaccid.

Before applying a plaster of this sort to a hairy skin the hair should be shaved off, and in removing the plaster from such a part it should first be softened by passing lightly over its free surface a bottle of hot water or a warm flat-iron. The portion of pitch which still adheres may be partially removed by pressing upon it a linen or muslin rag, to which the adhesive material will cling rather than to the skin itself, and the remainder may be washed off with warm alcohol.

PIX CANADENSIS, *U. S.*—CANADA PITCH.

Hemlock pitch, E.; *Poix de Canada*, Fr.; *Canadisches Pech*, G.

The prepared resinous exudation from Abies (Pinus, *Linné*, Picea, *Link*, Tsuga, *Carrière*) canadensis, *Michaux*. Bentley and Trimen, *Med. Plants*, 264.

Nat. Ord.—Coniferæ.

Origin.—The *hemlock spruce* is a common forest tree of Canada and the Northern United States, but is more rare farther south, where it grows principally in the Alleghanies. It attains a height of 60 or 80 feet (18–24 M.), has horizontal branches, the young ones drooping; has flat, obtuse, somewhat denticulate, and on the lower surface glaucous, leaves, and elliptic-ovate cones about an inch (25 Mm.) in length. The wood is light, coarse-grained, and less valuable for boards than that of other pines. The bark is very astringent, and by treatment with water furnishes an extract rich in tannin, and is largely employed in tanning under the name of *extract of hemlock-bark.* By distilling the branches with water a volatile oil is obtained, which is sold as *oil of spruce* or *oil of hemlock;* 8 pounds of the boughs yield about 1 ounce of oil (Stearns, 1858).

Collection.—According to Stearns, there are two methods of collecting Canada pitch, one of which consists in cutting cup-like incisions into the living tree and removing the soft oleoresin as it exudes; the other and most common one is to remove the wood and bark around the knobs or knots of the felled trees, which are rich in resin; these being placed in water in a large kettle, the resin is boiled out, and rising upon the top is skimmed off, and further purified by remelting and straining.

Description.—Canada pitch is found in the market in opaque reddish-brown masses, which gradually become translucent on the surface. It is brittle at the ordinary temperature, but usually takes the form of the vessel in which it is kept; it is of a somewhat lighter color internally, breaks with a shallow conchoidal and glossy fracture, is softened by the heat of the hand, and has a weak somewhat terebinthinate odor.

Constituents.—It is composed of one or more resins and of a minute quantity of volatile oil, which have not yet been examined.

Adulteration.—Stearns states that Canada pitch is often adulterated by the collectors with common rosin to the extent of 70 per cent. Such an addition must render it harder and less fusible, but no test is known by which to determine the sophistication.

Off. Prep.—Emplast. picis canadensis, *U. S.*

Medical Action and Uses.—Canada pitch is almost identical with Burgundy pitch in its action and uses, but owing to its greater softness is less convenient for making plasters. Its volatile oil, known as oil of spruce and oil of hemlock, is said to have been employed to produce abortion. There is no reason for attributing to it a specific action on the uterine system.

PIX LIQUIDA, *U. S., Br., P. G.*—TAR.

Resina empyreumatica liquida.—*Goudron*, *Goudron végétal*, Fr.; *Theer*, G.

An empyreumatic oleoresin obtained by destructive distillation from the wood of Pinus palustris, *Miller*, and of other species of Pinus. Bentley and Trimen, *Med. Plants*, 258.

Nat. Ord.—Coniferæ.

Origin.—The principal species used for the production of tar are Pinus palustris, *Miller*, P. Tæda, *Linné*, P. rigida, *Miller*, which grow in North America, and P. sylvestris, *Linné*, and Larix sibirica, *Ledebour*, indigenous to Northern Europe. (See TEREBINTHINA.) Sufficient tar is produced in the United States to supply the domestic market and leave a portion for exportation. 60,393 barrels of tar and pitch were exported in 1882.

Preparation.—Pine wood which is unfit for use as timber is usually employed. It is cut into billets of suitable size, which are arranged into large conical stacks, or, as is sometimes the case in Europe, are closely packed in clay furnaces of a similar shape. The stacks or piles are covered with a layer of earth and ignited above, and the draft is regulated so as to sustain a slow combustion without flame. The tarry products, as they are formed, gradually descend and collect in a cavity or ditch at the base of the pile, from which they are transferred into barrels. The process is one of destructive distillation, in which, however, the pyroligneous acid and volatile oil of the wood are lost. These products may likewise be saved by the use of furnaces or stills, in which the distillation may be carried on in the same manner as in the stacks; but the charcoal obtained is said to be inferior to that made in the ordinary way. The tar obtained by slow combustion as described above is largely employed in the arts for various purposes, for some of which the tar resulting in the prepararion of pyroligneous acid cannot be substituted.

Description.—Tar is a thick, viscid, semi-fluid mass, heavier than water, of a deep blackish-brown color, transparent in thin layers if free from water, and has an unpleasant empyreumatic odor and a sharp and bitter taste. On standing, it usually separates a granular crystalline matter consisting of *pyrocatechin*, and often assumes the consistence of thick honey. It has an acid reaction, which, together with a light-brown color and sharp bitterish taste, is imparted to water agitated with it. On the application of heat, water and acetic acid distil over, together with a yellow volatile oil (see p. 19). Tar is soluble in alcohol, ether, chloroform, fixed and volatile oils, and caustic alkalies. The aqueous infusion of tar is colcred transiently green by ferric chloride, due to the presence of pyrocatechin, and with lime-water acquires permanently a brown-red color.

Constituents.—Tar is of a very complex composition, which varies with the kind of wood, the amount of resins present therein, and the care with which it has been prepared. It contains *acetic acid*, *acetone* (page 11), *methylic alcohol* (page 150), *mesit*, $C_6H_{12}O_2$, *tuluol*, C_7H_8, *xylol*, C_8H_{10}, *cumol*, C_9H_{12}, *methol*, C_9H_{12}; likewise phenol, C_6H_6O (see p. 39), cresol, C_7H_8O (see p. 42), creasote (see page 513), *paraffin*, naphthalin (page 1011), pyrene, $C_{16}H_{10}$, chrysene, $C_{18}H_{12}$, retene, $C_{18}H_{18}$, and others. Of the compounds mentioned, the first series up to methol pass over with the light tar oil, which also contains Reichenbach's *eupion*, a very light oily product of low boiling-point. The *heavy tar oil* contains the other compounds named, and in addition *cedriret*, *kapnomor*, *picamar*, and *pittakal*, which names were introduced by Reichenbach to designate various substances not yet obtained in a pure state. After distilling from tar the light and most of the heavy oil a substance is left behind which is still recognized in some pharmacopœias as

PIX NAVALIS, s. *Pix nigra*, s. *solida*, s. *Resina pini empyreumatica.*—Pitch, Black pitch, *E.;* Poix noire, *Fr.;* Schwarzes Pech, Schiffspech, *G.*—It is a black, resinous, brittle mass, which becomes soft when held in the hand, and has the odor of tar.

Allied Drug.—PIX BETULÆ, s. BETULINUM, Oleum betulæ empyreumaticum, Oleum rusci.—Birch tar, *E.;* Huile russe, Huile de bouleau, *Fr.;* Birkentheer, Birkenöl, *G.*—It is prepared in Russia from the wood and bark of Betula alba, *Linné*, and is also known in commerce under the name of *dagget* or *degutt*. It resembles wood-tar in appearance, but remains liquid and has a peculiar penetrating odor, like that of Russia leather, in the manufacture of which it is used. It was partly examined by Sobrero (1842), who obtained from it a yellowish volatile oil, $C_{10}H_{16}$, of an agreeable odor, like that of birch-bark, and boiling at 156° C. (312.8° F.). (See also page 317.)

Pharmaceutical Products.—SACCHARATED TAR, tar purified by dissolving in warm alcohol, straining, and evaporating, 4 parts, sugar 96 parts: mix (Roussin, 1871).

AQUA PICIS, s. PICEA, *P. G.;* INFUSUM PICIS LIQUIDÆ, *U. S.* 1870.—Tar-water, Infusion of tar, *E.;* Eau de goudron, *Fr.;* Theerwasser, *G.*—Mix well tar 1 part with powdered pumice-stone 3 parts, and agitate the mixture, which may be kept on hand, for 5 minutes with water 10 parts. Tar-water is to be made fresh when wanted.—*P. G.*

Prepared in this manner, the water is enabled to exert its solvent action upon all the constituents of tar. Magnesia is unsuited for dividing the tar, owing to the formation of soluble salts. Magnes-Lahens (1876) pulverized the tar by mixing it with twice its weight of inert sawdust; 27 Gm. of this mixture will give with 1 liter of water a saturated solution containing 6 Gm. of extract. The large quantity of resinous and oily principles present in tar interferes with the solvent action of water; hence an excess of tar must be used, the first infusion being strongly acid, and, according to the French Codex, is rejected. Lefort (1868) determined the amount taken up by hot water to be 2 Gm. to the liter.

GLYCERITUM PICIS LIQUIDÆ, *U. S.* 1870.—Glycerite (glycerol) of tar, *E.;* Glycérolé de goudron, *Fr.;* Theerglycerol, *G.*—Triturate tar 1 troyounce with magnesium carbonate 2 troyounces; afterward with portions of a mixture composed of glycerin 4 fluidounces, alcohol 2 fluidounces, and water 10 fluidounces; express the liquid, put the residue into a percolator, and displace first with the expressed liquid, and afterward with water, until 18 fluidounces of percolate are obtained. This is essentially the formula proposed by J. B. Moore in 1869. The glycerite is of a rich reddish-brown color, and perfectly transparent when recently prepared, but gradually deposits blackish resinous matter, which should be filtered off.

TINCTURA PICIS BETULÆ, TINCTURA RUSCI, Tincture of birch-tar. Dissolve birch-tar 1 part in alcohol 10 parts, and filter.

Off. Prep.—Syrupus picis liquidæ, *U. S.;* Unguentum picis liquidæ, *U. S.*, *Br.*

Physiological Action.—Tar is hostile to insects, and is used successfully for destroying the Acarus scabiei. Applied to the skin where it is delicate, it is apt to cause a sense of heat and irritation, and occasionally even vesication, with an erythematous redness. Internally and in small doses it acts as a general stimulant, although when freely given it tends to impair the appetite. In larger doses it occasions oppression, nausea, vomiting, colic, and diarrhœa, with frequency of the pulse. In excessive quantities, besides these effects it may give rise to headache, a sense of intoxication and general depression, with irritation of the kidneys, and the secretion of high-colored urine smelling strongly of tar and giving a deposit on the addition of nitric acid. This deposit is distinguished from albumen by its solubility in alcohol or ether. Cases are reported of fatal poisoning by tar. Tar-water in small doses is said to quicken the pulse and augment the secretion of the skin and kidneys. The vapor of tar, when inhaled, increases the normal bronchial secretion, but diminishes that which depends upon an atonic condition of the bronchia. Applied to the skin pure or in an ointment, and especially in the treatment of skin diseases, it is very apt to occasion nausea and vomiting or diarrhœa; the discharges from the stomach and bowels have the characteristic odor of tar, and the urine the peculiar color and smell caused by tar taken internally.

Medical Uses.—Anciently, tar was used as a dressing for wounds and sores and various cutaneous eruptions in man and beast, and was administered internally as a remedy for chronic pulmonary complaints. These are the affections in which even now it is principally used. Tar-water is prepared by stirring 1 part of tar with 10 parts of pure water, and allowing them to stand for several days, and then decanting the impregnated water. It has been used with the greatest advantage in *chronic bronchitis* and in many cases of pulmonary *phthisis*, lessening the expectoration, diminishing the oppression and pain in the chest, and soothing the cough, without increasing the thirst or impairing the digestion. But when hectic symptoms are prominent it is seldom tolerated. This is true even of the treatment of these diseases by the inhalation of tar vapors, which in the more torpid cases is sometimes remarkably beneficial. The best mode of using tar vapors is the following: In a cup placed in a small water-bath over a common night-lamp mix some tar with about a twenty-fourth part of its weight of carbonate of potassium, in order to neutralize the pyroligneous acid which may be present and which would irritate the lungs. The vapors should be extricated very slowly at first, so as moderately to charge with them the air of the chamber which the patient chiefly inhabits, and afterward they may be generated more freely. Quite as beneficial, and more convenient and agreeable, is the inhalation of tar-water, and even of wine of tar. from a steam atomizer.

Of other internal uses of tar may be mentioned that of tar pills for the relief of *constipation*, the use of tar-water by the mouth and by injection in chronic *vesical catarrh*, *gleet*, *leucorrhœa*, etc.

The ancient use of tar in the treatment of *scabies* is sometimes still resorted to, but it is less certain than other methods of curing it permanently, and it involves the ruin of the patient's body- and bed-linen. In *scaly eruptions* its efficacy is much more unequivocal, but the same objection to it exists as in the case of the disease just mentioned. Moreover, lepra and psoriasis generally get well under the use of arsenic alone. If this falls short of its purpose, tar may be employed in addition. For its efficient use it is necessary that the scales upon the skin should first be removed by a warm bath; after which the tar or its ointment should in small quantity be rubbed into the patches of the eruption with a brush, and the patient rolled in a blanket and allowed to remain quiet for five or six hours, when the excess of the application can be removed with cloths and the ordinary clothing resumed. In some cases of inveterate *eczema*, when the skin has become dry, rough, and thick, tar ointment or oil of tar is a most efficient remedy, provided that its strength be duly proportioned to the sensibility of the skin. It is also useful in *herpes circinatus* and in *prurigo*.

Tar has long been employed by the vulgar for *excoriations*, *boils*, *scorbutic sores*, and *unhealthy ulcers* generally. Of late it has been extensively used in the form of oakum as a dressing for such lesions, especially in hospitals. It seems especially adapted to burns which suppurate copiously. It corrects the fetor of such sores. The oakum is applied after being moistened with water, and is covered with an impermeable tissue. Tar and tar-water have been applied to *mercurial ulcers* of the mouth and throat, and the former is an excellent application to *fissured nipples* and *hæmorrhoids*. Finally, the fumes of tar are commonly used to deodorize and purify vessels, rooms, etc. tainted with *foul smells* or supposed to be infected with morbid poisons. They have also been employed advantageously in the treatment of senile *gangrene* (Post, *Trans. New York State Med. Soc.*, 1877, p. 246).

Tar may be given mixed with milk or beer, or else in pills. From 30 grains to ½ ounce (Gm. 2–16) may be taken daily. The glycerite of tar is a convenient form of the medicine. Tar-water may be taken to the extent of a pint or two daily.

PLANTAGO.—Plantain.

Rib-grass, *Ribwort*, *Ripple-grass*, E.; *Plantain*, Fr.; *Wegerich*, G.

Plantago lanceolata, Linné, and *Pl. major*, Linné.
Nat. Ord.—Plantaginaceæ.

Description.—These are acaulescent perennials, with short oblique rhizomes. The first-named species has lanceolate, obscurely toothed, more or less hairy and about five-ribbed leaves, and a deeply-furrowed scape bearing a dense ovate spike. The second species has broadly ovate or elliptic, somewhat toothed, about seven-ribbed, nearly smooth, petiolate leaves and a terete scape, bearing a cylindrical elongated spike. The flowers are small, have a dry membranaceous four-lobed corolla with four stamens, and produce small capsules containing two, or in the second species about ten, peltate brown seeds. The plants are indigenous to Europe, but now grow along roadsides and in fields in most temperate countries. They are inodorous and have a somewhat astringent, saline, and bitterish taste.

Constituents.—The analyses by Sprengel, Koller, Bley, and Schlesinger showed the presence of a bitter principle, albumen, sugar, resin, and various salts. Runge (1828) stated that, in common with various Umbelliferæ and Compositæ, they contain *viridinic acid*, which forms with ammonia a yellow compound turning green on exposure to air; it belongs doubtless to the tannins.

Allied Plants.—Plantago virginica, *Linné*, White plantain. It is common in sandy fields of the United States. The radical leaves are white-pubescent, obovate or spatulate, about 2 inches (5 Cm.) long; the short scape bears a dense cylindrical spike; the capsules are two-seeded. The plant agrees with the preceding ones in taste.

Plantago Psyllium, *Linné*. This annual plant is indigenous to the basin of the Mediterranean. The seeds are employed and are known as fleaseed, *E.*; graines de puces, *Fr.*; Flohsamen, *G.* They are about $\frac{1}{12}$ inch (2 Mm.) long, boat-shaped, dark red-brown, and glossy, upon the convex back with a lighter colored line, the hilum located in a broad groove upon the lower side. The seeds of Plantago arenaria, *Waldstein et Kitaibel*, are somewhat smaller, black and less glossy; those of Plantago Cynops, *Linné*, are somewhat larger and lighter brown. The epithelial layer of these seeds yields much mucilage; this is also obtained from

Spogel-seeds, known in India as *ispaghúl*. They are about $\frac{1}{8}$ inch (3 Mm.) long, pinkish-gray, and on the convex side marked with a brown-yellow spot. They are obtained from Plantago Ispaghula, *Roxburgh*, which is regarded as a cultivated variety of Pl. decumbens, *Forskal*, indigenous to Northern Africa. (See Bentley and Trimen, *Med. Plants*, 211.) The seeds of several other species are likewise mucilaginous.

History and Uses.—The several species of plantain appear to have enjoyed the undeserved reputation of being remedies for divers diseases, including malignant ulcers, defluxions and mortifications, hæmorrhages, intermittent fever, etc. They owe whatever virtues they possess to their bitter and astringent constituents. In Europe they are still used for the same purposes as of old, and their fresh leaves are applied to wounds and inflammations of the skin. Quite recently (1883) Prof. Quinlan, observing a cottager arresting hæmorrhage by the application of the chewed leaves of P. lanceolata, "satisfied himself as to the hæmostatic power of the plant when applied to bleeding surfaces either in the chewed form or in that of the dried leaves" (*Practitioner*, xxx. 49).

Psyllium (Plantago psyllium), *fleawort*, was anciently used in the treatment of ulcers, and was reckoned a cooling and astringent medicine. In Asia and in Southern Europe the mucilage derived from its seeds is used very much as the mucilages of quince, flaxseed, and slippery elm are applied to palliate external and also internal irritations. It has been employed with advantage to relieve habitual *constipation* by swallowing a tablespoonful of the seeds in half a tumbler of water before the principal meal. But it soon loses its original effect.

PLATINUM.—Platinum.

Platine, *Or blanc*, Fr.; *Platin*, G.

Symbol Pt. Atomicity bivalent and quadrivalent. Atomic weight 194.4.

Origin and Preparation.—This metal was apparently observed as early as the sixteenth century, but was more fully described and investigated after the middle of the eighteenth century by Watson, Scheffer, Lewis, Bergman, and others. It is found pure and in combination with palladium, rhodium, osmium, iridium, and other metals in California, in various parts of South America, in the Ural Mountains and other parts of Europe, and in Asia and Africa. It is often met with in auriferous sand, and occasionally in lead, iron, and other ores. The ore is treated with strong hydrochloric acid, well washed by elutriation, the residue treated with nitromuriatic acid, the acid solution evaporated, redissolved in water, and precipitated with ammonium chloride; on igniting the resulting ammonio-platinic chloride, platinum is obtained in a spongy condition.

Properties.—Spongy platinum is gray, soft, and porous, and fusible only by the aid of the oxyhydrogen blowpipe. The metal is of a silver-white color and metallic lustre, is soft like copper, possesses considerable malleability and ductility, and at a white heat may be forged. Platinum resists the action of most chemicals except mixtures of nitric with hydrochloric or hydrobromic acid, but at a high temperature it is readily attacked by most elements. With oxygen it forms a protoxide, PtO, and a binoxide, PtO_2, which are reduced to the metal at a red heat. The platinous salts are brown, red, or colorless; the platinic salts have a yellow or brown color. The following compounds have been used:

Platini chloridum.—Platinic chloride, *E.*; Perchlorure de platine, *Fr.*; Platinchlorid, *G.* $PtCl_4.5H_2O$; molecular weight 426.—It is prepared by dissolving 3 parts of platinum in a mixture of 16 parts of hydrochloric and 7 parts of nitric acid, evaporating the solution nearly to dryness, redissolving in hydrochloric acid, heating to expel the nitric acid, and evaporating at a moderate heat to dryness, when a red crystalline mass is left, which may be obtained from water in handsome red crystals containing 46 per cent. of platinum. When heated to 100° C. these lose $4H_2O = 16.9$ per cent., and turn brown. If the salt is permitted to crystallize in the presence of free hydrochloric acid, brownish-red needles are obtained which have the composition $PtCl_4.2HCl.6H_2O$, and contain 38 per cent. of platinum. This is the compound usually met with in commerce. Heated to above 110° C., it parts with hydrochloric acid and chlorine, and near 225° C. (437° F.) dark-brown platinous chloride is left. Platinum chloride dissolves readily in alcohol and water, yielding reddish-yellow liquids which precipitate the chlorides of potassium and of ammonium.

PLATINI ET SODII CHLORIDUM, Platino-chloride of sodium, Chloride of sodium and platinum. The double salt, $2NaCl.PtCl_4.6H_2O$, crystallizes in light-red prisms, and is freely soluble in water and alcohol. For medicinal purposes a preparation containing an excess of the sodium salt is used, made by dissolving 3 parts of platinic chloride and 5 parts of sodium chloride in water, and evaporating to dryness, stirring continually. It is an orange-yellow powder having a saline and metallic taste.

PLATINI IODIDUM, Platinic iodide, PtI_4. A solution of platinic chloride is mixed with a solution of an equivalent quantity of potassium iodide, the deep-red mixture nearly neutralized with potassium carbonate, and digested for an hour. The precipitate, after washing and drying, is a brown-black amorphous and tasteless powder, insoluble in water, but soluble in carbonate and iodide of potassium with a pale-red color.

PLATINI ET POTASSII CYANIDUM, Platino-cyanide of potassium, $2KCN.Pt(CN)_2.3H_2O$. It is best prepared, according to Meillet, by mixing rather concentrated solutions of 1 part exsiccated platinic chloride and 2 parts potassium cyanide, and heating the mixture until the precipitate is redissolved; carbonate of ammonium and nitrogen are given off, and on cooling the double salt crystallizes. It forms long needles and prisms, having in different positions a yellow or bright-blue color, and when exposed to the air become opaque and rose-red. The salt is freely soluble in hot water, and its solution precipitates cupric salts greenish-blue, mercurous nitrate bright-blue, and ferrous salts bluish-white.

Physiological Action and Medical Uses.—There is very little to be added to the statements that were made by Höfer in 1840 respecting the compounds of this metal. He found that its chlorides were as poisonous as the chlorides of gold and mercury—the perchloride in 1-grain doses, the chloroplatinate of sodium in the dose of 2 grains. The perchloride in strong solution irritates the skin and occasions a slight eruption upon it. Internally, in small doses, it irritates the stomach, causes headache, and gradually modifies the blood and the secretions. The chloroplatinate of sodium, on the other hand, is not a local irritant, and its internal action is not as distinct as that of the perchloride of platinum. According to Bryk, perchloride of platinum applied to the skin produces a thick, yellowish-white, dry eschar, surrounded by intense injection and even extravasation. Given to rabbits in the dose of 30 grains, it caused convulsions and death. The experiments of Kebler (1878) led him to conclude—1. That it deprives frogs of the power of voluntary motion by acting on the motor centres, but at the same time excites spasmodic movements resembling those made by volition. The irritability of the paralyzed muscles is sensibly diminished, but not lost until death. The heart-muscles are unaffected. 2. In mammals it produces vascular paralysis, whose cause is in an altered state of the peripheral extremities of the nerves. The vomiting, diarrhœa, sometimes with bloody stools, the hyperæmia of the abdominal organs, the ecchymoses of the stomach, intestines, and bladder, were regarded as effects of the same cause, and in part also the phenomena displayed by the central nervous organs. (Compare Hofmeister, "Ueber die physiologische Wirkung der Platinbasen," *Archiv f. exp. Pathol. u. Pharmakol.*, xvi. 393.)

According to Höfer, chloride of platinum is an efficient remedy for *syphilis*, and especially for its inveterate constitutional forms, and chloroplatinate of sodium is more suitable in the primary stages of the disease. The former has been described as analogous in its effects to the chlorides of gold and mercury. The *dose* of it is stated to be from $\frac{1}{8}$ to $\frac{1}{2}$ grain (Gm. 0.008–0.03) several times a day in mucilage or pill. A solution of 30 grains in 8 ounces (Gm. 2 in Gm. 250) of water has been used as an injection in *leucorrhœa* and *gleet*, and a liniment containing 2 grains to the ounce (Gm. 0.12 to Gm. 32) of olive oil or lard has been applied to indolent *ulcers*.

PLUMBI ACETAS, *U. S.*, *Br.*—ACETATE OF LEAD.

Plumbum aceticum, P. G.; *Acetas plumbicus*, *Saccharum saturni.*—*Sugar of lead*, E.; *Acétate de plomb*, (*Sucre*) *de saturne*, Fr.; *Essigsaures Bleioxyd*, *Bleizucker*, G.

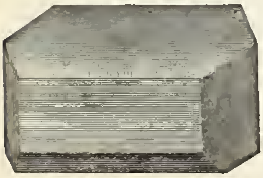
Formula $Pb\,(C_2H_3O_2)_2 3H_2O$. Molecular weight 378.5.

Preparation.—Take of Oxide of Lead, in fine powder, 24 ounces; Acetic Acid 2 pints or a sufficiency; Distilled Water 1 pint. Mix the acetic acid and the water, add the oxide of lead, and dissolve with the aid of a gentle heat. Filter, evaporate till a pellicle forms, and set aside to crystallize, first adding a little acetic acid should the fluid not have a distinctly acid reaction. Drain, and dry the crystals on filtering-paper without heat.—*Br.*

The process described is frequently followed on a large scale. Sometimes, however, metallic lead is dissolved in acetic acid, which requires to be done in the presence of air, since the metal is unable to displace the hydrogen of the acid. Plates of lead are placed endwise in open vessels containing acetic acid, one-half of their length projecting above the liquid, and as fast as the metal under these conditions is oxidized by the oxygen of the air, it is dissolved, so that the formation of the salt in both cases is the result of the action between plumbic oxide and acetic acid, water being formed at the same time; $PbO + 2C_2H_4O_2$ yields $Pb2C_2H_3O_2 + H_2O$. To obtain handsome and well-defined crystals the solution must have a very distinct acid reaction; if it is permitted to become neutral or faintly acid, a portion of the salt forms small granular crystals agglomerated into soft cauliflower-like masses, containing perhaps a basic lead compound.

For uses in the arts large quantities of impure acetate of lead are prepared from wood-vinegar, and vary in color from various shades of brown to pale-red and white.

FIG. 222.



Crystal of Lead Acetate.

Properties.—Pure acetate of lead crystallizes in colorless, glossy, transparent or translucent prisms, which are often tabular and have an acetous odor and a sweet astringent and metallic taste. It is slightly efflorescent in the air, and on continued exposure is superficially converted into carbonate of lead. It fuses at 75.5° C. (168° F.), and congeals on cooling slowly to a radiating crystalline mass. At 100° C. (212° F.) it rapidly loses water and a portion of the acid, and at a higher temperature is decomposed, giving off acetic acid and acetone. It contains 14.2 per cent. of water of crystallization, which it loses over sulphuric acid and by the action of absolute alcohol, crystallizing from this liquid in an anhydrous condition; but when dissolved in hot stronger alcohol the salt crystallizes on cooling with $2H_2O$. It dissolves at 15° C. (59° F.) in 1¾ parts, at 40° C. (104° F.) in 1 part, and at the boiling-point in ½ part of water. The solution has a slight acid reaction, and if concentrated and mixed with strong alcohol gradually separates a portion of the salt in crystals. It dissolves also in about 1 part of boiling and in 8 parts of cold alcohol, and is precipitated from this solution as a crystalline powder on the addition of ether. The aqueous solution acquires a red color on the addition of a little dilute solution of ferric chloride, and is precipitated by the various reagents for lead salt (see below). On heating the salt in the flame of the blowpipe upon charcoal, globules of metallic lead are obtained, surrounded by a reddish-yellow incrustation. The salt is decomposed by the mineral and many organic acids, acetic acid being liberated.

Tests.—Acetate of lead should yield a clear solution with distilled water. A slight turbidity resulting from the presence of a little carbonate must disappear on the addition of a small quantity of acetic acid. Perfect solubility indicates the absence of sulphate and notable quantities of chloride. The aqueous solution, completely precipitated by sulphuretted hydrogen, should yield a filtrate which is not precipitated by ammonia and sulphydrate of ammonium (zinc, etc.) or oxalic acid (calcium, barium), and it does not leave any fixed residue on being evaporated to dryness (alkalies). Small quantities of copper would be indicated by the blue color of the filtrate obtained after precipitating the solution of the salt with an excess of ammonia. Ferrocyanide of potassium should yield a white precipitate (absence of copper, iron, etc.), and on treating the salt with sulphuric acid in the presence of a crystal of ferrous sulphate a black color should not be produced (nitrate). "38 grains of acetate of lead dissolved in water require for complete precipitation 200 grain-measures of the volumetric solution of oxalic acid."—*Br.*

PLUMBUM ACETICUM CRUDUM, *P. G.* The solution of the salt in 3 parts of distilled water may be opalescent, but should yield a white (not a colored) precipitate with potassium ferrocyanide.

Off. Prep.—Liq. plumbi subacetatis, *U. S.*, *Br.*; Pilula plumbi c. opio, Suppos. plumbi comp., Unguent. plumbi acet., *Br.*

Physiological Action.—*On Animals:* Given to dogs in large but not immediately poisonous doses, acetate of lead occasions signs of pain, with vomiting and purging, and sooner or later death; after which the gastric mucous membrane is injected with venous blood and covered with thick mucus. If the dose has not been sufficient to prove fatal within a few days, paralysis occurs, of the hinder and then of the fore limbs, with embarrassed and spasmodic breathing, signs of extreme distress, and death by exhaustion. Injected into the veins, it destroys life, with signs of pulmonary congestion and feeble action of the heart, the right cavities of which, with the lungs, are after death found distended with blood. After such poisoning lead may be found in the portal blood, the liver, the spleen, the urine, etc., but most of all in the bones, according to some observers —in the spleen, according to others. In his experiments on the slow poisoning of rabbits and guinea-pigs Maier found fatty degeneration of the gastro-intestinal glands, dilatation of the arteries, venous congestion, proliferation of the submucous connective tissue, and sclerous degeneration of the submucous and mesenteric ganglionic apparatus. These lesions he associates with saturnine colic and the emaciation of the animals experimented upon (*Virchow's Arch.*, xc. 455). Popow directed his attention more particularly to the alterations produced by lead in the spinal marrow. He found that the earliest local changes consisted of congestion of the veins of the pia mater and scattered exudations of blood. The gray substance of the cord was also hyperæmic, and presented bloody extravasations. The nerve-cells of the gray substance were in all cases altered. This appeared to be uniformly the starting-point of the lesion even when the white substance was more or less involved. Hence, concludes Popow, the spasms, anæsthesia, etc. of lead-poisoning must all be referred to their primary origin in the spinal centres, and not to any lesion of the nerve-trunks (*Ibid.*, xciii. 362). Esculent plants nourished by water from lead-factories become poisonous, and animals that breathe the air of such places are apt to be affected with convulsions or paralysis. According to Rutherford, acetate of lead seems to be a direct hepatic depressant.

On Man: Locally applied, a solution of acetate of lead blanches and corrugates the skin; hence it is said to be astringent. It is shown to be a cardiac sedative by its power of reducing the pulse-rate. An overdose, besides causing a sense of constriction and sweetness in the mouth, soon excites pain in the abdomen, with vomiting and diarrhœa, which is sometimes bloody; the limbs tremble and are affected with slight spasms, or even convulsions. Sometimes there is a giddiness like that of intoxication. There may be fever, hurried respiration, and scanty urine. Recovery from acute lead-poisoning is the rule, however severe the primary symptoms may be. Doses of from 2 to 8 drachms of the acetate have been taken without injury, but sometimes also a protracted derangement of the digestion is induced, which ultimately proves fatal. One case is recorded in which a drunken man took 3 ounces of this salt, and, although not treated for 24 hours, recovered (Luck). A singular case of death by acetate of lead was that of a woman who while using this salt as a vaginal injection was seized with peritonitis, of which she died. A precipitate of sulphide of lead was found on the surface of the peritoneum (*Amer. Jour. of Med. Sci.*, Oct. 1880, p. 577).

The long-continued use of medicinal doses of acetate of lead produces a metallic taste in the mouth, tenderness and swelling of the gums, and often a bluish line where they are attached to the incisor teeth, slowness and feebleness of the pulse, colic, a sense of constriction of the trunk, and some numbness of the hands and feet. To these symptoms may be added fetid breath, loosening of the teeth, blackened feces, neuralgic pains in the legs first, and then in the arms. It may be remarked, however, that these effects must be very rare indeed, since hardly any of the physicians who prescribe the medicine habitually have witnessed them. The most common evidence of chronic lead-poisoning is a peculiar paralysis of the extensor muscles (not of the supinators) of the hands first, and subsequently of the legs. It has been produced by hair-dyes and face-powders, by lotions, ointments, plasters, etc., containing lead; in compositors by handling type; by the use of snuff, wine, cider, beer, water, flour, and even air, impregnated with lead particles, as in freshly-painted rooms; by the use of food put up in leaden coverings or cooked in leaden utensils, and by chewing tobacco kept in leaden wrappers. Among those who work in lead in its manufacture or in its use as a pigment, or who drink liquors impregnated with it, the most usual effect is the so-called painter's colic, which appears to be a neuralgia with spasmodic contraction of the intestines. The investigations of Friedländer into the nature of the lesions causing lead-paralysis led him to conclude that lead affects the structure of muscles as well as their function, causing wasting of the nuclei of their cells and an atrophy of their fibres. Next in order, and probably as an effect, a degeneration of the nerves of the muscles takes place. Hence a paralysis is produced which is essentially peripheral, and which leads to the rapid atrophy of the affected muscles. This opinion is opposed to that of Popow given above.

Besides the paralysis of the extensor muscles, which is apt to result in their atrophy and a corresponding rigid contraction of the opposing flexors, other nervous symptoms arise from the same poison, and delirium, convulsion, or coma gives characteristic features to the attack. The delirium varies from mere wandering of the mind to maniacal violence; the convulsive attacks are generally epileptiform. and coma may either follow convulsion or occur independently of it. After death the only apparent lesion may be hypertrophy of the brain.

In many cases of chronic lead-poisoning albuminuria has been observed, and lead detected in the bile and urine; in pregnancy the death of the fœtus and abortion are very apt to occur. Where paralysis has long continued the muscles and the nerves that supply them are atrophied, and sulphuret of lead has been extracted from the spinal cord after death.

Although such effects are occasionally traceable to the influence of the acetate of lead, they are in the great majority of instances due to the toxical influence of other compounds of the metal; and when the vehicle is drinking-water its effects are owing to the presence of oxide and carbonate of lead diffused in water which does not contain enough sulphuric acid, and possibly of some other substances, to precipitate them. Hence the purer the water conveyed through leaden pipes or contained in leaden cisterns, the greater is the risk of its contamination. It has been suggested that those who, while they use water impregnated with lead, partake of salt freely, are more liable than others to be poisoned, since the chloride of sodium favors the production of a soluble and therefore readily-absorbed salt of lead.

The conclusions of Harnack's experiments on the mode of action of lead salts are important enough to be introduced here: "1. Lead colic as a symptom of chronic lead-poisoning is due to an irritation of the intestinal ganglia by the lead, and the consecutive disorder of the intestinal functions. In man the usual obstinate constipation is owing to general spasm of the intestine, but in the lower animals, on the other hand, there are increased peristaltic action and diarrhœa. The spasm of the intestine expels the blood from its vessels, causing plethora in other organs, while arterial tension is observed and slowing of the pulse. The pain is caused by intestinal spasm, and in part also by the consequent irritation of the peritoneum. The retraction and rigidity of the abdomen result from a reflex contraction of the muscles of its walls. [The more palpable explanation is more probable—viz. that the shrinking of the bulk of the contents of the abdomen involves the sinking in of its movable walls.] 2. The symptoms of lead-paralysis are due to the action of lead on the striated muscles. The fact that in the beginning the muscles do not lose their excitability, but only are rapidly exhausted, makes intelligible why muscles paralyzed with lead are not tetanized by the induced current, but are still competent to manifest their reaction occasionally. 3. Neuralgia of the joints from lead is due to the irritation of certain motor nerve-centres by the metal. 4. Cerebral symptoms of chronic lead-poisoning are due to modifications produced by it in various parts of the central organs of the nervous system. They are mostly of an irritative nature, and do not usually involve until late the centres situated in the brain and medulla oblongata. Experiments upon animals throw no light upon the occurrence of anæsthesia, amaurosis, etc. from lead." The observations of Friedländer are fully in accord with these conclusions (*Virchow's Archiv*, lxxv. 24), as are those of Dejerine, and so is the report of a fatal case by Zunker (*Zeitschrift f. klin. Med.*, i. 496), who found a high degree of degenerative neuritis—greatest, however, at the periphery and diminishing toward the origin of the nerves—a marked degeneration and atrophy of the affected muscles, and an irregularly distributed atrophy of the gray substance of the cord. On the whole, he concludes that in lead-palsy the nerves and muscles alone are at first affected, and that only in course of time do lesions arise in the spinal cord and other organs. Among these lesions is degeneration of the arteries, causing in the eye amblyopia, in the kidneys chronic sclerotic nephritis, and in the joints arthritis, which in predisposed persons assumes the characters of gout. (Compare Duckworth, *St. Bart's Hosp. Reports*, xvii. 249.)

When a *poisonous dose* of acetate of lead has been taken, sulphate of magnesium in a large quantity of water, with the addition of ipecacuanha, should be given to neutralize the poison and favor its rejection by vomiting. Afterward the solution of sulphate of magnesium should be continued, as an antidote to whatever portion of the lead salt may have reached the intestine and to cause its expulsion by purgation. If pain exists, it should be palliated by opiates, especially by the hypodermic injection of morphia. The ordinary treatment of *lead colic* consists in the methodical use of opiates and evacuants—the former hypodermically, the latter in the form of a solution of sulphate of magnesium or of sodium with tartar emetic, while large purgative enemata are repeatedly administered and large and warm emollient cataplasms are applied to the abdomen. Instead of saline cathartics, croton oil may be used. The action of purgatives may be aided, or even superseded, by that of induced electricity, which has the advantage of relieving the pain at the same time. Alum, as elsewhere stated, is a most valuable remedy in this affection, and by some is held to be superior to purgatives.

In the more chronic forms of *lead-poisoning* the chief dependence must be placed upon iodide of potassium, which carries off the lead with the urine, and upon sulphurous baths, which remove it as it is eliminated from the skin, while means are taken to stimulate the paralyzed muscles by means of friction, massage, and, above all, by induced electricity. It is true that the use of the iodide of potassium as a means of eliminating lead from the system has been objected to on the ground that it must form an insoluble iodide of lead, and therefore only confirm the hold of the poison upon the tissues. Whether this must be the result of administering the remedy or not may be left to ingenious scientists to determine for their own satisfaction, while physicians continue to cure their patients by means which time as well as reason has approved. Meanwhile, it should be observed that under the use of the iodide of potassium in cases of lead-paralysis, lead is actually found in the urine (*Monthly Abst.*, Feb. 1881, p. 122; *Edinb. Med. Jour.*, xxviii. 651). A possible source of error in testing urine for lead by means of iodide of potassium is the fact that if the patient is taking bismuth a yellow iodide of that metal will be formed, identical in appearance with the iodide of lead (Putnam, *Boston Med. and Surg. Jour.*, Oct. 1883, p. 815). As a stimulant to the spinal centres of muscular motion strychnia is of extreme utility. The cerebral affections produced by lead are but little under the control of any medicine except opium, which is of great value in subduing delirium in the maniacal form.

Medical Uses.—*Internally:* Among internal *styptics* which act after absorption into the blood none is so general in its application or certain in its effects as acetate of lead. It is said to be more efficient in active than in passive hæmorrhages, but the rule, if it be one, is not absolute. It has repeatedly and unequivocally displayed its virtues in *hæmoptysis*, not so distinctly in *uterine hæmorrhage* connected with menstruation and with parturition, and still less conspicuously, though decidedly, in hæmorrhage from the *stomach*, *bowels*, and *kidneys;* in all of which cases ergot, the chlorides of iron, creasote and its congeners, excel it.

The sedative action of acetate of lead upon the heart, and its power of promoting coagulation of the blood, are thought to be illustrated by cures of sacculated *aneurism* alleged to have taken place under its use; and, although the evidence may not be conclusive, it is strong enough to inspire a certain degree of confidence in this plan of treatment. The same may be said of *hypertrophy of the heart.* But in the latter case the utility of the medicine is less demonstrable and more improbable.

In chronic *dysentery* and *diarrhœa* acetate of lead is one of the most valuable medicines of its class when given by the mouth and also by the rectum; and the same is true of its use in the decline of the acute form of the first-named disease. While the febrile symptoms continue it should seldom be employed. It is best administered in doses of 1 or 2 grains (Gm. 0.06–0.12) three or four times a day, associated with a grain or less of opium or 2 or 3 grains of Dover's powder. In some cases of *tympanites* due to indigestion, and of the same condition during *typhoid fever*, it has afforded relief.

The astringency it manifests in the diseases already named has been further shown in pulmonary affections with excessive secretion. It has long been in common use for diminishing the sputa in *tubercular phthisis* and *chronic bronchitis*, as well as for checking *sweats* in both diseases. In *whooping cough* with profuse bronchial secretion it has also been used. It has been recommended as the safest and best remedial agent in *pneumonia*, and particularly as superior to digitalis, tartar emetic, and veratrum; which may very well be, since these medicines are worse than useless in the disease.

In various nervous diseases, including *epilepsy*, *neuralgia*, *chorea*, and *hysteria*, it has been alleged to be curative; but this statement is without substantial foundation, except in regard to epilepsy, but that disease has seldom been treated by acetate of lead.

Externally: Acetate of lead has been less frequently employed than the subacetate as an astringent of external parts, yet it may be applied with advantage in lotions to *contusions*, *excoriations*, *sprains*, *fractures*, etc. It is more conveniently employed in collyria for *conjunctivitis*, both acute and chronic, and as an injection into the urethra in *gonorrhœa* and into the vagina in *leucorrhœa*. In chronic granular *conjunctivitis* finely-powdered acetate of lead has been applied to the mucous surface of the eyelids. A preparation which is in reality a solution of subacetate of lead has been made with acetate of lead 5 parts, litharge 3½ parts, glycerin 20 parts. These ingredients, on being exposed to a temperature of 350° F. for some time and filtered through a hot-water funnel, furnish a clear viscid glycerole containing 120 grains of subacetate of lead to the ounce. When used, it can be diluted with glycerin. It is stated to be peculiarly applicable to the treatment of certain forms of *chronic eczema*, especially of the lower extremities. It appears to be most useful when the affection is extensive, of a dusky hue, accompanied by much weeping, oozing, and infiltration of the skin, together with swelling of the subcutaneous tissue and a full and varicose condition of the veins. Its diligent application should be followed by careful bandaging (Duhring and Van Harlingen).

Administration.—As a styptic the *dose* of acetate of lead should be not less than 2 grains (Gm. 0.12) every hour, and generally associated with opium. As much as 5 grains (Gm. 0.30) every hour has been used successfully, and without damage, in certain cases of hæmorrhage. In diarrhœal and dysenteric affections 1 grain, with ½ grain of opium (Gm. 0.06 with Gm. 0.03), three or four times a day, is the average dose; and for colliquative sweats 2 grains (Gm. 0.12) several hours before the usual time of appearance of the symptom.

PLUMBI CARBONAS, *U. S., Br.*—CARBONATE OF LEAD.

Cerussa, P. G.; *Plumbum carbonicum, s. hydrico-carbonicum, Carbonas plumbicus.*—*White lead*, E.; *Carbonate de plomb, Blanc de plomb, Céruse*, Fr.; *Bleiweiss, Bleicarbonat*, G.

Formula $2PbCO_3.PbH_2O_2 = Pb_3(CO_3)_2(OH)_2$. Molecular weight 773.75.

Preparation.—On passing carbonic acid gas through a solution of acetate of lead, or on adding an alkaline carbonate to a solution of a neutral lead salt, a precipitate of $PbCO_3$ is obtained, which, as a pigment, has less *body* than the basic salt. The latter is obtained in two ways. One method, known as the *Dutch process*, is as follows: Cast sheets of lead are suspended in earthen pots containing a small quantity of vinegar or pyroligneous acid; a number of these pots are arranged in rows, alternating with layers of dung or spent tan, until a shed is filled, which is entirely covered with the same material. A warm and moist atmosphere, charged with carbonic acid, is thus produced in the shed, favorable for the oxidation of the metal and its conversion by the acetic vapors into basic acetate of lead, which is decomposed by the carbonic acid, yielding white lead and neutral acetate. The latter again unites with a fresh portion of oxide, forming basic acetate of lead, which is again acted upon by the carbonic acid; and the process continues until, in the course of a few weeks, the lead is completely covered with a thick crust of white lead, which is detached, ground with water, and washed to remove acetate of lead, and dried. Various modifications of this process have been recommended and are in use, the most important one being that largely used in Austria, where the sheet lead is suspended in wooden boxes, vapors of acetic acid, moisture, and carbonic acid gas being supplied in various ways; a number of such boxes are placed in a suitable room, where the temperature is slowly raised from about 25° to 50° C. (77° to 132° F.), until, after several weeks, the conversion is completed.

The other method is known as *Thénard's process*, according to which a solution of subacetate of lead is prepared in the usual way, and carbonic acid gas passed through it, the filtrate from the precipitate being again used in the preparation of the lead solution. This process has been modified by Benson, so that levigated litharge is mixed with 1 or 2 per cent. of sugar of lead and sufficient water to form a thin paste, which, with frequent stirring, is exposed to the action of carbonic acid until this ceases to be absorbed; the carbonate is washed with water.

Properties.—Commercial carbonate of lead is in pulverulent masses or forms a non-gritty, heavy, white powder, which is not altered on exposure to air unless sulphuretted hydrogen be present, when it turns black. It is inodorous, and at first tasteless, but gradually develops a slight sweetish and metallic taste. It is insoluble in water and alcohol, but dissolves with effervescence in diluted acetic or nitric acid. The solutions yield with sulphuric acid a white, and with potassium iodide a yellow, precipitate. The white precipitates occasioned in the solution by soda and potassa are soluble in an excess of the precipitant. Heated to 155° C. (311° F.), carbonate of lead parts with its water; near 180° C. (356° F.) it begins to lose carbonic acid and turns yellow, and when heated before the blowpipe upon charcoal it yields metallic globules of lead, surrounded by a reddish-yellow incrustation.

Tests.—Carbonate of lead may be adulterated with the sulphates of lead, barium, or calcium, which would be left behind as a white residue upon treatment with dilute nitric acid; only a trifling residue should be left. On adding to this solution an excess of caustic soda, the white precipitate at first formed should be completely dissolved (calcium salt), and this alkaline solution should not be rendered permanently turbid on the addition of 1 drop of diluted sulphuric acid (barium carbonate); but on precipitating the solution completely with sulphuric acid the filtrate should be colorless, and should not be precipitated or colored by potassium ferrocyanide (zinc, etc.) or by an excess of ammonia (copper, alumina, *P. G.*). The solution in diluted nitric acid, on being completely precipitated by sulphuretted hydrogen, should yield a filtrate which is not rendered turbid by sulphuric acid (barium and calcium carbonate), nor "on evaporation leave more than a trifling residue (zinc, earths, alkalies)."—*U. S.* On heating lead carbonate to redness it should not be charred (organic matters), and should leave at least 85 per cent. of oxide of lead.

Composition.—White lead is an oxycarbonate, and has the formula given above, in which case it will leave a residue of 86.2 per cent. upon being heated to redness. But the composition may vary from the presence of other oxycarbonates, and the residue left on ignition has been found as low as 83.7 and as high as 86.7 per cent.

Pharmaceutical Uses.—White lead is used in preparing Liq. gutta-perchæ, *U. S.*, *Br.*, and is an ingredient in some plasters and in Ung. plumbi carbonatis, *U. S.*, *Br.*

Medical Action and Uses.—This preparation is only used externally in the form of a powder to protect irritated surfaces, as in *erythema*, *erysipelas*, *intertrigo*, etc., and to produce constriction of the congested skin. It should never be applied where the cuticle is broken, as it is one of the most poisonous of the salts of lead. It enters into an officinal ointment, and it is sometimes used in the form of white paint, mixed with linseed oil, as an application to superficial *burns* and *scalds*, but care should be taken to apply it only to the unbroken skin.

PLUMBI IODIDUM, *U. S.*, *Br.*—IODIDE OF LEAD.

Plumbum iodatum, P. G.; *Ioduretum plumbicum.*—*Iodure de plomb*, Fr.; *Jodblei*, G.
Formula PbI_2. Molecular weight 459.7.

Preparation.—Take of Nitrate of Lead, Iodide of Potassium, each 4 ounces; Distilled Water a sufficiency. Dissolve the nitrate of lead, by the aid of heat, in 1½ pints and the iodide of potassium in ½ pint of the water, and mix the solutions. Collect the precipitate on a filter, wash it with distilled water, and dry it at a gentle heat.—*Br.*

The reaction between the two salts results in the production of nitrate of potassium, which remains in solution, and iodide of lead, which precipitates; $Pb2NO_3 + 2KI$ yields $2KNO_3 + PbI_2$. The quantities ordered by the Pharmacopœia are almost exactly in equivalent proportions, and the yield is 5½ ounces. Boudet (1847) ascertained that acetate of lead cannot be advantageously used in the preparation of the iodide, inasmuch as double iodide of lead and potassium is invariably produced, and remains dissolved in the newly-formed potassium acetate. The nitrate does not exert any similar influence; hence nearly the whole theoretical quantity of lead iodide is obtained by the officinal process.

Properties.—Iodide of lead, if precipitated in the cold, is a bright-yellow powder, and if obtained from boiling solutions crystallizes in thin, shining, golden-yellow scales. It has the spec. grav. 6.1, is inodorous, of a slight metallic taste, and when heated turns brick-red, blackish-brown, and, if air be excluded, fuses to a red-brown liquid, and volatilizes, partly undecomposed, at a strong red heat; on cooling it gradually acquires again its yellow color. When heated in contact with air it melts, iodine is given off, and oxyiodide of lead remains behind, having an orange-yellow or amber-yellow color. It is permanent in a dry atmosphere, but when exposed to the light while moist is slowly decomposed, binoxide and carbonate of lead being formed, besides free iodine. Denot (1834) ascertained that it requires 1235 parts of cold and 187 parts of boiling water for solution. According to Lassaigne (1831), the aqueous solution, saturated at 20° C. (68° F.), contains .17 per cent. (1 in 590), and at 100° C. .39 per cent. (1 in 200), of iodide of lead. The U. S. and German Pharmacopœias give its solubility in cold water (of 15° C.) as being 1 in about 2000 parts. These solutions are colorless and neutral to test-paper. The salt dissolves more readily in solutions of ammonium chloride and of soluble iodides and alkali acetates, and is at least partly converted into double iodides. Alcohol dissolves very little of the salt, and, according to Vogel, boiling ether decomposes it, dissolving iodine and leaving pale-yellow oxyiodide.

Tests.—Its purity is ascertained from the properties described. The presence of a double compound with potassium iodide is indicated by the lighter color of the product, and is proven by dissolving a sample in warm solution of ammonium chloride, which leaves lead chromate undissolved, precipitating the lead with either sulphuric or hydrosulphuric acid, evaporating the filtrate to dryness, and igniting, when no fixed residue should be left. The presence of lead oxyiodide or chromate renders the salt incompletely soluble in hot water. The last-named compound dissolves in caustic potassa or soda with a yellow color, while the solution of lead iodide in the same reagents is colorless. On triturating 1 part of lead iodide with 2 parts of ammonium chloride, and adding 2 parts of cold water, the mixture should soon acquire a white color, and when heated should form a colorless solution without leaving any residue (lead chromate).

Off. Prep.—Emplast. plumbi iodidi, *Br.*; Unguent. plumbi iodidi, *U. S.*, *Br.*

Medical Action and Uses.—Iodide of lead is generally used as an external application in the form of an ointment, which is officinal. It has, however, been given internally, with alleged advantage, to diminish malarial enlargement of the *spleen*, in the *dose* of $\frac{1}{5}$ grain (Gm. 0.013) twice a day in pilular form, and gradually increased.

PLUMBI NITRAS, *U. S.*, *Br.*—NITRATE OF LEAD.

Plumbum nitricum, *Nitras* (*Azotas*) *plumbicus*.—*Azotate* (*Nitrate*) *de plomb*, Fr.; *Salpetersaures Bleioxyd*, *Bleisalpeter*, G.

Formula $Pb(NO_3)_2$. Molecular weight 330.5.

Preparation.—Metallic lead dissolves slowly in warm dilute nitric acid, but litharge or carbonate of lead is readily taken up by the acid, the latter with effervescence of carbonic acid gas. A solution of nitrate of lead is also obtained in the preparation of binoxide of lead from the red oxide by digesting it with dilute nitric acid. If prepared from litharge containing copper, the resulting copper nitrate remains at first in the mother-liquor, but will contaminate the last crops of crystals, necessitating washing with water and recrystallization.

Properties.—Nitrate of lead crystallizes on slow evaporation in colorless transparent octahedrons. When obtained by the cooling of hot solutions the crystals are white and translucent or opaque. It has the specific gravity 4.4, is not altered by exposure, and when heated decrepitates, fuses, and gives off oxygen and nitrous vapors, leaving finally oxide of lead. Kremers (1854) ascertained that 1 part of the salt requires at 10° C. (50° F.) 2.07, at 25° C. (77° F.) 1.65, at 45° C. (113° F.) 1.25, and at the boiling temperature 0.72, parts of water for solution. It is likewise soluble, though less freely, in weak alcoholic liquids, but is nearly insoluble in strong alcohol and in nitric acid. The salt is inodorous, possesses a sweetish astringent and somewhat metallic taste, and deflagrates slightly on being triturated with sulphur or thrown upon red-hot charcoal. Its solution has the reactions of soluble lead salts and of nitrates, contains 62.5 per cent. of lead, and is free from water of crystallization.

Tests.—The aqueous solution, on being completely precipitated by hydrosulphuric acid, should yield a filtrate which on evaporation leaves no fixed residue (zinc, earths, and alkalies). The solution should not be rendered turbid by silver nitrate (chloride), and after having been completely precipitated by sodium sulphate should yield a filtrate which is not colored red by potassium sulphocyanide (iron) nor blue by an excess of ammonia (copper), nor should this ammoniacal liquid be precipitated by ammonium sulphydrate or ammonium phosphate (zinc, magnesia).

Pharmaceutical Uses.—In the preparation of Plumbi iodidum.

Other Lead Salts.—PLUMBI CHLORIDUM, *Chloride of lead*, $PbCl_2$ (mol. weight 277.3), is obtained by precipitating a solution of lead salt with hydrochloric acid or chloride of sodium. It is a white crystalline powder, which fuses when heated, and congeals to a horn-like mass (*Plumbum corneum*). It is soluble in 105 parts of water, sparingly soluble in dilute hydrochloric acid, and more freely so in the same acid when concentrated. It dissolves also in alkaline acetates and hyposulphites.

PLUMBI TANNAS, *Tannate of lead*, is prepared by dropping a solution of tannin into a solution of acetate of lead, washing and drying the precipitate. It is at first nearly white, but turns gradually brown.

UNGUENTUM PLUMBI TANNICI, PLUMBUM TANNICUM PULTIFORME, s. CATAPLASMA AD DECUBITUM, *P. G.*, is made by triturating tannin 1 part with solution of subacetate of lead 2 parts, and incorporating the mixture with 17 parts of lard. It is prepared extemporaneously.

Medical Action and Uses.—A solution of nitrate of lead (gr. x to ℥j) may be employed as a discutient for bruises and local inflammations, but it is much more useful as a deodorizing agent to correct the fetor arising from *gangrenous sores* and *offensive discharges* from the nostrils, ears, vagina, and rectum. It is a very efficient remedy for non-constitutional *ozæna* and a palliative of the syphilitic form. It is best applied by means of the nasal douche, in a solution containing from 2 to 5 grains to the ounce of water (Gm. 0.12–0.30 in Gm. 32). As a cicatrizing astringent it is very useful in the treatment of *sore nipples* when dissolved in glycerin or brandy in the proportion of 10 grains to the ounce (Gm. 0.60 to Gm. 32). It should be applied after suckling, and the child should not be allowed to take the breast again until the nipple has been thoroughly washed. If the ulcer or fissure is deep, a stronger solution than the above may be required. Powdered nitrate of lead appears to be an efficient application to the sanious fungous ulcers resulting from *onychia*. After the first dressing, it is said, the pain ceases, the swelling decreases, suppuration is lessened, and the fetid odor is destroyed. As the application is painful, it is recommended that the ulcer be first washed with a strong solution of sulphate of morphia. This lead salt is also stated to have cured several cases of *epithelioma* when its powder was dusted over the affected part several times. *Chloride of lead* has been used externally in an ointment with a view of allaying pain and repressing morbid growth, very much as the ointment of carbonate (or the cerate of subacetate) of lead has been employed. *Tannate of lead* has been similarly applied in ointments and liniments and in the *Cataplasma ad decubitum* above described.

PLUMBI OXIDUM, *U. S., Br.*—OXIDE OF LEAD.

Lithargyrum, *Plumbum oxydatum*, P. G.—*Litharge*, E.; *Protoxide de plomb*, Fr.; *Bleioxyd*, *Bleiglätte*, G.

Formula PbO. Molecular weight 222.5.

Preparation.—Oxide of lead is prepared by combining metallic lead with oxygen derived from the air. If heated to near a white heat, lead begins to volatilize, and in contact with the air burns with a bright white flame to oxide, which was formerly known as *flowers of lead*. When merely heated to fusion the metal oxidizes, forming a yellow amorphous powder known as *massicot*, but at a higher temperature the oxide melts and congeals in crystalline scales known as *litharge*, or *semi-vitrified oxide of lead*. In this state it is obtained in several processes, such as that known as *cupellation*, in which the lead is oxidized, and the litharge, as it forms, removed by a blast, leaving any silver behind which may have been contained in the lead. An identical product is obtained by passing a current of air over molten lead heated to dull redness and constantly renewing the surface.

Properties.—Litharge is a more or less crystalline powder which is composed of small scales varying in color between yellowish and pale brick-red. When of a distinct yellow tint and glossy surface it has been called *argyritis*, *yellow* or *silver litharge* (Silberglätte, *G.*), while the red-tinted kind is sometimes known as *chrysitis*, *red* or *gold litharge* (Goldglätte, *G.*). Its density varies between 9.25 and 9.5. It is inodorous and tasteless; in contact with the atmosphere it gradually combines with a little carbonic acid. When heated, it acquires a red-brown color, and at a higher heat fuses, congealing on cooling in scales. In the presence of even a small proportion of silica it congeals to a glass-like mass, and in the presence of charcoal it is reduced to metallic lead. It is soluble in dilute nitric acid and in hot acetic acid, the solutions showing with reagents the behavior of lead salts. It is now generally conceded that oxide of lead is completely insoluble in alcohol and water; according to older statements, it dissolves in 70,000 parts or more of water after prolonged contact. It appears to be somewhat soluble in water under increased pressure, also in glycerin and in solutions of sugar and other carbohydrates, which on being digested with it acquire a brownish color and a caramel-like odor.

Tests.—Oxide of lead should dissolve in diluted nitric acid with very little effervescence (carbonate), and leaving merely a slight residue (lead binoxide); and this solution, when precipitated by sulphuric acid, should yield a filtrate which, on being supersaturated by ammonia, does not acquire a blue color (absence of copper) and does not yield a brown precipitate, or but a slight one, consisting of ferric hydrate; nor should a white precipitate be produced on the further addition of sulphydrate of ammonium (zinc) or of oxalate of ammonium (calcium). The tests given by the U. S. Pharmacopœia do not indicate the presence of copper or of metallic lead. The latter is detected in the residue left on dissolving the oxide in acetic acid. The amount of carbonic acid is ascertained by the loss occasioned by ignition; according to the German Pharmacopœia, it should not exceed 2 per cent., indicating the presence of not more than about 14 per cent. of oxycarbonate of lead.

Composition.—Pure oxide of lead consists of 92.82 lead and 7.18 oxygen.

Pharmaceutical Uses.—Oxide of lead is used in the preparation of most lead salts and of plasters, and in preparing digitalin.

Other Oxides and Metallic Lead.—Plumbi oxidum rubrum, Minium, *P. G.*—Red lead, *E.;* Oxyde rouge de plomb, *Fr.;* Mennige, *G.*—On heating massicot to near 450° C. (840° F.) it gradually combines with more oxygen, and is converted into red lead; the conversion of the denser litharge into red lead is attended with greater difficulties. It is a bright orange-red, granular, crystalline powder, which, on being heated, becomes deeper red, purplish, and finally black, and has a density varying between 8.7 and 9.1. It is partly soluble in dilute nitric acid, leaving binoxide of lead; at a red heat it is converted into litharge, oxygen being given off; and when heated upon charcoal metallic lead is produced. When mixed with about 20 per cent. of sugar and then treated with dilute nitric acid, it is wholly dissolved. When pure it contains 90.66 per cent. of lead and 9.34 of oxygen, its formula being $Pb_3O_4 = 2PbO.PbO_2$. A variety of red lead less dense than the ordinary kind, and of a bright orange-red color, is used as a pigment under the name of *orange mineral* or *Paris red.*

Plumbi binoxidum.—Peroxide (Binoxide) of lead, Puce oxide of lead, *E.;* Peroxyde (Oxyde puce) de plomb, *Fr.;* Bleihyperoxyd, *G.*—This is left behind as an insoluble powder on treating red lead with diluted nitric acid, and is also produced from solution of lead salts by mixing them with an excess of solution of chlorinated lime or chlorinated soda. It is a dark-brown powder, which, on exposure to the light, slowly gives off oxygen, leaving red lead, and by heat is converted into oxygen and litharge. When triturated with one-eighth of its weight of sugar or with its own weight of oxalic acid, it is reduced to oxide or converted into carbonate. Its mixture with sulphur may be ignited by friction—a behavior which renders it useful in the manufacture of matches. Since it readily parts with one-half of its oxygen, it is a valuable reagent for strychnine and some other organic bodies, yielding colored oxidation-products. Its formula is PbO_2, and it contains 86.61 lead and 13.39 oxygen.

Plumbum.—Lead, *E.;* Plomb, *Fr.;* Blei, *G.* Symbol Pb. Atomicity bivalent or quadrivalent. Atomic weight 206.5.—Lead has been known from the most remote period. It is found in the United States and many other countries, occasionally as oxide, more frequently as carbonate (*white lead ore*), or in combination with other acids. The most abundant lead ore is *galena*, a sulphide of lead, PbS, which is frequently associated with the sulphides of zinc, iron, copper, and silver. The metal is obtained from the galena by roasting it, whereby a portion is oxidized to sulphate of lead, while another portion parts with its sulphur, which escapes as sulphurous acid, the metal being converted into oxide. The newly-formed compounds react with the unaltered galena, forming lead, which fuses, and sulphurous acid, which escapes. A considerably quantity of lead remains in the slag, which is used in a subsequent operation. The extraction of silver is effected by cupellation (see page 267), and the oxide of lead is then reduced to the metallic state by heating it with charcoal.

Lead has a bluish-gray color and a bright metallic lustre. It is a soft metal, and when cooled slowly leaves a mark on being drawn over paper. Its specific gravity is 11.4; it is very malleable and ductile, but less tenacious than most other common metals; fuses at 325° C. (617° F.) and volatilizes at a white heat. On congealing, it expands slightly, but afterward contracts considerably, and under some circumstances it may be obtained crystallized in regular octahedrons. When exposed to a moist atmosphere it is superficially oxidized and becomes covered with a grayish layer. In contact with water and air or in the presence of a minute quantity of ammonia or of nitric acid, the metal is corroded and small quantities of it are held in solution. Sulphates prevent the lead from being dissolved, or, if dissolved, precipitate an insoluble sulphate.

In addition to the three oxides described above, the existence of a suboxide, Pb_2O, has been assumed, but is doubted by many chemists. The *sesquioxide of lead*, $Pb_2O_3 = PbO.PbO_2$, has been obtained as a yellow precipitate by adding chlorinated soda to an alkaline solution of lead, and more recently (1878) by H. Debray as a greenish-brown powder by heating peroxide of lead to 350° C. (662° F.).

There are two series of *lead salts*, in one of which lead is contained in the acidulous radical, while in the other it constitutes the base. The former are called *plumbates*, and are obtained by heating together peroxide of lead with alkaline hydrates; the alkaline plumbates are colorless, decomposed by much water, and yield plumbates of the metals by acting upon metallic salts. The *plumbic salts* are white or colorless, unless colored by the acid; mostly insoluble in water, and then usually soluble in dilute nitric acid. The salts, which are soluble in water, have a sweet and metallic taste and an acid reaction to litmus, and their solutions yield white precipitates with carbonates, sulphates, phosphates, and chlorides, the last of which is slightly soluble in water, but less soluble in hydrochloric acid, while the precipitated sulphate of lead is insoluble in water and dilute sulphuric and hydrochloric acids. Alkalies produce white precipitates of plumbic hydrate, which is insoluble in ammonia, but soluble in potassa and soda. Ferrocyanide of potassium yields a white precipitate. The precipitates by potassium chromate and potassium iodide are characterized by a bright-yellow color; the latter crystallizes from hot solutions in golden-colored scales. Sulphuretted hydrogen precipitates black sulphide of lead, which is insoluble in dilute acids and in sulphydrate of ammonium. Iron and zinc separate from the solutions of lead salts the lead in the metallic state, and by heating the salts with carbonate of sodium upon charcoal before the blowpipe, metallic globules of lead and a reddish-yellow incrustation of lead oxide are obtained.

Off. Prep.—The following chemical compounds are officinal: Plumbi acetas, Plumbi carbonas, Plumbi iodidum, Plumbi nitras, Plumbi oxidum; and as solutions in water, Liquor plumbi subacet. and Liq. plumbi subacetat. dilut., *U. S.*, *Br.*

The following pharmaceutical preparations contain compounds of lead: Ceratum plumbi subacet., Emplastrum ammoniaci cum hydrarg., Empl. arnicæ, Empl. asafœtidæ, Empl. capsici, *U. S.;* Empl. belladonnæ, *U. S.*, *Br.;* Empl. calefaciens, Empl. cerati saponis, *Br.;* Empl. ferri, Empl. galbani, Empl. hydrargyri, Empl. opii, Empl. plumbi, Empl. resinæ, Empl. saponis, *U. S.*, *Br.;* Suppositoria plumbi comp., Unguentum plumbi acetatis, *Br.;* Ung. plumbi carbon., Ung. plumbi iodidi, *U. S.*, *Br.;* Ung. plumbi subacet. comp., *Br.*

Medical Action and Uses.—Oxide of lead is seldom used alone. It enters into the composition of lead plaster, and hence of most of the plasters which owe their adhesiveness to that compound. A mixture of oxide of lead with sweet oil has been applied to superficial *burns*, and ordinary white paint, containing litharge, linseed oil, and oil of turpentine, is a popular and excellent remedy for the same affection. Care should be taken not to leave it in contact with the broken skin.

PODOPHYLLUM, *U. S.*—MAY-APPLE.

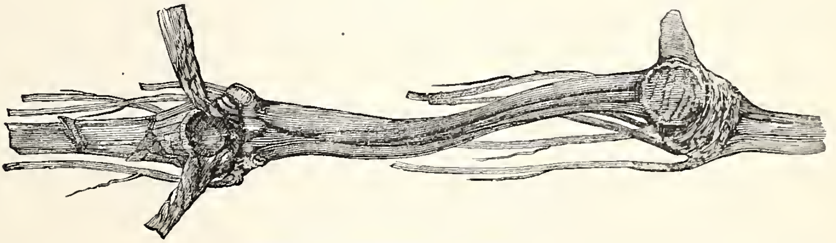
Podophylli rhizoma, Br.—*Podophyllum-root; Mandrake-root*, E.; *Rhizome de podophyllum*, Fr.; *Fussblattwurzel*, G.

The rhizome of Podophyllum peltatum, *Linné.* Bentley and Trimen, *Med. Plants*, 17. *Nat. Ord.*—Berberidaceæ.

Origin.—Mandrake is an herbaceous perennial growing in rich woodlands in Canada and the United States. The pale-green stem is about 10 or 12 inches (25 or 30 Cm.) high, and bears at its summit two peltate, deeply five- or seven-lobed leaves, which are 4 to 6 inches (10–15 Cm.) in diameter, and a single white flower with six or nine petals and twice the number of hypogynous stamens. The flowerless stems frequently bear only a single leaf. The fruit is a yellowish, oval, fleshy berry, and contains twelve or more seeds, which are enclosed in a pulpy arillus. The rhizome is collected in autumn.

Description.—The rhizome is horizontal, several feet long, but as found in commerce is always in fragments varying from 1 to 6 or 8 inches (3 to 20 Cm.) in length. It consists of joints or annual shoots, 1 to 3 inches (25 to 75 Mm.) long, ⅛ to ¼ inch (3–6 Mm.) thick, and marked with distant leaf-scars. The end of each joint is enlarged to the diameter of about half an inch (12 Mm.), is depressed globular in shape, and occasionally branching, has approximate leaf-scars, on the upper side a circular depressed stem-scar containing one or two rows of wood-bundles, and on the lower side is beset with from eight to twelve nearly simple rootlets. Rhizome and rootlets are of a yellowish- or reddish-brown color externally, smooth or with longitudinal wrinkles, very brittle, and therefore the radicles often detached; nearly inodorous, and of a sweetish somewhat bitter and acrid taste. The rhizome is white and mealy inside, and has a rather thick bark and a thin circle of yellowish wood-bundles enclosing a compact central pith. The rootlets have a thick white bark and a thin yellowish central cord.

FIG. 223.



Rhizome of Podophyllum peltatum, *Linné.*

Constituents.—The analysis of podophyllum by J. R. Lewis (1847) showed the presence of starch and other common vegetable principles, and of two resins, one soluble, the other insoluble, in ether. According to H. A. Tilden (1859), the former resin predominates largely in the rhizome collected in October, but if collected in April it contains the two resins in nearly the same proportion. The bitter principle was obtained in an impure condition by Hodgson (1831). F. F. Mayer (1863) announced the presence of berberine and another (white) alkaloid, and of saponin. After the precipitation of the resin from the strong alcoholic tincture by means of water we have on several occasions obtained a yellow precipitate on the addition of hydrochloric acid, which could be recrystallized from alcohol and was regarded as muriate of berberine. Investigations by F. B. Power (1877–78), however, indicate the total absence from the rhizome of any alkaloid; and we have subsequently shown that at all periods of its growth the rhizome is free from alkaloid. Power doubts also the existence of Mayer's saponin, and regards the frothing of the infusion as due to the acid resin, a compound of which seems to constitute the yellow coloring matter. The mother-liquor from which the resin has been precipitated gives indications of the presence of protocatechuic acid, which later investigations (1878) proved, however, not to pre-exist in the rhizome. (See page 1299.)

Tinctura Podophylli, *Br.*—Resin of podophyllum 160 grs.; rectified spirit 20 fl.oz.

Off. Prep.—Abstractum podophylli, Extractum podophylli, Extr. podophylli fluid., *U. S.*; Resina podophylli, *U. S.*, *Br.*

Physiological Action.—*On Animals:* Administered by the stomach to dogs and other animals, podophyllin produces retching, salivation, and vomiting, followed by purging, with colic and tenesmus. Hypodermically, its operation is the same, except that it is said not to occasion vomiting. Injected into the cavity of the peritoneum, it appears not to have caused any inflammation of that membrane nor any special symptoms until after a number of hours, when dry retching occurred and purging of glairy mucus mixed with blood. The animal seemed to suffer great pain, its pulse grew rapid and feeble, and death took place by exhaustion. No evidence was given of any special influence of the medicine on the liver. Experiments performed with the direct intention of inquiring into the cholagogue action of the drug have led to diametrically opposite conclusions—on the one hand, that podophyllin diminishes the total amount of the biliary secretion or of its constituents, according to the dose administered; and, on the other hand, that it increases greatly the amount of biliary secretion, preserving the normal proportion of the special biliary matter. The latest judgment in the matter is that expressed in a report to the British Medical Association (1879) of a series of experiments performed on dogs, and which agrees with the conclusion of Rutherford published in 1876. It is as follows: "Podophyllin is a very powerful stimulant of the liver. During the increased secretion of bile the percentage amount of special bile solids is not diminished. If the dose be too large the secretion of bile is not increased. It is a powerful intestinal irritant."

On Man: Workmen employed in pulverizing podophyllum find it excessively irritating to the eyes, nose, mouth, respiratory passages, and even to the skin (*Med. Record*, xii. 357). The resin applied to an ulcer produces its characteristic purgative effects with nausea. Internally, in small doses, it is a very slow and gentle laxative, producing formed or semi-solid stools, but in large doses it is a drastic and persistent purge. Its bitter and nauseous taste, when taken in powder or in solution, causes salivation, but under any form, and however introduced into the system, it has the same effect if it occasions nausea, which it does by irritating the stomach. It excites the secretion of bile, if at all, in the same way as it does that of the saliva, by the reflex influence of the irritation produced by it in the stomach and duodenum. In the case of a woman who took 10 grains of podophyllin severe abdominal pains came on in about 2 hours, but did not last for more than an hour. The most striking symptom was extreme prostration, with sweating and a violent headache, sharp at first, but afterward dull. In 3½ hours from taking the medicine copious vomiting set in and lasted about 8 hours, each paroxysm being attended with purging. There was very little pain, and the patient recovered (*Phila. Med. Times*, xii. 520). It is alleged that its contact with the mouth blunts the sense of taste and causes the salivary glands to swell (*Ibid.*, x. 564). Prof. Rothrock states that the leaves of podophyllum are just as active as the root (*Ibid.*, viii. 96); and Dr. Hilsman relates that a child two years old having eaten a quantity of poke-berries, the next morning it was unable to see and its muscles were all relaxed, the heart was rapid and feeble, and the extremities cold, and it had a convulsion. After recovery it was affected with urticaria (*Med. Record*, xix. 27). These phenomena appear to us to have been the effect of indigestion, and not of a specific poison.

According to Podwyssotski (*Arch. f. Pathol. u. Pharm.*, xiii. 29), the essential constituent of podophyllum is podophyllotoxin, of which he says that the dose is from one-fourth to one-third of a grain for an adult.

Medical Uses.—Podophyllum has, like jalap, the excellent quality of causing a slow but complete evacuation of the bowels, without greatly tending to render them torpid, provided it be given in suitable doses. This quality makes it useful in habitual *constipation*. For this purpose ⅙ grain (Gm. 0.01) of podophyllin with ⅕ grain (Gm. 0.013) of extract of belladonna, 1 grain (Gm. 0.06) of extract of hyoscyamus, and a grain (Gm. 0.06) of soap may be made into a pill to be taken at bed time. Like other active cathartics, podophyllin in removing constipation removes also one of the causes which tend to prolong constipation—the condition which is generally spoken of as *torpor of the liver*, and which is attended with hepatic fulness and perhaps some yellowness of the skin, and which is, in fact, generally due to the infarction of the excretory ducts of the liver with inspissated bile. It nearly always arises from sluggish habits of living, imprudence in diet, and neglect of the function of defecation. In the constipation produced by *lead* the following formula may be employed: ℞. Podophyllin gr. ss; Ext. nucis vom. gr. j; Ext. belladonnæ gr. ss; for a pill to be taken two or three times a day.

The *dose* of powdered podophyllum as a purgative is from 10 to 20 grains (Gm. 0.60–1.20); the dose of the extract is about the same; as a laxative, from 5 to 10 grains. The strength of resin of podophyllum is uncertain, and its dose varies from $\frac{1}{6}$ grain to 1 grain (Gm. 0.01–0.06) and upward. It seldom begins to act in less than 12 hours. It has been given in varnished capsules, which are supposed not to dissolve before reaching the duodenum, and thus the nausea and gastric irritation are alleged to be mitigated. The following may be found a convenient formula: ℞. Podophyllin gr. ij; tincture of ginger fʒij; diluted alcohol to f℥ij. M.—S. A teaspoonful in a wine-glassful of water as a habitual laxative in constipation. Braun states the dose of podophyllin to be for a child of thirteen years from $\frac{1}{6}$ to $\frac{1}{2}$ grain, and under one year from $\frac{1}{12}$ to $\frac{1}{6}$ grain; and of podophyllotoxin, for children under one year, from $\frac{1}{60}$ to $\frac{1}{80}$ grain; up to four years, $\frac{1}{30}$ to $\frac{1}{15}$ gr.; and above that age $\frac{1}{10}$ to $\frac{1}{8}$ grain. It is most conveniently dissolved in the proportion of $\frac{3}{4}$ grain in about 100 drops of rectified spirit. Of this solution from 2 to 10 drops may be given in a teaspoonful of syrup (*Practitioner*, xxviii. 54).

POLYGALA.—Bitter Polygala.

Polygale, *Laitier*, Fr.; *Kreuzblume*, *Milchwurz*, G.

The root and herb of Polygala rubella, *Willdenow*, s. P. polygama, *Walter*.
Nat. Ord.—Polygalaceæ.

Description.—The bitter polygala or *bitter milkwort*, which has been dismissed from the last U. S. Pharmacopœia, is a biennial herb growing in dry fields and pastures from Canada southward to the Gulf of Mexico. It has a fusiform root and numerous glabrous nearly simple stems which are 6 to 8 inches (15–20 Cm.) high, and bear a terminal narrow raceme of about fifteen to twenty-five purple, finally pendulous flowers. The leaves are alternate, linear-oblong or oblanceolate, narrowed below, obtuse, and somewhat mucronate. The flowers are showy and conspicuously crested; racemes of inconspicuous flowers are produced on procumbent stems, and usually fertilized in the bud. The plant is without odor and has a bitter taste.

Allied Species.—Pol. sanguinea, *Linné*. It grows in similar localities to the preceding, has the stem fastigiately branched above and leafy to the top; narrow linear or lance-linear leaves, and terminal globular heads of dark-red and inconspicuously crested flowers. Several others, like Pol. fastigiata, *Nuttall*, and Pol. Nuttallii, *Torrey et Gray*, are closely related to it.

Pol. amara, *Linné*. It grows in mountainous woods and meadows of Europe, is about 6 inches (15 Cm.) high, has rosulate obovate or spatulate radical leaves, smaller linear or oblong linear stem-leaves, and lax racemes of blue flowers. It is used in Europe as *Herba polygalæ*.

Pol. vulgaris, *Linné*. A common European perennial with ascending stems, 5 to 9 inches (12–22 Cm.) long, lanceolate or spatulate radical leaves, longer linear-lanceolate stem-leaves, and short or lax and elongated racemes of blue or purplish flowers.

Pol. major, *Jacquin*. It is a perennial herb of South-eastern Europe, the root of which is used as *Radix polygalæ hungaricæ*. This is about $1\frac{1}{2}$ inches (38 Mm.) long and $\frac{1}{6}$ inch (4 Mm.) thick, is somewhat branched, has a thin pale yellowish-brown bark and a thick cylindrical woody meditullium, is nearly inodorous, and has a sweetish, unpleasant, acrid, and slightly bitter taste.

Pol. serpentaria, *Ecklon et Zeyher*, is indigenous to Southern Africa, where the root is used as an alexipharmic. It is about 8 inches (20 Cm.) long, light-brown, and has a thin, internally reddish-brown bark and a brownish or yellowish wood.

Pol. venenosa, *Jacquin*, a shrub of Java, with large oblong or obovate leaves, is considered to be poisonous.

Soulamea amara, *Lamarck*, indigenous to the Moluccas, is a shrub or tree, all parts of which are intensely bitter and are reputed to possess anti-periodic properties.

Monnina polystachya, *Ruiz et Pavon*, is a Peruvian shrub, the root-bark of which contains saponin, and is used there in diarrhœa and as a substitute for soap in washing and in polishing metals.

Constituents.—Reinsch (1839) obtained from Polygala amara small quantities of solid volatile oil, tannin, and wax, considerable pectin, and a crystalline compound, *polygalamarin*, which has a very bitter taste and foams considerably when agitated with water.

Medical Action and Uses.—Polygala rubella is said to be closely analogous in medicinal virtues to P. amara of Europe. Some of the most recent European works on the materia medica reject the latter altogether. It is, however, a mild bitter tonic, with some influence in *bronchial catarrh*, and may be convenient in domestic medicine, but scarcely deserves an officinal rank. P. vulgaris possesses the same virtues essentially. Its active principle is analogous to senegin.

POTASSA, *U. S.*—Potassa.

Potassa caustica, Br.; *Kali causticum fusum*, P. G.; *Potassæ* (*Potassii*) *hydras, Kali hydricum fusum, Oxydum potassicum, Lapis causticus chirurgorum.—Caustic potash, Potassium hydrate*, E.; *Potasse caustique, Potasse fondue, Pierre à cautère*, Fr.; *Aetzkali*, G.

Formula KHO. Molecular weight 56.

Preparation.—Take of Solution of Potash 2 pints. Boil down rapidly in a clean silver vessel until there remains a clear fluid of oily consistence, a drop of which, when removed on a warm glass rod, solidifies on cooling. Pour this into proper moulds, and when it has solidified, and while it is still warm, put it into stoppered bottles.—*Br.*

The process by which the solution is made is described and explained on p. 916. This solution is evaporated, and the remaining potassium hydrate fused until ebullition ceases, and a glass plate laid upon the vessel ceases to become moist from condensed water; the fused mass is then poured upon a cold iron plate, and after congealing broken into smaller pieces, or it is poured into clean cylindrical iron moulds which have been previously warmed. If it is desired to obtain the potassa in powder, the melted mass while cooling is briskly stirred with a silver spatula, or the solid pieces are rapidly triturated in a warm iron mortar. The finished product should in all cases be at once put into well-stopped bottles made of hard glass. Vessels made of glass, porcelain, copper, and of most other materials are corroded by the concentrated solution and the fused hydrate; the operation must therefore be performed in a vessel of silver or of well-cleaned iron.

Properties.—Caustic potassa is either pulverulent or in irregular pieces of crystalline texture: more generally it is in dry white cylindrical pieces, which break readily with a crystalline and somewhat translucent fracture. It is inodorous or has a faint odor of lye; its taste is strongly caustic and acridly alkaline. It dissolves at 15° C. (59° F.) in 0.47 parts of water (Bineau) and in 2 parts of alcohol, and is much more soluble in both liquids at the boiling temperature; the taste and reaction of these solutions are strongly alkaline. The alcoholic solution is yellowish, and on keeping turns brown. Potassa is but slightly soluble in ether. On exposure to the air it rapidly absorbs moisture, liquefies, and combines with carbonic acid. When heated it fuses to a colorless oily liquid, and in a strong red heat it slowly volatilizes, forming white acrid vapors. The aqueous solution has the properties and chemical behavior of liquor potassæ (see page 917).

Tests.—Most of the salts likely to be present in caustic potassa are insoluble in alcohol, and are therefore precipitated if the potassa is dissolved in 2 parts of water and the solution mixed with 4 parts of alcohol; only a scanty precipitate (sulphate, silicate, and nitrate of potassium, alumina, ferric oxide) or a small amount of dense watery liquid (potassium carbonate) should be separated. Minute quantities of chloride and sulphate are usually present, indicated by the white turbidity produced with silver nitrate and with barium chloride in the solution acidulated with nitric acid. For the detection of small quantities of nitrate Hager recommends a freshly-prepared mixture of 3.5 Ccm. of sulphuric acid, 7 Ccm. of water, and a little sodium chloride; while still hot about 1 Gm. of potassa is dropped in, and the test-tube is closed with a small paper filter, the point of which is moistened with a solution of potassium iodide: the liberation of iodine indicates the presence of nitric acid. 1 part of potassa should yield with 2 parts of distilled water a colorless solution (absence of organic matter), and on "boiling this with 15 parts of lime-water a filtrate should be obtained which on being poured into an excess of nitric acid does not evolve any gas-bubbles."—*P. G.* This test admits the presence of 3.9 per cent of potassium carbonate. "To neutralize 2.8 Gm. of potassa should require not less than 45 Ccm. of the volumetric solution of oxalic acid, corresponding to at least 90 per cent. of absolute hydrate of potassium."—*U. S.* This test is without value unless the total absence of soda is ascertained.

An impure potassa of a deep-gray or greenish color is sometimes met with. It is unfit for medicinal purposes, and may be purified by treating it with alcohol, which dissolves the alkali, and evaporating this solution to dryness.

Composition.—The formula of potassa is given above. When pure it contains 16.07 per cent. H_2O and 83.93 per cent. K_2O, but as met with in commerce there is usually an excess of water, amounting to 6 or 8 per cent.

Pharmaceutical Uses.—Potassa is used in the preparation of Æther, Liquor potassæ, Potassa cum calce, Potass. iodidum, *U. S.*, and Potass. permanganas, *Br.*

Metallic Potassium and Salts.—Potassium, or Kalium, was first isolated by Humphrey Davy (1807), and is obtained with some difficulty by heating hydrate or sulphide of potassium with metallic iron, in which case ferric oxide or sulphide is formed; or an intimate mixture of potassium carbonate and charcoal is heated to strong redness, when carbonic oxide is produced, and the metal distils into a receiver containing petroleum.

It is silver gray, of a strong metallic lustre, harder than sodium, but softer than lead, fuses at 58° C. (136.4° F.), is brittle at the freezing-point of water, and at a red heat volatilizes, forming green vapors. Its density is 0.865, its atomic weight 39, and its atomicity univalent. It has a great affinity for oxygen, and when thrown upon water decomposes this liquid, melts, and burns with a purple flame. It must be preserved under petroleum naphtha, which is free from oxygen. There are three oxides of potassium known—the *monoxide*, K_2O, *dioxide*, K_2O_2, and *tetroxide*, K_2O_4, of which only the former is of importance on account of the uses in medicine and the arts to which its combinations with water and acids are put.

Salts of Potassium. Potassa is a very strong base, and completely neutralizes the strongest acids. The salts are colorless, unless the acid has a distinct color, and are neutral to test-paper, except those with weak acids, which have a distinct alkaline reaction. They are mostly readily soluble in water, and in such solutions, if not too dilute, are precipitated in a gelatinous condition by hydrofluosilicic acid, and in a crystalline form by perchlorate of ammonium, tartaric acid, acid tartrate of sodium, platinic chloride, and picrate of sodium. The last two precipitates are yellow, the others white. When heated before the blowpipe the potassium salts impart a purplish tinge to the flame, which is masked by the presence of a small quantity of sodium salt. The yellow color of the latter is absorbed by looking at the flame through blue glass, and the potassium flame becomes then visible.

Physiological Action.—*On Animals:* Injected into the veins of dogs, 5 grains of caustic potassa dissolved in water produced difficult breathing, exhaustion, paralysis, and speedy death. Larger doses administered to horses by the veins were not fatal, but, besides causing signs of distress, produced increased urination. Given to dogs by the stomach, potassa excites violent and fatal gastro-enteritis.

On Man: Potassa is one of the strongest caustics. It destroys animal tissue by abstracting water, neutralizing free acids. decomposing nitrogenous compounds, and forming solutions of fibrin, albumen, and gelatin. Between the fingers it has a soapy feel. In contact with the soft tissues it causes severe burning pain, and produces a moist, ashen, and then black, leathery slough, which leaves a granulating ulcer behind it.

The symptoms of poisoning by a solution of potassa are these: An acrid, urinous, and caustic taste in the mouth, burning in the throat; nausea, and vomiting of alkaline matters, which are usually bloody; intense pain in the fauces, œsophagus, stomach, and bowels; diarrhœa, convulsions, delirium; a cold, clammy skin, and, if the dose has been large and not instantly rejected, speedy death. Sometimes death takes place from inflammation of the larynx; sometimes, after several weeks from the gastro-intestinal lesions (which consist of more or less destruction of the mucous membrane, etc.); and, finally, it may occur after several months from stricture of the œsophagus.

In small or medicinal doses potassa increases the amount of urine secreted, rendering it less acid; in larger or in long-continued doses it diminishes the coagulability of the blood, and may give rise to a cachectic condition, with paleness and œdema of the skin, passive hæmorrhages, and general emaciation—a state identical with that occurring in scurvy.

Medical Uses.—Potassa in solution is used as an antacid to correct *acidity of the stomach* which proceeds either from fermentation of the contents of the organ or from an excessive amount of its proper secretion, and which is accompanied with heartburn, sour eructations, aphthæ, spasm of the œsophagus, vomiting, gastric cramp, colic, tympanites, irregular diarrhœa, etc. In treating such conditions with alkalies the acidity is indeed palliated, but its cause must be removed to make a cure certain, and that is usually best secured by means of tonic medicines and regimen. For the relief of *calculous disorders* potassa is less appropriate than soda and its carbonates. 20 minims (Gm. 1.30) of solution of potassa largely diluted are said to prevent and also to relieve *strangury* from *cantharides*. Formerly, this medicine was considered as almost a specific in the treatment of glandular *scrofula*, but the influence of the hygienic conditions existing at the same time appears to have been underrated. It should not, however, be neglected, but given in the dose of 5 drops (Gm. 0.30), largely diluted, after meals. Solution of potassa is useful in some cases of *acne rosacea*, and in the treatment of *boils* it has been thought efficient.

Externally, potassa is used chiefly as a caustic to promote the healing of callous ulcers and sinuses and to destroy fungous granulations. It has been especially employed to destroy *chancres* in their first stage and to cauterize *poisoned wounds*. It is much used in the treatment of *ingrown nail* and *paronychia*, and was formerly employed for opening *scrofulous abscesses*. It has been applied as a counter-irritant in diseases of the *hip-joint* and other joints and for the purpose of exciting inflammation in the ends of *ununited fractured bones*; but these uses, as well as its application to *carbuncles*, *erectile tumors*, *varicose veins*, and to the spine in *tetanus*, are wellnigh obsolete, having been superseded by more efficient and less painful remedies. The same may be said of its use in the treatment of *urethral stricture*. It is one of the most convenient agents for establishing *issues*. To prevent the caustic action from spreading laterally, a piece of adhesive plaster should be applied first, with an aperture of the size of the intended issue. Upon the skin thus exposed and moistened a small portion of fused potassa is laid, and the degree of its action regulated by the duration of its contact. The action may be arrested at any point by a sponge or cloth wet with vinegar. Milder action may be secured by applying the stick of fused potassa, duly covered, except at one end, with shellac varnish or sealing-wax, and maintaining its contact for a longer or shorter time according to the effect desired. (For other uses of potassa see LIQUOR POTASSÆ and POTASSA C. CALCE.)

POTASSA CUM CALCE, *U. S.*—POTASSA WITH LIME.

Pulvis causticus cum calce, *Pulvis causticus Viennensis* (*Londinensis*).—*Vienna caustic*, E.; *Caustique* (*Poudre*) *de Vienne*, Fr.; *Wiener Aetzpulver*, G.

Preparation.—Potassa, Lime, of each 50 parts (1 oz.). Rub them together so as to form a powder, and keep it in a well-stopped bottle.—*U. S.*

Properties.—This is a grayish-white powder of a strongly caustic taste and alkaline reaction. When exposed to the air it absorbs moisture and carbonic acid. Treated with diluted nitric or hydrochloric acid, it dissolves completely with slight effervescence, and yields a solution in which both potassium and calcium are indicated by reagents.

CAUSTICUM CUM POTASSA ET CALCE, *F. Cod.*, is a stronger preparation, known in France as *caustique de Filhos*, and made by fusing 100 parts of caustic potassa, adding thereto 10 parts of powdered burned lime, and pouring the mass into lead tubes of suitable size to harden.

CAUSTICUM COMMUNE MITIUS. Under this name a preparation was formerly employed which was made either by intimately mixing equal weights of soft soap and powdered burned lime, or caustic potassa was dissolved in three times its weight of water, and a sufficient amount of lime added until the whole was converted into a pasty mass.

Medical Action and Uses.—This caustic is milder in its operation than pure potassa. When applied in a dry state to the skin, it absorbs moisture from it and from the air, and partially deliquesces. It is best employed after being reduced to a paste with a little alcohol. Its action may be limited laterally by means of adhesive plaster, and in depth by the duration of its contact. The sticks of Filhos's caustic may be protected from the air by waxed paper, by sealing-wax, gutta-percha, or varnish. For still further mitigating the caustic action of the potassa in this preparation the alakali may be fused with gutta-percha in any required proportion. Its uses are the same as those of potassa.

POTASSA SULPHURATA, *U. S.*, *Br.*—SULPHURATED POTASSA.

Potassii sulphuretum, U. S. 1870; *Kalium sulfuratum*, P. G.; *Hepar sulphuris*.—*Sulphuret of potassium*, *Liver of sulphur*, E.; *Sulfure de potasse*, *Foie de soufre*, Fr.; *Schwefelleber*, G.

Origin.—The name "liver of sulphur" was introduced by Basilius Valentinus in the fifteenth century, but the process of melting together sulphur with an alkali was known already to Albertus Magnus in the thirteenth century, and the solubility of sulphur in alkalies to Geber in the eighth century. Spielmann (1766) recommended the preparation of liver of sulphur from 2 parts of carbonate of potash and 1 part of sulphur, in which proportion the ingredients are still employed.

Preparation.—Sublimed Sulphur 1 part; Carbonate of Potassium 2 parts. Rub the carbonate of potassium, previously dried, with the sulphur, and heat the mixture gradually in a covered crucible until it ceases to swell and is completely melted. Then pour the liquid on a marble slab, and when it has solidified and become cold break it into pieces, and keep them in a well-stopped bottle of hard glass.—*U. S.*

The different pharmacopœias prepare this compound in a like manner, and use the sulphur and carbonate of potassium in the proportion given above. On heating the mixture an evolution of carbonic acid takes place, causing the mass to swell, and when this ceases the heat is finally raised to a dull redness, so as to produce perfect fusion (*Br.*), and continued until a small portion of the mass is found to be entirely soluble in water without separating any sulphur (*P. G.*). The crucible must be kept covered to prevent the sulphur from igniting, and after the melted mass has been poured out on a slab, flagstone, an oiled iron plate, or into a porcelain mortar, it is either broken into suitable pieces as soon as it has congealed, or first allowed to cool, being in the mean time covered with a porcelain basin or bell-glass, so as to exclude the air as completely as possible (*Br.*). The yield from the quantities given in the formula is about 2¼ parts.

On fusing sulphur with carbonate of potassium the latter is decomposed, with the evolution of carbonic acid gas, the sulphur uniting with the potassium to form a potassium polysulphide, a portion of which is oxidized by the oxygen of the carbonate, in excess over that contained in the carbonic acid gas, to form sulphate or hyposulphite of potassium; $4K_2CO_3 + 5S_2$ yields $K_2SO_4 + 3K_2S_2 + 4CO_2$, and $3K_2CO_3 + 4S_2$ yields $K_2S_2O_3 + 2K_2S_3 + 3CO_2$. But the degree of heat is likewise of importance, since at a high temperature the hyposulphite of potassium is decomposed into pentasulphide and sulphate; $4K_2S_2O_3$ yields $K_2S_5 + 3K_2SO_4$. It is evident from this that products of very different composition are obtained by varying the proportion of the material, or, if this be used in the same relative proportions, by the injudicious application of heat, by which a part of the sulphur may be sublimed. The directions of the Pharmacopœia should therefore be strictly adhered to.

Properties.—Sulphurated potassa, when recently made or well preserved in closed vessels, is in irregular fragments, breaking with a shallow conchoidal fracture and having a liver-brown color, which in contact with moisture changes to greenish-yellow or brown-yellow. It has a slight odor of sulphydric acid, a bitter and acridly alkaline sulphurous taste, and an alkaline reaction to test-paper. It is partly deliquescent on exposure, and yields with water a brownish-yellow solution which has a strong odor of sulphuretted hydrogen, and evolves the latter freely on the addition of hydrochloric or sulphuric acid, sulphur being at the same time deposited. After boiling the hydrochloric acid solution until the sulphuretted hydrogen has been expelled, the liquid, freed from sulphur by filtration, will yield a yellow precipitate with chloride of platinum and a white precipitate with chloride of barium. The acid solution on being neutralized with soda yields, with a saturated solution of sodium bitartrate, a white crystalline precipitate of potassium bitartrate (*U. S.*). The same precipitate is obtained on dissolving sulphurated potassa in 20 parts of water, boiling with excess of acetic acid, filtering, and adding tartaric acid (*P. G.*). About one-half of the weight of sulphurated potassa is dissolved by rectified spirit (*Br.*), the insoluble portion being mainly sulphate of potassium.

When intended for internal use the compound should be perfectly soluble in 2 parts of water. For external use an impurer article, *Kalium sulfuratum ad balneum*, is made like the above, with the exception that impure carbonate of potassium (pearlash) is substituted for the purified.

If not protected from contact with air, sulphuret of potassium becomes green, and afterward gray, being partly converted into carbonate through the carbonic acid of the air, and partly oxidized to hyposulphite, sulphite, and sulphate, sulphur being at the same time liberated.

Tests.—On triturating together 10 parts of sulphurated potassa and 12.69 parts of crystallized sulphate of copper with 60 parts of water, and filtering, the filtrate should remain unaffected by hydrosulphuric acid (presence of at least 56 per cent. of true sulphide of potassium).—(*U. S.*) Hirsch states (*Vergleichende Uebersicht*, page 206) that 10 parts of the freshly-prepared compound, made with potassium carbonate of 90 per cent. purity, will precipitate 9 parts of crystallized copper sulphate, but should be regarded as of good quality if from 7.5 to 8 parts of the latter salt be precipitated; Hager adopts 8 parts of the copper salt as the lowest limit. None of the pharmacopœias give a test for the detection of soda which may have been partly substituted for the potassa salt; it is best detected by accurately precipitating the aqueous solution with nitrate of lead, evaporating the filtrate, powdering the residue, and leaving it in contact with alcohol of spec. grav. .879, of which 17 parts will dissolve 1 part of sodium nitrate, while potassium nitrate is sparingly soluble. The alcohol, previously saturated with the latter salt, will dissolve the sodium salt, the amount of which may thus be estimated.

Off. Prep.—Unguent. potas. sulphuratæ, *Br.*

Allied Compounds.—Potassii sulphidum, Potassium monosulphide, K_2S; molecular weight 110. Sulphuretted hydrogen gas is conducted into a solution of potassa as long as it is absorbed, and an equal bulk of potassa solution is added. The colorless liquid has a bitter taste and a strongly alkaline reaction, and on evaporation *in vacuo* yields colorless deliquescent quadrangular prisms, containing $5H_2O$, which are somewhat soluble in alcohol.

Potassii sulphocarbonas, Sulphocarbonate or thiocarbonate of potassium, K_2CS_3. On agitating a solution of potassium monosulphide with carbon bisulphide the liquid acquires a yellow or red-brown color, according to its concentration and purity, and on careful evaporation at 30° C. (86° F.) yields orange-yellow deliquescent crystals of the hydrated salt, or a crystalline precipitate of the same salt on mixing the brown liquid with alcohol. It has a cooling, pungent, and somewhat sulphurous taste, and is sparingly soluble in alcohol. On agitating potassa solution with carbon bisulphide a brown liquid containing both carbonate and sulphocarbonate of potassium is obtained. Such a solution has been employed in Europe for the destruction of the phylloxera insect which infests grapevines.

Physiological Action.—Experiments on animals and observations on man show that the local action of this compound is that of an irritant, and even a caustic. Taken internally in doses of several drachms, it causes inflammation of the throat, stomach, and intestine, and sometimes speedy death. The corresponding symptoms are burning in the parts mentioned, vomiting, purging, fever, muscular trembling and spasm, and in fatal cases dyspnœa, a small and irregular pulse, venous congestion of the skin, and loss of sensibility and consciousness. After death the blood is fluid and dark and the alimentary canal inflamed. In medicinal and long-continued doses it is said to give rise to a state of the blood such as mercury occasions—*i. e.* a loss of coagulability—and at the same time to impair the digestion, producing flatulence and discharges of sulphuretted hydrogen.

Medical Uses.—The extremely offensive smell and taste of this preparation have caused its use as an internal medicine to be nearly abandoned; but even if these obstacles had not existed it would scarcely have held its ground against the results of accurate observation. At one time it was thought to be a specific remedy for *membranous croup*, but longer experience showed that the supposed merits of the medicine were, as in so many other cases, due to errors in diagnosis, to mistaking spasmodic croup, which is seldom fatal, for pseudo-membranous laryngitis, from which recovery is rare. It is no longer used, although once regarded as a specific, for *whooping cough;* nor for *pulmonary consumption*, in which it was formerly employed; nor yet for *scrofula*, especially of the glands, which it was once believed to cure; nor does it continue to be prescribed as an antidote in acute *poisoning* by *lead, arsenic, mercury*, or *copper* salts. There is more reason to think it of service in chronic poisoning with mercury and lead. It has been used with doubtful advantage in the treatment of certain forms of *dyspepsia*, apparently those attended with mucous regurgitation or vomiting.

Externally, lotions and ointments made with sulphurated potassa have been much used in the treatment of limited eruptions of *acne, impetigo, psoriasis*, etc., and for lessening *mucous* or *purulent discharges* from the nostrils, ears, vagina, etc. It is sometimes employed in the treatment of *scabies*, as in the following liniment: ℞. Potass. sulphurat. ʒvj; Saponis alb. Oij; Ol. olivæ ℥iv; Ol. thymi ʒij; M. (Jadelot); but less commonly than sulphur itself It is, however, very efficient, although if thoroughly applied after the skin is softened by a prolonged warm bath, it is apt to produce eruptions of eczema, which require time and treatment for their cure.

The action and uses of baths containing this preparation are as follows: About 4 ounces (Gm. 128) of it are sufficient for a full bath. Such a bath, even at ordinary temperatures, stimulates the skin and is apt to cause sleeplessness, but these and corresponding effects are more decided when the temperature of the water is equal to that of the skin or above it. Hence these baths are contraindicated when fever is present or a tendency to hæmorrhage exists. Such conditions apart, they are often very serviceable in *chronic rheumatism, scrofula, cutaneous eruptions*, and chronic *profluvia* from the bowels and urinary organs, and have been used in *lead-palsy* and other *paralyses*. They excite copious sweating, and, as above remarked, tend to produce papular and vesicular eruptions of the skin, particularly if the baths are prolonged, as they sometimes are, for several hours. If these effects, and especially the perspiration, are wanting, a sense of fulness, and indeed a relative plethora, may be induced, which is not free from the dangers before alluded to. In such cases a douche directly applied to the affected part is to be preferred.

Internally, the *dose* of sulphuret of potassium is from 3 to 10 grains (Gm. 0.20–0.60).

POTASSII ACETAS, *U. S.*, *Br.*—ACETATE OF POTASSIUM.

Potassæ acetas, Br.; *Kalium, s. Kali aceticum*, P. G.; *Acetas potassicus, s. kalicus, Terra foliata tartari.—Acetate of potash* (*potassa*), E.; *Acétate de potasse*, Fr.; *Kaliumacetat, Essigsaures Kali*, G.

Formula $KC_2H_3O_2$. Molecular weight 98.

Preparation.—Take of Carbonate of Potash 20 ounces; Acetic Acid 2 pints or a sufficiency. To the acetic acid, placed in a thin porcelain basin, add gradually the carbonate of potash, filter, acidulate, if necessary, with a few additional drops of the acid, and, having evaporated to dryness, raise the heat cautiously so as to liquefy the product. Allow the basin to cool, and when the salt has solidified, and while it is still warm, break it in fragments and put it into stoppered bottles.—*Br.*

On adding carbonate or bicarbonate of potassium to acetic acid an effervescence of carbonic acid gas takes place, and water and potassium acetate are formed: $K_2C_3O + 2HC_2H_3O_2$ yields $2KC_2H_3O_2 + H_2O + CO_2$, and $KHCO_3 + HC_2H_3O_2$ yields $KC_2H_3O_2 + H_2O + CO_2$. On the application of heat the carbonic acid which remains dissolved in the water is expelled, and the liquid should now have a neutral or preferably a slightly acid reaction, in which case it contains a slight excess of acetic acid. The evaporation of this solution is effected either by means of a sand-bath or over the naked fire, and the salt may be obtained dry and granulated by continued stirring at about 120° C. (248° F.); or the dry salt is fused by the cautious application of heat, so as not to char it, after which the melted salt is allowed to solidify. In making this salt bicarbonate of potassium is preferable, in being nearly free from impurities and yielding at once a salt perfectly soluble in water. Carbonate of potassium is less pure, but usually yields a clear solution with acetic acid, which, on being evaporated to dryness and again dissolved in water containing a little acetic acid, leaves some floccules of silica behind, from which it may be filtered and afterward again evaporated.

Acetate of potassium may also be prepared from acetate of lead by precipitating its solution with a slight excess of carbonate of potassium, filtering, acidulating the filtrate with acetic acid, testing with sulphydric acid to ensure its complete freedom from lead, and evaporating.

Properties.—Acetate of potassium is a white salt forming a crystalline soft mass or a dry granular powder, or more frequently it is seen as a satiny, foliaceous, crystalline mass which melts to an oily liquid at about 280° C. (536° F.), and at a higher temperature evolves acetic acid, acetone, empyreumatic and inflammable products, and leaves potassium carbonate and charcoal. The salt is nearly inodorous, is free from acetous odor, has a warm and somewhat pungently saline taste, and is very deliquescent in the air. It dissolves at 15° C. (59° F.) in 0.4 (*U. S.*), 0.36 (*P. G.*) part of water, and in 2.5 (*U. S.*), 1.4 (*P. G.*) of alcohol. According to Osann, it dissolves at 2° C. (35.5° F.) in 0.531 part, at 13.9° C. (57° F.) in 0.437 part, and at 28.5° C. (83.3° F.) in 0.321 part of water. The aqueous solution, saturated while boiling, contains 1 part of the salt to 0.125 part of water, and boils at 169° C. (336° F.) (Berzelius). Cold absolute alcohol dissolves one-third, and at the boiling temperature one-half, its weight of the salt. The alcoholic solution on the addition of ether gives a crystalline precipitate of the salt. and on passing carbonic acid gas through it potassium carbonate is separated and acetic ether produced. The aqueous solution has a nearly neutral but faintly alkaline reaction, disengages acetous vapors on the addition of sulphuric acid, and yields with platinic chloride a yellow, and with sodium bitartrate a white, crystalline precipitate, and it gives with ferric chloride a dark-red color, and on boiling a brown-red precipitate. A solution of the salt in 20 parts of water precipitates potassium bitartrate on the addition of tartaric acid. On triturating the salt with iodine it acquires an indigo-blue color, changing to brown on the addition of water.

Tests.—Acetate of potassium, when strewn upon colorless sulphuric acid, should not impart a dark color to the latter (organic impurities). Its solution in distilled water should not give a precipitate or a turbidity on the addition of hydrosulphuric acid, hydrosulphate of ammonium, or ferrocyanide of potassium (absence of heavy metals). A 2 per cent. solution of the salt should not give more than a faint opalescence with carbonate of sodium (alkaline earths), with chloride of barium (sulphate or carbonate), or, if acidulated by nitric acid, with nitrate of silver. The concentrated aqueous solution of the salt on being dropped into acetic acid should not produce any effervescence (carbonate), and if mixed with an excess of hydrochloric acid and evaporated to dryness the remaining salt should be completely soluble in water (silica from potassium carbonate). "If 4.9 Gm. of acetate of potassium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 49 Ccm. of the volumetric solution of oxalic acid (corresponding to at least 98 per cent. of absolute acetate of potassium)."—*U. S.* Since the other pharmacopœial tests admit only mere traces of other salts, this test is intended to prove the absence of sodium acetate and of more than 2 per cent. of moisture. The latter is more readily estimated by drying the salt at 120° C. (248° F.); considering the hygroscopic nature of the salt, 3 or 4 per cent. of moisture would seem to be admissible. The presence of notable quantities of sodium acetate is best determined by the intense yellow color imparted by the salt to a non-luminous flame. 4.9 Gm. of dry potassium acetate, evaporated to dryness with an excess of hydrochloric acid, leave a residue of KCl weighing 3.72 Gm., or, allowing for 2 per cent. of moisture, 3.645 Gm. The same weight of exsiccated sodium acetate leaves only 3.49 Gm., and of the crystallized sodium salt 2.104 Gm., NaCl.

Pharmaceutical Uses.—Potassium acetate, being unfit for dispensing in the dry state, is always prescribed in solution. For convenience in dispensing the German Pharmacopœia recognizes—

LIQUOR KALII ACETICI, S. KALII ACETICUM SOLUTUM, which contains one-third of its weight of the dry salt, and is prepared by neutralizing 100 parts of acetic acid spec. grav. 1.041 with 48 or 50 parts of potassium bicarbonate, expelling the carbonic acid gas by heat, and diluting with sufficient water to obtain 147 parts. Its specific gravity is 1.176–1.180.

Off. Prep.—For preparing Liquor ferri acetatis, *Br.*

Physiological Action.—It acts upon the blood as a solvent and diluent, upon the glands and mucous membranes as a depurative, augments the secretion of bile, urine, and sweat, and does not readily disorder the digestion. In doses of from half an ounce to an ounce (Gm. 16–32) it is a mild laxative. It is decomposed in the system, and is discharged with the urine as carbonate of potassium, rendering this secretion alkaline and increasing its quantity as well as its solid contents. In large and continued doses it is said to occasion renal catarrh, and even bloody urine.

Medical Uses.—The title *sal diureticus* which was formerly applied to this salt it is justly entitled to, and there is good reason to believe that, besides increasing the quantity of the urine secreted, it also promotes the disintegration and discharge with that secretion of various effete and noxious elements. It displays this virtue notably in chronic infarctions of the *liver* accompanied with *jaundice*, in analogous congestions of the *spleen*, *uterus*, and *hæmorrhoidal vessels*, and particularly in such conditions resulting from malarial poisoning. In like manner, probably, must be explained its virtues in *gout*, *lithiasis*, *furuncles*, *carbuncles*, and various *cutaneous affections*, as well as in *acute articular rheumatism*. In the last-named disease especially are its virtues conspicuous when it is given in such doses and so frequently as to render the urine alkaline. Like other forms of the alkaline treatment of this disease, it lessens the risk of cardiac complications. In this and other affections distinguished by an excess of uric acid it acts in the same manner as the carbonates of the alkalies.

In several forms of *dropsy* its diuretic virtue is of extreme value. Most conspicuously is it efficient in the dropsy following scarlatina and in other forms of tubular desquamative nephritis. But it is also very efficient in cardiac dropsy and in ascites of hepatic origin. In an inferior degree it is useful in splenic dropsy also. According to circumstances, it may be associated with squill, digitalis, parsley, broom, dandelion, etc. Under the title *potio Riverii* acetate of potassium has long been employed in acute febrile affections as a *diaphoretic*. This draught is made by saturating 2 drachms (Gm. 8) of carbonate of potassium with vinegar, and adding 6 ounces (Gm. 190) of sweetened water. A tablespoonful of it every two hours is the proper dose.

This salt should always be administered in a large quantity of liquid, except when it is prescribed as a diaphoretic. In febrile affections, as a sedative, its *dose* is 10 grains (Gm. 0.60). In acute articular rheumatism 30 grains (Gm. 2) may be given every four hours. As an alterative it may be prescribed in the same or in still larger doses. As a laxative the dose is about ½ ounce (Gm. 16).

POTASSII BICARBONAS, *U. S., Br.*—BICARBONATE OF POTASSIUM.

Potassæ bicarbonas, Br.; *Kalium bicarbonicum*, P. G.; *Kali carbonicum acidulum, Bicarbonas potassicus, s. kalicus.—Bicarbonate of potash*, E.; *Bicarbonate de potasse*, Fr.; *Kaliumbicarbonat, Doppelt-kohlensaures Kali*, G.

Formula $KHCO_3$. Molecular weight 100.

Preparation.—This salt was first prepared by Cartheuser (1757) from potash and ammonium carbonate. Cavendish originated the process which is still used, acting with carbonic acid gas upon a solution of the carbonate.

Take of Carbonate of Potash 1 pound; Distilled Water 2 pints; Hydrochloric Acid 1½ pints; Water 3 pints; White Marble, in fragments, 1 pound or a sufficiency. Dissolve the carbonate of potash in the distilled water, and filter the solution into a 3-pint bottle capable of being tightly closed by a cork traversed by a glass tube sufficiently long to pass to the bottom of the fluid. Introduce the marble into another bottle in the bottom of which a few small holes have been drilled, and the mouth of which is closed by a cork also traversed by a glass tube, and place the bottle in a jar of the same height as itself, but of rather larger diameter. Connect the two glass tubes air-tight by a caoutchouc tube. The cork of the bottle containing the carbonate of potash having been placed loosely, and that of the bottle containing the marble tightly, in its mouth, pour into the jar surrounding the latter bottle hydrochloric acid previously diluted with the water. When carbonic acid gas has passed through the potash solution for 2 minutes, so as to expel the whole of the air of the apparatus, fix the cork tightly in the neck of the bottle, and let the process go on for a week. At the end of this time numerous crystals of bicarbonate of potash will have formed, which are to be removed, shaken with twice their bulk of cold distilled water, and, after decantation of the water, drained, and dried on filtering-paper by exposure to the air. The mother-liquor, filtered if necessary, and concentrated to one-half at a temperature not exceeding 43.3° C. (110° F.), will yield more crystals. The tube immersed in the solution of carbonate of potash, which should have as large a diameter as possible, may require the occasional removal of the crystals formed within it, in order that the process may not be interrupted.—*Br.*, 1867.

Carbonate of potassium, kept in flat, open vessels in localities where saccharine liquids are undergoing vinous fermentation, is gradually converted into bicarbonate. The same salt is also obtained on passing carbonic acid gas over the moist carbonate. For preparing it on a small scale a rather concentrated solution of carbonate of potassium in water is made, into which carbonic acid gas is conducted. 1 molecule of this gas unites with 1 molecule each of potassium carbonate and water, forming 2 molecules of the bicarbonate, thus: $K_2CO_3 + H_2O + CO_2 = 2KHCO_3$. The bicarbonate being less soluble in water than the carbonate, a portion of it crystallizes out, the crystals being larger if they form slowly. To accomplish this the British Pharmacopœia directs a peculiar arrangement of the apparatus, by means of which the generation of carbonic acid is regulated by the rapidity with which it is absorbed by the solution, an excess of it remaining in the apparatus, displacing the acid liquid from the bottle containing the marble, thereby completely stopping the further generation of the gas until after partial absorption has taken place. When somewhat larger quantities of the salt are to be prepared, it is convenient to divide the solution among three or more vessels and pass the gas successively through them. In all cases the delivery-tube of the gas dipping into the solution should be of large bore, and preferably widened in the shape of a funnel, which precaution will prevent the closing of the tube by the crystallizing bicarbonate. Since the commercial carbonate of potassium is usually contaminated with silicate, silica is separated by the carbonic acid in the form of foccula, and may afterward be removed by agitating the crystals with cold water and decanting the liquid with the suspended silica. The remaining solution is then filtered and evaporated, or the liquid may be heated to a temperature not exceeding 60° C. (140° F.) until the crystals are dissolved, then rapidly filtered while warm, and, if necessary, further concentrated at the temperature mentioned, and set aside to crystallize. The complete saturation of the solution with carbonic acid is conveniently ascertained, according to Hirsch, by means of a very dilute solution of barium chloride, which yields no precipitate in the cold with bicarbonate, but at once a white one with carbonate of potassium. The crystals should be drained and dried at the ordinary temperature.

329,149 pounds of bicarbonate of potassium and saleratus were imported into the United States in 1876, and 1,571,012 pounds in 1883.

Properties.—Bicarbonate of potassium crystallizes in transparent, colorless, monoclinic prisms, which are permanent in the air, inodorous, and have a saline and slightly alkaline but not a caustic taste. When heated to near 200° C. (392° F.) it gives off carbonic acid and water, suffering a loss of 31 per cent. The salt is very sparingly soluble in alcohol, and at 15° C. (59° F.) dissolves in 3.2 (*U. S.*), 4 (*P. G.*) parts of water. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 23.23 parts, at 20° C. (68° F.) 26.91 parts, and at 60° C. (140° F.) 41.35 parts, of the salt; the solution has a slight alkaline reaction to test-paper, effervesces briskly on the addition of acids, yields with an excess of tartaric acid a white crystalline precipitate of potassium bitartrate, and parts with one-half its carbonic acid slowly when evaporated *in vacuo*, and rapidly when heated to the boiling-point. 5 Gm. of the salt exposed to a low red heat leave 3.45 Gm. of a white residue consisting of carbonate of potassium, which requires for exact neutralization 50 Ccm. of the volumetric solution of oxalic acid. 20 grains of bicarbonate of potassium neutralize 14 grains of citric acid or 15 grains of tartaric acid.—*Br.* A less pure bicarbonate of potassium in a pulverulent state is met with in commerce under the name of *sal aëratus*, but much sold as such is bicarbonate of sodium.

Tests.—The presence of carbonate of potassium causes the bicarbonate to become moist on exposure, and its solution in cold water to yield a white precipitate with sulphate of magnesium and a yellow or brick-red one with corrosive sublimate; the latter reagent produces a white precipitate with pure bicarbonate of potassium. The limit of carbonate is ascertained as follows: "If 1 Gm. of the salt be dissolved in 200 Ccm. of cold water, and the solution be carefully mixed, without agitation, with a solution of 1.22 Gm. of chloride of barium in 200 Ccm. of cold water, no precipitate or opalescence should make its appearance within 10 minutes."—*U. S.* Metallic salts, if present as impurities, remain behind on dissolving the salt in water, or are indicated by producing a precipitate on the addition of sulphuretted hydrogen. Other salts of potassium are best detected in the solution in 20 parts of water acidulated with nitric acid by nitrate of silver (chloride) or nitrate of barium (sulphate); no precipitate should be produced, but an opalescence is admissible. Sodium salts present as impurities will impart an intense yellow color to a non-luminous flame. The complete solubility of the salt in 4 parts of cold water excludes notable quantities of sodium bicarbonate.

Composition.—Bicarbonate of potassium represents 47 per cent. K_2O, 44 per cent. CO_2, and 9 per cent. H_2O.

Pharmaceutical Uses.—In the preparation of Liq. magnesii citratis, *U. S.*, *Br.*; Liq. potassæ, Liq. potass. arsenit., Liq. potass. citrat., *U. S.*; Liq. potass. efferves., *Br.*; Mistura potass. citrat., *U. S.*

Medical Action and Uses.—Bicarbonate of potassium increases the quantity of the urine and renders it alkaline. The very interesting experiments of Balfe (1878) show that when taken on an empty stomach the acidity of the urine on the day of administration is only slightly depressed, while on the day following the acidity is considerably higher than on the day before the salt was taken. But when it is administered during the process of digestion the acidity of the urine entirely disappears. This fact is readily explained by the different conditions of the stomach when it is empty and when it contains food. In the former case the acid salt is received into the stomach when its secretions are either neutral or alkaline, and is absorbed undecomposed into the blood; but when, on the other hand, it is taken during digestion, the acid contents of the stomach decompose it, carbonic acid is liberated, and escapes by the mouth, while the alkaline base passes into the system and causes the urine to assume an alkaline reaction. This explanation is, of course, as applicable to the sodium as to the potassium bicarbonate. This salt in ordinary doses of 10 or 15 grains does not appreciably affect the biliary secretion (Rutherford).

In the manner now described bicarbonate of potassium dissolves and eliminates an excess of *uric acid* in the system. Even when *stone* actually exists in the bladder, it lessens the irritability of the organ, diminishing the pain and the frequent necessity of urination. Doubtless, also, its primary action in the *primæ viæ* is to neutralize the excessive acidity of their contents, and thus, from the start, to prevent irritation of the nervous system. In *jaundice* depending upon high living or upon malarial poisoning, with enlargement of the liver, dyspeptic symptoms, constipation, and scanty and turbid urine, this salt is of signal advantage. In all of these cases its virtues probably depend upon its power of increasing the alkalinity of the blood and rendering the secretions more liquid. In *cutaneous eruptions* depending upon, or connected with, the previously mentioned conditions its virtues are unquestionable. Although bicarbonate of sodium is more generally employed than the potassium salt in the treatment of *diabetes*, the latter is nevertheless of great utility, and is by some authorities preferred, as promoting more effectually the elimination of uric acid. It is prescribed in doses of from 30 to 60 grains (Gm. 2–4) in 24 hours, dissolved in about 3 pints of water, which should be taken partly at intervals during and after meals with red wine. As a general rule, it may be stated, according to Balfe, that in cases of acid dyspepsia arising from the excessive formation of acid within the system, as in lithæmia, the alkaline bicarbonates should not be administered before food, but after, and that their administration before meals is indicated in those cases where the free acid is formed in the stomach itself, the result of fermentative changes of undigested food or morbid mucus, when it is necessary to diminish the too high degree of acidity thus caused in order to permit digestion to be properly performed.

POTASSII BICHROMAS, *U. S., Br.*—BICHROMATE OF POTASSIUM.

Potassæ bichromas, Br.; *Kalium bichromicum*, P. G.; *Bichromas kalicus.—Bichromate of potash*, E.; *Bichromate de potasse*, Fr.; *Kaliumdichromat, Doppeltchromsaures Kali*, G.

Formula $K_2Cr_2O_7$. Molecular weight 294.8.

Origin.—The metal *chromium* was discovered by Vauquelin in 1797 in a Siberian mineral which is composed of chromate of lead, but it is more abundantly found as *chrome iron ore*, which is a compound of chromic and ferrous oxides, $FeO.Cr_2O_3$. It is met with in several localities in the United States, in Russia, and in Sweden, and is used in preparing the bichromate.

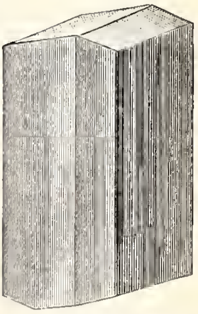
Preparation.—The ore is roasted, finely powdered, mixed with carbonate of potassium and chalk, and the mixture strongly heated in a current of air, which oxidizes the iron to ferric oxide, and the chromium to chromic acid, the latter combining with the potassium carbonate to chromate of potassium with the evolution of carbonic acid. To facilitate the oxidation a small portion of nitrate of potassium is sometimes added, but is not necessary; the chalk is used merely for preventing the mixture from fusing. After the roasting has been completed the mass is lixiviated with water, which dissolves neutral chromate of potassium, and the solution, after being acidulated with nitric or acetic acid, is evaporated and crystallized. Sulphuric acid is not as well adapted for this purpose, because the sulphate and chromate of potassium, being isomorphous, would crystallize together. The chrome iron ore may also be roasted with lime, in which case chromate of calcium is formed, which is dissolved in water and decomposed by carbonate or sulphate of potassium. During the year 1876–77 there were 2,471,669 pounds, and in 1881 4,404,237 pounds, of bichromate and chromate of potassium imported into the United States.

Properties.—Bichromate of potassium crystallizes in large yellowish-red transparent four-sided prisms or plates, which are inodorous and are not altered on exposure. The salt melts below a red heat to a transparent dark brown-red liquid, which on cooling crystallizes and finally falls into a crystalline powder. At a white heat the salt is decomposed into oxygen gas, green chromic oxide, and yellow chromate of potassium, which may be separated by dissolving the latter in water. Bichromate of potassium is insoluble in alcohol; it is soluble in water, 1 part of the salt requiring

at	0°	10°	20°	40°	60°	80°	100° C.,	
in	20.14	11.81	7.65	3.43	1.98	1.37	0.98	parts of water (Kremers);
in	21.76	13.51	8.06	3.86	2.22	1.46	1.06	" (Alluard).

The solution has an orange-red color, an acid reaction, and a bitter styptic, metallic taste, and is deoxidized, with the formation of chromic oxide or chromic salts, on the addition of sulphuretted hydrogen, sulphurous acid, or of sulphuric acid and alcohol, or other organic matters. Heated with hydrochloric acid, chlorine is given off. The solution yields a pale-yellow precipitate with chloride of barium, a yellow one with acetate of lead, and a purplish-red one with nitrate of silver, the three precipitates being soluble in nitric acid. With a cold saturated solution of sodium bitartrate a white crystalline precipitate of potassium bitartrate is produced.

FIG. 224.



Crystal of Potassium Bichromate.

Tests.—As met with in commerce, the salt is usually pure. Its solution in 100 parts of water should not be precipitated on the addition of excess of carbonate potassium (absence of calcium salt), and after having been acidulated with nitric acid should not be disturbed by barium chloride (absence of sulphates) or by silver nitrate (chlorides).

Composition.—The salt is free from water, and represents 31.86 per cent. K_2O and 68.14 CrO_3; it may be regarded as a compound of chromic anhydride with potassium chromate = $K_2CrO_4.CrO_3$, or as the neutral salt of *dipyrochromic acid*, $H_2Cr_2O_7$, which is not known in the uncombined state.

Other Chromates.—Chromate of Potassium, K_2CrO_4; molecular weight 194.4. It is obtained by adding carbonate of potassium to a hot solution of the bichromate as long as effervescence is observed; the solution changes in color to yellow, and yields on evaporation six-sided lemon-yellow crystals, which may be fused without decomposition and dissolve in less than 2 parts of water, the solution having an alkaline reaction. It is employed as a reagent.

Chromate of Lead, $PbCrO_4$, the well-known pigment known as *chrome-yellow*, *Paris yellow*, or *lemon-chrome*, is obtained by precipitating the solution of a lead salt with chromate or bichromate of potassium. It contains 68.9 per cent. of oxide of lead and 31.1 per cent. of chromic anhydride. On being digested with dilute solution of potassa or with chromate of potassium, it parts with one-half of its chromic acid, leaving a bright red basic compound, which, either pure or mixed with more or less chrome-yellow, is used as a pigment under the names of *American vermilion*, *chrome-red*, and *chrome-orange*. A mixture of chrome-yellow and Prussian blue in various proportions constitutes *chrome-green*.

Pharmaceutical Uses.—In the preparation of chromic acid, valerianic acid, and, dissolved in water, as a test liquid.

Medical Action and Uses.—A man after swallowing 3 drachms of bichromate of potassium was seized with vomiting, purging, and severe abdominal pains. The whole body was cold, and the hands shrivelled and blue; the face also was dusky; the breath was cold and the voice feeble. The mouth and throat were dark, thick, bloody mucus was vomited, the thirst was excessive, the pulse feeble and frequent, the respiration hurried, the urine suppressed, and continued so for several days. The patient recovered (*Med. News and Abst.*, Sept. 1881, p. 563). Falck refers to four cases of poisoning by this salt, of which two ended fatally, the doses in the fatal cases being respectively 8 and 15 Gm. (ʒii and ʒiv) (*Lehrbuch*, 1880, p. 144). Bichromate of potassium, applied topically, acts like chromic acid, but more mildly. It should therefore be preferred where the full escharotic action of the acid is not required. We have known it to act decidedly as a caustic upon the delicate integument behind the corona glandis when applied for the removal of *venereal warts*. Ordinary warts of the softer sort may generally be destroyed by it.

POTASSII BITARTRAS, *U. S.*—Bitartrate of Potassium.

Potassii tartras acida, Br.; *Tartarus depuratus*, P. G.; *Cremor tartari*, *Kali bitartaricum*, *Bitartras potassicus s. kalicus.*—*Acid tartrate of potash*, *Cream of tartar*, E.; *Bitartrate de potasse*, *Crème de tartre*, *Pierre de vin*, Fr.; *Weinstein*, G.

Formula $KHC_4H_4O_6$. Molecular weight 188.

Origin.—Acid tartrate of potassium is contained in many acidulous fruits, but is collected altogether from the juice of the grape, in which it becomes insoluble after fermentation, and is deposited in the casks in crystalline crusts. These form the *crude tartar* or *argol*, and consist of potassium bitartrate, with calcium tartrate, coloring and extractive matters, and yeast and other vegetable fragments. *Red argol* is deposited from red wines and has a brownish-red color; *white argol*, obtained from white wines, is gray or brownish-white. Crude tartar is not used medicinally, and little is collected in the United States; but the importation of it has increased from 6,965,015 pounds in 1876 to 18,313,544 pounds in 1882, while in the same years the importation of refined and partly-refined tartar has decreased from 2,582,651 to 82,887 pounds, and to 26,448 pounds in 1883.

Purification.—Crude tartar is boiled with water, much of the coloring matter precipitated by the addition of clay, the liquid filtered through animal charcoal or otherwise clarified, and crystallized. The operation has to be repeated several times. The amount of tartrate of calcium contained in crude tartar varies between about 5 and 15 per cent. Although this salt is insoluble in water, it dissolves to some extent (more in hot than in cold) solutions of tartrates; hence it cannot be completely removed from cream of tartar by simple recrystallization. However, the crystals forming on the side of the crystallizing-vats contain less of this impurity than the crusts deposited at the bottom, and by careful management the amount may be reduced to about 3 per cent or less.

To obtain it free from calcium salt, finely-powdered cream of tartar is macerated for 24 hours with 8 or 10 per cent. of hydrochloric acid, previously diluted with water, or it is dissolved in boiling water, the same amount of hydrochloric acid added, and the solution continually stirred while it cools. The mother-liquor is drained off, the crystalline powder washed with cold water, and dried. A considerable proportion of bitartrate of potassium remains in the mother-liquor, and may be utilized in the preparation of tartaric acid by neutralizing it with lime, when tartrate of calcium is deposited.

Properties.—When a hot solution of bitartrate of potassium is rapidly cooled the salt separates in very small crystals, which float on the liquid, and from this behavior it has received the name *cream of tartar.* The larger crystals, which are deposited, were formerly distinguished as *crystalli tartari.* They are rhombic prisms, and quite pure, are colorless, but as usually seen are more or less opaque from the presence of calcium tartrate. But in this form it is rarely kept in the shops, where it is almost exclusively employed in the form of powder. This is white, somewhat gritty, not altered on exposure, inodorous, and has a pleasant acidulous taste and distinct acid reaction. Bitartrate of potassium requires at 15° C. (59° F.) 210 (*U. S.*), 192 (*P. G.*) parts, and at 100 C° (212° F.) 15 (*U. S.*), 20 (*P. G.*) parts of water for solution; it is freely soluble, with the formation of neutral salts, in ammonia and potassa solution, and in solution of alkali carbonates, with the evolution of carbonic acid gas. It is insoluble in alcohol, is more soluble in dilute hydrochloric acid than in water, and is precipitated from this solution by alcohol; the solutions in dilute sulphuric and nitric acids, however, when mixed with alcohol, deposit sulphate and nitrate of potassium. The solutions in alkaline liquids again deposit the salt on being sufficiently acidulated with hydrochloric, acetic, or other acid. When neutralized with potassa or soda the aqueous solution yields with nitrate of silver a white curdy or crystalline precipitate of silver nitrate, which on boiling becomes brown, and then black. When heated in a crucible it evolves inflammable gas and the odor of burnt sugar, and leaves a black residue known as *black flux*, which is a mixture of potassium carbonate and charcoal; the latter is finally consumed on continuing the ignition with free access of air, leaving potassium carbonate or *white flux.* These fluxes are often made by deflagration of intimate mixtures of 2 parts of cream of tartar with potassium nitrate, using 1 part of the latter for the black, and 4 parts for obtaining the white flux. On subjecting potassium bitartrate to destructive distillation, carbonic acid, carbonic oxide, and various hydrocarbons are obtained in the gaseous state; also an aqueous liquid containing much acetic acid, a sublimate of pyrotartaric acid, various tarry products, and, in the retort, carbonate of potassium.

Tests.—The United States Pharmacopœia states that when bitartrate of potassium is treated with a hot solution of potassa whatever remains undissolved is impurity. In this way only the coarser adulterations, such as *terra alba* (see p. 329), sand, etc., or calcium tartrate if present as impurity to a considerable extent, can be detected. Cream of tartar has been adulterated with gypsum, chalk, alum, amylaceous substances (stale bread, etc.). These substances are best detected by treating the powder with an excess of ammonia, wherein it should be completely soluble, and the solution should not be precipitated by hydrosulphuric acid (absence of copper, iron, etc.), and should become merely opalescent by oxalate of ammonium (calcium salts). The residue left by ammonia will acquire a blue color on the addition of iodine if starch is present; cold dilute hydrochloric acid added to the residue will leave terra alba, starch, and some gypsum undissolved, and produce effervescence if chalk is present. The acid solution, mixed with an excess of acetate of ammonium or sodium, should not yield white precipitates with ferric chloride (phosphates), ammonia (alumina), or carbonate of ammonium (calcium salt). Chlorides and sulphates are most conveniently detected in the aqueous solution of cream of tartar, which, after addition of a few drops of nitric acid, should not be precipitated by barium nitrate (sulphates) or silver nitrate (chlorides). "204 grains heated to redness till gas ceases to be evolved leave an alkaline residue, which requires for exact neutralization at least 1000 grain-measures of the volumetric solution of oxalic acid."—*Br.* This test proves the absence of more than 7.8 per cent. of admixtures and impurities. The U. S. Pharmacopœia requires the total absence of sulphate and chloride, but admits not more than 6 per cent. of calcium tartrate; the German Pharmacopœia permits the presence of traces of chloride, and of not more than ¼ per cent. of calcium tartrate. For the detection of the latter both pharmacopœias have adopted the test proposed by Biltz: 1 Gm. of the salt is repeatedly agitated and macerated for half an hour with 5 Gm. of acetic acid (Acidum aceticum dilutum, *P. G.*): then diluted with 25 Gm. of distilled water (sufficient to make 500 Ccm. *U. S.*), and the filtrate (25 Ccm. of the filtrate, *U. S.*) is mixed with 8 drops (5 Ccm. *U. S.*) of test solution of ammonium oxalate, when it should not become cloudy in less than 1 minute (*P. G.*), nor distinctly turbid in less than 1½ minutes (*U. S.*). The diluted acetic acid (*P. G.*) is nearly identical with the acetic acid (*U. S.*). In the above test with 8 drops of ammonium oxalate a turbidity beginning after ½, 1, or 2 minutes indicates respectively ⅓, ¼, or ⅙ per cent. of calcium oxalate.

Composition.—Bitartrate of potassium does not contain any water of crystallization. Each molecule contains 1 atom of potassium, and 25 per cent. of its weight is represented by K_2O, and on ignition 36.7 per cent. of K_2CO_3 is left.

Pharmaceutical Uses.—In the preparation of Acid. tartaricum, Antim. et potassii tartras (Antimonium tartaratum), Ferri et potassii tartras (Ferrum tartaratum), Potassii et sodii tartras (Soda tartarata), and Potass. tartras, *Br.* It is an ingredient of Confectio sulphuris, *Br.*, and Pulv. jalapæ comp., *U. S.*, *Br.*

Medical Action and Uses.—In full doses cream of tartar is refrigerant, laxative, and diuretic; the last operation, however, is more evident after small doses given in a large proportion of water. It is apt to disturb digestion by causing flatulence and griping, and, when long continued, to impair nutrition. In excessive doses it may act poisonously, causing vomiting, purging, thirst, colic, and great exhaustion, even to paralysis, which may terminate fatally.

In *febrile* diseases a weak solution of the salt moderates vascular excitement and augments the secretion of urine. For this purpose it is conveniently dissolved in lemonade. As a purgative it is frequently associated with sulphur, magnesia, or jalap. With sulphur or with confection of senna it forms a convenient laxative in cases of *hæmorrhoids.* With jalap it is often used as a hydragogue cathartic in *dropsy*, and especially in anasarca, and as a diuretic in the same disease, dissolved in an infusion of juniper-berries. With magnesia it has been recommended in *habitual vomiting* arising from gastric acidity, and in pregnancy.

The *dose* of cream of tartar, as a cathartic, is from ½ ounce to an ounce (Gm. 32–64); as a diuretic, from 60 to 120 grains (Gm. 4–8) in water, largely diluted and taken in divided doses. For the same purpose whey may be employed, prepared by adding 120 grains (Gm. 8) of the bitartrate to a pint of milk.

POTASSII BROMIDUM, *U. S.*, *Br.*—BROMIDE OF POTASSIUM.

Kalium bromatum, P. G.; *Bromuretum potassicum, s. kalicum.*—*Bromure de potassium*, Fr.; *Bromkalium*, *Kaliumbromid*, G.

Formula KBr. Molecular weight 118.8.

Preparation.—Combine 2 ounces of bromine with sufficient iron (1 ounce) in the presence of 24 ounces of water until a green solution is obtained; filter, add solution of 2⅛ ounces of pure potassium carbonate in 24 ounces of water until it ceases to produce a precipitate; heat the mixture for half an hour; filter, wash the precipitate with hot water, evaporate the filtrate, and crystallize.—*U. S.* 1870. Take of solution of potash 2 pints; bromine 4 fluidounces or a sufficiency; wood-charcoal, in fine powder, 2 ounces; boiling distilled water ½ pint. Put the solution of potash into a glass or porcelain vessel, and add the bromine in successive portions, with constant agitation, until the mixture has acquired a *permanent* brown tint. Evaporate to dryness, reduce the residue to a fine powder, and mix this intimately with the charcoal. Throw the mixture in small quantities at a time into a red-hot iron crucible, and when the whole has been brought to a state of fusion remove the crucible from the fire and pour out its contents. When the fused mass has cooled dissolve it in the water, filter the solution through paper, and set it aside to crystallize. Drain the crystals and dry them with a gentle heat. More crystals may be obtained by evaporating the mother-liquor and cooling. The salt should be kept in a stoppered bottle.—*Br.*

In the first process ferrous bromide is formed by the action of bromine upon iron, and the solution of this salt, which is of a green color, is decomposed by potassium carbonate, resulting in the production of potassium bromide, which remains in solution, and of a white precipitate of ferrous carbonate; $FeBr_2 + K_2CO_3$ yields $2KBr + FeCO_3$. The latter is very bulky, but by boiling it for some time is converted into a denser ferric hydrate, which is more readily washed out with water than the carbonate. On concentrating the filtrate, crystals of potassium bromide are obtained.

On adding bromine to solution of potassa, 5 molecules of bromide and 1 of bromate of potassium are produced; $3Br_2 + 6KHO$ yields $5KBr + KBrO_3 + 3H_2O$. By evaporating the solution to dryness, mixing the salts with charcoal, and heating to redness, the bromate is deoxidized to bromide, while the oxygen unites with the charcoal, forming carbonic oxide, which escapes; $KBrO_3 + C_3$ yields $KBr + 3CO$. Dissolving in water and concentrating the solution will yield the bromide in crystals. Instead of deoxidizing with charcoal, the same result may be attained by passing sulphuretted hydrogen through the solution, when the hydrogen of the latter will unite with the oxygen of the bromate, forming water, while sulphur is liberated and requires to be separated by filtration; $KBrO_3 + 3H_2S$ yields $KBr + 3H_2O + S_3$.

On treating a solution of calcium bromide (see p. 349) with potassium sulphate and filtering from the precipitated gypsum, the liquid will yield potassium bromide, requiring recrystallization for obtaining it pure. The salt is extensively manufactured in the United States.

Properties.—Pure bromide of potassium crystallizes in colorless cubes which are neutral to test-paper. As met with in commerce, the crystals are white, glossy, and, having been obtained from an alkaline solution, have a slight alkaline reaction. It is permanent in the air, inodorous, has a pungent, saline taste, and when heated decrepitates, melts at a dull red heat, and on cooling congeals again to a transparent mass; at a bright red or at a white heat it is slowly volatilized without decomposition. According to Kremers (1856), 1 part of this salt dissolves at 0° C. (32° F.) in 1.87, at 20 °C. (68° F.) in 1.55, at 40° C. (140° F.) in 1.34, and at 100° C. (212° F.) in 0.98 part, of water. It is sparingly soluble in alcohol, requiring of it about 200 parts (or, according to Hager, 180 parts) of 90 per cent. alcohol; "it dissolves in 16 parts of boiling alcohol."—*U. S.* The aqueous solution yields a white crystalline precipitate on the addition of tartaric acid or of a saturated solution of sodium bitartrate, and on the addition of a few drops of chlorine-water liberates bromine, which dissolves in ether, chloroform, or carbon disulphide with a reddish-yellow or brown-yellow color, which in the last two solvents will have a violet tint if iodide be present. 1 Gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.579 Gm. of dry bromide of silver.

Tests.—Crystals or fragments of the crystals of the salt laid upon moistened red litmus-paper should not at once produce a violet-blue stain (absence of more than about 0.1 per cent. of alkali).—*U. S.*, *P. G.* A little of the powdered salt taken up with the loop of a platinum wire and held in a non-luminous flame should to the latter at once impart a violet color.—*P. G.* The crushed salt should not with diluted sulphuric acid at once assume a yellow color (absence of bromate).—*U. S.*, *P. G.* 20 Ccm. of a 5 per cent. solution of the salt should not become turbid with 4 drops of a solution of nitrate of barium (*P. G.*), or should not produce an immediate cloudiness or precipitate with 5 or 6 drops of the same test solution (*U. S.*). 1 Gm. of the salt dissolved in 10 Ccm. of water should, after the addition of a few drops of test solution of ferric chloride and of some chloroform, not impart a violet color to the latter (*P. G*); the same solution, on being mixed with some gelatinized starch, and on the careful addition of a few drops of chlorine-water upon the top of the mixture, should not produce a blue zone at the line of contact of the two liquids (*U. S.*). Both tests prove the absence of iodide. If 3 Gm. of the well-dried salt be dissolved in distilled water to make 100 Ccm., and 10 Ccm. of this solution be treated with a few drops of test solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not less than 25.14 Ccm. (*Br.*), and not more than 25.5 (*Br.*), 25.7 (*U. S.*), 25.6 (*P. G.*) Ccm. of the latter should be consumed before the red color ceases to disappear on stirring. 0.3 Gm. of pure potassium bromide would require 25.25 Ccm. of the volumetric solution, but in the presence of 2 or 3 per cent. of potassium chloride 25.6 or 25.7 Ccm. respectively are necessary. A very delicate test for chloride is the following: To a solution of the salt are added bichromate of potassium and sulphuric acid, and the mixture distilled; the distillate will contain *chlorochromic anhydride*, CrO_2Cl_2, and after neutralization with ammonia will have a yellow color and show the reaction of chromates.

Physiological Action.—*On Animals:* Experiments on various animals demonstrate that the effects of bromide of potassium are not due to the action of the salt upon the nervous centres alone, but upon all the parts which immediately fall under its influence. It is indeed correctly described as a sedative of the heart and of the cerebro-spinal centres, for whether administered to animals by the stomach or hypodermically the following phenomena occur: paralysis of the hind legs and of the thoracic muscles, irregular and feeble action of the heart, paralysis of the iris, evacuation of the bowels, and death, usually by asthenia, but sometimes preceded by tetanic spasms. Paralysis of motion precedes that of sensation, and the loss of both functions is primarily due, not to an impression upon the great nervous centres, but upon the nervous extremities; for the loss of function begins in the extremities and advances toward the spinal cord and brain, voluntary motion and the respiratory act not ceasing until after complete spinal paralysis. Administered by the stomach, the first effect upon the circulation is to produce languor of movement in the capillary blood-vessels, which is due chiefly to the sedative action of the salt upon the heart, and, as a necessary consequence, a diminution of the calibre of those blood-vessels. The heart, however, continues to beat until all other signs of life become extinct. But if the bromide in a large dose is applied directly to the heart or injected into the veins, death takes place by syncope, the paralyzed heart remaining after death distended. Applied immediately to the capillary vessels, it primarily stimulates and contracts them. The opinion has been advanced, as the result of experiment, that it is not the bromine nor the bromide of potassium, but the potassium alone, which occasions the striking phenomena of sedation in the nervous and muscular systems. It is probable that the diminished frequency and force of the heart may be due to this element, and hence the lowering of the temperature; but no other potassium salt than the bromide diminishes the reflex excitability or occasions sleep, or produces either the acneïform eruption or the group of phenomena described as bromism (Krosz), nor does any other have the slightest influence in preventing epileptiform attacks. That the bromine is essential to the production of these effects is proved by their occurring when, instead of combinations of bromine with alkalies, hydrobromic acid, bromated acetic acid, bromo-benzol, etc. are employed (Steinauer).

On Man: The functional effects of bromide of potassium, generally manifested after the prolonged use of the salt in daily doses of from 40 to 120 grains, are usually such as these: The fetid odor of bromine upon the breath, redness of the soft palate, and an increased or diminished secretion of saliva; diminution, and even abolition, of the reflex sensibility of the palate, the root of the tongue, and the epiglottis, without diminution of the sensibility of those parts to contact and to pain; frequently a craving appetite for food, but sometimes a complete suspension of this function; constipation; some diuresis, or else arrest of the urinary secretion; sedation or complete suspension of sexual desire; diminution and retardation of the menses; pulmonary catarrh; a general heaviness or inertness, drowsiness, diminished clearness of the intellect; sleep, which is generally natural, but sometimes resembles the most profound lethargy; sedation of the excito-motor functions of the spinal marrow and an impairment of the general sensibility; the memory, especially for words, is enfeebled, and they are often strangely misused; eruptions, of acne principally, sometimes of ulcers or boils, or of eczema, appear upon the skin, which grows muddy or bronzed (the presence of bromine in the pustules of acne has been chemically demonstrated). In rare cases a form of eruption occurs in infants which may be described as a hypertrophic or papillomatous dermatitis. The eruption has been compared to a half-ripe raspberry; the papules degenerate, and, if neglected, form sanious ulcers (Parker, *Trans. Clin. Soc.*, xii. 199; Seguin, *New York Med. Record*, xxii. 474). The muscles are enfeebled and their co-ordinated movements imperfect; the gait is unsteady and tottering, and frequently there is loss of flesh. In the more striking cases of bromism the patient is excessively feeble and depressed; the sight and hearing lose their acuteness; the gums are red, swollen, and painful; the nostrils are filled with hardened mucus, and diarrhœa exhausts the strength; there is sometimes profuse sweating or incontinence of urine and feces; pulmonary catarrh impedes respiration, and occasionally death takes place, with febrile symptoms and coma. In exceptional cases mental derangement is superadded, with maniacal violence and hallucinations. It is related that a hemichoreic woman took 610 grains of this salt in three days. "The patient suddenly developed delirium, which continued after the bromide was stopped. Subsequently, she became apathetic and semi-idiotic" (*Med. Record*, xx. 627).

It has been remarked that children of from seven to fifteen years of age tolerate larger doses of the bromide than other persons, and are less apt than adults to become dull and sleepy or to have their muscular co-ordination impaired. This peculiarity is probably due to the rapid elimination of the salt, especially by the salivary glands, the kidneys, and the skin. It is stated that while a nursing mother was taking 30 grains of bromide of potassium daily her infant became emaciated and anæsthetic, and its urine contained potassa. The child speedily recovered on ceasing to use its mother's milk (*Med. Record*, xxii. 336).

All of the phenomena produced by bromide of potassium appear to depend upon its power of restricting the capillary circulation. This seems to be a legitimate inference from the inhibitory and paralyzing influence it exerts upon the spinal nervous system, including, especially, its anaphrodisiac and anti-spasmodic operation, and from its influence on the brain in producing its characteristic sleep and in palliating pain. If, as seems probable, it causes contraction of the capillary blood-vessels, as well as sedation of the heart's action, the phenomena alluded to may be ascribed to these agencies, as may also those morbid alterations of nutrition above described. Since this judgment was written the observations of Dr. Mary Putnam Jacobi on the human brain exposed by an opening in the cranium have been published. They led to the conclusion that bromide of potassium produces a contraction of the smallest blood-vessels and capillaries, the larger remaining the same; or, in other words, that it limits directly the nutrition, and therefore the activity, of the organ.

Medical Uses.—As is usual in the history of medicines, the virtues of bromide of potassium were discovered accidentally. The high price of iodide of potassium, which is so largely used in the treatment of constitutional syphilis, caused a trial to be made of the bromide in the hope that it might serve as a substitute for the more costly salt. The result showed that the scientific anticipation was totally unfounded, but at the same time it revealed the sedative, anæsthetic, and hypnotic virtues of the medicine, and led to its more suitable use in therapeutics, at first in allaying priapism and other forms of sexual excitement, then in hysteria and in hystero-epilepsy, and finally in epilepsy itself. Since then it has been employed in numerous diseases, especially of the nervous system.

In *sleeplessness* depending upon nervous excitement, exhaustion, and irritability—in hysterical and maniacal wakefulness, for example—rather than upon cerebral hyperæmia as it occurs in sthenic inflammatory diseases, the utility of the medicine is most conspicuous. This fact is not altogether incompatible with the probable theory which ascribes the hypnotic virtues of the bromide to its power of diminishing the amount of blood in the brain, but is more in accordance with the view that it causes sleep by anæsthetizing the organ, precisely as it does in the fauces and other parts when directly applied to them. It is a valuable substitute for opiates in those cases of infantile wakefulness which depend more upon nervous erethism than upon pain or any local disease. In the last-named cases a dose of 10 grains (Gm. 0.60), repeated if necessary, will suffice, but in adults from 20 to 40 grains (Gm. 1.30–4) should be administered every hour or two until the proper effect is secured. This may be promoted by cold ablutions of the head or prolonged tepid general baths.

Neuralgia occurring in connection with general nervous erethism induced by exhausting causes, or with a state of hypochondriac melancholy, with more or less functional derangement of the stomach, heart, etc., or with an overstrained nervous system goaded by unsatisfied sexual desires, has been repeatedly palliated, and sometimes cured, by this medicine. The best result is most apt to be reached in the last-named form of the disease. But a case is on record in which a man of sixty-two, who had suffered from tic-douloureux for 28 years, was completely cured in a fortnight by the daily administration of 100 grains (Gm. 7) of the bromide, given in divided doses (Peter).

In almost all forms of *insanity* attended with excitement and insomnia this preparation is of great value, no other having an equal power of allaying the symptoms with so little risk of injury. In *delirium tremens* it is equally efficient, but it is less so in mania-a-potu. In the latter it should be associated with cold baths. In *chorea* no other medicine exerts as powerful a restraint upon the movements or more frequently leads to a permanent cure. But the greatest triumph of bromide of potassium is shown by its control over *epilepsy*, a disease more intractable than any other that is not inherently fatal. In this connection the experiments of Albertoni are of high interest (*Archiv. f. exp. Pathol, etc.*, xx. 251). In a number of animals he tested the epileptogenous zone on one side of the brain, and found that convulsive attacks were excited by irritating it. He then administered full doses of bromide of potassium until its physiological effects were developed, and, having exposed the sensitive centre of the uninjured side of the brain, he found that irritation of it no longer brought on convulsions. When epilepsy is congenital or is caused by traumatic or other substantial lesions, this medicine, like all others, may be altogether inefficacious. The nearer the disease approaches to a purely functional disorder, the more amenable it is to treatment, and therefore the more so in proportion as it is of recent origin and before those alterations of nutrition have taken place in the blood-vessels and in the substance of the nervous centres which render the disease inveterate. Such, at least, is, as we conceive, the more judicious opinion; but in the judgment of some neither the cause, degree, nor duration of the disease enables one to judge how well or ill it may be affected by the medicine. All are, however, agreed that it must be administered in full doses and for a long time—in daily doses amounting to not less than 60 grains (Gm. 4) and gradually increased as its active power declines. Whether or not radical and absolute cures are ever made of genuine epilepsy is undetermined, but the great preponderance of opinion is unquestionably upon the negative side of the proposition. The most authoritative judgment is, that the epileptic is never secure against a return of his attacks, and that if he is prudent he will, in spite of an apparent cure, continue to use the medicine at intervals for the remainder of his life, or, as one has phrased it, it should become, as it were, his daily bread. It has been customary in the treatment of epilepsy to employ a prescription containing, besides bromide of potassium, the bromides of sodium, and ammonium, and also the iodide of potassium and the carbonate of ammonium, the whole dissolved in water and flavored with tincture of colombo. The bitter saline taste of this mixture soon renders it very disagreeable to many persons who can take without serious repugnance a simple solution in water of one or more of the salts. It may very well be questioned whether the presence in the above formula of any of the salts except the bromides of potassium and ammonium increases its efficacy.

In *tetanus*, idiopathic as well as traumatic, this bromide has exhibited decided curative powers, and some cases have recovered after enormous quantities of it had been taken. In one successful case about a pound of the salt was consumed in the treatment, and in another 13 ounces were used in 20 days. In *poisoning by strychnia* the results have been equally striking and conclusive, and confirm clinically what physiological experiment had before demonstrated, that bromide of potassium is a true antagonist of strychnia. It is remarkable that a medicine supposed to have a special influence upon the nervous centres connected with the genital organs should not have proved more curative of *hysteria* than of epilepsy itself. Clinical experience, however, shows its influence over hysterical attacks to be very slight and transient; and yet, on the other hand, it is efficacious in certain *local hysterical spasms*, as of the eyelids, œsophagus, and facial muscles, connected with uterine irritation. *Infantile convulsions*, arising from teething and other eccentric causes of irritation, have repeatedly been arrested by this medicine, which may be administered by the rectum if it cannot be given by the mouth in doses of from 5 to 10 grains (Gm. 0.30–0.60), repeated every hour. In some cases of *puerperal convulsions* it has proved equally efficacious, but is probably a less reliable remedy than the anæsthetics. In *whooping cough* bromide of potassium has been employed by the stomach and also by the inhalation of its atomized solution. By the former method the spasmodic element is eliminated in part indirectly, and by the latter through a direct anæsthetic action upon the larynx. In this manner one of the most dangerous factors of the disease is removed. For inhalation there may be used a solution of 2 grains of the salt in an ounce (Gm. 0.12 in Gm. 32) of water. *Spasmodic asthma* has been treated in the same manner, and with notable advantage. *Spasmodic vomiting*, due to reflex irritation, as in *pregnancy*, is sometimes controlled by the bromide, especially when full doses of 60 to 90 grains (Gm. 4–6) are given either by the mouth or the rectum. Usually, the latter mode of administration is to be preferred, or, if the medicine is given by the stomach, it should be in small and repeated doses. It need hardly be remarked that an essential part of the treatment consists in rectal alimentation. For this purpose the pancreatic emulsion is the most appropriate agent. The *vomiting of phthisis*, which is so serious a symptom in the advanced stages of the disease, may generally be controlled by applying a strong solution of the salt to the pharynx and larynx by means of a brush or by atomization. Bromide of potassium appears to be the most successful medicine hitherto used in *sea-sickness*. It should be taken in the dose of about 10 grains in cold water flavored with tincture of ginger, before meals and at whatever times nausea is marked. *Mercurial tremor* and *nervous palpitation* of the heart are favorably influenced by this bromide. The latter affection is oftenest relieved when associated with functional *angina pectoris*.

Bromide of potassium, it has already been stated, even when freely used by healthy persons, blunts or suspends both sexual desire and power, and it has been employed with great advantage when erections of the penis result from morbid conditions either of the sexual organs or of the nervous centres. There is no more efficient preventive of *chordee* produced by gonorrhœa, of the persistent *erections* so frequently met with in infants, and those which sometimes follow the application of cantharidal blisters. The same is true of certain less ordinary cases of persistent *priapism*, as well as of the common examples of nocturnal *seminal emissions*, especially as they occur in young men of chaste life and sedentary habits and in those who have been more or less addicted to self-abuse. Not less serviceable is it in relieving nocturnal *incontinence of urine* in children. It has also been used with excellent results in those cases of hysteroidal excitement which verge on *nymphomania*. In these instances large doses of the medicine must be employed. Instead of being administered by the mouth, the bromide may be injected into the rectum or the bladder in cases like those enumerated or of more substantial disease of these organs. A solution of 1 : 20 has been found the most useful. Its anæsthetic virtues are also shown in its allaying the pain of *teething* when it is applied to the swollen gums mixed with honey or in watery solution. It alleviates *toothache* when introduced into a carious cavity. In a lotion the salt palliates the burning and stinging of *urticaria* and the itching in some other diseases of the skin.

Several examples have been published which go to prove that bromide of potassium is occasionally successful in curing *intermittent fever* when quinine and arsenic have failed; and even when, after the cure of the paroxysmal attacks, the *spleen* remains enlarged, it is asserted that no other remedy so promptly and certainly reduces it to its normal dimensions as this preparation. It need not usually be prescribed in larger doses than 15 or 20 grains (Gm. 1–1.30) a day. In the defective sight or *amblyopia* sometimes produced by intemperance this bromide has been found very useful when given in doses at first of 10 grains (Gm. 0.60) three times a day, and gradually increased until its specific effects upon the nervous system begin to show themselves. It probably acts by diminishing the congestion of the cerebral blood-vessels. Several other diseases have been reported to be curable by it, among others *diphtheria*. But an examination of the evidence produced in the discussion of the subject leaves no doubt that this bromide, like all topical applications whatever, has not the least influence on the course and issue of the disease. At best, it may hasten the separation of false membrane from the pharynx, but of this the evidence is far from conclusive.

The association of bromide of potassium with quinine, and also with iron, is said to prevent the headache, throbbing, and general discomfort which some persons experience on taking those medicines, and also the nauseant and depressing effects which occasionally follow the use of opiates.

The anæsthetic action of the medicine upon the *pharynx* and *larynx* has already been referred to in connection with ulcerated states of these organs; the same influence is resorted to for facilitating the use of the laryngoscope, and for lessening the irritability of the *urethra* when the introduction of instruments through it is required. In the treatment of *gangrenous sores* its antiseptic virtues may be invoked.

The *acneïform eruption* produced by the continued use of bromide of potassium, and which with many patients forms a serious objection to its use, may very generally be prevented, as Echeverria first pointed out (1870), by adding to each dose of the bromide from 5 to 8 minims of Fowler's solution. This dose of the latter medicine is entirely too large, and cannot be continued, as it must be to prevent the eruption. Gowers (1878) recommended doses of from 1 to 5 minims, and stated that they need not bear any direct proportion to the degree of the eruption, which, he adds, occurs not only with bromide of potassium, but also with the sodium salt, and still more readily with bromide of ammonium. Duckworth recommends the use of the following lotion: ℞. Precipitated Sulphur ʒij; Spirit of Camphor fʒj; Lime-water f℥ij; twice a day after washing the skin with oatmeal gruel instead of soap (*St. Bart's Hosp. Rep.*, xv. 15). In this country Indian corn meal would be preferable. Prowse recommended a solution of 1 grain of salicylic acid in an ounce of water, to be applied frequently (*Brit. Med. Jour.*, Aug. 1880, p. 127).

The commencing *dose* of bromide of potassium is from 3 to 30 grains (Gm. 0.20–2), according to the age of the patient. It is necessary to repeat the dose several times a day, and in most cases to increase it until its specific effects begin to appear. It should then be reduced or for a brief space of time suspended.

POTASSII CARBONAS, *U. S., Br.*—CARBONATE OF POTASSIUM.

Potassæ carbonas, Br.; *Kalium carbonicum (purum, s. e tartaro)*, P. G.; *Carbonas potassicus, s. kalicus, Potassii carbonas purus*, U. S. 1870; *Sal tartari.—Carbonate of potash (potassa)*, E.; *Carbonate de potasse*, Fr.; *Kaliumcarbonat, Kohlensaures Kali*, G.

Formula $(K_2CO_3)_23H_2O$. Molecular weight 330.

Origin and Preparation.—Carbonate of potassium is contained in many mineral waters, and is met with in the animal economy chiefly after the administration of citrate or tartrate of potassium. Plants take their inorganic constituents from the soil, and when incinerated leave them behind as *ashes.* The ash of most plants contains potassium, sodium, calcium, and magnesium in combination with chlorine, carbonic, sulphuric, phosphoric, and silicic acids, usually ferric oxide, and occasionally some other elements. As a general rule, plants grown near the seashore yield an ash rich in sodium, and those grown inland an ash in which potassium salts predominate. Succulent plants or parts of plants generally yield a larger percentage of ash (calculated for the exsiccated substance) than dry or woody parts. The amount of ash and its constituents necessarily varies to a certain extent, being influenced by the nature of the soil, the age of the plant, and by various other causes; the composition of the ash and of its soluble portion must therefore vary for the same species. Among the vegetables which yield an ash rich in potassium salts must be mentioned *corn-cobs*—that is, the fully-developed axis of the fruit-spikes of Zea Mays, *Linné*, after having been deprived of the corn. Examined by H. Hazard (1872), they were found to contain, on an average, when air-dried, 0.762 per cent. of carbonate of potassium, which may easily be obtained in a nearly pure state; and, estimating the corn crop of the United States at 1.100.000.000 bushels, and 14 pounds of cobs to the bushel, he calculated that 115,000,000 pounds of this alkali could be obtained from that source alone.

At the present time this article is chiefly obtained in those countries, as in some parts of Europe and North America, where wood is cheap or where its transportation to more remunerative markets is too costly, by burning the wood and lixiviating the ashes. The solution is obtained as concentrated as possible by passing the weaker liquids through fresh portions of ash, afterward evaporated and heated in iron vessels, so that on cooling it will solidify to a very hard mass; this constitutes the *crude potash* of the market. This crude potash is of a more or less deep-brown, reddish-brown, or bluish color, due to organic impurities and to iron, copper, or manganese; it is deliquescent on exposure and has a very caustic taste. It is not recognized by any of the pharmacopœias.

Large quantities of potash are at present prepared from the ash obtained from the residue of beet-sugar manufacture, which contains about one-third its weight of this salt, and is freed from other potassium and sodium salts by allowing these to crystallize from concentrated solutions at different temperatures. On washing the fleeces of sheep with water, evaporating the solution, and igniting the residue, an ash is obtained containing but a small percentage of sodium salts and a larger proportion of chloride and sulphate of potassium. The potassium salts obtained in these processes, notably in the former one in large quantities, also the potassium salts from the Stassfurt mines, are by suitable processes converted into potassium sulphate, and this salt into carbonate by a process similar to that of Leblanc for soda (see Sodii Carbonas), by heating the sulphate with lime and charcoal, whereby carbonate of potassium and an insoluble oxysulphide of calcium are formed. Balard (1865) found it advantageous to employ not pure sulphate of potassium, but a salt containing about 20 per cent. of magnesium sulphate, which leaves the product of ignition in a porous condition, so that it may readily be exhausted by water.

Various methods of obtaining carbonate of potassium from other sources have been recommended, and to some extent are used. E. Meyer (1857) proposed to ignite an intimate mixture of 10 parts of *feldspar* (silicate of aluminium and potassium) with from 14 to 18 parts of lime, to boil the mass with water under pressure, and to evaporate the solution, at the same time conducting the products of combustion over the liquid, in order to convert the caustic potassa into carbonate and to precipitate the alumina which was in solution.

1. Potassii carbonas impurus, *U. S.* 1870; Kalium carbonicum crudum, *P. G.*; Cineres clavellati.—Impure carbonate of potassium, Pearlash, *E.*; Potasse impur, *Fr.*; Rohe Pottasche, *G.*—This is the white salt, still impure, the preparation of which has been described above. It is at present only recognized by the German Pharmacopœia, which for the anhydrous or nearly anhydrous salt requires it to contain 90 per cent. of potassium carbonate, and 2 Gm. of it to be neutralized by not less than 26.7 Ccm. of normal hydrochloric (or oxalic) acid.

2. Potassii carbonas, *U. S.* 1870; Kali carbonicum depuratum, *P. G.* 1872.—Carbonate of potassium, *E.*; Carbonate de potasse, *Fr.*; Gereinigtes kohlensaures Kali, *G.*—This salt, no longer officinal, but frequently found in the shops, is prepared by treating the preceding with its own weight of cold water, decanting the clear solution, evaporating it in a bright iron vessel, and granulating.

3. Officinal Potassium Carbonate. For its preparation the following directions were given in the U. S. P. 1870: Take of bicarbonate of potassium, in coarse powder, 12 troyounces; distilled water 12 fluidounces. Put the bicarbonate of potassium into a capacious iron crucible; heat gradually until the water of crystallization is driven off; then raise the heat to redness, and maintain that temperature for half an hour. Having taken the crucible from the fire and allowed it to cool, dissolve its contents in the distilled water and filter the solution. Pour this into an iron vessel and evaporate over a gentle fire until it thickens. Lastly, remove it from the fire, and stir constantly with an iron spatula until it forms a granular salt.

When an organic salt of potassium is ignited, the residue left contains carbonate of potassium. Cream of tartar, being the most common salt available for this purpose, was formerly more extensively employed than at present for preparing pure carbonate of potassium; hence the name *salt of tartar*, which is, however, in the United States usually employed as a synonym for *purified* carbonate of potassium. In making carbonate from the bitartrate of potassium, the latter is usually mixed with saltpetre, which should be entirely free from chloride, and then deflagrated by throwing the mixture in small portions into a red-hot crucible, when the potassium of both the bitartrate and nitrate is left behind as carbonate. In this way *black* and *white flux* are prepared, of which the latter usually contains nitrite of potassium. By exhausting the black flux with water and evaporating the solution a very pure carbonate of potassium is obtained.

Since pearlash contains, besides carbonate, various other soluble salts of potassium and sodium, a pure carbonate cannot be obtained from it, though many of the foreign salts may be removed by the use of cold water in small quantities in which the other salts are less soluble than the carbonate. But by converting the carbonate into bicarbonate the latter salt may be obtained nearly chemically pure, and when heated to redness will give off water and carbonic acid, and leave an equally pure carbonate; $2KHCO_3$ yields $K_2CO_3 + H_2O + CO_2$. In these operations only silver or clean iron vessels should be employed, for reasons explained under POTASSA.

Properties.—Carbonate of potassium in its pure state is a white inodorous salt, sometimes crystalline, but usually in the form of a granular powder, which has a strong alkaline reaction and a strongly alkaline but scarcely a caustic taste, and is deliquescent in the air, forming a colorless or yellowish liquid of an oily appearance (*Oleum tartari per deliquium*). It is soluble in its own weight of cold water and in two-thirds its weight of boiling water, and from its concentrated solution may with some difficulty be obtained in transparent crystals containing 16.36 per cent. of water. It is insoluble in alcohol, dissolves in dilute acids with effervescence, and has the chemical behavior of potassium salts. Since solutions of sodium carbonate, unless rather diluted, yield with an excess of tartaric acid a crystalline precipitate, it is best to test for potassium with a fragment of the salt attached to the loop of a platinum wire, which should impart a violet but not a permanently yellow color to a non-luminous flame; or, the salt may be dissolved in a slight excess of diluted hydrochloric acid; such a solution will give a yellow precipitate with test solution of platinic chloride and a white crystalline precipitate with a saturated solution of sodium bitartrate. The salt when heated to redness loses between 15 and 18 (about 16, *Br.*) per cent. of water; this exsiccated salt melts at a bright-red heat, and slowly volatilizes at a white heat. The German Pharmacopœia recognizes the anhydrous or nearly anhydrous salt containing at least 95 per cent. of pure potassium hydrate; hence 2 Gm. of it should be neutralized by not less than 27.4 Ccm. of normal hydrochloric or oxalic acid, which indicates 94.5 per cent. K_2CO_3. 83 grains require for neutralization not less than 980 grain-measures (*Br.*), or 3.45 Gm. of the salt not less than 40.5 Ccm. (*U. S.*), of the volumetric solution of oxalic acid, corresponding to, respectively, 82 (*Br.*) and 81 (*U. S.*) per cent. of K_2CO_3. Before applying the volumetric test the absence of notable quantities of sodium carbonate should be proven.

Tests.—"A solution of the salt in 20 parts of water should not be affected by sulphide of ammonium (metals) nor by ammonium carbonate (alumina); it should yield with an excess of silver nitrate a white precipitate, which on being moderately heated should not acquire a dark color (sulphur compounds). If to the same aqueous solution a little ferrous sulphate, ferric chloride, and an excess of hydrochloric acid be added, the liquid on warming should not become blue (cyanide). If a solution of the salt, prepared with diluted sulphuric acid, be mixed with half its volume of strong sulphuric acid, and a solution of ferrous sulphate be carefully poured upon the mixture, a brown zone should not make its appearance between the two layers (nitrate or nitrite)."—*P. G.* "A solution of the salt supersaturated with nitric acid and evaporated to dryness leaves a residue which should be entirely soluble in water or leave merely a trifling amount of insoluble matter (silica); this solution should produce not more than a cloudiness with sodium carbonate (earths, etc.) or with barium chloride (sulphate), or after acidulation by nitric acid with silver nitrate (chloride)."—*U. S.* The German Pharmacopœia directs a 5 per cent. solution for these tests.

Pharmaceutical Uses.—LIQUOR KALI CARBONICI. 11 parts of pure carbonate of potassium are dissolved in 20 parts of distilled water; the solution has the specific gravity 1.330 to 1.334, and 3 parts of it should contain 1 part of potassium carbonate.—*P. G.*

Pearlash is only employed for preparing purified carbonate of potassium. In the preparation of most potassium salts the pure carbonate or the bicarbonate of potassium may be employed. Carbonate of potassium is employed in preparing Atropia, Liquor arsenicalis, *Br.;* Mistura ferri comp., Potass. sulphuretum, *U. S., Br.;* and for Decoct. aloes comp. and Enema aloes, *Br.*

Medical Action and Uses.—Carbonate of potassium is less irritating than potassa, but more so than the bicarbonate. In large doses it acts as an irritant on the stomach, and even as a caustic when pure. It has been employed in baths in the treatment of *tetanus, puerperal convulsions, paralysis,* chronic *gout* and *rheumatism, glandular swellings, suppressed cutaneous eruptions,* etc. In all of these cases it probably acts through its substitutive or its counter-irritant rather than by its alkaline virtues.

Internally, carbonate of potassium has been much used, in common with other antacids, in the treatment of *gouty* and *dyspeptic* conditions attended with a highly acid state of the urine. It is most efficient when the tendency to this form of secretion, which probably depends upon the imperfect oxidation of effete matters, is corrected by bitter tonics and hygienic measures. Formerly, theoretical views of the action of alkalies led to the use of carbonate of potassium in various inflammations, membranous and parenchymatous, but especially in those attended with plastic exudation. It was hence much employed in *membranous croup, pneumonia, peritonitis,* and *glandular enlargements,* and positive assertions were made of its curative powers; their value was, however, greatly impaired by the fact that in general mercury was associated with the alkaline medicine, as well as by leaving out of account the influence of hygienic measures, the natural tendency of the disease, etc. Very probably, subacute inflammations of the *lymphatic glands,* and enlargement of the liver with *jaundice* affecting intemperate eaters and drinkers, have been benefited by this medicine, since, like all the alkaline carbonates, it tends to render the blood more watery, and therefore less nutritive and less apt to produce congestions in parenchymatous organs. In this way, doubtless, it has been profitably used in hepatic and splenic *dropsy.* On the whole, there is nothing in carbonate of potassium to render it superior, or even equal, to the sodium carbonates for any purpose to which alkaline medicines are applied internally.

The *dose* of carbonate of potassium is from 10 to 30 grains (Gm. 0.60–2). For external use a solution of 120 grains in a pint of water (Gm. 8 in Gm. 500), or an ointment containing from 10 to 60 grains of the salt in an ounce (Gm. 0.60–4 in Gm. 32) of lard, may be employed.

POTASSII CHLORAS, *U. S., Br.*—CHLORATE OF POTASSIUM.

Potassæ chloras, Br.; *Kalium chloricum,* P. G.; *Kali oxymuriaticum, Kali muriaticum oxygenatum, Chloras potassicus s. kalicus.—Chlorate of potash,* E.; *Chlorate de potasse,* Fr.; *Kaliumchlorat, Chlorsaures Kali,* G.

Formula $KClO_3$. Molecular weight 122.4.

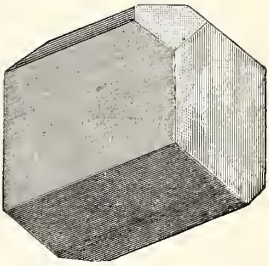
Preparation.—Take of Carbonate of Potash 20 ounces; Slaked Lime 53 ounces; Distilled Water a sufficiency; Black Oxide of Manganese 80 ounces; Hydrochloric Acid 24 pints. Mix the lime with the carbonate of potash, and triturate them with a few ounces of the water, so as to make the mixture slightly moist. Place the oxide of manganese in a large retort or flask, and, having poured upon it the hydrochloric acid, dilute it with 6 pints of water, apply a gentle sand heat, and conduct the chlorine as it comes over, first through a bottle containing 6 ounces of water, and then into a large carboy containing the mixture of carbonate of potash and slaked lime. When the whole of the chlorine has come over, remove the contents of the carboy and boil them for 20 minutes with 7 pints of the water; filter and evaporate till a film forms on the surface, and set aside to cool and crystallize. The crystals thus obtained are to be purified by dissolving them in three times their weight of boiling distilled water, and again allowing the solution to crystallize.—*Br.*

On passing chlorine gas into a solution of potassa, hypochlorite and chloride of potassium are formed; $6KHO + 3Cl_2$ yields $3KClO + 3KCl + 3H_2O$. On boiling the solution, or on heating it to between 70° and 80° C. (158° and 176° F.), the hypochlorite is decomposed into chlorate and chloride; $3KClO$ yields $KClO_3 + 2KCl$. The entire reaction, therefore, results in the production of 1 molecule of chlorate and 5 of chloride of potassium, and the two salts must be separated by recrystallization. To avoid the loss of potassium salt, Graham (1841) proposed to substitute an equivalent quantity of lime for five-sixths of the potassa; and this is the process which is now often followed in making the chlorate on the large scale, and the details of which, as recommended by the British Pharmacopœia, have been described above. It has the additional advantage that the previous preparation of caustic potassa is unnecessary. In the presence of water hydrate of calcium reacts with chlorine in a manner precisely analogous to that of hydrate of potassium, yielding hypochlorite and chloride of calcium (see page 361), and by heat the hypochlorite is decomposed into chloride and chlorate of calcium, the latter of which, by mutual decomposition with carbonate of potassium, produces chlorate of potassium and carbonate of calcium. It will be observed that the reactions in this process are apparently complicated, but, as explained above, the final results are expressed by the equation $K_2CO_3 + 6CaH_2O_2 + 6Cl_2 = 2KClO_3 + 5CaCl_2 + CaCO_3 + 6H_2O$.

Chloride of potassium is now obtained in large quantities, and this salt is advantageously used in the preparation of chlorate by a process very similar to that of Graham, as was shown by Liebig (1842). In this case the reaction results as follows: $KCl + 3CaH_2O_2 + 3Cl_2 = KClO_3 + 3CaCl_2 + 3H_2O$. Or chlorinated lime may be boiled with chloride of potassium, in which case the final products are likewise chlorate of potassium and chloride of calcium.

Potassium chlorate seems to have been known to Glauber (1657); it was described by Higgins (1786) as a kind of saltpetre, and was recognized by Berthollet (1786) as the compound of a hitherto unknown acid. The United States imported 474,598 pounds of this salt in 1876; at present the importation averages about 1,200,000 pounds.

Fig. 225.



Crystal of Potassium Chlorate.

Properties.—Chlorate of potassium crystallizes in colorless, shining plates or in short monoclinic prisms. It is inodorous, has a cooling saline taste and neutral reaction, is permanent in the air, melts without decomposition at 334° C. (633.2° F.), gives off oxygen at 355° C. (671° F.); at the same time it forms potassium perchlorate, and at a higher temperature parts with all its oxygen (39.2 per cent. of its weight), leaving 60.8 per cent. of potassium chloride having the properties described below. It requires, at 15° C. (58° F.). 16.7 parts of water for solution. According to Gay-Lussac, 100 parts of water dissolve

at	0°	13.3°	15.4°	24.4°	35°	49.1°	74.9°	104.8° C.,
	3.33	5.60	6.03	8.44	12.05	18.96	35.4	60.24 parts salt.

Gerardin's determinations agree with these results. Ammonium nitrate increases, but ammonium chloride and acetate decrease, the solubility in water (Pearson, 1869). The salt is slightly soluble in ordinary alcohol, but is insoluble in absolute alcohol. It should never be triturated together with sulphur, sugar, tannin, or other readily oxidizable substances except in the presence of water; or, if dry mixtures are to be made, the ingredients should be powdered separately, and mixed by means of a sieve and without friction, in order to avoid violent explosions. As ordinarily met with in commerce, the salt contains traces of calcium chloride, from which it is freed by dissolving it in two or three times its weight of distilled water, and stirring the solution while cooling; it will then be obtained in small crystals, which, after draining and washing with cold water, are pure. The saturated aqueous solution of the salt yields with tartaric acid a white crystalline precipitate of potassium tartrate, and on being warmed with hydrochloric acid becomes greenish-yellow and gives off the odor of chlorine. When strong sulphuric acid is added to chlorate of potassium, *chloric peroxide*, Cl_2O_4, is formed; this is a yellow, heavy gas, which, in the presence of combustible matter or by a slight elevation of temperature, is decomposed with a powerful explosion into oxygen and chlorine. On adding strong hydrochloric acid to potassium chlorate a deep-yellow, dangerously explosive gas, the *euchlorine* of Davy, is produced; it is a mixture of chlorine and of *chloro-chloric acid*, $Cl_2O_3.(Cl_2O_5)_2$, which, on being dissolved in water, is decomposed into chlorine and chloric peroxide.

Tests.—The aqueous solution, containing 1 (*U. S.*, 5 *P. G.*) per cent. of chlorate of potassium, should not be precipitated by chloride of barium (sulphate), nitrate of silver (chloride), or oxalate of ammonium (calcium salt), nor should it be colored by hydrosulphuric acid or by potassium ferrocyanide. The U. S. Pharmacopœia permits the presence of a trace of chloride, indicated by a faint cloudiness with the silver test. After heating the salt to redness until gas ceases to be evolved, the residue should have a neutral reaction to test-paper, and should not produce a red precipitate with corrosive sublimate (absence of nitrate).

Pharmaceutical Uses.—Chlorate of potassium is an ingredient of Trochisci potass. chloratis, *U. S.*, *Br.*, and is used in the manufacture of permanganate of potassium and of oxygen. It enters also into the composition of fireworks and of several blasting-powders.

Other Potassium Salts containing Chlorine.—Potassii chloridum, s. Kalium chloridum (chloratum), Chloruretum potassicum, Sal digestivum Sylvii.—Chloride of potassium, *E.;* Chlorure de potassium, Sel digestif, *Fr.;* Kaliumchlorid, *G.* Formula KCl; molecular weight 74.4.—It is obtained in large quantities at Stassfurt from *carnallite*, a double chloride of potassium and magnesium, and forms white or colorless, inodorous cubes or quadrangular prisms which have a saline taste resembling that of table-salt, and which are fusible without decomposition. The salt dissolves in 3 parts of cold and a little less than 2 parts of hot water, and is slightly soluble in alcohol, but is insoluble in absolute alcohol. Its aqueous solution should have a neutral reaction, and should yield with saturated solution of sodium bitartrate a white crystalline precipitate, and with silver nitrate a white curdy precipitate soluble in ammonia, but insoluble in nitric acid; the solution should not be affected by barium chloride (sulphate) or potassium carbonate (salts of metals). This salt should not be confounded with potassium chlorate (see above), nor with chlorinated potassa (see page 925). It is largely employed in the manufacture of other potassium compounds, and was imported into the United States during the year 1877–78 to the amount of 19,655,204 pounds, and 43,475,660 pounds in 1882.

Potassii perchloras, $KClO_4$, Perchlorate of potassium; molecular weight 138.4. To obtain it, chlorate of potassium is carefully heated until it melts and just begins to evolve oxygen, and is kept at this temperature until gas is no longer given off, and a portion of the residue, on being tested with strong hydrochloric acid, acquires only a faint yellow color. The saline mass is dissolved in water and freed from chloride by recrystallization. Perchlorate of potassium is in colorless rhombic crystals which have a slight saline taste, and when heated to about 400° C. (752° F.) is decomposed into oxygen gas and potassium chloride. It is insoluble in alcohol, and dissolves in 5½ parts of boiling water, but requires at 15° C. (59° F.) 65 parts, and at 10° C. (50° F.) 88 parts, of water for solution.

This salt is employed in preparing *perchloric acid*, which is an ingredient of chlorodyne (see page 440). Bullock (1865) devised the following process: The perchlorate of potassium is distilled with twice its weight of sulphuric acid mixed with $\frac{1}{10}$ part of water. The distillate, containing perchloric, sulphuric, and a little hydrochloric acid and chlorine, is carefully treated with carbonate of lead until the sulphuric acid has been completely precipitated. The liquid is filtered, freed from lead by sulphuretted hydrogen, filtered again, and boiled until it attains a specific gravity of about 1.6, when by distillation it may be obtained of the density 1.693. It is a colorless, oily, very acid liquid, containing 72 per cent. of $HClO_4$, boiling at 203° C., and not affected by sunlight or by sulphydric, sulphurous, or hydrochloric acid, but readily decomposed by iodine and bromine. The acid is monobasic, forms mostly deliquescent salts, which are also soluble in alcohol, and when added to not too dilute solutions of potassium salts produces precipitates of potassium perchlorate.

Physiological Action.—The large amount of oxygen contained in this salt early led to its being used to cure a variety of diseases which, according to the fashion of the day, were supposed to depend upon putrefactive changes in the blood, etc. These theoretical notions met with their usual fate, and the medicine had been but little used for more than forty years when attention was attracted to it by its power of rapidly healing cancrum oris and aphthous ulcers of the mouth. No sensible effects are produced by it in daily doses of from 15 to 60 grains (Gm. 1–4), but in doses of from 1 to 4 or 5 drachms (Gm. 4–20) it renders the venous blood everywhere more florid, so that the gums and fauces are of a bright-red color and the teeth are whitened. The appetite is increased, and in children sometimes the bowels become loose, with greenish stools. It increases the flow of urine, and may be recovered from that secretion; sometimes it causes aching in the kidneys. It also passes off with the saliva, the bile, the milk, tears, nasal mucus, and perspiration. It has been known to occasion an erythematous eruption (Stelwagon). In excessive doses it may be poisonous. In one case 300 grains (Gm. 20) were taken daily for four successive days by a consumptive patient. Obstinate vomiting and severe intestinal pain continued until death, after which inflammation of the mucous coat of the stomach was found. In a second case ½ ounce (Gm. 16), largely diluted, was taken early in the morning; diuresis continued during the day, and in the evening vomiting, purging, and cramps occurred, with extreme prostration and a cold blue skin. The urine was scanty and dark, and then suppressed. For a week "violent enteritis, gastritis, and cystitis ensued, with incessant vomiting and intense pain." Death took place on the seventh day, and on examination the mucous membranes of the whole alimentary tract and of the bladder were disorganized, and crystals of the chlorate were found in the pelves of the kidneys. (For fuller details of this case, as well as on the whole subject, see Stillé, *Therapeutics*, 4th ed., ii. 919.) In some protracted cases there is intestinal hæmorrhage, an earthy or yellowish tint of the skin, debility, emaciation, delirium, or coma. In the case of a hearty, well-developed little girl two years and a half old about half an ounce of the dry crystals of the salt had been eaten. The only symptoms were persistent vomiting, with rejection of a portion of the undissolved salt, and a strong inclination to slumber, which became a lethargic condition, and ended in death after five or six hours. There were no indications of pain (Kennedy, *Am. Jour. Phar.*, March, 1878). The urine of a girl who died after taking 600 grains of the salt had a sp. gr. of 1055 (Fowler, *Med. News*, xliv. 161).

No less than eleven fatal cases of poisoning by this salt are referred to by Jacobi (1879), besides several others in which, owing to the nature of the disease, dipththeria, doubts may exist respecting the share of the medicine in their issue. In 1880, Wegschneider collected thirty cases of poisoning by chlorate of potassium, but the proportion that proved fatal was not stated (*Bull. de thérap.*, civ. 141). From that date to May, 1884, we have met with the records of ten cases of such poisoning, and of these six were fatal. In 1879 the observations and experiments of Marchand (*Virchow's Archiv*, lxxvii. 455) led him to conclude that potassium chlorate superoxidizes, and so disorganizes, the blood-corpuscles, and renders them incapable of performing their function as oxygen-carriers, and that death from it is either due to this cause or to obstruction of the kidneys with effete blood-disks and (he might have added) crystals of the chlorate. The blood itself remains liquid, and it, as well as all the organs abounding in blood, are of a dark-chocolate color. This condition of the blood has also been observed by Fowler (*loc. sup. cit.*). The spleen is sometimes enlarged. Besides these tissue-lesions it exhibits other evidences of activity. It is antiseptic, but not because it yields oxygen. If it did so it should stimulate the heart, but it depresses that organ, and when injected into the veins of an animal it kills by arresting the heart.

Medical Uses.—The utility of this salt in curing *mercurial salivation* and mercurial *ulcers* of the mouth and throat is now attested by universal experience, but it is not so certain that it acts through the blood after absorption from the stomach, since the same favorable effects are observed when a solution of it is used as a topical application only. That it does not act through any relation it may have to mercury in the system is proved, not only by the fact just stated, but also by its equal efficiency in non-mercurial salivation—as, for instance, when the throat has been injured by caustic potassa—and in like manner in every form of buccal ulceration, as *ulcerative stomatitis*, *aphthæ* (or follicular stomatitis), *gangrenous stomatitis*, *buccal* and *pharyngeal diphtheritis*, and the sore mouth produced by chronic *arsenical poisoning*. Although the contrary has been asserted, it is utterly useless in an affection often confounded with, but very different from, them—*thrush*, or *muguet*, which is a parasitic growth from decomposed milk. It has been used internally, and also topically by atomized inhalation and in simple solution, for the treatment of *croup* (pseudo-membraneous laryngitis), and although it may in a slight degree tend to soften the membrane, its favorable influence on the issue of the disease is not well established.

Chlorate of potassium, which has been used by Isambert in the treatment of *diphtheria* with no radical advantage, was subsequently employed by Seeligmüller, who in publishing his results declared it a specific. He prescribed a saturated solution of the salt, or 1 part to 20 of water, to be given in spoonful doses every hour or two hours, day and night, without intermission. In 1877 he wrote as follows: "During the five years that I have ordered no other medicine against diphtheria besides our saturated solution this remedy has proved successful in all cases of diphtheria, except a few that were neglected in the beginning, in which the blood was already profoundly altered, and systemic poisoning had occurred when I was consulted." He dwells upon the necessity of giving no food or drink immediately after its administration, lest the solution be too quickly removed, and emphatically asserts there is no need of local applications besides, "the internal medication alone being sufficient in all cases." He, however, recognizes its debilitating influence on the heart's action, and alludes to one case in which it caused death by gastric irritation. Von Becker, physician to the Children's Hospital in Vienna (1877), condemns the notion that the medicine is a specific for diphtheria, and warns against the danger of giving it to young children, adding that while it is the mildest, it is also the least efficient, of disinfecting agents. Dr. A. Jacobi of New York spoke of it in 1875 in very similar terms, and in 1879 repeated that it was useful rather as a preventive than as a cure for diphtheria. The dose, according to him, for a child two or three years old should not be larger than ½ drachm (Gm. 2) in 24 hours. A baby of one year or less should not take more than 1 scruple (Gm. 1.33) a day. The dose for an adult should not be more than 1½ drachms, or at most 2 drachms (Gm. 6–8), in the course of 24 hours. The doses he recommends to be administered at short intervals, so that their local impression may be maintained. He also describes the method of Seeligmüller, in order to "raise his voice against it for the reason of its dangerousness." It should here be mentioned, however, that Seeligmüller greatly reduced the doses of the medicine which he prescribed

(1883). But in the protest against the original plan we heartily join, and not only for the reasons assigned by its author, that the medicine is a powerful cardiac sedative and renders those who largely use it liable to fatal nephritis, but because, in so far as it does good at all in this disease, chlorate of potassium is a mere local stimulant, and diphtheria never yet was cured by local applications merely. They may modify the faucial exudation, in very slight cases may possibly prevent it, but they cannot reach that poisonous element of the disease which constitutes its principal danger, and which is only to be combated successfully by general stimulants and tonics. Cases are reported of diphtheria cured by chlorate of potassium, iron, and food, and similar results from the like combination in certain manifestations of *scrofula.* There can be no doubt that in all of these cases the chlorate, so far as it was internally administered, was quite superfluous. The same remark applies to the alleged cure of the hæmorrhagic diathesis by this salt.

Several physicians have thought that a very dilute solution of this salt has been serviceable in low types of fever, and particularly in *scarlatina* and *typhoid fever;* but the ground of this opinion has, so far, been theoretical rather than practical, and the same remark is perhaps applicable to its alleged utility in *neuralgia.* Another example of the illusions which theoretical speculations may give rise to is the statement that in a case of cardiac *cyanosis* it maintained oxygenation of the blood long enough for the patient to accommodate himself to the influence of the malformation under which he suffered; and that in a case of pleural effusion, and in another of pleural hæmorrhage, it sustained life while nature effected the cure. This nature probably did in both instances without reference to the chlorate of potassium. On the same principle have been explained numerous cases of prevented *miscarriage.* Whether the medicine acted as supposed, or acted at all, its virtues in these respects are at least testified to by eminent obstetricians of Edinburgh.

In *ovarian dropsy* it is thought to have removed the disease or arrested its development (*Trans. Med. Soc. State of N. Y.*, 1879, p. 172), but its cures of the sort are neither so numerous nor so well attested as those of *general dropsy* from renal disease. Its diuretic operation has been noted above, and its presence in the kidneys after death, but whether it acts as a direct stimulant of these organs or otherwise, the clinical proof of its efficacy in certain cases of dropsy appears established. It has also been thought to be useful in *chronic cystitis.*

The utility of chlorate of potassium in the treatment of *ulcers* of the mouth naturally led to its use in other ulcerous affections, as those which follow syphilitic *buboes* and other *abscesses.* Its cicatrizing powers are unquestionably very great. In some cases of *phagedenic sores* the pulverized salt has arrested the progress of the disease. Enemas containing it in a moderately strong solution (ʒj to f℥ij–f℥iv) may be used in chronic dysentery, and will tend materially to heal the rectal sores, while those seated higher up in the bowel may be entrusted to astringents or to subnitrate of bismuth. An advantage which this salt possesses as a dressing for gangrenous sores and others discharging a *fetid secretion* is its deodorizing quality; it thus makes a suitable injection in *ozæna,* an appropriate gargle in certain cases of *fœtid breath,* etc. A solution of 60 grains in 4 fluidounces (Gm. 4 in Gm. 16) of water may be used for these purposes. In the treatment of *cancroid* the topical application of the salt in strong solution has sometimes been followed by healing of the ulcer, if that existed, and less frequently by a removal of the tumor. But Verneuil declares emphatically that epithelioma was never cured by this agent. He holds that the cases of alleged cure were ulcerated sudoriparous adenomas (*Bull. de thérap.*, xcix, 515).

The *dose* of chlorate of potassium for children under three years of age is about 5 grains (Gm. 0.30) three times a day, and for an adult from 10 to 30 grains (Gm. 0.60–2). It should be dissolved in hot water, and a sufficient quantity of gum and sugar added to suspend the undissolved portion when the liquid grows cold. It is best administered before meals. As a lotion from 15 to 30 grains in an ounce of water (Gm. 1–2 in Gm. 32) may be used. The iodates of potassium and sodium have been proposed as substitutes for the chlorate. On account of its richness in oxygen it is very apt to yield it to other substances associated with it; hence care must be taken that such combinations do not occur explosively. The bodies especially to be excluded from combination with it by friction are the metallic sulphides, glycerin, vegetable powders, as tannin, catechu, etc. In one case an ounce each of tannic acid and chlorate of potassium had been powdered separately, and on being immediately thereafter mixed together an explosion occurred, causing damage to person and property (*Phila. Med. Times*, xii. 512).

Chloride of potassium, according to Ringer and Murell's experiments on frogs—1, paralyzes all nitrogenous tissues; 2, acts by an equal affinity for all protoplasms, and destroys the tissues in the order of vital movement; 3, arrests the heart; 4, by arresting the circulation it depresses the reflex function of the cord in the summer months, indirectly through arrest of the circulation in the brain. What bearing, if any, these results have upon the action of potassium salts upon man, either physiologically or therapeutically, does not appear. It would seem that chloride of potassium is very analogous to chloride of sodium in its remedial powers. It has been called *sal digestivum* on this account; others have attributed to it nervous sedative powers like those of bromide of potassium, and still others an arterial sedative action like that of nitrate of potassium.

Chloride of potassium has been tested as a remedy for *epilepsy* by Dr. Seguin, in consequence of the assertion of Prof. Binz that the virtue of the bromide of potassium in that disease resided in its base. The conclusion arrived at was that chloride of potassium is not efficacious in the treatment of epilepsy.

POTASSII CITRAS, *U. S., Br.*—CITRATE OF POTASSIUM.

Potassæ citras, Br.; *Kalium citricum, Citras potassicus s. kalicus.—Citrate of potash*, E.; *Citrate de potasse*, Fr.; *Kaliumcitrat, Citronsaures Kali*, G.

Formula $K_3C_6H_5O_7.H_2O$. Molecular weight 324.

Preparation.—Take of Carbonate of Potassium 8 ounces or a sufficiency; Citric Acid, in crystals, 6 ounces or a sufficiency; Distilled Water 2 pints (Imperial). Dissolve the citric acid in the water, add the carbonate of potassium gradually, and if the solution be not neutral make it so by the cautious addition of the acid or of the carbonate; then filter, and evaporate to dryness, stirring constantly after a pellicle has begun to form till the salt granulates. Triturate in a dry, warm mortar, and preserve the powder in stoppered bottles.—*Br.*

The U. S. Pharmacopœia 1870 had a similar process, directing 14 parts of potassium bicarbonate and 10 parts of citric acid. The solution should be heated to facilitate the extrication of the carbonic acid gas.

The potassium of the bicarbonate or carbonate unites with the citric acid, forming citrate of potassium, while carbonic acid is given off; $3KHCO_3 + H_3C_6H_5O_7$ yields $K_3C_6H_5O_7 + 3CO_2 + 3H_2O$. On evaporating the clear solution, the heat should not be permitted to rise high enough to burn the salt; and continued stirring is necessary toward the end of the process to prevent the salt from forming a hard layer on the bottom of the vessel and to obtain it in a granular condition. When dry it may be triturated in a warm mortar, and may thus be rendered uniformly pulverulent.

Properties.—Citrate of potassium is a white granular, inodorous powder having a neutral or faintly alkaline reaction and a saline and slightly alkaline (feebly acid, *Br.*) taste. It is deliquescent on exposure, dissolves in 0.6 parts of water at 15° C. (59° F.) (*U. S.*), and is more freely soluble in boiling water. It is insoluble in absolute alcohol, and forms with dilute alcohol an aqueous solution upon which a stronger alcohol floats. Its solution gives a white crystalline precipitate with a saturated solution of sodium bitartrate, but it remains clear on the addition of chloride of calcium till it is boiled, when a white precipitate of calcium citrate takes place, which is readily soluble in acetic acid. From its concentrated solution it may be procured in transparent needles which have the above composition and contain $H_2O = 5.55$ per cent. This water of crystallization is not completely expelled until the heat is raised to about 200° C. (392° F.), a portion being retained by the salt as prepared by the above process. At about 230° C. (446° F.) the salt begins to turn brown, and at a higher temperature is completely decomposed, inflammable vapors having the odor of burnt sugar being giving off, while potassium carbonate remains behind mixed with charcoal, which is with difficulty completely consumed by continued heating. The salt, heated with strong sulphuric acid, yields a brown liquid, gives off an inflammable gas (carbonic oxide), and evolves the odor of acetic acid. "If 5.4 Gm. of citrate of potassium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 50 Ccm. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of the pure citrate of potassium)."—*U. S.* This test recognizes a salt containing 5.55 per cent. or less of water, while the Br. P. requires the anhydrous salt, of which 102 grains, heated to redness until gases cease to be evolved, leave an alkaline residue requiring for exact neutralization 1000 grain-measures of the volumetric solution of oxalic acid.

Tests.—The aqueous solution of the salt should not have an acid reaction to test-paper, and should not effervesce on the addition of acetic acid (absence of carbonate) or produce with it a crystalline precipitate (absence of tartrate). The precipitates produced by chloride of barium and nitrate of silver should be completely soluble in dilute nitric acid.

Medical Action and Uses.—The medicinal virtues of this salt are described under the heads of the SOLUTION and the MIXTURE OF CITRATE OF POTASSIUM, in which forms it is most usually prescribed. In solution it is an arterial sedative and a diaphoretic habitually used in *febrile affections*. Unduly acid urine becomes neutral or alkaline under its administration. Its utility in fever is increased by adding to its solution spirit of nitrous ether or antimonial wine. The *dose* of the citrate of potassium is from 20 to 60 grains (Gm. 1.30–4).

POTASSII CYANIDUM, *U. S.*, *Br.*—CYANIDE OF POTASSIUM.

Kalium cyanatum, Cyanuretum potassicum s. kalicum.—Cyanure de potassium, Fr.; *Kaliumcyanid, Cyankalium,* G.

Formula KCy or KCN. Molecular weight 65.

Preparation.—Mix Exsiccated Ferrocyanide of Potassium 8 parts with Pure Carbonate of Potassium 3 parts, and throw the mixture into a deep iron crucible previously heated to dull redness. Maintain the temperature until effervescence ceases and the fused mass concretes, of a pure white color, upon a warm glass rod dipped into it. Then pour out the liquid carefully into a shallow dish to solidify, ceasing to pour before the salt becomes contaminated with the precipitated iron. Break up the mass while yet warm, and keep the pieces in a well-stopped bottle.

This process was proposed by F. and E. Rogers (1834), and is generally followed in preparing potassium cyanide on the large scale. The reaction is explained by the equation $2K_4FeCy_6 + 2K_2CO_3 = 10KCy + 2KCyO + Fe_2 + 2CO_2$, showing that, besides cyanide, cyanate of potassium is also formed, carbonic acid gas is evolved, and iron is separated in the metallic state. Both salts must be well dried before they are mixed, otherwise considerable ammonia is given off; and if the carbonate is contaminated with sulphate the fused mass will contain a corresponding amount of sulphide of potassium. A portion of the product remains in the crucible with the iron, but if it is dissolved with water it becomes contaminated again with ferrocyanide of potassium, which may be regenerated by digestion with sulphide of iron and crystallization to free it from potassium sulphide.

A less profitable process consists in heating dry ferrocyanide of potassium to low redness, and in excluding the air until the residue has cooled. Nitrogen is liberated and escapes, and the cyanide of potassium remains mixed with carbide of iron: $K_4FeC_6N_6$ yields $4KCN + FeC_2 + N_2$.

Cyanide of potassium of the purity required by the U. S. Pharmacopœia is best prepared by generating hydrocyanic acid from 2 parts of potassium ferrocyanide with the requisite quantity of sulphuric acid (see page 66), and conducting the gas into a solution of 1 part of potassium hydrate in 5 or 6 parts of strong alcohol; the bulky crystalline precipitate is drained upon a funnel, washed with strong alcohol, and dried between bibulous paper at a moderate heat.

Properties.—Thus prepared, it is a white granular powder consisting of minute transparent cubes, or after melting at a dull red heat it forms on cooling a white opaque crystalline mass. When perfectly dry it is inodorous, but when moist it is decomposed by the carbonic acid of the atmosphere and has the odor of hydrocyanic acid. It has an alkaline and bitter taste, reacts upon test-papers strongly alkaline, is deliquescent on exposure, and is very freely soluble in water, but is nearly insoluble in absolute alcohol. 80 parts of boiling 90 per cent. alcohol dissolve 1 part of the cyanide; weaker alcohol dissolves it in larger proportion. The aqueous solution dissolves iron, zinc, copper, and nickel, with the evolution of hydrogen, and in the presence of oxygen also silver and gold. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate, and with silver nitrate a white curdy precipitate insoluble in nitric acid, but readily soluble in ammonia and in excess of potassium cyanide. The aqueous solution is decomposed on exposure to the air, absorbs carbonic acid, becomes brown, and deposits a dark-brown precipitate; on boiling it is partly decomposed, yielding ammonia and potassium formate. The salt fused in contact with the air is partly oxidized to cyanate, and if fused with sulphur yields potassium sulphocyanide.

Impure potassium cyanide, as obtained by the first process, and which is extensively used in the arts, has similar properties, but is in white opaque pieces. When dissolved in water the cyanate contained in it is gradually decomposed, with the formation of potassium and ammonium carbonates; $2KCNO + 4H_2O$ yields $K_2CO_3 + (NH_4)_2CO_3$. In the pure state cyanate of potassium crystallizes in a form similar to that of the chlorate; it is inodorous, and has a saline taste resembling that of saltpetre; it yields with nitrate of silver a white precipitate which is soluble in ammonia and is readily decomposed by heat.

Tests.—The impurities likely to be present in medicinal potassium cyanide are carbonate and chloride. A solution of the salt in 5 parts of water should not effervesce with hydrochloric acid, or should merely disengage isolated gas-bubbles. On heating to redness a mixture of 1 part of the salt with 3 parts of ammonium carbonate, dissolving the residue in water, and acidulating with nitric acid, the solution should give no (or only a faint) turbidity with silver nitrate. The U. S. Pharmacopœia requires the salt to contain at least 90 (94.9 *Br.*) per cent. of potassium cyanide, which is ascertained as follows: "If 0.65 Gm. of cyanide of potassium be dissolved in 12 Ccm. of water, and volumetric solution of nitrate of silver be gradually added, the precipitate first formed should dissolve on stirring, and a permanent precipitate should not appear until at least 45 Ccm. (47.45 Ccm., *Br.*) of the volumetric solution have been used."

Medical Action and Uses.—The action of cyanide of potassium is identical with that of hydrocyanic acid, for which it may be substituted. A solution of it applied to the tongue causes a sensation of coldness, followed by irritation and constriction of the fauces, and allowed to remain in contact with the skin, it is apt to excite a papular and even a vesicular eruption, and, applied in powder slightly moistened or incorporated with lard, it may produce an eschar. In substance or solution applied to the broken skin it may cause toxical symptoms. Internally it has been fatal in doses of from 3 to 5 grains. The employment of this salt in photography has of late years greatly multiplied the number of cases of poisoning by its use. The symptoms produced by it in such cases are insensibility, muscular spasm or convulsion, a cold, clammy, and pale skin, glistening eyes and dilated pupils, stertorous breathing, fixed jaws, foam on the lips, feeble or insensible pulse of the heart and arteries, and death in convulsion or by asthenia. On examination, the body is rigid, the eyes bright, the cavities exhale the odor of hydrocyanic acid, the lungs are congested, the auricles may be full and the ventricles empty, the brain is engorged, and also the lining membrane of the stomach, which presents a dark-red color streaked by the darker veins. In a word, its effects are, as above stated, those of hydrocyanic acid. (Compare ACID. HYDROCYANICUM DILUTUM.) Cyanide of potassium is used chiefly as a topical application for the relief of *headaches* associated with dyspepsia or with imperfect menstruation, or such as are generally included under the term sick headache. It has also been employed internally, and it is asserted with remarkable success, in the treatment of acute articular *rheumatism*, but the testimony appears to us insufficient. This treatment is vaunted by Dr. Luton of Rheims (*Bull. de thér.*, lxxxviii. 1), who prescribed the cyanide in solution to the extent of nearly 2 grains (Gm. 0.10) in the course of a day, or in pills of 1 grain each (Gm. 0.06), one or two of which were administered within the same space of time. He states that he did not in any case exceed the daily quantity of 2½ grains (Gm. 0.15), and, finding that it occasioned colic and vertigo, he resumed the smaller doses. If used internally at all, for which we can discover no necessity, it should not be prescribed at first in doses exceeding ⅛ grain (Gm. 0.008). A solution of from 2 to 4 grains of the salt in an ounce of water may be applied as a lotion to the head and as the most rapid means of removing stains produced by *nitrate of silver*. It is, however, too dangerous an agent to be used without extreme caution. (For an example of its fatal use through mischance see *Edinb. Med. Jour.*, xxvii. 506.)

POTASSII ET SODII TARTRAS, *U. S.*—TARTRATE OF POTASSIUM AND SODIUM.

Soda tartarata, Br.; *Sodæ et potassæ tartras*, *Sodæ potassio-tartras*, *Tartarus natronatus*, P. G.; *Natro-kali tartaricum*, *Sal polychrestum Seignetti*, *Tartras potassico-sodicus.*—*Rochelle salt*, *Tartarated soda*, E.; *Sel de Seignette*, *Soude tartarisée*, Fr.; *Seignettesalz*, G.

Formula $KNaC_4H_4O_6.4H_2O$. Molecular weight 282.

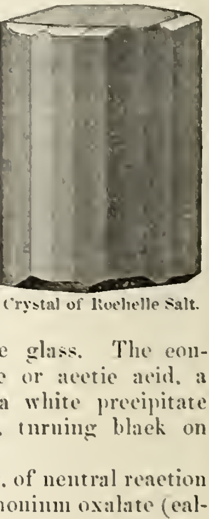
Preparation.—Take of Carbonate of Sodium 12 ounces; Acid Tartrate of Potassium, in fine powder, 16 ounces; Boiling Water 4 pints (Imperial). Dissolve the carbonate of sodium in the water, add gradually the acid tartrate of potassium, and if, after being boiled for a few minutes, the liquid has an acid or alkaline reaction, add a little carbonate or acid tartrate till a neutral solution is obtained. Boil and filter, concentrate the liquor till a pellicle forms on the surface, and set it aside to crystallize. More crystals may be obtained by again evaporating as before.—*Br.*

Since the molecular weight of bitartrate of potassium is 188, and ½ molecule of crystallized sodium carbonate weighs 143, 16 parts of the former require 12⅙ parts of the latter if both salts are chemically pure. Owing to the presence of calcium tartrate in the one, and the loss of water of crystallization by the other, the proportions required must vary somewhat with different samples of the commercial salts; but there is no difficulty in rendering the solution exactly neutral if the above directions are followed. The reaction between the two salts is explained by the equation $2KHC_4H_4O_6 + Na_2CO_3 = 2KNaC_4H_4O_6 + CO_2 + H_2O$; besides the double salt, water and carbonic acid are formed, the latter escaping with effervescence. It is advisable to keep the neutralized mixture for some time at a temperature of about 60° C. (140° F.), when much of the calcium tartrate will be deposited, and may be removed by filtration. Large and well-formed crystals are obtained if the solution is very slowly evaporated.

This double salt was first obtained in 1672 by Pierre Seignette, an apothecary of Rochelle in France, and was sold as a secret remedy. But in 1731 the process for obtaining it was communicated by Boulduc to the French Academy, and by C. J. Geoffroy to Sloane of London.

Properties.—Tartrate of potassium and sodium crystallizes in large perfectly transparent, inodorous, six- or eight-sided prisms, or more frequently half-prisms of the right rhombic order. If crystallized from a solution containing calcium tartrate, they are white and more or less opaque. In our commerce the salt is most generally met with in the state of white powder. It has a mild saline, faintly bitterish, and cooling taste, is slightly efflorescent in dry air, and dissolves at 11° C. (51.8° F.) in 2.4 parts, at 26° C. (78.8° F.) in 1.5 parts of water (Osann), and in all proportions of boiling water, but is nearly insoluble in alcohol. The salt melts in its water of crystallization when carefully heated to about 75° C. (167° F.), and after cooling remains liquid and soft for some time. By the heat of the water-bath it loses 19 per cent of water of crystallization, and at 130° C. (266° F.), or, according to Fresenius, near 215° C. (419° F.)—altogether 25.5 per cent. At a higher heat it is decomposed, gives off inflammable gases which have the odor of burnt sugar, and leaves charcoal which contains the carbonates of potassium and sodium, and imparts to a non-luminous flame a yellow color, appearing red when viewed through a blue glass. The concentrated aqueous solution yields, on the addition of hydrochloric or acetic acid, a crystalline precipitate of cream of tartar; with barium chloride, a white precipitate soluble in nitric acid; and with silver nitrate, a white precipitate, turning black on boiling.

FIG. 226.



Crystal of Rochelle Salt.

Tests.—The solution in 10 parts of distilled water should be clear, of neutral reaction to test-paper, and should produce no precipitate or turbidity with ammonium oxalate (calcium salt) or with ammonium sulphide (metals); and when acidulated with nitric acid and filtered from the precipitated acid potassium tartrate, the clear solution should not be affected by barium chloride (sulphate), and yield merely an opalescence (cloudiness, *U. S.*) with silver nitrate. Although ammonia is not likely to be present in a salt having the above properties, the U. S. and P. G. direct testing for it with caustic potassa. The alkaline residue left from the incineration of 3.53 Gm. of the salt should require for complete neutralization not less than 25 Ccm. of the volumetric solution of oxalic acid (*U. S.*), or 141 grains of the salt 990 grain-measures of the solution (*Br.*).

Off. Prep.—Pulvis effervescens compositus, *U. S.*

Medical Action and Uses.—In doses of from half an ounce to an ounce (Gm. 16–32) it operates as a gentle and cooling laxative, and seldom disagrees with the stomach. It is particularly acceptable in *Seidlitz powders*, which form an effervescing draught. In small and repeated doses it renders the urine alkaline. It is not incompatible with tartar emetic, with which it has sometimes been used as an emeto-cathartic, and also, in small doses, as a febrifuge. It may be given as a purgative in doses of about 1 ounce (Gm. 32). As an antilithic, from 60 to 120 grains (Gm. 4–8) may be taken, largely diluted, several times a day.

POTASSII FERROCYANIDUM, *U. S., Br.*—Ferrocyanide of Potassium.

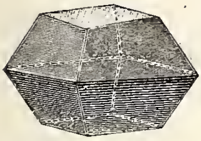
Potassæ prussias flava, Br.; *Kalium ferrocyanatum, Kalium borussicum, Cyanuretum ferroso-potassicum.—Yellow prussiate of potash*, E.; *Prussiate jaune de potasse, Ferrocyanure de potassium*, Fr.; *Ferrocyankalium. Blutlaugensalz*, G.

Formula $K_4FeCy_6.3H_2O = K_4Fe(CN)_6.3H_2O$. Molecular weight 421.9.

Preparation.—This salt was discovered by Macquer (1752) in boiling Prussian blue with caustic potassa. The iron contained in it was for a long time supposed to be an impurity, even after Berthollet (1787) had shown it to be one of its essential constituents. The salt is now extensively prepared by heating in suitable iron vessels potash which is free from sulphate until it is melted, and introducing a mixture composed of 1 part of iron filings and 28 to 33 parts of charcoal obtained from blood, hoofs, horn, hides, leather, or similar animal substances rich in nitrogen. It is less advantageous to employ these substances in the uncharred condition. 100 parts of potash require about 75 or 80 parts of the charcoal or about 100 parts of the animal matter. An evolution of carbonic acid and inflammable gases takes place after each addition to the melted mass, and when the whole fuses quietly the "melt," as it is termed, is ladled out, cooled, dissolved in water, decanted from the sediment, and crystallized. Before it enters commerce it requires purification by recrystallization from water. The above quantities yield about 120 parts of melt and about 25 parts of crystallized ferrocyanide of potassium. The insoluble portion of the melt consists of charcoal, iron, iron sulphide, phosphate of calcium, and silica. This black residue is used as manure, and is said to be destructive to the larvæ of insects. The mother-liquors, which furnish no longer well-defined crystals, are evaporated and used in another operation; they contain the excess of potash employed; also potassium sulphocyanide in case the potash was contaminated with sulphate. Although this salt is extensively manufactured in the United States, 56,000 pounds of it were imported in the year 1878 and 544,167 pounds in 1881.

Properties.—Ferrocyanide of potassium crystallizes from water in large inodorous, lemon-yellow, four-sided tables or prisms, which are translucent and rather soft and friable, and, being crystallized on a cord, usually cohere in columnar masses. It has the specific gravity 1.83, a sweetish and saline taste, and dissolves with a yellow color in 4 parts of water at 15° C. (59° F.) and in 2 parts of hot water, the salt being precipitated from this solution by alcohol in pale-yellow, pearly scales. The salt is permanent at a low temperature, but near 50° C. (122° F.) it begins to lose water of crystallization, of which it contains 12.8 per cent., and it becomes anhydrous at 100° C. (212° F.), leaving a white friable mass which melts below red heat, and at a higher temperature is decomposed into nitrogen gas and a mixture of potassium cyanide and carbide of iron. Exposed to light in the presence of moisture, it is slowly decomposed, with the formation of Prussian blue. Its solution has a neutral reaction and produces a dark-blue precipitate with ferric salts, a bluish-white precipitate (becoming dark-blue in contact with air) with ferrous salts; a brown-red precipitate with salts of copper, and white precipitates with acetate of lead and corrosive sublimate; also a white crystalline precipitate with a saturated solution of sodium bitartrate. Heated with dilute sulphuric acid, hydrocyanic acid is given off. Alkalies fail to precipitate the iron from its solution, but on fusing the salt with potassium carbonate, cyanide of potassium is formed and metallic iron is separated.

Fig. 227.



Crystal of Potassium Ferrocyanide.

Tests.—The concentrated solution of the salt should not effervesce on the addition of sulphuric acid (absence of carbonate), and when diluted with water and acidulated with hydrochloric acid should not produce a white precipitate with chloride of barium (absence of sulphate). Since nitrate of silver is precipitated white by ferrocyanide of potassium, the presence of chloride in the latter cannot be detected until after the salt has been decomposed by fusion with pure nitrate of ammonium, or by deflagration with an equal weight of pure potassium nitrate, when the solution of the residue, acidulated with nitric acid, should not give a curdy white precipitate with nitrate of silver. The U. S. Pharmacopœia permits the presence of a minute amount of sulphate and chloride.

Pharmaceutical Uses.—Ferrocyanide of potassium is used in the preparation of Acid. hydrocyan. dilut., *U. S., Br.*, of cyanides, ferrocyanides, and of the following salts:

Allied Salts.—Ferricyanide or ferridcyanide of potassium, *Red prussiate of potash*; $K_6Fe_2Cy_{12}$. On passing chlorine gas into a cold solution of ferrocyanide of potassium the liquid changes in color from yellow to red. When it ceases to produce a blue precipitate or color with ferric chloride it is concentrated and the crystals purified by recrystallization. The salt is in dark-red, transparent prisms, has a saline and slightly astringent taste, and dissolves in about 4 parts of cold water. On exposure to light the solution is readily altered, ferrocyanide being again produced, when it will yield a blue precipitate with ferric salt. The salt in its fresh solution is employed as a test, precipitating dark-blue with ferrous, red-brown with mercurous, brownish-yellow with cupric, and orange-colored with argentic salts. It yields no precipitates with ferric, mercuric, or lead salts. 12,287 pounds of this salt were imported in 1878, and 106,424 pounds in 1881.

Potassium sulphocyanate (sulphocyanide).—Sulfocyanure de potassium, *Fr.*; Kaliumsulfocyanat, Rhodankalium, *G.* Formula KSCN; mol. weight 97.—It is prepared by melting together 17 parts of potassium carbonate, 32 parts of sulphur, and 46 parts of anhydrous potassium ferrocyanide, and heating to low redness; the cold mass is treated with boiling alcohol. The salt crystallizes in colorless, four-sided, striated prisms, which are inodorous, have a pungent and saline taste, are deliquescent on exposure, and dissolve readily in water and in alcohol. A solution of the salt is used as a test for ferric salts, with which it gives a blood-red color which is not discharged by hydrochloric acid (difference from acetates and formates), but disappears on the addition of corrosive sublimate (difference from meconates).

Sodium nitro-prusside. $Na_2Fe(CN)_5NO.2H_2O$. It is prepared by digesting 1 part of potassium ferrocyanide with 2 parts of nitric acid and 2 parts of water, until the liquid ceases to produce a blue precipitate with iron salts. On cooling, potassium nitrate crystallizes, and the mother-liquor after neutralization with sodium carbonate yields colorless crystals of potassium nitrate and red ones of sodium nitro-prusside; the latter are recrystallized from water. The salt forms ruby-colored rhombic prisms which are permanent in the air and dissolve in 2½ parts of cold water, the solution being decomposed by light. A fragment of the salt heated with an oxygenated volatile oil darkens the latter, often producing a characteristic color; this reaction is prevented by oil of turpentine. In alkaline solution it is a delicate test for sulphides, producing with them a violet or blue color.

Medical Action and Uses.—Ferrocyanide of potassium has been reputed, on very slender authority, to possess active medicinal properties, anodyne, sedative, and astringent. A thorough investigation of its action by Regnauld and Hayem led them to conclude that it is inoperative both as a chalybeate and a sedative, and that it may be administered for weeks in the daily *dose* of several grains without deranging the health or altering the composition of the urine. It is used only as a chemical test for iron, copper, and zinc.

POTASSII HYPOPHOSPHIS, *U. S.*—HYPOPHOSPHITE OF POTASSIUM.

Kalium hypophosphorosum, Hypophosphis potassicus s. kalicus.—Hypophosphite de potasse, Fr.; *Kaliumhypophosphit, Unterphosphorigsaures Kali,* G.

Formula KH_2PO_2. Molecular weight 104.

Preparation.—This salt may be prepared in a manner similar to that by which hypophosphite of calcium (see page 352) is obtained. When a solution of potassa is boiled with phosphorus, hypophosphite of potassium is produced, which is freed from potassa by passing carbonic acid gas into the solution, evaporating, and dissolving the hypophosphite by alcohol. It is also yielded by the double decomposition of hypophosphite of calcium and carbonate of potassium, when carbonate of calcium is precipitated and hypophosphite of potassium remains in solution; $Ca2H_2PO_2 + K_2CO_3$ yields $CaCO_3 + 2KH_2PO_2$.

Properties.—It may be obtained in hexagonal tabular crystals, but, being extremely deliquescent on exposure, it is usually seen in white, opaque, crystalline masses or as a white granular powder. It is inodorous, has a pungent saline and bitterish taste, and a neutral or faintly alkaline reaction, and is very freely soluble in water and diluted alcohol, less soluble in absolute alcohol, but insoluble in ether. "It dissolves in 0.6 part of water and in 7.3 parts of alcohol at 15° C. (59° F.), in 0.3 part of boiling water and in 3.6 parts of boiling alcohol."—*U. S.* Heated to redness when not in contact with air or in a long test-tube, it evolves easily inflammable phosphoretted hydrogen, burning with a white (bright-yellow, *U. S.*) flame. According to Rammelsberg (1872), the gas given off consists of hydrogen and phosphoretted hydrogen, and the residue of pyrophosphate and metaphosphate of potassium. Heated in the air, the salt burns with a yellow flame, and when evaporated with nitric acid or triturated or heated with oxidizing agents it detonates violently. When boiled with potassa, hydrogen is given off; phosphite, and, after the solution becomes more concentrated, phosphate, of potassium is formed. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate of cream of tartar, and with nitrate of silver a white precipitate which rapidly turns brown and black, separating metallic silver; acidulated with hydrochloric acid, and gradually added to solution of corrosive sublimate, it causes a white precipitate consisting of calomel, and on further addition a black precipitate of metallic mercury.

Tests.—The above reactions, in connection with the ready solubility in water and alcohol, prove the purity of the salt. The aqueous solution of the salt should not effervesce with acids (carbonate), should not be rendered turbid by lime-water (carbonate, phosphate), should not be precipitated by ammonium oxalate (calcium), and should remain clear or merely become slightly cloudy with test mixture of magnesium (phosphate). Acidulated with hydrochloric acid, it should not become cloudy with barium chloride (sulphate).

Off. Prep.—Syrupus hypophosphitum, *U. S.*

Medical Uses.—This preparation has been especially recommended in the treatment of *chronic bronchitis*, but there is no sufficient proof of its efficacy in that or in any other disease, either alone or associated with the other alkaline and earthy hypophosphites. The virtue of the "syrup of the hypophosphites" resides in the iron which is one of its components.

POTASSII IODIDUM, *U. S., Br.*—IODIDE OF POTASSIUM.

Kalium jodatum, P. G.; *Kali hydroiodicum, Ioduretum potassicum, s. kalicum.—Iodure de potassium*, Fr.; *Jodkalium*, G.

Formula KI. Molecular weight 165.6.

Preparation.—The process recommended in the U. S. P. 1870 is as follows: To a hot solution of 6 ounces of potassa in 3 pints of distilled water sufficient iodine (about 16 ounces) is gradually added until the liquid remains slightly colored from excess of iodine; the solution is concentrated, 2 ounces of powdered charcoal are stirred in, the mixture is evaporated to dryness, and the powder heated for 15 minutes to dull redness in an iron crucible; the salt is then dissolved in distilled water and crystallized.

The process of the British Pharmacopœia does not essentially differ from the preceding except in some of the details. 1 gallon (Imperial) of potassa solution and 21 ounces or a sufficiency of iodine are directed for the production of a permanent brown tint. The liquid is evaporated to dryness, the residue powdered, mixed intimately with 3 ounces of charcoal, and the mixture, in small quantities at a time, is thrown into a red-hot crucible. When the contents are fused they are poured out, and after cooling dissolved in 40 ounces of boiling distilled water, and the solution filtered and crystallized.

On dissolving iodine in solution of potassa a reaction takes place precisely analogous to that which occurs in the action of bromine or chlorine upon the same liquid. (See POTASSII BROMIDUM and POTASSII CHLORAS.) $6KHO$ and $3I_2$ yield $5KI + KIO_3 + 3H_2O$. The iodate of potassium may be separated by evaporating the solution to dryness and treating the residue with alcohol, which dissolves the iodide of potassium only; or it may be deprived of its oxygen, and thus be converted into iodide. The deoxidation may be effected in the solution by means of sulphuretted hydrogen, but some loss of iodine is then unavoidable, and the salt is apt to contain sulphur. The saline mass left on evaporation, when heated to redness gradually parts with its oxygen, but the reduction is effected at a lower temperature and more rapidly if the mass had been previously mixed with charcoal, starch, sugar, or similar organic matter. For effecting the mixing of the charcoal with the saline mass the first directions given above are very convenient, but for reducing the iodate it is best to operate as directed by the British Pharmacopœia. If the mixture in small quantities is thrown into a red-hot crucible, each portion deflagrates, carbonic oxide is given off, and iodide of potassium formed. The sudden evolution of the gas from a large quantity of the mixture heated together is likely to occasion loss. This reaction is explained by the equation $KIO_3 + C_3 = KI + 3CO$.

Various other processes have been suggested, and are serviceable, more particularly for preparing potassium iodide on a limited scale. The following deserve to be mentioned: Iodine is converted into hydriodic acid by the action of sulphuretted hydrogen (see page 59), and the acid neutralized by carbonate of potassium. Or, iodide of iron is first prepared, and the green solution boiled with an equivalent quantity of carbonate of potassium, filtered from the oxide of iron, and evaporated. The iron will settle more rapidly if an additional quantity, equal to one-third of that used in preparing the solution of ferrous iodide, is added thereto before precipitation by potassa. Instead of potassa, Hesse recommends decomposing the solution by boiling with milk of lime; the filtrate is freed from excess of lime by carbonic acid gas, and the calcium iodide decomposed by a hot solution of potassium sulphate; the little calcium sulphate remaining in the filtrate is decomposed by potassium carbonate, after which the clear solution is evaporated to dryness. Fuchs (1865) recommended prolonged digestion of 100 parts of iodine, 240 of water, 75 of potassium carbonate, and 30 of iron, until carbonic acid ceases to be given off; the solution is further concentrated, exposed in a warm place until all iron has been converted into ferric oxide, then dried, heated to incipient redness, and extracted with water.

Nearly all the potassium iodide consumed here is now manufactured in the United States. Only 50 pounds were imported in the year 1883.

Properties.—When entirely pure, iodide of potassium is in transparent colorless cubes of a neutral reaction. This is the salt directed by the U. S. P., but as generally met with it is crystallized from an alkaline solution, and the crystals are white and opaque or merely translucent, and have a slight alkaline reaction. Crystals of similar appearance are also obtained, according to Wittstein (1861), from neutral solutions at a somewhat elevated temperature, and, according to Erlenmeyer, from very concentrated solutions. Iodide of potassium has a slight peculiar odor, a pungent saline afterward bitterish taste, melts below a red heat (Gay-Lussac), and congeals on cooling to a pearly mass. On melting the salt in contact with air a trace of iodate is formed, a little iodine given off, and the mass acquires an alkaline reaction (Petterson, 1870); at a bright-red heat the salt is slowly volatilized. It is permanent in the air, but in a damp atmosphere or when of an alkaline reaction is somewhat deliquescent. It is freely soluble in water, requiring, according to Mulder (1864), at 15° C. (59° F.) 0.714, at 30° C. (86° F.) 0.657, at 60° C. (140° F.), 0.57, and at 100° C. (212° F.), 0.48 part of this solvent. It is likewise soluble in alcohol, requiring at the ordinary temperature 40 parts of absolute alcohol, 16 parts of alcohol sp. gr. .835, 8 parts of alcohol sp. gr. .850, and 1½ parts of diluted alcohol. The salt dissolves in about one-half the quantities named of boiling alcohol, and on cooling crystallizes partly in needles. The aqueous solution yields with tartaric acid or with sodium bitartrate a white crystalline precipitate of potassium bitartrate, and with a few drops of chlorine-water liberates iodine, which is recognized by the blue color it imparts to starch-paste or by the violet color of its solution in chloroform or bisulphide of carbon. On exposure to sunlight the solutions of iodide of potassium acquire a yellow or brownish color from the liberation of iodine, the decomposition being due to the influence of ozone, according to Houzeau (1858), or to the presence of carbonic or other acid, according to Bastaudier (1876). The experiments of Papasogli (1881) prove that sunlight, both diffuse and direct, does not decompose pure potassium iodide or its mixture with iodate; but carbonic anhydride liberates from the mixture a small quantity of iodine, while at low temperatures it has no effect upon either one of the pure salts, yet at high temperatures separates hydriodic acid in solutions of the pure iodide. Strong mineral acids liberate from the salt hydriodic acid and iodine. A mixture of the salt with chloride of ammonium becomes moist and brown on exposure, and when heated is decomposed, chloride and iodide of potassium being left behind. Baup observed that 100 parts of the iodide dissolved in 200 parts of water will dissolve 153 parts or 2 atoms of iodine, forming a dark-red liquid, from which water throws down a portion of the iodine. If the salt is dissolved in about thirty times its weight of water, the solution takes up 1 atom of iodine. These solutions are completely decolorized when agitated with ether, chloroform, or bisulphide of carbon; but if the solution has been made with alcohol instead of water, carbon bisulphide fails to extract the iodine, although this element is removed by the solvent mentioned from the simple tincture of iodine (Jörgensen, 1870). An aqueous solution of iodine in iodide of potassium produces with subacetate of lead dark-colored precipitates, which Dossios and Weith (1869) regarded as being mixtures of iodide of lead with finely-divided iodine; but Piffard (1861) found the precipitate with acetate of lead, after drying, could be heated to 71° C. (159.8° F.) without evolving iodine, which could likewise not be extracted with simple solvents. These facts, it seems, point to the existence of compounds of 1 atom of potassium with 1, 2, and 3 atoms of iodine. (See also LIQUOR IODINII COMP. and TINCTURA IODINII COMP.)

Tests.—If impurities other than bromide and chloride are present, the large cubical crystals will usually be the purest; for the following tests it is therefore advisable to triturate together crystals of different size: A little of the powdered salt taken up with the loop of a platinum wire and held in a non-luminous flame should at once impart a violet color to the latter (absence of sodium salt). Single crystals or several fragments of crystals laid for a moment upon moistened (not wet) red litmus-paper should not at once produce violet-blue stains (limit of potassium carbonate, about 0.1 per cent.). The aqueous solution should not be colored dark or rendered turbid by hydrosulphuric acid (metals). An aqueous solution of the salt, mixed with a little gelatinized starch, should not become blue on being added to a mixture of diluted hydrochloric acid and test zinc (nitrate). Iodine is also liberated by this test in the presence of iodate, but the absence of the latter salt is recognized by adding gelatinized starch to the aqueous solution of the salt, and afterward a dilute acid (sulphuric, hydrochloric, or tartaric, but not nitric), when a blue color should not at once be developed. "0.2 Gm. of the salt dissolved in 2 Ccm. of ammonia-water, and then agitated with 13 Ccm. of volumetric solution of silver nitrate, should yield a filtrate which on being acidulated with nitric acid should not become so turbid within 10 minutes as to lose its pellucidness."—*P. G.* This test proves the absence of more than about 1 per cent. of chloride and bromide. It has also been admitted by the U. S. P., where, however, five times the quantity of material is ordered, and where it is required that in the acidulated filtrate *no* cloudiness should make its appearance within 10 minutes; which excludes even traces of chloride and bromide. Silver iodide is also slightly soluble in (about 3000 parts of) ammonia-water. "A solution of 1 Gm. of the salt in 20 Ccm. of water, mixed with 5 or 6 drops of test solution of barium nitrate, should show no immediate cloudiness or precipitate."—*U. S.* This test admits the presence of a trace of sulphate, which is excluded by the P. G. (the solution mixed with 10 drops of solution of barium nitrate should not be turbid in 5 minutes). Cyanide may be present from using impure potassium carbonate or impure iodine; its presence is determined by adding to a solution of the iodide a little ferrous sulphate, a drop of solution of ferric chloride or sulphate, and a slight excess of solution of soda. On warming the mixture and acidulating it with hydrochloric acid a blue color (of Prussian blue) should not be produced. "1 Gm. requires for complete precipitation 60.2 Ccm. (60.387 Ccm. for the pure salt) of the volumetric solution of silver nitrate."—*Br.*

Carbonate, sulphate, iodate, nitrate, and cyanide of potassium are insoluble in strong alcohol, which dissolves only small quantities of bromide and chloride of potassium. An adulteration of the iodide with more than mere traces of the last two salts may be detected by treating the iodide with eighteen times its weight of warm alcohol, and, after cooling, testing the undissolved portion. These admixtures may be estimated from the silver precipitate, which from 10 grains of pure iodide of potassium weighs 14.15 grains (or 1.415 Gm. from 1 Gm. of the salt), from the same quantity of bromide 15.8, from chloride 19.2 grains, and from cyanide 20.57 grains. Moreover, the last three may be extracted from the former by ammonia, and, after acidulating this solution with nitric acid, collected and weighed separately; or, instead of dissolving it in water, the salt to be tested may be dissolved in ammonia-water, when on the addition of silver nitrate only iodide of silver will be thrown down.

Pharmaceutical Uses.—Iodide of potassium is used in preparing the iodides of lead and of mercury. It is an ingredient of Linim. iodi, Linim. potass. iodidi cum sapone, *Br.;* Liquor iodi comp. (iodi), Tinct. iodi comp., Unguentum iodi, Ung. potassi iodidi, *U. S.*, *Br.*

Potassii iodas.—Iodate of potassium, *E.;* Iodate de potasse, *Fr.;* Kaliumjodat, Jodsaures Kali, *G.* KIO_3; molecular weight 214.—This salt is left behind on treating the product of the reaction of iodine upon potassa with alcohol; or it may be prepared, according to L. Henry (1870), by diffusing 127 parts of iodine in cold water, passing chlorine into it until chloride of iodine, ICl, has been formed and dissolved in water, adding 122.5 parts of chlorate of potassium and heating, when chlorine gas will be evolved, and iodate of potassium crystallizes on cooling; $ICl + KClO_3$ yields $KIO_3 + Cl_2$. The salt crystallizes in translucent or milk-white cubes, dissolves in 13 parts of cold and in 3.1 parts of boiling water, and is more freely soluble in solution of potassium iodide and insoluble in alcohol. When heated, the salt fuses, and at a high temperature parts with its oxygen, leaving potassium iodide. It detonates, but less violently than the chlorate, when thrown upon burning coal. On the addition of arsenious acid or stannous chloride the solution separates iodine; if not too diluted, its solution yields white granular precipitates with salts of barium, lead, and silver.

Physiological Action.—By the stomach, and given in large doses to animals, iodide of potassium causes efforts at vomiting, and if this is prevented by ligature they suffer depression, accompanied by diuresis, and followed by spasms and death. The mucous membrane is vascular, soft, and ulcerated. Injected into the veins, it also causes convulsions and speedy death. In man it is very rapidly absorbed and eliminated by all the emunctories without undergoing decomposition, but it is discharged mainly through the kidneys, for nearly nine-tenths of the amount used may be recovered from the urine. The elimination is not always rapid, for in some cases the salt may be detected in the urine several weeks after it was taken. It has no uniform influence on either the amount or the quality of the urine secreted, but sometimes occasions albuminuria. The continued use of iodide of potassium excites eruptions of the skin, the most common of which is acne indurata. More rarely blood-blisters or watery blebs form. Cases are sometimes met with in which the smallest dose of the salt excites urticaria (*Phila. Med. Times*, xi. 672). Iodic purpura occurs in the form of discrete purple spots upon the skin, most frequently of the legs, and which usually disappear spontaneously in two or three weeks. (Compare Mackenzie, *Times and Gaz.*, May, 1879, p. 501.) The pustular and bullar forms of the eruption seem to take their origin in the hair-follicles according to some dermatologists, in the sebaceous glands according to others. The blebs are sometimes very large, measuring an inch or more in diameter, and are filled with a clear, turbid, or bloody serum, and have been described under the name *hydroa*. They are very painful to the touch. They are of rare occurrence, and seem to depend upon some peculiarity of the patient, since they may be produced by very small doses of the medicine. In one case an attack of hemiplegia occurred during the use of massive doses of the iodide (Hallopeau). Iodide of potassium is apt to cause salivation, much resembling that which occurs during pregnancy. The symptom is mild, is not accompanied with the fetor of mercurial salivation, and ceases when the medicine is suspended. A familiar effect produced by the salt is a coryza with lachrymation and a congested state of the eyes, nostrils, frontal sinuses, antrum Highmorianum, and throat; more rarely the larynx exhibits catarrhal symptoms, with hoarseness, obstruction, and harassing cough, and sometimes very moderate doses have caused fulness of the head, giddiness, and trembling of the legs in walking. Sometimes, also, there has been impairment of vision and articulation and a partial paralysis of the vocal organs. These effects are often produced by a prolonged use of very small doses, but sometimes very large doses, such as 40 or 60 grains a day, may be taken for weeks without causing any special phenomena. The addition of aromatic spirit of ammonia to a solution of the iodide is said to greatly diminish the tendency to such consequences as have been now described. After a single dose of 8 grains of this iodide the mouth and throat became swollen and secreted viscid mucus and saliva; œdema affected not only the face, but gradually extended to the nostrils and throat and to the whole body; respiration was embarrassed. The symptoms were much relieved by the hypodermic injection of morphia, but did not disappear for several days (*Boston Med. and Surg. Jour.*, Oct. 1882, p. 405). In rare cases iodide of potassium produces an effect which is not so unusual after the prolonged administration of iodine—atrophy of the testicles.

Medical Uses.—Iodide of potassium, although sometimes successful, is not as efficacious as iodine in relieving *mercurial sore mouth*; indeed, it often aggravates the local affection. At the same time, it is the most effectual means of *eliminating mercury* from the system, and thereby curing paralysis, neuralgia, and other symptoms which occur in chronic poisoning by this metal. The same is true of *lead-poisoning* in its chronic form. If the iodide be given to a person by whom lead or mercury has been taken for a considerable period without producing characteristic toxical symptoms, those symptoms will presently be manifested in consequence of the liberation of the metal by the salt, and at the same time the former may be detected in the urine, and sometimes in the saliva, by appropriate chemical tests. To prevent a renewal of the poisoning under this treatment the iodide must be cautiously administered. According to Pouchet, during the period of aggravated symptoms the urine contains on an average 1 Mgm. of metallic lead to the liter. Under the influence of from 4 to 6 grains daily of potassium iodide the elimination of lead increases greatly for a week or ten days, and then declines below its original quantity. Hence, according to Pouchet, the remedy should not be administered continuously (*Boston Med. and Surg. Jour.*, Aug. 1881, p. 125). The power of the iodide to combine with mercury already in the system is illustrated in the treatment of *constitutional syphilis*—*i. e.* of the skin, cellular tissue, bones, and nervous system—by this medicine in persons who had taken mercury during the earlier stages of the disease. It is not unusual for them to experience the full effects of mercurial salivation. Three different explanations have been proposed for the cure of constitutional syphilis by the iodide of potassium: 1, that it revives the mercury in the system and enables it to work its specific cure; 2, that it eliminates the mercury from the system, and so removes an obstacle to the cure; and 3, that it cures syphilis by its intrinsic powers. These propositions are not incompatible with one another, and each may, in individual cases, be true. Clinical observation renders it probable that such is the case. The successful use of the iodide in this disease depends greatly upon its dose, which should never be less than 10 grains three times a day, and often must be twice or thrice as much. Indeed, not a few experts in the treatment of syphilis maintain that unless very large doses of the iodide are given, so as to saturate the system with it, its best effects will not be displayed. In one case the patient seems to have been rescued from an apparently hopeless condition by taking 300 grains of the salt daily for three weeks (Henry, *New York Med. Record*, xx. 590). The eliminative operation of this salt is also shown in chronic *arsenical poisoning* (Falck, *Toxicologie*); a striking illustration of it was presented by the case of an arsenic-eater in Philadelphia (Da Costa, *Phila. Med. Times*, xi. 385).

The value of iodide of potassium in the treatment of *aneurism of the aorta* was discovered, as that of all really valuable medicines has been, "by the merest hazard;" and although the method which some have pursued in employing it included the absolute and prolonged repose of the patient, the share of the iodide in the result cannot fairly be challenged. In cases of aneurism of the aortic arch "not only has relief of neuralgic pains and of the general distress followed its administration, but the local-pressure symptoms have been mitigated, and firm thrombosis has taken place within the sac, while the area of pulsation and of percussion-dulness has exhibited sensible reduction" (Walshe). More recently Balfour (1868) and Bramwell (1878) proved, the former by reports of fifteen, and the latter of seven cases, that this medicine, continuously given while the patient remains at absolute rest in bed and uses a non-stimulating diet, has caused a complete disappearance of all the active signs of an aneurismal tumor, and rendered possible a return to an industrious life. In 1882 a case of cure of aneurism of the aorta by this salt, given in daily doses of 75 or 80 grains and continued for several weeks, was reported by Rhett (*Med. News*, xli. 429). It is not said whether rest was conjoined or not. The medicine must be given in doses ranging from 20 to 30 grains (Gm. 1.33–2) thrice daily, and, with occasional intermissions when iodism occurs, should be continued for weeks or months.

Numerous cases of *dropsy* owe their cure to this medicine, including ascites due to splenic or hepatic induration, and hydrothorax depending upon cardiac obstruction. It has cured acute hydrocephalus from *granular meningitis*, but chiefly when mercury had been previously administered, and *chronic hydrocephalus* under similar circumstances. In these intractable diseases it should never be neglected; and in regard to tubercular or granular meningitis, which so rarely recovers under any treatment, the use of mercury followed by iodide of potassium cannot be too strongly recommended. In not a few cases also presenting signs of *tumor of the brain*, whether syphilitic or not, the symptoms have been greatly mitigated, and sometimes quite removed, by this medicine. Seguin insisted on the necessity of administering very large doses in all such cases (*Med. Record*, xxi. 50).

In the various forms of *muscular rheumatism* iodide of potassium is one of the most efficient remedies, but especially in acute lumbago, which it often cures with marvellous rapidity. In *sciatica* and other forms of rheumatic neuralgia it is sometimes of great advantage, and even in *angina pectoris* it may afford relief. It is worse than useless in acute *articular rheumatism*, but in the chronic disease, with thickening of the fibrous capsules of the joints and effusion within them, it is often the most efficient remedy. It need not, however, be given in large doses for this affection, nor for *chronic gout*, in which also it has been found of service, but its use must be long maintained. In *chronic bronchitis* with asthma, depending upon dilatation of the bronchia or upon thickening of their walls, the iodide is often signally beneficial. The paroxysmal affection is then subordinate to the lesion of nutrition. Sée (1878) referred to twenty-four cases of "*asthma*" which he treated with this medicine and either entirely cured or materially relieved. He gave daily from 20 to 45 grains (Gm. 1.25–3) in divided doses, and continued them for several weeks. In 1882 the same physician renewed the expression of his confidence in the medicine, calling it "the remedy *par excellence* for asthma," and yet stating that it is the most useful remedy for dyspnœa of cardiac origin. He admitted that if the treatment was too prolonged the patients were apt to suffer from bloody extravasations in the mouth and nostrils, or even pulmonary hæmorrhage when a tuberculous diathesis existed, loss of appetite and aversion to food, emaciation, atrophy of the mammæ, etc. A close scrutiny of this author's cases, so far as he describes them, and of several other cases published to confirm them, renders it more than probable that they were asthmatic only in so far as they complicated chronic bronchitis, a disease which the iodide of potassium has often cured. It is worthy of notice that Casey (1866) reported his having employed this medicine in twenty-five or thirty cases of "asthma," in every instance with decided and unequivocal relief. But the dose prescribed by him was only from 2 to 5 grains. The incongruity between the methods of the French and American physicians is very remarkable in view of the apparent identity of their results. More rational, and probably much more efficient, than administering iodide of potassium by the stomach in large or in small doses for the relief of asthmatic bronchitis is the inhalation of an atomized solution of the salt of the strength of 5 per cent. The inhalation should be frequently repeated (Everard). On the whole, we do not find any reason for believing that asthma, in its proper sense, has been cured by iodide of potassium. In cases of *paralysis* due probably to pressure upon a motor centre or upon a nervous trunk, produced by syphilitic or other swellings, the medicine is often singularly efficient, and should never be omitted from the treatment. The same remark applies to many cases of spinal paralysis, and especially to those of incoördination of movements due to *sclerosis of the cord.* (Compare Mitchell, *Phila. Med. Times*, x. 422.) In all of the affections mentioned in this paragraph it is probable that the iodide is operative by its causing the absorption of indurations which compress the source or the channels of nervous power. That it restrains nutrition generally, normal as well as abnormal, is shown by its emaciating operation upon the testes, mammæ, and ultimately on other organs, and that it at the same time promotes elimination is rendered probable by the history of its use in diseases of the skin and constitutional syphilis, etc.

The *dose* of iodide of potassium cannot be accurately defined; according to the object to be attained, it should be given in small doses, as 2 or 3 grains (Gm. 0.12–0.20), or very large ones, as from 10 to 20 grains (Gm. 0.60–1.30), three times a day, and always in a large quantity of liquid. It should be remembered that water dissolves more than its own weight of this salt. Its unpleasant taste is best concealed by dissolving it in carbonic acid water or in artificial Vichy water. This medicine has been used hypodermically in certain cases of its intolerance by the stomach, 8 grains being administered at each injection. According to Rabuteau, sulphate of quinine should not be administered before or after iodide of potassium, for mutual decomposition of the two medicines takes place and iodine is liberated, which may act poisonously.

POTASSII NITRAS, *U. S., Br.*—NITRATE OF POTASSIUM.

Potassæ nitras, Br.; *Kalium nitricum*, P. G.; *Nitrum depuratum*, *Sal petræ*. *Sal nitri*, *Nitras potassicus s. kalicus.*—*Nitrate of potash*, *Nitre*. *Saltpetre*, E.; *Azotate* (*Nitrate*) *de potasse*, *Nitre prismatique*, *Salpêtre*, Fr.; *Kaliumnitrat*, *Salpetersaures Kali*, *Salpeter*, *Kalisalpeter*, G.

Formula KNO_3. Molecular weight 101.

Origin and Preparation.—Nitrum of the Romans was alkali carbonate, that of sodium being chiefly thus designated. Saltpetre was known to Geber in the eighth century, and in the Latin translations of his writings is called sal petræ and sal petrosum. Subsequently, it was distinguished as sal nitrum or sal nitri, until at the close of the sixteenth century it was called nitrum. (See SODII CARBONAS.) Fused by itself or with the addition of a small quantity of sulphur, it was formerly used as *sal prunelle* or *nitrum tabulatum*. Saltpetre is produced near the surface of the earth wherever nitrogenous organic substances are undergoing decomposition in the presence of air, moisture, and potassium compounds. It is present in considerable quantities in the calcareous soil near dwellings of some parts of India. This soil becomes impregnated with urine, and after it has been exhausted of its soluble salts soon generates them again, the decomposition being hastened by the hot and moist climate. In several parts of Europe nitrates are formed in a precisely analogous manner, either by collecting the urine of domestic animals in ditches which have been previously filled with a porous calcareous earth, or by mixing in the so-called *saltpetre-beds* animal and vegetable substances with wood-ashes and marl or other material containing lime, and forming this mixture into mounds which are occasionally moistened with drainings from the dung-pit, until after two or three years the salt accumulates in the outer layer of the heap, which is then removed, lixiviated with water, and left in contact with wood-ashes in order to decompose the nitrates of calcium and magnesium which are usually present. In India, which furnishes the greater part of the nitre, the process of exhausting the earth is very similar, except that it is usually packed upon wood-ashes and the whole lixiviated.

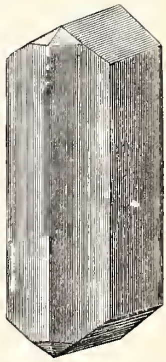
In the Mammoth Cave of Kentucky, and in other localities of the United States, saltpetre has occasionally been procured, and it may be obtained in variable quantities from most soils where vegetable and animal materials have been decaying, and from which it is taken up by the plants growing there, some of which are very rich in this salt. A. Boutin (1874) ascertained that Amarantus melancholicus ruber contains 16, and Am.

atropurpureus even 22.77, per cent. of potassium nitrate, calculated for the dry herb. The same salt crystallizes in some old extracts.

Since the Stassfurt mines have been worked the large quantities of chloride of potassium obtained have also been utilized in the production of saltpetre by a process of mutual decomposition effected with native nitrate of sodium (Chili saltpetre). Equivalent quantities of the two salts are boiled together with water until the chloride of sodium commences to separate in the boiling liquor, which is then concentrated and the chloride removed as it crystallizes. On the cooling of the solutions the crystallization of the nitre is usually disturbed by frequent stirring in order to better drain off the mother-liquor, in which most of the foreign salts remain dissolved. Variable quantities of these salts, and particularly of sodium and potassium chlorides, are always found in crude nitre, which for further purification is redissolved in water and granulated by evaporation and stirring. The last portions of adhering chlorides are in some places removed by percolating the granular powder with a concentrated solution of nitre, in which they are dissolved, while the nitrate is recovered by boiling the solution and removing the sodium chloride as it separates.

Most of the saltpetre used in the United States is purified here from the foreign crude article, of which during the year 1881–82 11,796,091 pounds were imported, besides 453,794 pounds of refined and partly refined nitrate of potassium.

Fig. 228.



Crystal of Potassii Nitras.

Properties.—Nitrate of potassium crystallizes in colorless, transparent, six-sided, striated prisms of the rhombic system, which frequently have cavities in the interior filled with mother-liquor, so that on trituration they yield a damp powder. It is often kept in the granulated state, and is then a white crystalline powder. When heated to 339° C. (642.2° F.) it fuses to a colorless liquid, and congeals again on cooling to a radiating crystalline mass; in the presence of even a small proportion of chloride of sodium the radiating arrangement is less distinct, at least in the centre of the mass, or entirely wanting. At a higher temperature it gives off oxygen, and afterward oxygen and nitrogen, being gradually converted into nitrite, oxide, and peroxide of potassium; on the addition of sulphuric acid this residue gives off nitrous vapors. Potassium nitrate is neutral to test-paper, inodorous, has a pungently saline and cooling taste, and dissolves in water with a marked diminution of temperature. 1 part of the salt dissolves

at	0°	15°	30°	40°	50°	60°	80°	100°	114.1° C.
in	7.25	3.85	2.25	1.563	1.163	.901	.582	.405	.306 parts of water,

the boiling-point of the most concentrated solution being 114.1° C. (237.4° F.). The salt is insoluble in absolute and sparingly soluble in dilute alcohol. It is permanent in the air, but, according to Mulder (1864), absorbs a considerable amount of water when kept in a confined atmosphere saturated with moisture. When thrown upon red-hot coal it deflagrates. Warmed with sulphuric acid and copper, it evolves red nitrous vapors; its aqueous solution gives a white crystalline precipitate of cream of tartar on the addition of a concentrated solution of tartaric acid or of sodium bitartrate, and if acidulated with hydrochloric acid yields a yellow precipitate with perchloride of platinum. The solution, mixed with an equal bulk of sulphuric acid, and afterward with ferrous sulphate, acquires a brown-black color.

Tests.—The aqueous solution of the salt should have a neutral reaction, and should not be affected by hydrosulphuric acid or sulphide of ammonium (absence of metals), chloride of barium (absence of sulphate), nitrate of silver (chloride), carbonate of ammonium (calcium salt), or after the addition of carbonate of ammonium by phosphate of ammonium (magnesium salt). The U. S. P. permits a faint opalescence with silver nitrate. On mixing the powdered salt or its concentrated solution with alcohol, and igniting the latter, the flame should have a violet but not a yellow color (sodium salt). On mixing 1 Gm. of the dry salt with 1 Gm. of sulphuric acid, evaporating to dryness, and igniting, the residue consists of sulphate of potassium, and should weigh .86 Gm. In the presence of nitrate of sodium the weight is less.

Off. Prep.—Argenti nitras dilutus, Charta potassii nitratis, *U. S.*

Pulvis temperans, s. Pulvis refrigerans. Mix by trituration nitrate of potassium 1 part, bitartrate of potassium 3 parts, and sugar 8 parts.—*P. G.* 1872.

An older formula directs equal weights of sulphate and nitrate of potassium, and this, mixed with 10 per cent. of vermilion, is PULVIS TEMPERANS (RUBER) STAHLII; Poudre tempérante de Stahl, *F. Cod.*

Physiological Action.—*On Animals:* In large but non-lethal doses a solution of nitrate of potassium thrown into a vein increases the arterial blood-pressure and reduces the frequency of the pulse. In lethal doses it causes a rapid fall in the arterial blood-pressure and the pulse-rate, and death by syncope is preceded by epileptiform convulsions. It appears to act as a sedative poison on the heart-muscle as well as upon the cardiac nerves. In small doses it reduces the pulse-rate and lowers the temperature, but the latter effect is more persistent than the former. In the composition and condition of the blood no change takes place, unless the use of the salt be greatly prolonged, and then the coagulability of the blood is impaired. Injected into a vein near the heart, it arrests the action of that organ, and injected into an artery supplying a limb, it first of all paralyzes the muscles with which it comes primarily into contact.

On Man: The action of nitrate of potassium upon man does not differ essentially from its action upon the lower animals. In small doses it is diuretic, provided it be given in an abundant watery vehicle; in large doses it is a cardiac and nervous sedative and a purgative; and in excessive doses a local irritant poison, as well as a powerful sedative of all the vital functions. A small piece of the salt dissolved in the mouth occasions a sense of coolness in the part and a saline taste; given in small and repeated doses to healthy persons, it does not clearly affect any function, although in some cases it appears to augment the secretion of urine, which is probably due to its local irritant action upon the kidneys, since a large proportion of it is eliminated, unchanged, with the urine. When large doses of the salt are given, however, this secretion is diminished and its specific gravity raised, chiefly by the nitre eliminated with it.

After large but non-poisonous doses the following symptoms have been observed: general weakness, giddiness, confusion of ideas, and indisposition to mental and bodily exertion, weakness of the lower limbs especially, low spirits, a tendency to grow fatigued and to sleep, tinnitus, and a slow and weak pulse. The pulse may fall at last to 20 per minute, and continue at the same rate for seven or eight days after the medicine has been discontinued. Appetite and digestion are not usually impaired, and the bowels are only occasionally loose. As a rule, however, full medicinal doses do not tend to relax the bowels. The effects upon the pulse and nervous system are among those which have led to the recognition of a close analogy between the salt under consideration and the bromide of potassium, and to the extraordinary suggestion that the potassium in the latter compound is the real source of its soporific powers!

When poisonous doses of nitre are taken, as an ounce and upward, there are symptoms of gastro-intestinal inflammation, and sometimes blood is vomited and passed by stool; the urine is diminished or suppressed; there are coldness of the extremities, a feeble and thready pulse, slow respiration, great debility, tremulousness, insensibility, blindness, deafness, and even convulsions. A case is on record in which a person who had taken 3½ ounces of nitre presented no marked symptoms at first, but at the end of 5 hours suddenly fell from his chair and expired. It is remarkable that poisoning by this substance generally ends in recovery, although for some time the patient may suffer from irritability of the stomach, colic, dysuria, and a sense of chilliness in the back and limbs, with weakness of the latter. After death a florid color of the lips has been noted, and a similar hue of the blood, which, indeed, other salts, as chloride of sodium, chloride of magnesium, etc., produce; the stomach is apt to contain blood, and its lining membrane is injected, softened, or corroded. The upper part of the small intestine may present a similar condition.

Medical Uses.—Nitre has long been used in acute *rheumatism*, given in a large amount of water or other liquid diluent, as 2 or 3 drachms (Gm. 8–12), and from that to an ounce (Gm. 32), in about a quart of water, which quantity was taken in 24 hours. There is no lack of competent authorities who declare that it subdues the fever and pain and shortens the attack, while others of equal competency allege that it is useless therapeutically, and repulsive to the taste and stomach. We have no doubt that the latter is the truer judgment of the two. At the present day this method of treatment is hardly thought of in the acute, and still less in the chronic, form of rheumatism. The same remark applies to *pneumonia*, various *fevers*, etc., and even in *dropsy* the diuretic virtues of nitre are too uncertain to entitle it to any confidence. It has been claimed as a remedy for *scurvy* on theoretical and unsubstantial grounds, and also upon the ground of its efficacy when dissolved in vinegar, without due consideration of the well-established virtues of the solvent in this disease. In *spasmodic asthma*, whether complicated with *bronchitis* or not, inhalation of the fumes of burning paper impregnated with nitre renders the breathing freer and less stridulous, and sometimes, by repetition, cures the disease. The fumes may be employed by diffusion through the air of the patient's bedroom, or inhaled from a cigarette or from thin linen paper impregnated with a solution of nitre burned under a funnel, from the mouth of which the patient inspires. Powdered nitre, moistened with water and applied to the face night and morning, is one of the best remedies for *freckles* (lentigo). A similar solution is useful in *bruises* and *abrasions*. Nitre may be prescribed in powder in doses of from 10 to 30 grains (Gm. 0.60–2) or more, or in solution, which is preferable. The effects of an overdose of nitre are best palliated by the free use of water or of some bland liquid, and by warm narcotic fomentations of the epigastrium.

Potassium nitrite has been supposed to possess the powers of amyl nitrite, because their physiological action is very similar. But Dr. Hinsdale (*Inaug. Thesis*, Univ. of Penna., 1881) found that it aggravated the paroxysms of *epilepsy* and rendered them more frequent. As an antidote to strychnia he concluded that it displayed no power whatever.

POTASSII PERMANGANAS, *U. S., Br.*—PERMANGANATE OF POTASSIUM.

Potassæ permanganas, Br.; *Kalium permanganicum*, P. G.; *Kali hypermanganicum crystallisatum*, *Hypermanganas potassicus, s. kalicus.*—*Permanganate of potash*, E.; *Permanganate de potasse*, Fr.; *Kaliumpermanganat*, *Uebermangansaures Kali*, G.

Formula $K_2Mn_2O_8$. Molecular weight 314.

Permanganate of potassium should be kept in well-stopped bottles, and should not be triturated nor combined in solution with organic or readily oxidizable substances. —*U. S.*

Origin.—This salt appears to have been obtained by Glauber (1659), who by melting together magnesia (black oxide of manganese) with fixed alkali (potash), and dissolving the mass in water, found the solution to be of a purple color and to change to blue, red, and green. Chevillot and Edwards (1817) showed that for the production of this colored compound the presence of oxygen was necessary, whereby the manganese was oxidized to an acid. Forchhammer (1820) distinguished in the green and red compound two acids, the composition of which was determined by Mitscherlich (1830).

Preparation.—Take of Caustic Potash 5 ounces; Black Oxide of Manganese, in fine powder, 4 ounces; Chlorate of Potassium 3½ ounces; Carbonic Acid a sufficiency; Distilled Water 2½ pints. Reduce the chlorate of potash to fine powder, and mix it with the oxide of manganese; put the mixture into a porcelain basin and add to it the caustic potash, previously dissolved in 4 ounces of the water. Evaporate to dryness on a sand-bath, stirring diligently to prevent spurting. Pulverize the mass, put it into a covered Hessian or Cornish crucible, and expose it to a dull red heat for an hour, or till it has assumed the condition of a semi-fused mass. Let it cool, pulverize it, and boil with 1½ pints of the water. Let the insoluble matter subside, decant the fluid, boil again with ½ pint of the water, again decant, saturate the united liquors with carbonic acid, and evaporate till a pellicle forms. Set aside to cool and crystallize. Drain the crystalline mass, boil it in 6 ounces of the water, and strain through a funnel the throat of which is lightly obstructed by a little asbestos. Let the fluid cool and crystallize, drain the crystals, and dry them by placing them under a bell-jar over a vessel containing sulphuric acid.—*Br.*

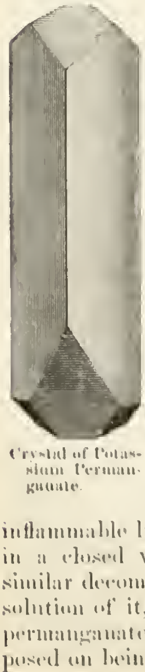
When binoxide of manganese is heated to dull redness with an excess of potassa a portion of it is oxidized to manganic acid at the expense of a part of the oxygen of another portion of the binoxide, which is thereby reduced to manganic oxide. But if oxygen is at the same time conducted into the mass, all the manganese will be converted into manganic acid, which unites with the potassa, forming potassium manganate. It is more convenient to supply oxygen by means of an oxidizing agent, such as nitrate or chlorate of potassium, the former of which will supply an additional quantity of alkali for uniting with the manganic acid, while the latter will be converted into potassium chloride, which remains mixed with the manganate. In this case the result will be explained by the equation $6KHO + 3MnO_2 + KClO_3 = 3K_2MnO_4 + KCl + 3H_2O$. The proportions adopted by the British Pharmacopœia are those of Gregory, and refer to a nearly pure binoxide of manganese. If the article to be used should not contain at least 93 per cent. of MnO_2, a correspondingly larger quantity should be employed. The ignited mass contains, besides the manganate and chloride of potassium, all the mineral impurities which were present in the black oxide. It has a green color, and when treated with a little cold water yields a dark-green solution, which may be evaporated over sulphuric acid *in vacuo*, yielding blackish-green crystals. These dissolve unchanged in solution of potassa, but yield with water a solution which rapidly acquires a red color from the decomposition of the manganate into permanganate, manganic binoxide, and potassium hydrate; $3K_2MnO_4 + 2H_2O$ yields $K_2Mn_2O_8 + MnO_2 + 4KHO$. On account of this change of color the green manganate was formerly known as *chameleon mineral.* The hydrate of potassium which is liberated in the reaction with water will dissolve a portion of the manganate without change until combined with carbonic, sulphuric, or other acid, when the whole of the manganate will be decomposed as stated. After the impurities and manganic peroxide have subsided the clear liquid is drawn off, the sediment drained and washed upon asbestos or powdered glass (since a paper or muslin filter would decompose the permanganate), and evaporated to crystallization. The first crop or two of crystals are usually pure; subsequently they become mixed with chloride and sulphate of potassium, and require to be purified by recrystallization. Finally, the other salts accumulate in the mother-liquors to such an extent that crystals of pure permanganate can no longer be obtained, and the liquids are advantageously used for disinfecting, bleaching, or other purposes.

Graeger (1866) proposed to utilize the manganic oxide, which may be obtained in large quantities and at little expense from the liquors, in the preparation of chlorine. The production of the manganate is explained by the equation $Mn_2O_3 + KClO + 4HKO_3 = 2K_2MnO_4 + KCl + 2H_2O$. The process of Städeler (1868) for converting the manganate into permanganate of potassium by means of chlorine gas, and without separation of manganic peroxide, is apt to contaminate the product with small quantities of potassium chlorate, but with due care yields the crystallized salt, equal to 85 or 90 per cent. of the weight of the black manganese used.

In a process proposed by Squibb (1864) the formation of other crystallizable salts is avoided by heating the intimate mixture of potassa and manganic peroxide thoroughly to short of redness; while the mass is hot a small stream of water is directed upon it; the heating is renewed and the operation several times repeated. The mass is exhausted with water, and after the permanganate has been crystallized the mother-liquor is evaporated and used over again in place of a corresponding quantity of potassa.

Properties.—Permanganate of potassium is in dark-purple or deep violet-red, nearly black rhombic prismatic crystals, which have a greenish or bluish metallic lustre, do not react upon turmeric- or litmus-paper, are permanent in the air and without odor, and have a sweet, astringent taste. A small quantity of it imparts to a large quantity of water a rich purple tint, which is destroyed by organic matter and deoxidizing agents. Alcohol, acetone, acetic acid, oxalic acid, glycerin, tartaric acid, citric acid, sugar, gum, tannin, quinine, aniline, gelatin, and many other organic compounds are more or less readily oxidized in the cold or on boiling. According to Mitscherlich, the salt dissolves at 15° C. (50° F.) in 16 parts (20 parts, *U. S.*) of water and in 2 parts (3 parts, *U. S.*) of boiling water. The solution of the pure salt may be boiled without being decomposed, but in the presence of much potassa it acquires a green color from the formation of manganate, oxygen being given off at the same time; $K_2Mn_2O_8 + 2KHO$ yields $2K_2MnO_4 + H_2O + O$. A diluted solution of potassa exerts no reducing action except in the presence of organic matter. The solution of permanganate is decolorized by hydrosulphuric acid, carbon disulphide, hyposulphites, sulphites, phosphorus, hypophosphites, iodine, iodides, and many other inorganic oxidizable substances, as well as by organic compounds; the brown oxide which precipitates yields with diluted sulphuric acid a colorless or reddish solution. When heated to redness the salt parts with a portion of its oxygen and leaves a black residue of an alkaline reaction, from which water extracts potassium hydrate. When thrown upon red-hot charcoal it deflagrates, and on being triturated with sulphur or other inflammable bodies the mixture is decomposed with detonation. On mixing its solution in a closed vessel with glycerin, syrup, or other liquids containing organic matter a similar decomposition, accompanied by explosion, will take place. A warm concentrated solution of it, mixed with nitrate of silver and allowed to cool, deposits large crystals of permanganate of silver, which require over 100 parts of water for solution and are decomposed on being boiled with water.

FIG. 229.



Crystal of Potassium Permanganate.

Tests.—The solution of the salt in much water should have a rose-color, without a tinge of green (absence of manganate). "If a solution of the salt be mixed with enough oxalic and diluted sulphuric acid to produce a clear, colorless liquid, and a portion of this be poured upon a cold solution of ferrous sulphate in sulphuric acid, no brown or blackish-brown zone should make its appearance at the line of contact of the two liquids (absence of nitrate). Another portion of the decolorized liquid should yield no permanent precipitate or cloudiness on the addition of a few drops of test-solution of nitrate of silver (chloride). On boiling the aqueous solution of the salt with an excess of ammonia until all the manganese is precipitated as hydrated oxide, the colorless filtrate (acidulated with nitric acid) should yield no precipitate, or at most only a faint cloudiness, with test solution of nitrate of barium (limit of sulphate)."—*U. S.* An excess of oxalic acid used for decolorizing the permanganate solution is likely to produce a precipitate with silver nitrate, the oxalate being almost insoluble in water. The presence of chloride and sulphate may be determined directly in a diluted solution of the permanganate, or the latter may be decolorized by boiling with alcohol (*P. G.*); such a solution, on being mixed with diluted sulphuric acid and zinc, and afterward with solution of starch and zinc iodide, should not acquire a blue color (absence of nitrate).—*P. G.* "If 0.785 Gm. of the salt be dissolved in 50 Ccm. of boiling distilled water, and 5 Ccm. of sulphuric acid be cautiously added, the solution so formed should require for complete decoloration not less than 24.7 Ccm. of the volumetric solution of oxalic acid (corresponding to at least 98.8 per cent. of pure permanganate of potassium)."—*U. S.* The British Pharmacopœia requires 5 grains of the salt dissolved in water to be completely decolorized by a solution of not less than 44 grains of pure ferrous sulphate, acidulated with 2 fluidrachms of diluted sulphuric acid. This test depends upon the oxidation of 10 molecules (2779) of ferrous to ferric sulphate by 1 molecule (314) of pure permanganate of potassium.

Off. Prep.—Liquor potass. permanganatis, *Br.*

Physiological Action.—Vulpian found that a solution of permanganate of potassium (Gm. 1 : water Gm. 200 = gr. xv : f℥vi) thrown into the veins of a large dog occasioned general debility, prostration, vomiting, diarrhœa, and death in from 10 to 20 hours; rapid putrefaction, dissolved blood, ecchymoses in many parts, congestion of the gastro-intestinal mucous membrane and of the kidneys, bloody urine, sometimes pulmonary infarcts, etc. (*Bull de thérap.*, cii., 251). The readiness with which permanganate of potassium yields its oxygen to bodies having a strong affinity for that element accounts for its alleged utility in limiting putrefaction and correcting putrid smells. For these purposes it was first used in 1857, but as regards the former of them the notion was erroneous, although exceedingly minute proportions of the salt neutralize the smell of putrefaction. A solution of 1 part in 5000 parts of water is promptly destructive of infusoria, but it does not destroy the germs upon which fermentation depends; a much stronger solution is necessary for that purpose. Applied pure to the sound skin, it produces a brown stain; upon mucous surfaces it causes neither pain nor irritation, but smarting and burning when applied to a raw surface. Internally, it has been taken in doses of from 8 to 10 grains without injury when largely diluted.

Medical Uses.—Internally, permanganate of potassium has been used in *diphtheria*, *diabetes*, and *acute rheumatism*, but without any beneficial results. Ringer and Murrell extol this salt as a most efficacious remedy for *amenorrhœa* due to transient causes, such as catching cold, and even where the suspension is due to repeated pregnancies and suckling. It was given in doses of a grain at first, but gradually increased to 2 grains four times a day, as near as possible to the regular date of menstruation, and continued for three or four days. Either in pill or in solution the medicine is apt to produce a sense of substernal pressure or heartburn, and in the latter form it is very disagreeable (*Practitioner*, xxx. 128). Locally, it is chiefly employed to correct fetor in *cancer*, especially of the uterus, in corroding *ulcers*, *ozæna*, *abscesses*, *caries*, and *gangrene*. In these cases it is applied in a strong solution with a brush or sponge, or in a weaker solution upon pledgets and compresses of lint. A similar application has been made to *carbuncles* after incision. In *ozæna* it forms one of the best palliatives when applied with the nasal douche, and has also been used with great advantage in an atomized solution inhaled in *gangrene of the lung*. Injections of the solution and lint saturated with it are among the best means of treating fetid *otorrhœa*. In the proportion of about 3 grains to an ounce (Gm. 0.20 in Gm. 32) of water it forms an excellent mouth-wash and gargle when *foul breath* arises from carious teeth or from the altered secretions of the faucial glands. As a wash it palliates the fetid exhalations of the *feet* and *armpits* in certain persons, and is useful in purifying the hands from the *smell* acquired in dissecting-rooms, in post-mortem examinations, and in various obstetrical and surgical manipulations. In *gonorrhœa* a solution of 1 or 2 grains in an ounce (Gm. 0.06–0.12 in Gm. 32) of water is a very efficient injection. It seems to act partly as a stimulant of the urethral mucous membrane, and partly by its destructive action on the pus which is the vehicle of the specific virus in true gonorrhœa. In *leucorrhœa* stronger preparations may be employed. and the same may be applied to diminish the *lochial discharge* and correct its fetor. Solutions of this salt have been widely used as disinfectants. But if the infectious qualities of decomposing animal matter are to be measured by its power of decolorizing a solution of permanganate of potassium, then a very curious conclusion has been reached by Dr. Dougall (1878)—viz. that 1 ounce of such matter, represented by the alvine discharges of typhoid fever, deoxidizes not less than 10 ounces of Condy's liquid, and that 1 ounce of urine has the same effect on at least 2 ounces of that liquid. It follows from these premises that each patient whose excreta are so treated would cost five dollars a day for this item alone. It is more than probable, therefore, that the method is hardly ever efficiently carried out. This salt has been recommended as an antidote to *serpents' poison* (Lacerda, *Bull. de thérap.*, ci. 325; civ. 556; Richards, *Times and Gazette*, Jan. 1882, p. 93). The observations and experiments that refer to the subject only prove that the permanganate mixed with any such poison destroys its virulence, and that if introduced into the wound made by a venomous animal immediately on the infliction of the wound, no toxical phenomena will arise. Evidently, this agent destroys the constitution of the poison. The introduction of the salt in any other way than that indicated, by the mouth, by intravenous injection, or hypodermically, except at the point at which the poison entered, is useless. It seems probable that such hypodermic injection of wounds made by rabid animals would be more efficient in preventing *rabies* than any other form of cauterization.

Water contaminated by organic matter may be purified and rendered palatable by adding to it drop by drop a solution of the permanganate until the pink color of the solution ceases to be destroyed after the lapse of 24 hours. The clear liquor may then be decanted and used without danger.

A solution of not more than 2 grains of the salt to a fluidounce (Gm. 0.12 in Gm. 32) of pure water is most appropriate as a commencing injection for the vagina and urethra and as a wash for simple wounds and ulcers. A solution of 8 grains to the fluidounce (Gm. 0.50 in Gm. 32) may be used for disinfecting purposes. Internally, it may be given in *doses* of from 2 to 5 grains (Gm. 0.13–0.30) dissolved in a large quantity of water. The stains left by this salt upon linen may be removed by washing it in water acidulated with sulphurous or muriatic acid, oxalic acid, salt of sorrel, or simply by lemon-juice, or finally by a weak solution of sulphate of iron.

POTASSII SULPHAS, *U. S., Br.*—SULPHATE OF POTASSIUM.

Potassæ sulphas, Br.; *Kalium sulfuricum*, P. G.; *Sulfas potassicus s. kalicus; Arcanum duplicatum, Tartarus vitriolatus, Sal polychrestum Glaseri.—Sulphate of potash*, E.; *Sulfate de potasse*, Fr.; *Kaliumsulfat, Schwefelsaures Kali*, G.

Formula K_2SO_4. Molecular weight 174.

Origin.—This salt is present in sea-water and in various mineral waters, in the ashes of many plants, in many salt-beds, and in the lava of different volcanoes. It is obtained as a secondary product in many chemical processes, such as the preparation of iodine from kelp, of nitric acid from potassium nitrate, of hydrochloric acid from potassium chloride, and in the purification of potash, etc. It appears to have been prepared in the fourteenth century from the saline residue left in the preparation of nitric acid, and to have been used medicinally by Paracelsus in the sixteenth century. Glaser (1663) prepared it by adding sulphur to melted saltpetre.

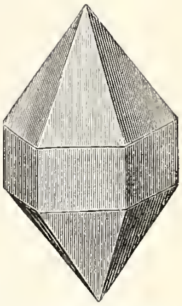
Preparation.—In the manufacture of the products of the Stassfurt mines it is obtained by decomposing potassium chloride with a hot concentrated solution of *schœnite* (sulphate of magnesium and potassium), and by separating the sulphate of potassium from the double chloride of potassium and magnesium, which is formed at the same time, before the latter can crystallize. In Kalusz, Gallicia, the salt is prepared from *kainite*, a mixture of sulphate and chloride of magnesium and potassium, by exhausting with a little water, boiling the residue with potassium chloride, and granulating the newly-formed potassium sulphate.

Properties.—Sulphate of potassium crystallizes in transparent, colorless, and hard six-sided rhombic prisms or pyramids, or combinations of the two forms. It is permanent in the air, inodorous, has a somewhat sharp and saline bitterish taste, is neutral to test-paper, has the specific gravity 2.65, and yields a white powder. According to Mulder (1864), the salt dissolves

at	5°	15°	30°	40°	60°	80°	100° C.
in	11	9.7	8.13	7.15	5.62	4.6	3.82 parts of water.

It has the specific gravity 2.65, is insoluble in alcohol, but dissolves in about 500 parts of diluted alcohol. The aqueous solution, acidulated with hydrochloric acid, gives with barium chloride a white, with platinic chloride a yellow, and with saturated solution of sodium bitartrate a white crystalline, precipitate. When heated it decrepitates strongly, melts at a bright-red heat without decomposition, and at a white heat volatilizes slowly in white non-alkaline vapors, leaving a residue which on cooling is crystalline and has an alkaline reaction; when mixed with an excess of chloride of ammonium and ignited it leaves potassium chloride. It imparts a purple color to the flame.

Fig. 230.



Crystal of Potassium Sulphate.

Tests.—The aqueous solution of sulphate of potassium should not be affected by sulphuretted hydrogen or sulphydrate of ammonium (absence of heavy metals), nor should it be precipitated by carbonate or oxalate of ammonium (calcium, etc.), or by nitrate of silver (chloride). The solution, mixed with an equal volume of sulphuric acid, should not give a brown or black color on the addition of ferrous sulphate (nitrate). Held in a non-luminous flame, this should not be permanently colored yellow. 1 Gm. of sulphate of potassium, when completely precipitated by chloride of barium, yields 1.338 Gm. of dry sulphate of barium.

Off. Prep.—Pil. colocynth. comp., Pil. colocynth. et hyoscyami, Pulv. ipecacuanhæ comp., *Br.*

Allied Salt.—Potassii bisulphas, $KHSO_4$; molecular weight 272. Bisulphate or acid sulphate of potassium is the saline mass remaining in the retort on preparing nitric acid from nitrate of potassium and sulphuric acid (see page 73), and may be obtained in needle-shaped prisms by dissolving it in less than its own weight of boiling water and cooling. The crystals are colorless and transparent, have a strongly acid taste, an acid reaction to litmus, are fusible when heated, congealing on cooling to a translucent mass, and at a higher heat are decomposed, with the evolution of oxygen and sulphurous acid gas, neutral sulphate of potassium being left. The salt dissolves without change in 2 parts of cold water, but when dissolved in a larger quantity of hot water neutral sulphate crystallizes on cooling, the liquid containing sulphuric acid. A like decomposition into neutral sulphate and acid is occasioned by alcohol.

Medical Action and Uses.—Under the name of *Sal de duobus* or *Sal polychrest* sulphate of potassium was formerly used as a purgative. It acts in a smaller dose than other salines, but is apt to be harsh, producing colicky pain and burning in the abdomen. In several instances doses of from ½ ounce to 2 ounces have caused fatal poisoning, and oftener alarming symptoms. The symptoms were severe gastric pain, vomiting, purging, and collapse. After death inflammation of the gastro-intestinal mucous membrane was found. Its *dose* as a purgative is from 2 to 4 drachms (Gm. 8–16), but it is seldom prescribed, nor does any good reason appear that it should be so employed. The bisulphate is represented as possessing the qualities of the sulphate in a more marked degree.

POTASSII SULPHIS, *U. S.*—SULPHITE OF POTASSIUM.

Kalium sulfurosum, Sulfis potassicus s. kalicus.—Sulfite de potasse, Fr.; *Kaliumsulfit, Schwefligsaures Kali,* G.

Formula $K_2SO_3.2H_2O$. Molecular weight 194.

Preparation.—On passing sulphurous acid gas into a solution of carbonate of potassium until the carbonic acid has been expelled, and adding an equal weight of potassium carbonate, the sulphite, having the above composition, will crystallize on evaporation.

Properties.—Sulphite of potassium crystallizes in oblique rhombic octahedrons, which are inodorous or of a slight sulphurous odor, somewhat deliquescent, dissolve freely in water, are sparingly soluble in alcohol, show an alkaline reaction to test-paper, and have a bitter saline and sulphurous taste. Rammelsberg ascertained that an aqueous solution of the salt saturated in the cold becomes turbid on heating and clear again on cooling. Fourcroy and Vauquelin determined the salt to be soluble in its own weight of cold water; the U. S. P. states the solubility as being 1 part in 4 parts of water at

15° C. (59° F.) and in 5 parts of boiling water. When heated the salt gives off water, evolves sulphurous acid, and leaves finally a mixture of sulphate, sulphide, and hydrate of potassium. On exposure to the air it is oxidized and gradually converted into sulphate; it should therefore be preserved in well-stopped bottles. On adding sulphuric or hydrochloric acid to its solution the odor of burning sulphur is given off, but no turbidity from liberated sulphur is produced (difference from hyposulphite). This solution gives the reactions of potassium salts on the addition of chloride of platinum or of tartaric acid or of saturated solution of sodium bitartrate. The commercial salt is usually in the form of white opaque crystalline fragments or powder, obtained by evaporating the aqueous solution.

Composition.—The salt contains 48.5 per cent. K_2O, 33 per cent. SO_2, and 18.5 per cent. H_2O.

Tests.—"A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should produce no precipitate, or at most only a white cloudiness, on the addition of a few drops of test solution of chloride of barium (limit of sulphate). If 0.485 Gm. of the salt be dissolved in 25 Ccm. of water, and a little gelatinized starch added, at least 45 Ccm. of the volumetric solution of iodine should be required until a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure sulphite of potassium)."—*U. S.* The same amount of the volumetric solution of iodine is required by 0.27 Gm. of pure bisulphite of potassium.

Allied Salts.—BISULPHITE OF POTASSIUM, $KHSO_3$; molecular weight 120. It is prepared by passing into a concentrated solution of carbonate of potassium an excess of sulphurous acid gas and adding strong alcohol. The salt crystallizes in white needles, has a sulphurous taste and neutral reaction to test-paper, and on exposure slowly evolves sulphurous acid gas. On passing sulphurous acid gas into a warm saturated solution of potassium carbonate the liquid finally becomes greenish, and on cooling deposits hard, glossy, tabular crystals of *potassium pyrosulphite*, $K_2(SO_2)_2O$, which have a saline taste, and on heating give off sulphur and sulphur dioxide, leaving potassium sulphate.

Medical Action and Uses.—The sulphite of potassium is believed to possess the same power of controlling fermentation and putrefaction which belongs to the sulphites of sodium and magnesium. But it is much less used than either. It may be given internally, in a very dilute solution, to the extent of from 2 drachms to ½ ounce (Gm. 8–16) in the 24 hours. The hyposulphite and the bisulphite have analogous properties, and the latter has sometimes been used externally as a stimulant and deodorizer.

POTASSII TARTRAS, *U. S., Br.*—TARTRATE OF POTASSIUM.

Potassæ tartras, Br.; *Kalium tartaricum*, P. G.; *Tartras potassicus s. kalicus*, *Tartarus solubilis*.—*Tartrate of potash*, *Soluble tartar*, E.; *Tartrate de potasse*, *Tartre soluble*, *Sel végétale*, Fr.; *Kaliumtartrat*, *Neutrales weinsaures Kali*, G.

Formula $(K_2C_4H_4O_6)_2.H_2O$. Molecular weight 470.

Preparation.—This salt appears to have been known in the sixteenth century. Boerhaave (1732) prepared it by neutralizing cream of tartar with salt of tartar, and named it *tartarus tartarisatus*. That a solution of the same salt is obtained on neutralizing cream of tartar with lime was shown by Rouelle and Marggraf (1770). It is obtained in the first part of the process for making tartaric acid (see page 107), but it is usually prepared by Boerhaave's process, or preferably with potassium bicarbonate, using 25 parts of this salt, 17 parts of pure potassium bitartrate, and about 100 parts of boiling water. The neutral or faintly alkaline solution is concentrated until a pellicle forms, and set aside to crystallize; the crystals are drained and dried. The mother-liquor is further concentrated, and when it begins to yield colored crystals may be decomposed by hydrochloric acid to obtain the remaining salt as bitartate. The yield of crystallized potassium tartrate is about 55 or 56 parts.

The British Pharmacopœia directs 9 ounces of carbonate of potassium, 20 ounces of acid tartrate of potassium, and 50 ounces of water, and proceeds in all essential details as stated above. In the reaction between the two salts 1 molecule (188) of cream of tartar decomposes ½ molecule (69) of dry carbonate or 1 molecule (100) of bicarbonate of potassium, forming the neutral tartrate; $2KHC_4H_4O_6 + K_2CO_3$ yields $2K_2C_4H_4O_6 + CO_2 + H_2O$, and $KHC_4H_4O_6 + KHCO_3$ yields $K_2C_4H_4O_6 + CO_2 + H_2O$. Provided the salts are pure, it will be observed that 16 parts of anhydrous carbonate will require 43⅗ parts of bitartrate, and 9 parts of the former 24½ parts of the latter, for complete neutralization. In the last formula there is a considerable excess of carbonate, which requires to be neutralized by the further addition of bitartrate. If the latter has been contaminated with tartrate of calcium, this salt may be decomposed by prolonged boiling with potassium carbonate, calcium carbonate being deposited. Calcium tartrate is soluble in a solution of potassium tartrate, and, unless decomposed as stated, is best removed by evaporating the solution to dryness, granulating the salt, and treating it with twice its weight of *cold* water, when most of the calcium tartrate will be left undissolved. The same treatment, and for the same reason, is also advisable if potassium tartrate is obtained as a by-product in the manufacture of tartaric acid, by neutralizing cream of tartar, diffused in boiling water, with calcium carbonate, when potassium tartrate contaminated with calcium tartrate will remain in solution.

Properties.—Tartrate of potassium crystallizes in four- or six-sided colorless and transparent crystals of the monoclinic system, which in the presence of calcium tartrate are white and rather opaque. It is more frequently met with as a granular or fine white powder, is inodorous, has a saline bitterish taste, is without action on litmus-paper, and may be heated to 100° C. (212° F.) without losing in weight; but at 180° C. (356° F.) 1 molecule (3.8 per cent.) of water is given off (Dumas and Piria), and near 220° C. (428° F.) about 5.5 per cent. of acetone and other volatile products, the residue containing potassium carbonate; above this temperature the salt becomes colored, melts, gives off inflammable vapors with the odor of burnt sugar, and leaves a black residue having an alkaline reaction and effervescing strongly with acids. Heated with sulphuric acid, it forms a black tarry fluid, evolving inflammable gas and the odor of burning sugar. It requires 240 parts of boiling alcohol for solution, and is nearly insoluble in cold alcohol. The salt absorbs moisture on exposure to the air, and is gradually liquefied when kept in a damp atmosphere. According to Osann, it dissolves at 2° C. (35.6° F.) in .75 part, at 14° C. (57.2° F.) in .66 part, and at 64° C. (147.2° F.) in .47 part, of water. The aqueous solution yields with calcium chloride a white precipitate soluble in acetic acid and in cold potassa solution, and it gives a white precipitate with silver nitrate, becoming black on boiling. Acetic acid added to its aqueous solution causes the separation of a white crystalline precipitate consisting of bitartrate of potassium.

Tests.—When 122 grains are heated to redness till gases cease to be evolved, the alkaline residue will require for exact neutralization 990 grain-measures of the volumetric solution of oxalic acid, (*Br.*), or 25 Ccm. of the latter for 2.938 of the salt (*U. S.*). If sodium is present a larger quantity of the acid solution will be required. Sodium would also be indicated by the yellow color imparted to a non-luminous flame by the alkaline residue left on ignition. Carbonate is detected by the effervescence on the addition of an acid, and ammonia by its odor on warming the solution with potassa or soda. "A 5 per cent. aqueous solution of the salt should not be affected by sulphide of ammonium (iron, zinc, lead, aluminium), nor by oxalate of ammonium (calcium), nor after acidulation with hydrochloric acid by hydrosulphuric acid (lead, copper, etc.), or by barium nitrate (sulphate). A similar solution of the salt acidulated with nitric acid should at most become opalescent on the addition of silver nitrate (chloride)."—*P. G.* The U. S. P. directs testing for calcium salt in a 10 per cent. solution, and for sulphate and chloride in a 1 per cent. solution, of the salt.

Composition.—The French Codex recognizes the anhydrous salt $K_2C_4H_4C_6$, mol. weight 226. The U. S. P. adopts the view of Dumas and Piria of the presence of $\frac{1}{2}H_2O = 3.83$ per cent. The Br. P. gives the formula $K_2C_4H_4O_6.H_2O$, mol. weight 244, and by its alkalimetric test admits 1 per cent. of impurity.

Other Soluble Tartars.—The name of *soluble tartar* was formerly applied also to other tartrates, of which two are still recognized by European pharmacopœias:

Tartarus boraxatus, *P. G.;* Cremor tartari solubilis, Kalium tartaricum boraxatum, Borax tartarisata.—Boro-tartrate of potassium and sodium, *E.;* Tartro-borate de potasse et de soude, *Fr.;* Boraxweinstein, *G.*—2 parts of borax are dissolved in 20 parts of distilled water and digested with 5 parts of cream of tartar. When entirely dissolved the filtered liquid is evaporated with constant stirring, the resulting residue dried in thin layers, and while still warm reduced to powder and preserved in well-corked bottles.—*P. G.* It is a white, amorphous, deliquescent powder of an agreeably acidulous taste and acid reaction. It is soluble in its own weight of cold and less than half its weight of boiling water, insoluble in alcohol, and when heated is decomposed, leaving a residue of borax, carbonate of potassium, and charcoal. The aqueous solution of the salt is not disturbed by acetic acid or by a small quantity of diluted sulphuric acid, but after the addition of tartaric acid a crystalline precipitate is produced. Moistened with sulphuric acid, the salt imparts a green color to the flame of alcohol. A 10 per cent. aqueous solution should not be altered by sulphide of ammonium (metals), should not evolve ammonia on being warmed with potassa, should not be precipitated by ammonium oxalate (calcium), and after the addition of a few drops of nitric acid it should not be precipitated by barium nitrate, and should merely become opalescent with silver nitrate.

Potassii tartro-boras, Tartras borico-potassicus.—Boro-tartrate of potassium, *E.;* Tartrate borico-potassique, Creme de tartrate soluble. Tartre boraté, *Fr.;* Borsäureweinstein, *G.*—4 parts of cream of tartar, 1 of boric acid, and 10 of water are heated together until dissolved: the solution is evaporated to dryness and the residue powdered.—*F. Cod.* It forms a white inodorous powder or may be obtained in thin transparent scales, has an acidulous taste, is not deliquescent, and dissolves in 2 parts of cold water. When long kept it becomes less soluble in water, but its solubility is restored on treating it with boiling water.

Ammonii et potassii tartras, Tartarus solubilis ammoniatus.—Tartrate of ammonium and potassium, *E.;* Tartras de potasse et d'ammoniaque, *Fr.:* Weinsaures Ammoniak-Kali, *G.* $KNH_4C_4H_4O_6$; molecular weight 205.—It is prepared by diffusing 1 part of cream of tartar in 2½ or 3 parts of boiling water, adding carbonate of ammonium as long as effervescence takes place, filtering, and crystallizing. It is well to render the solution alkaline by the addition of a little ammonia. The double salt crystallizes in transparent prisms having a pungent and cooling saline taste and becoming opaque on exposure from loss of ammonia. It is soluble in about 2 parts of cold and less than its own weight of hot water.

Medical Action and Uses.—Tartrate of potassium appears to promote the urinary secretion when given in small doses freely diluted, but in larger quantities it operates as a laxative. It is excreted by the kidneys as carbonate of potassium, in full doses rendering the urine alkaline. It may be used as a mild cooling purgative in all affections requiring saline aperients. It acts more gently than the sulphate of sodium or magnesium. Like other salines, it renders the bile more liquid and promotes its secretion, and hence it may be used in cases of *hepatic* and *portal congestion*, and especially for the relief of *hæmorrhoidal swellings*. It is not unusual to associate it with senna, manna, or rhubarb, which concur in producing those effects, and with scammony and gamboge to mitigate the griping operation of those medicines. It is not very often used at present. As a purgative its *dose* is from half an ounce to an ounce (Gm. 16–32).

Boro-tartrate of potassium and sodium is a mild laxative or diuretic when given dissolved in a large proportion of water, the former in doses of from half an ounce to an ounce (Gm. 16–32), and the latter in doses of from 10 to 30 grains (Gm. 0.60–2). Husemann mentions larger doses (Gm. 25–60) for purgation, and adds that the preparation is costly, and that a convenient and cheaper substitute for it may be prepared by mixing 2 parts of cream of tartar with 1 part of borax. The *tartrate of ammonium and potassium* has also been used as a diuretic and laxative in the doses first above mentioned.

POTENTILLA.—CINQUEFOIL.

Firefinger, E.; *Potentille*, Fr.; *Fingerkraut*, G.

Potentilla canadensis, *Linné.*

Nat. Ord.—Rosaceæ, Dryadeæ.

Description.—This perennial herb is common in dry fields and woods of North America. It has an ascending or procumbent stem, which sometimes remains simple (Pot. simplex, *Michaux*), but usually produces slender and creeping runners; the radical leaves are long-petiolate, the stem-leaves on short petioles or nearly sessile; all are digitately five-foliate, with the leaflets about 1 inch (25 Mm.) long, wedge-obovate and incised or toothed above. The peduncles are axillary, about as long as the leaves, and one-flowered; the calyx is five-cleft, with five bract-like appendages between the lobes; the five petals are yellow; the stamens and ovaries are numerous, the latter on ripening forming akenes attached to a convex dry receptacle. The entire plant is more or less silky-hairy, inodorous, and has a somewhat astringent and bitterish taste. It flowers from April to September.

Allied Plants.—Potentilla anserina, *Linné.*—Silverweed, *E.:* Argentine, Ansérine, *Fr.:* Gänserich, Silberkraut, *G.*—This is indigenous to the northern hemisphere; it has radical, interruptedly pinnate leaves, composed of nine to nineteen oblong, deeply serrate leaflets, which are silvery white and downy underneath. It has solitary, long-peduncled flowers, and produces thread-like runners which take root at the nodes.

Pot. fruticosa, *Linné, Shrubby cinquefoil*, is likewise found in the northern hemisphere; is shrubby, about 3 feet (.9 M.) high, has pinnate leaves, with five to seven linear or lance-oblong, entire, and silky leaflets, and numerous flowers.

Pot. rupestris, *Linné*, a native of the mountainous parts of Europe and Siberia, has pinnate radical and three-lobed stem-leaves.

Pot. palustris, *Scopoli*, s. Comarum palustre, *Linné, Marsh cinquefoil*, grows in cool, boggy localities in Europe and North America; has the leaves with five or seven lance-oblong underneath whitish leaflets and purple-colored flowers.

POT. ARGENTEA, *Linné*, *Silvery cinquefoil*, grows in dry fields in North America and Europe; has an ascending stem, palmately five-foliate leaves and wedge-oblong, incised and beneath silvery canescent leaflets.

POT. REPTANS, *Linné*.—Creeping cinquefoil, *E.;* Potentille rampante, Quintefeuille, *Fr.;* Fünffingerkraut, *G.*—It grows in moist fields in Europe and Asia; has slender, creeping stems, long-petiolate, palmately five-foliate leaves, oblong-obovate, deeply serrate leaflets, and single, axillary, long-stalked flowers.

With the exception noted, all the above species have yellow flowers; they are inodorous, and their roots and herbaceous portions have a slightly astringent and bitterish taste.

Constituents.—The plants contain a little tannin, bitter, mucilaginous, and other common vegetable principles.

Medical Action and Uses.—Creeping cinquefoil is almost identical in its qualities with P. tormentilla. It has been employed from ancient times in Europe, on account of its slight astringency, as a remedy for *diarrhœa*, *dysentery*, *leucorrhœa*, *passive hæmorrhages*, *sore throat*, etc., and is still used as a domestic remedy. The other species have similar properties. It is generally given in a decoction made with from 2 to 4 drachms to 8 ounces of water (Gm. 8–16 in Gm. 250), and in tablespoonful doses.

PRENANTHES.—RATTLESNAKE-ROOT.

Lion's-foot, *White lettuce*, *Cancer-weed*, *Gall of the earth.*

Prenanthes (Harpalyce, *Don*) alba, *Linné*, s. Nabalus albus, *Hooker*.

Nat. Ord.—Compositæ, Ligulifloræ.

Description.—This North American perennial grows in rich soil on the borders of woods, and flowers in July and August. The stem is 3 to 6 feet (.9–1.8 M.) high, purplish and glaucous, branched above, and grows from a tuberous, spindle-shaped root. The leaves are petiolate, angular, hastate, the radical ones palmately five- or seven-lobed, those of the stem ovate-roundish and sinuate-toothed; the flower-heads are in loose, racemose cymes, drooping, have a cylindrical involucre, with the linear, purplish, and white scales in a single row, and a few bractlets at the base, and contain from eight to twelve ochroleucous or purplish florets, with linear-oblong, striate, and unbeaked akenes, and a pale-brownish pappus composed of several rows of rough hairs. All parts of the plant contain a milky juice and have a bitter taste. The variety *serpentaria* has the lower leaves almost palmately divided and the stem-leaves three-lobed or deeply toothed.

No analysis of its constituents has been made.

Medical Action and Uses.—The extreme bitterness of the root of this plant caused it to be used as a domestic tonic in the Southern States. Nearly thirty years ago it was affirmed to be a certain remedy for the *rattlesnake's bite*, in confirmation of a long antecedent tradition. "The milky juice of the plant was taken internally, and the leaves, steeped in water, were applied to the wound and frequently changed." No recent addition appears to have been made to these statements.

PRIMULA.—PRIMROSE.

Cowslip, E.; *Primevère*, Fr.; *Schlüsselblume Primel*, G.

Primula officinalis, *Jacquin*, s. P. veris, *Linné*.

Nat. Ord.—Primulaceæ.

Origin.—The primrose is an acaulescent perennial indigenous to woodlands and grassy places of Europe and Northern Asia and frequently cultivated in gardens.

Description.—The subterraneous portion consists of a short, upright, brownish, and scaly root-stalk, beset with a number of fleshy rootlets, about 6 inches (15 Cm.) long, and containing a thick mealy bark and a yellowish meditullium. The flowers (*flores primulæ*) are upon short or elongated scapes in umbels of ten or twelve pendulous flowers; the calyx is ½ inch (12 Mm.) or more long, pentangular, tubular, somewhat inflated, acutely lobed, and pale-yellowish; the corolla is about an inch (25 Mm.) long, funnel-shaped, five-lobed, the lobes obcordate, of a lemon-yellow color, and has in the throat five saffron-colored spots. The corolla alone is collected. It has when fresh a honey-like odor and a sweetish taste, and on drying usually acquires a dark-greenish color. The fresh root has a slight sweetish odor and a sweetish afterward bitterish and acrid taste.

Constituents.—The odor of the root and flowers appears to be due to a small quantity of a butyraceous volatile oil. The *primulin* of Hünefeld is considered by Gmelin to be identical with mannit. The acrid principle is either saponin or closely related to it; Saladin (1830) regarded it as identical with cyclamin.

Allied Plants.—Primula elatior, *Jacquin.* The flowers are large and inodorous; the corolla is sulphur-yellow, and has a flat margin, with emarginate, not cordate, lobes.

Primula Auricula, *Linné.* The auricula is a native of mountainous regions of Europe, and, like both preceding species, often cultivated; the corolla is fragrant, in the wild state lemon-yellow, and has a flat margin; the short calyx has rather obtuse lobes.

Anagallis arvensis, *Linné.*—Red chickenweed, Red pimpernel, Weather-glass, *E.;* Mouron rouge, *Fr.;* Gauchheil, Rothe Miere, *G.*—A European weed naturalized in sandy fields of North America. It has a procumbent or ascending branched quadrangular stem about 10 inches (25 Cm.) long, and opposite or whorled sessile ovate and three-nerved leaves, entire on the margin and blackish-punctate beneath; the small flowers are axillary, long-peduncled, and have a brick-red corolla little exceeding the calyx. An. cœrulea, *Schreber,* the blue pimpernel, has a blue corolla. The plants are inodorous and have a somewhat bitter and acrid taste, which is due to saponin (D. Malapert, 1857) or to cyclamin (Saladin, 1830).

Lysimachia nummularia, *Linné.*—Moneywort, *E.;* Monnayère, *Fr.;* Pfennigkraut, *G.*—A creeping European plant, frequently cultivated and somewhat naturalized in North America. The leaves are short-petioled, roundish, smooth, and finely brown punctate; the flowers are axillary, bright-yellow, and rather large.

Lysimachia quadrifolia, *Linné,* Crosswort. It is a common North American herb, with an erect hairy stem, with petiolate lance-ovate leaves in whorls of four and five, and with long-peduncled, axillary yellow flowers.

Medical Action and Uses.—The bitter, astringent, and acrid taste of the root, and also the aroma of the flowers of this plant, doubtless first led to its being employed medicinally, and the discovery in it of a substance compared to saponin by some, and to mannit or senegin by others, confirms the popular belief that it possesses medicinal virtues. Pliny speaks of its popular esteem as a panacea, "In aqua potam omnibus morbis mederi tradunt." It is represented as being a stimulant of the bronchia and of the stomach, its powdered root is an active sternutatory, and the whole plant was formerly held to be anodyne, narcotic, and anti-spasmodic, and was used by noted physicians of the last two centuries for the relief of *toothache, insomnia,* spasmodic *hysterical* attacks, *hemicrania, dysmenorrhœa,* and muscular *rheumatism.* So fixed was the belief in its power of curing *gout* and *paralysis* that among the names it bore were *radix arthritica, radix paralyseos.* An infusion of the flowers was thought to be especially adapted to functional nervous disorders. A decoction of the root was given for the cure of *gravel,* and an infusion in wine or beer as a *vermifuge.* In England a fermented drink known as "cowslip wine" has long been one of the most esteemed articles of the domestic pharmacopœia, and in some parts of Germany an allied species, P. auricula, has for centuries been used as a remedy for consumption. It will be well if some of the heroic medicines of the present day shall, after as great a lapse of time, have as favorable a record of their virtues as this humble plant enjoys. The dose of the flowers is stated to be 15 or 20 grains (Gm. 1–1.30), and an infusion is made with from 5 to 10 parts to 100 of water.

PRINOS, *U. S.*—Black Alder.

Winterberry, Feverbush, E.; *Prinos,* Fr., G.

The bark of Prinos verticillatus, *Linné,* s. Ilex verticillata, *Gray.*

Nat. Ord.—Aquifoliaceæ.

Origin.—The black alder or winterberry is a shrub about 8 feet (2.4 M.) high, growing in low swampy ground in Canada and the United States. It has alternate oval or obovate, acuminate, serrate leaves, about 2 or 3 inches (5 to 8 Cm.) long, downy on the veins beneath, and narrowed into petioles about ½ inch (12 Mm.) long. The small whitish flowers are diœciously polygamous, have a subrotate, six-parted corolla, usually six stamens, and are in little umbels, all on very short peduncles. The fruit is a globose, bright-red, six-seeded berry, which is persistent in winter, grows in clusters, apparently verticillate, and has an acidulous and bitter taste. The plant flowers in May and June, and ripens the fruit in October.

Description.—The bark is in slender pieces, ¼ or ½ inch (6–12 Mm.) wide, or in fragments, about $\frac{1}{25}$ inch (1 Mm.) thick, fragile; externally of a brownish ash-color, with irregular light-gray or whitish patches lined with black and sprinkled with minute black or small brown circular spots. Older bark is marked with short, transverse, oblong, shallow scars, often margined with ridges. The inner surface is pale-greenish or orange-yellow, shortly striate, otherwise smooth, and has frequently thin sections of the white wood adhering. The bark breaks with a short fracture, and shows upon transverse section a green color and a tangential arrangement of tissue. It is inodorous, and has a bitter somewhat astringent taste.

Constituents.—L. C. Collier (1880) found in the bark chlorophyll, wax, resin, tannin, sugar, starch, albumen, and an amorphous yellow bitter principle which is precipitated by basic lead acetate and by salts of platinum, silver, mercury, and tin.

Allied Species.—Prinos (Ilex, *Gray*) lævigatus, *Pursh*, grows in wet grounds in the Northern States, and southward in the mountains to Virginia, and is distinguished by its lanceolate or lance-oblong and smooth leaves, and by the staminate flowers being on slender peduncles.

Prinos glaber, *Linné*, s. Ilex glabra, *Gray*, known as *inkberry*, is found near the coast from Massachusetts southward, but chiefly in the Southern States. It has coriaceous, smooth, lanceolate, or oblong leaves, with a wedge-shaped base, and serrate near the apex; the berries are black.

Medical Action and Uses.—The bark of black alder is astringent and tonic, and is popularly employed in *intermittent fever* and *diarrhœa*, as a topical application to *gangrenous* and other ill-conditioned *sores*, and both internally and locally in chronic *cutaneous eruptions*. It is prescribed in substance in doses of 30 grains (Gm. 2), and in a decoction made with 2 ounces (Gm. 64) of the bark in 3 pints of water boiled to a quart, of which the *dose* is 2 or 2 fluidounces (Gm. 64–96). A saturated tincture is also prepared with the berries as well as with the bark.

PRUNUM, *U. S., Br.*—Prunes.

Prunes, Fr.; *Pflaumen*, *Zwetschen*, G.

The fruit of Prunus domestica, *Linné*. Bentley and Trimen, *Med. Plants*, 96.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The plum tree is indigenous to Western Asia. It has been cultivated from a very early period, and is now met with in most countries having a temperate climate. A large number of varieties have been produced, differing in the size, color, and shape of the fruit. The tree is about 20 feet (6 M.) high, without thorns, has oval-elliptic serrate leaves and whitish pedunculate flowers, either solitary or in pairs. Some botanists consider the subglobular plums to be the cultivated varieties of Prunus insititia, *Linné*, which resembles the other species, but is thorny and has elliptic or somewhat lanceolate leaves. The Br. P. orders the ovoid or oblong fruit of the var. Juliania, *DeC.*

Description.—The dried fruit is a subglobular or oblong drupe of a dark-blue or purplish-blue color, glaucous, shrivelled, with a shallow longitudinal furrow, the sarcocarp brownish-yellow, and the putamen hard, oblong, somewhat oblique, more or less flattened, smooth, or with irregular ridges. The seeds resemble the almond, but are smaller. The fleshy portion of the fruit, which is alone used, has an agreeable, sweet, and acidulous taste; the seed has the taste of bitter almond, and contains about 25 per cent. of a yellow bland fixed oil.

Constituents.—Prunes contain sugar, pectin, albumen, malic acid, and various salts. The sugar of the different varieties varies in amount between about 12 and 25 per cent. of the weight of the fresh fruit.

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*

Medical Action and Uses.—Prunes are nutritious and laxative, but in excess are apt to create flatulence and colic, owing chiefly to the indigestibility of their skins. When stewed with sugar they relieve *costiveness*, and are more efficient when thus prepared with senna, whose tendency to gripe they partially correct. For this reason they enter into the confection of senna.

PRUNUS VIRGINIANA, *U. S.*—Wild-Cherry Bark.

Ecorce de cérisier de Virginie, Fr.; *Wildkirschenrinde*, G.

The bark of Prunus (Cerasus, *Loiseleur*) serotina, *Ehrhart*, s. Prunus (Cerasus, *Michaux*) virginiana, *Miller*. Bentley and Trimen, *Med. Plants*, 97.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The wild cherry is a large North American forest tree, growing from Canada to Florida and westward to Eastern Nebraska and Texas. It attains the height of 60 or 80 feet (18 to 24 M.) with the trunk sometimes 4 feet (1.2 M.) in diameter and undivided to the height of 20 or 30 feet (6 or 9 M.). When grown in the open field it is usually much smaller. The wood is compact, close-grained, and pale-red or brownish-red. The leaves are alternate lance-oblong, taper-pointed, petiolate, 3 to 5 inches (7 to 12 Cm.) long, and are finely serrate, with incurved teeth. The small white flowers are in elongated racemes 4 or 5 inches (10–12 Cm.) long, and terminal on the branchlets. The fruit is a small, globose, purplish-black drupe of a sweet and bitterish taste. The subglobular seed has the flavor of bitter almonds, and contains about 25 per cent of a bland green-yellow fixed oil, which readily separates a granular deposit. The leaves were suggested by Prof. Procter (1858) as a substitute for cherry-laurel leaves, and found to yield nearly $\frac{1}{10}$ per cent. of hydrocyanic acid when recently collected. This species has long been confounded with the *choke cherry*, Prunus (Cerasus, *De Candolle*) virginiana, *Marshall*, s. Prunus obovata, *Bigelow*. This is likewise a native of Canada and the United States, but grows westward to Colorado and Central Texas. It is shrubby, about 8 or 10 feet (2.4 or 3 M.) high, or arborescent, has thinner oval or obovate and abruptly pointed, sharply serrate leaves, short and close racemes, and red or purplish fruits of an astringent and bitterish taste.

Description.—Wild-cherry bark is met with in irregular fragments or slightly curved pieces; the thinner pieces are obtained from the branches and trunks of younger trees, are about $\frac{1}{12}$ inch (2 Mm.) thick, externally of a blackish-gray or green-brownish color, smooth and somewhat shining, or partly deprived of the exfoliating corky layer, and then of a greenish or light yellowish-brown. Older bark has usually the outer corky layer removed, is $\frac{1}{8}$ inch (3 Mm.) and more in thickness, and has a rather uneven outer surface of a rust-brown color. The inner surface is smooth, somewhat striate, cinnamon-colored or rust-brown. The bark is brittle, breaks with a granular fracture, is radially striate upon transverse section, and yields a pale reddish-brown powder. It has a very slight odor while dry, but when macerated in water it develops the odor of bitter almond; its taste is astringent, aromatic, and bitter, with the flavor of bitter almond. The thick corky layer of old bark, if present, should be rejected. The bark should be collected in October.

Constituents.—Stephen Procter (1834) showed the bark to contain tannin, gallic acid, resin, starch, and other common vegetable principles, and obtained by distillation a volatile oil containing hydrocyanic acid. This volatile oil was further examined by Prof. Procter (1837, 1838), and found to agree in the main with the volatile oil of bitter almond, and, like this, to be produced from *amygdalin* by the action of a proteid resembling emulsin, or perhaps identical with it. It is coagulated or altered by heat, and the powdered bark, introduced into hot water, does not yield any volatile oil. J. S. Perot (1852) ascertained that the bark collected in autumn yielded three times as much hydrocyanic acid as that collected in April. From the latter he obtained .0478 per cent.; when gathered in October the yield was .1436 per cent., or $\frac{1}{7}$ grain HCy from 100 grains of the bark, which would therefore be equal to about 7 or 8 drops of officinal hydrocyanic acid. The same author ascertained also that the bitter principle of wild-cherry bark is not phlorizin. J. L. Williams (1875) obtained the bitter principle by concentrating the aqueous infusion, mixing it with an equal bulk of alcohol, agitating with milk of lime, evaporating the filtrate, and exhausting the residue with hot alcohol, on the spontaneous evaporation of which a transparent, brownish, somewhat gelatinous, bitter mass was left; it was insoluble in ether, somewhat soluble in water, more soluble in alcohol, and was colored brown-red by sulphuric acid. The bark from the trunk, as well as from the root, was found by J. L. Lemberger (1871) to contain the largest proportion of tannin when collected in October, and to yield then also infusions of a dark wine-color. C. F. Kramer (1882) estimated the tannin with gelatin and found 3.42 per cent.

Off. Prep.—Extract. pruni virg. fluid., Infus. pruni virg., Syrup. pruni virg., *U. S.*

Medical Action and Uses.—Wild-cherry bark is tonic through its bitter principle, and more or less sedative through the hydrocyanic acid which it generates with water. For the latter effect, however, very large doses are required. It is more used in pulmonary *consumption* than in any other disease, under the impression that it improves the appetite and strengthens the digestion, while it moderates the cough and allays the irritability of the nervous system. It is a gentle and harmless palliative in this disease, while its use may prevent the employment of opiate and expectorant mixtures, whose injurious influence on the digestion outweighs their utility in moderating the cough. It is particularly useful in cases of nervous *cough* produced by reflex action, or even by slight bronchial or laryngeal irritation. It is equally useful during *convalescence* from various acute diseases when febrile excitement is maintained by general debility of the system. *Palpitation of the heart* is reputed to be especially under its control. When this symptom depends upon organic causes the medicine is inadequate to allay it except in a very slight degree; but when it is associated, as it more frequently is, with anæmic, chlorotic, dyspeptic, or nervous disorders, the bark is sometimes of real advantage. The cold infusion forms a useful collyrium in mild cases of acute *ophthalmia.*

The dose of the powdered bark is stated to be from 30 to 60 grains (Gm. 2–4). The cold infusion and the fluid extract are more efficient and eligible preparations; the syrup is chiefly to be recommended as a flavoring agent.

PSORALEA.—PSORALEA.

Psorale, Fr.; *Psoralie, Drüsenklee,* G.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The genus is characterized by a five-cleft persistent calyx having the lowest lobe longest, by diadelphous or sometimes monadelphous stamens, by a short one-seeded pod, the pointed end of which projects from the calyx, and by the glandular dots with which the calyx, and frequently also the leaves, are more or less covered. The following species have been employed:

PSORALEA MELILOTOIDES, *Michaux,* s. P. eglandulosa, *Elliott,* grows in dry soil in the Southern and Western United States, is a slender, erect, pubescent, and slightly glandular herb about 2 feet (60 Cm.) high, and has a spindle-shaped root, trifoliate leaves with oblong-lanceolate, rather obtuse leaflets, and long-peduncled, oblong, finally elongated spikes of purplish flowers; the legume is nearly orbicular and transversely wrinkled. The plant has a slight aromatic odor and a somewhat spicy and bitterish taste. It flowers in June and July, and should be collected when in full bloom.

P. ESCULENTA, *Pursh,* has a tuberous or turnip-shaped farinaceous edible root, which is known as *bread-root,* and likewise as *Indian turnip,* and formerly as *pomme blanche* and *pomme de prairie.* It grows on the prairies from Wisconsin to Missouri and westward.

P. GLANDULOSA, *Linné,* was formerly said to yield *yerba mate* (see page 810). It is a shrub of Chili, about 6 feet (1.8 M.) high, with rough glandular petioles, ovate-lanceolate, acute glandular leaflets, and white or blue flowers. The root is emetic, and the leaves have aromatic properties, their flavor resembling that of rue.

P. PENTAPHYLLA, *Linné,* of Mexico, has a thick root, which is sometimes known as *white contrayerva* from its color and medicinal properties.

P. BITUMINOSA, *Linné,* of Southern Europe, is suffruticose, and has a disagreeable bituminous odor.

P. CORYLIFOLIA, *Linné,* is indigenous to India and Arabia, has a whitish angular stem and simple ovate somewhat cordate and toothed, glandular leaves with short ovate ciliate stipules. The herb has a resinous, aromatic, and bitter taste, and, like the seeds known in India as *bauchee seeds,* is used as a tonic and in skin diseases.

Several other species of Psoralea, in addition to the two named above, are indigenous to the United States. They all appear to contain resin, volatile oil, tannin, and bitter principle, but have not been sufficiently analyzed.

Medical Action and Uses.—The leaves and the root have a bitter, pungent, and aromatic taste, which is most decided in the root. It has been described as a gentle, stimulating, and tonic nervine, and compared in its action to Chinese tea. It is said to have been used with advantage in chronic *diarrhœa* depending upon strumous conditions of the mesenteric glands, and in chronic *dyspepsia* attended with vomiting of blood. The medicine has been administered chiefly in the form of a tincture prepared with several other plants besides Psoralea, so that its special virtues cannot be extricated from the compound effect. The *dose* of the tincture is stated to be from 3 to 6 fluidrachms (Gm. 12–24) several times a day. As far as can be judged, it appears to partake of the qualities of aromatic and bitter tonics in general.

PTELEA.—SHRUBBY TREFOIL.

Hoptree, Waferash, E.; *Orme à trois feuilles,* Fr.; *Hopfenbaum, Kleebaum,* G.

Ptelea trifoliata, *Linné.*

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Description.—The hoptree is a handsome North American shrub growing southward and westward from New Jersey and Pennsylvania, chiefly, however, west of the Alleghanies, and is cultivated in Europe. The shrub is about 8 to 12 feet (2.4 to 3.6 M.) high, with dark-brown branches, which, like the leaves, are downy when young. The *leaves* are alternate, petiolate, light-green, and trifoliate, with sessile, pointed, indistinctly serrate, and finely pellucid-punctate leaflets, of which the lateral ones are obliquely ovate, and very uneven toward the base, the outer half being broadest, while the larger terminal one is elliptic or obovate and wedge-shaped at the base. They are from 3 to 5 inches (7 to 12 Cm.) long, when broken exhale a rather unpleasant odor, and have a bitter and somewhat astringent taste. The small greenish-white polygamous flowers are in compound terminal cymes, have a disagreeable odor, and are followed by a flat orbicular *fruit*, which is two-celled and two-seeded, and is surrounded by a circular membranous and slightly emarginate wing, the whole fruit being about ⅘ inch (2 Cm.) in diameter and of a pleasant hop-like flavor. The fruit, leaves, and *bark of the root* have been employed. The latter is in fragments and irregular quills of a brown color, longitudinally wrinkled, lighter and smooth on the inner surface, breaks with a short fracture, and has a bitter and pungent taste.

Constituents.—G. M. Smyser (1862) found in the leaves *tannin* and *gallic acid*, in the fruit a soft acrid *resin*, and in the bark a reddish-brown *resin* soluble in ether and alcohol and of a pungent and acrid taste. All parts contain volatile oil and other principles commonly met with in plants. Justin Steer (1867) isolated *berberine* from the bark, and regards it as the bitter and tonic principle.

Allied Plant.—Ptelea angustifolia, *Bentham*, a native of Colorado, has lanceolate pubescent leaves, and a smaller more deeply notched fruit than the preceding.

Medical Action and Uses.—The bark of the root appears to be aromatic and tonic, and has been used in tincture and infusion for *dyspepsia* and as a stimulant in *typhoid* febrile states. The leaves and young shoots have also been employed in strong infusion as anthelmintics. Of its administration we only know that a spirit made by macerating 6 ounces of the bark and ½ ounce of ginger in 2 quarts of whiskey was prescribed in the *dose* of 1 or 2 tablespoonfuls (Gm. 16–32) three times a day. How much of the stimulant effects was due to the alcohol and how much to the ginger, and how much remained for the share of the trefoil, has not been estimated.

PULSATILLA, *U. S.*—Pulsatilla.

Pasque-Flower, E.; *Pulsatille*, *Coquelourde*, Fr.; *Küchenschelle*, G.

The flowering herb of Anemone Pulsatilla, *Linné* (s. Pulsatilla vulgaris, *Miller*), Anemone (Pulsatilla, *Miller*) pratensis, *Linné*, and of Anemone (Pulsatilla, *Miller*) patens, *Linné*, var. Nuttalliana, *Gray* (s. An. Nuttalliana, *De Candolle*, s. An. Ludoviciana, *Nuttall*). Meehan, *Nat. Flowers*, i. p. 49.

Nat. Ord.—Ranunculaceæ, Anemoneæ.

Origin.—The first two species are indigenous to the greater portion of Europe, and grow also in Siberia in sandy soil and in dry, open woodlands. The third species grows in similar localities from Central Europe eastward throughout Siberia, and in the western section of North America from Lake Superior south to Illinois, west to the Rocky Mountains, and north-westward into British America. The American plant differs slightly from the typical form of Eastern Europe. The section Pulsatilla differs from the other species of Anemone in having a narrowly-divided involucre, large flowers, and long feathery styles, which are permanent in the fruit. The plants flower early in spring, from March to May. They should be collected after the flowers have expanded, and should be carefully preserved and kept not longer than one year.

Description.—A. pratensis has a dark-brown, oblique, several-headed root, and pinnately two- or three-cleft, petiolate radical leaves with linear acute segments, and at the base surrounded by several ovate lanceolate sheaths. The flowering scape is about 6 inches (15 Cm.) high, and bears a single nodding bell-shaped flower reflexed at the apex, varying in color between dark-violet and light-blue, and surrounded by a distant sessile involucre composed of three palmately-divided and cleft bracts with linear lobes. The numerous ovaries are prolonged into a feathery tail (style). All herbaceous parts are clothed with long, soft, silky hairs, are nearly inodorous, but when rubbed exhale a very acrid vapor, and have a burning acrid taste. A. Pulsatilla closely resembles the former, but has the flowers erect and sepals spreading above, but not reflexed. A. patens has its purplish or whitish erect flowers developed before the leaves, which are twice or thrice deeply three-parted and have linear acute lobes.

Constituents.—The fresh plants of the section Pulsatilla, when distilled with water, yield a distillate from which ether extracts a very acrid yellow oil, which is gradually, or more rapidly in the presence of water, converted into *anemonin* and *anemonic acid*, from which hot alcohol dissolves the former. Basiner (1881) found the yellow oil as well as the anemonin to be soluble in glacial acetic acid, from which solution they are removed by agitation with benzol. Anemonin, which was first observed by Störk (1771), and investigated by Heyer (1779), forms colorless friable crystals which are neutral, inodorous, and when fused exceedingly acrid, soluble in chloroform, nearly insoluble in ether and water; the composition of these crystals, according to Fehling (1841), is $C_{15}H_{12}O_6$. Löwig and Weidmann (1839) and Fehling (1841) observed that boiling baryta-water converts it into a brown amorphous acid. Anemonic acid, $C_{15}H_{14}O_7$, is a white crystalline tasteless powder insoluble in most simple solvents, and dissolves in alkalies with a yellow color. Similar results were obtained with American pulsatilla by A. W. Miller (1862) and F. E. Miller (1873).

The acrid oily principles of different species of Ranunculus, and probably of some other ranunculaceous plants, appear to be allied to, if not identical with, the above.

Pharmaceutical Preparation.—EXTRACTUM PULSATILLÆ. The expressed juice of the fresh flowering herb is heated, strained to remove albumen, evaporated to a small bulk, mixed with an equal measure of alcohol, filtered, and evaporated to the proper consistence.

Allied Plants.—Acrid properties resembling those of the preceding plants are met with in most species of Anemone, which are distinguished from the section Pulsatilla chiefly by the styles being much shorter and not feathery. An. nemorosa, *Linné*, *wind-flower* or *wood anemone*, a native of North America, Northern Asia, and Europe, has a long-petiolated trifoliate leaf with ovate or elliptic cut and toothed leaflets, an involucre of three similar leaves, and a white or purplish flower. An. coronaria, *Linné*, has been employed in the Levant, where it is indigenous; it is sometimes met with in gardens. An. sylvestris and An. ranunculoides, *Linné*, indigenous to Northern Asia and Europe, are used in Siberia. These species lose some of their acrid properties by drying and rapidly deteriorate on keeping.

AN. CERNUA, *Thunberg*. The root-stock is used in Japan and China under names signifying "white-headed old man." The root is about 4 inches (10 Cm.) long, about $\frac{1}{6}$ inch (4 Mm.) thick, unbranched, cylindrical, wrinkled, brittle, internally brown, with a central cavity lined with white tissue; it has a sweet and slightly acrid taste.

Physiological Action and Medical Uses.—Given to rabbits in the dose of from 5 to 10 grains, it reduces the pulse- and respiration-rate and the temperature, causes dyspnœa and stertor, debility, and then paralysis of the limbs, stupor, dilatation followed by contraction of the pupil, and death without convulsion. The characteristic lesions found on dissection are distension of the heart and great vessels, and of the veins of the brain and medulla oblongata, with dark blood (Clarus). The bruised fresh plant rubbed upon the skin irritates and may even vesicate it. The extract and tincture cause a sense of burning and numbness in the mouth. Internally, pulsatilla may inflame the stomach and bowels and cause fatal convulsions. In medicinal doses it is reported to act as a general excitant (Schroff). Anemonin applied to the tongue occasions a severe burning pain and persistently benumbs its sensibility. Internally, it acts as a general stimulant and a diuretic. Heyer (1779) related that an amaurotic patient who was taking about half a grain (Gm. 0.03) of anemonin twice a day experienced a dreadful sense of tension in the head and copious diuresis (Husemann).

Different species of anemone were recognized by ancient physicians as being identical in their medicinal power. According to Galen, the anemones are endowed with acrid, drawing, cleansing, and opening virtues. When chewed, anemone excites a secretion of mucus, its juice cleanses the brain and nostrils, and lessens or removes opacities of the cornea. It purifies foul ulcers, cures lepra and pityriasis, is emmenagogue and galactagogue. Neither Dioscorides, Pliny, nor the Arabians added anything to this enumeration, and the medicine seems to have been almost forgotten until the close of the eighteenth century. Pulsatilla nigricans was then highly praised by Störck and some of his contemporaries as an efficient remedy for *opacities of the cornea*, *cataract*, *paralysis*, *rheumatism*, *amenorrhœa*, *melancholy*, constitutional *syphilis*, old *ulcers*, and scaly *diseases of the skin*. In the last-named affections he held it to be peculiarly useful, generally prescribing the extract in doses of 1 or 2 grains, and gradually increasing them to 15 grains (Gm. 0.10–1). But subsequent observers of the best repute imitated Störck's practice without obtaining his results. The author who relates this history of Störck's use of the drug (Cazin) suggests that its more recent failures were due to the use of an improperly made extract. He refers to several physicians of previous generations who wrote of its singular efficacy in *whooping cough*, *visceral engorgements*, *gravel*, *comatose attacks*, and *obstructions of the nostrils*. Deniau used pulsatilla in several nervous disorders, and concluded that the medicine is "a direct sedative of nervous irritability, but only indirectly a vascular sedative" (*Bull. de thérap.*, civ. 81). By the greater number of recent writers on the materia medica the medicine is either wholly unnoticed or its virtues are described in accordance with the above history, which, it will be observed, assigns to it the characters of a panacea, so diverse and numerous are the diseases which it is reported to have cured. This list of incongruous diseases benefited by pulsatilla may be lengthened by *nervous headache* produced by overtaxing the mind (Tucker), and by *dysmenorrhœa*, which in several cases was cured by 2 drops of a tincture of pulsatilla taken before meals for three days before the menstrual epoch (Piffard). The same physician reports that in *epididymitis* he administered 5-drop doses of the tincture with the effect of aggravating the inflammation, while he rapidly cured seven or eight cases of the disease by doses of "one-tenth of a minim well diluted, and administered every two or three hours." No other treatment was employed. Similar statements have been made by Sturgis (*Med. News*, xlii. 267). From this summary it may fairly be concluded that pulsatilla is either a remedy of extraordinary and incomprehensible power, or that the reporters of its cures have been misled by their imagination or a neglect of the precautions necessary in studying the virtues of medicines.

The powdered herb was formerly prescribed in *doses* of 4 or 5 grains (Gm. 0.25–0.30), and an infusion made with 1 drachm of the fresh plant in 3 ounces of wine or water (Gm. 4 in Gm. 100) was given during the day in divided doses. The alcoholic extract may be used in doses of from $\frac{1}{2}$ grain to 3 grains (Gm. 0.03–0.20). Anemonin is directed in doses of from $\frac{1}{6}$ to $\frac{1}{2}$ gr. (Gm. 0.01–0.03) in pilular form. A tincture, also made from the fresh plant, is prescribed in doses of from 3 to 10 drops (Gm. 0.20–0.60) several times a day.

THALICTRUM MACROCARPUM furnishes an alkaloid, thalictrin, and also macrocarpin, of which the former only seems to produce definite physiological effects. Rochefontaine and Doassans state that its extract kills a frog in the dose of gr. $\frac{1}{3}$ to $\frac{1}{2}$ (Gm. 0.02–0.03); that its sulphate or muriate is fatal to the same animal in the dose of gr. $\frac{1}{32}$ to $\frac{1}{12}$ (Gm. 0.002–0.005); and that when injected into the vein of a dog it caused death in the dose of gr. xv. to gr. xxii. (Gm. 1–1.50). Subcutaneously, twice the latter dose was required to kill. In frogs thalictrin destroys voluntary and then reflex movement, and after rendering the heart irregular arrests it in diastole. In dogs it first produces a state of somnolence and inertness, with vomiting, purging, and micturition; the blood-pressure declines and general sensibility is abolished; the heart beats vigorously, although the pulse becomes hurried and feeble and the respiration frequent and full. A convulsion follows, the pupils dilate, and the heart, and then the respiration, cease (*Archives gén.*, Juill., 1880, p. 368; *Practitioner*, xxvii. 214).

PULVERES.—Powders.

Poudres, Fr.; *Pulver*, G.

Preparation.—All solid drugs may be reduced to powder, but the means by which pulverization is effected must vary very considerably according to the nature of the drug. The large majority of crystallized chemical compounds are readily powdered by *trituration* in a porcelain or Wedgewood mortar; many of those which are insoluble or sparingly soluble in alcohol may be powdered by *precipitating* them from their concentrated solution by pouring it slowly and with continual agitation into alcohol. Compounds which are insoluble in water may frequently be obtained in a more or less fine powder, which is either amorphous or crystalline, by means of double decomposition and *precipitation*. Soluble compounds may also be powdered by evaporating their solution, and, as it thickens, by stirring it continually, so as to disturb crystallization or prevent the compound from separating as a solid mass. This process is termed *granulation*, and is equally applicable to fusible substances, which, after having been liquefied by heat, are stirred or triturated while they are cooling and congealing. Volatile compounds and elements (calomel, sulphur, etc.) may be finely powdered by *sublimation*, and by suddenly condensing their hot vapors in a large chamber with a current of air, or, if insoluble in water, with a current of steam.

In several of these processes the powder is not obtained of uniform fineness, and then requires to be *sifted*, or the finer particles are separated from the coarser by means of *elutriation*, which process consists in diffusing the powder in water and decanting from the heavy sediment. The fine powder, which remains longest in suspension, is then permitted to subside, and, after withdrawing the liquid, dried. It is evident that only those substances are adapted to this treatment which are heavier than water, and which are entirely insoluble therein; elutriation is usually preceded by *levigation*, which is simply a process of trituration in the presence of sufficient moisture to render the mass soft. The operation is performed either in a mortar or upon a slab by the aid of a muller.

Drugs which are composed of vegetable tissue or which consist of exudations cannot, as a rule, be reduced to powder by these means. In these cases *contusion* is required, and this is the method most frequently employed. The substance is placed in a rather deep mortar, and broken by perpendicular strokes with the flattened surface of a heavy pestle. The process is called *bruising* if the substance is to be broken merely into a coarse powder. If the drug contains a certain amount of oil or resin, the heat produced by the pounding will often render the material more or less soft or adhesive. This result is best prevented by exposing the drug to a low temperature and powdering in the cold, when it will retain its pulverulent condition at ordinary temperatures, or, if it conglomerates, it may be rubbed into powder by slight trituration. Mortars made of iron or brass are best adapted for preparing powders by contusion. Some tough materials are conveniently reduced to powder by *rasping*.

Most of the vegetable powders are, however, prepared on a large scale at the drug-mills by *grinding*, the grinding surface being a bed of hard stone upon which either iron balls or millstones are made to revolve. A draught is thereby created which carries the fine powder up to a certain height, and if this alone is collected it is called a *dusted powder*. Oily seeds and similar material cannot profitably be powdered in this manner, because by the pressure and heat created by the grinding the oil rises to the surface and agglutinates a part of the powder. Such material is best ground, or rather cut, between horizontal millstones suitably prepared for the purpose. A number of drug-mills which may be worked by hand have been constructed, and serve a good purpose for the use of the pharmacist in preparing the coarser kind of powders, but none have been made which could be used with advantage for finely powdering moderate quantities.

Whether contusion or grinding is resorted to, the drugs to be powdered should be deprived of the moisture remaining in them by exposing them in a drying-room to a temperature of about 50° C. (122° F.). Drugs, however, which owe their virtues to volatile oil, and which should be powdered in the air-dry condition or on a small scale, are conveniently dried over burnt lime. The different tissues of plants are not reduced to powder with equal facility; the fibro-vascular bundles and the bast-fibres are usually more refractory than parenchyma-tissue, and more or less of the former generally remains behind as a coarse powder. When the powder is intended to be exhausted by percolation or otherwise, the coarse particles are utilized with the fine powder; but in case the latter be intended for dispensing, the coarser portion is removed by a sieve. The fine powder which may be sifted off from time to time during the process of powdering should be carefully mixed to ensure uniformity in composition. The fibrous portion of vegetable drugs is usually less active than the remainder, and if in such a case the whole of it be rejected, the resulting powder must necessarily be stronger than the crude drug from which it has been prepared; thus, if the bark of ipecacuanha-root be separated from the wood and powdered by itself, such powdered ipecacuanha will possess an activity about 20 per cent. greater than the root itself.

Fineness of Powders.—The United States Pharmacopœia designates five degrees of fineness—namely, *very fine*, when passed through a sieve of eighty or more meshes to the linear inch; *fine*, when passed through one of sixty meshes; *moderately fine*, through one of fifty meshes; *moderately coarse*, through one of forty meshes; and *coarse*, if passed through a sieve of twenty meshes to the linear inch. The fineness of powders is often conveniently described as being No. 20, etc., indicating that it has been passed through a sieve of that size (see page 605).

Compound Powders.—Since nearly all solid drugs may be obtained and kept in the state of powder, the pharmacopœias give special directions only for those powders which are composed of two or more ingredients. In preparing these it is generally advisable to reduce each substance separately to powder; the powders are then weighed out and mixed in a mortar, or are passed repeatedly through a suitable sieve. Some special observations will be made in connection with several officinal powders.

Dispensing of Powders.—In the majority of cases when powders are prescribed the ingredients are such as are kept on hand pulverized or in such a condition that they may be easily powdered by trituration in a mortar. The latter ingredients are then weighed out first, and rubbed fine before the powders are added. Should soft substances, such as extracts, or liquids, such as volatile oils, be directed, they are triturated with the sugar which usually is a constituent of magistral powders until reduced to powder, when the other articles are added and well mixed. In most cases, perhaps, it will be of advantage not to use finely-powdered sugar, but to employ sugar in small lumps, which, while being rubbed to powder in the presence of the other ingredients, will tend to cause their still greater subdivision through the prolonged attrition. There are, however, occasional exceptions to the procedure as described, for in consequence of the elevation of temperature produced by the trituration chemical processes are likely to be induced which would interfere with the stability of the powder; such instances are the mixing of oxidizing agents like chlorate of potassium with vegetable substances, which under the pressure of the pestle would cause an explosion; or the mixing of salts, which in the presence of a little moisture would result in liquefaction, as in triturating together acetate of lead and sulphate of zinc. Compound powders of this nature ought invariably to be made by powdering the constituents separately in a mortar; if necessary, they should then be well dried, and finally mixed upon smooth paper with the aid of a spatula, without exerting any friction.

Powders are rarely prescribed in bulk, except when intended for external use; in nearly all cases they are divided by the pharmacist, each dose being dispensed in a separate paper. Deliquescent and odorous powders are best dispensed in waxed paper (see p. 421).

Administration.—Powders are generally taken suspended in water or in a liquid flavored with syrup or some pleasant aromatic. The nauseous taste will not always thus be disguised. To remedy this difficulty it has been customary in some countries to envelop the powder in a wafer of sufficient size and soften this by a brief immersion in water, when it may be swallowed without any inconvenience. *Cachets de pain*, or *wafer-capsules*, an elegant modification of this process, were introduced by M. Limousin (1873). The sheet wafer is punched into circular disks; these are dampened, and then pressed between two warmed plates of the desired shape, whereby they become concave on one side. A dose of the powder is placed on this side, the margin is very slightly dampened, and an empty disk is placed upon and fastened to it by sufficient pressure. Various apparatuses have been suggested for sealing the wafers. In taking such a wafer-capsule it is first dipped in water for a moment, then at once placed upon the back part of the tongue, and swallowed with a draught of water or other suitable liquid. Nauseous powders of small bulk are conveniently administered in unsealed gelatin-capsules, one of which is slipped over the open end of another one containing the powder (see page 725).

Granular Powders.—These are made in various ways. A method of granulating vegetable and similar powders was suggested by Dr. Thomas Skinner (1862), and is executed by triturating the powder with sufficient mucilage until a crummy non-adhesive mass is obtained, which is dried in thin layers, bruised, and separated by sieves into powders as desired; these granules may then be covered with tolu in the same manner as pills. Various saline mixtures, usually of an effervescing nature, have been granulated by powdering separately citric or tartaric acid, sugar, bicarbonate of sodium, carbonate of magnesium, etc., mixing them together by sifting, adding sufficient strong alcohol to render the mixture slightly damp and adherent, and rubbing with slight pressure through a No. 8 or other suitable sieve. After drying, the granules of the different sizes are separated by suitable sieves.

Preservation.—When perfectly free from moisture, vegetable powders may be preserved in hermetically-sealed vessels; but since they attract moisture on occasional exposure, it is much better to keep them in a dry place enclosed in vessels which will admit the air but exclude the light. As a rule, such powders will be found to keep well in good paper boxes unless they contain volatile oil.

PULVIS AMYGDALÆ COMPOSITUS, *Br.*—COMPOUND POWDER OF ALMONDS.

Confectio amygdalæ, Conserva amygdalarum.—Confection of almond, E.; *Conserve d'amandes*, Fr.; *Mandelconserve*, G.

Preparation.—Take of Sweet Almonds 8 ounces; Refined Sugar, in powder, 4 ounces; Gum-Acacia, in powder, 1 ounce. Steep the almonds in warm water until their skins can be easily removed, and when blanched dry them thoroughly with a soft cloth and rub them lightly in a mortar to a smooth consistence. Mix the gum and the sugar, and, adding them to the pulp gradually, rub the whole to a coarse powder. Keep it in a lightly-covered jar.—*Br.*

Medical Uses.—The compound powder of almonds serves for the convenient preparation of the almond mixture when mixed with water in the proportion of 2½ ounces to a pint (Gm. 75 in Gm. 500).

PULVIS ANTIMONIALIS, *U. S., Br.*—ANTIMONIAL POWDER.

Pulvis antimonii compositus. Pulvis Jacobi.—James's powder, E.; *Poudre antimoniale de James*, Fr.; *James's Antimonpulver*, G.

Preparation.—Oxide of Antimony 33 parts (330 grains); Precipitated Phosphate of Calcium 67 parts (670 grains); to make 100 parts (1000 grains). Mix them intimately.—*U. S.*

Take of oxide of antimony 1 ounce; phosphate of calcium 2 ounces. Mix them thoroughly.—*Br.*

Antimonial powder has been recently admitted into the U. S. P., and is practically identical with that of the Br. P. It is intended as a simplified substitute for a nostrum which has enjoyed considerable reputation in Great Britain and elsewhere for more than a hundred years. Another formula, formerly recognized as yielding a good substitute, requires the ignition of a mixture consisting of 1 part of sulphuret of antimony and 2 parts of horn shavings by throwing this in small quantities into a red-hot crucible, powdering the product, and keeping again for some time at a red heat.

A somewhat similar preparation is known here as *Tyson's antimonial powder*, of which two kinds are sometimes employed. One, designated as No. 1, consists of oxide of antimony 10 parts and phosphate of calcium 90 parts. No. 2 is made by triturating oxide of antimony 10 parts and sulphate of potassium 45 parts into a fine powder, and adding 45 parts of phosphate of calcium.

Medical Action and Uses.—Antimonial powder acts in virtue of the oxide of antimony it contains, the phosphate of lime serving only to divide it minutely. Its action is essentially the same as that of tartar emetic, but slower in consequence of its inferior solubility. It is therefore less apt to act as an emetic than as a diaphoretic in *febrile states.* It may be given in *doses* of from 3 to 15 grains (Gm. 0.20–1).

PULVIS AROMATICUS, *U. S.*—AROMATIC POWDER.

Pulvis cinnamomi compositus, Br.—*Compound powder of cinnamon*, E.; *Poudre des épices*, *P. des aromates*, *Poudre aromatique*, Fr.; *Gewürzpulver*, *Aromatisches Pulver*, G.

Preparation.—Cinnamon, in No. 60 powder, 35 parts (7 oz.); Ginger, in No. 60 powder, 35 parts (7 oz.); Cardamom, deprived of the capsules and crushed, 15 parts (3 oz.); Nutmeg, in No. 20 powder, 15 parts (3 oz.); to make 100 parts (20 oz.). Rub the cardamom and nutmeg with a portion of the cinnamon until reduced to a fine powder; then add the remainder of the cinnamon and the ginger, and rub them together until they are thoroughly mixed.—*U. S.*

Grated as finely as possible, the nutmeg is gradually added, with constant trituration, to the crushed cardamom-seed and a portion of the powdered cinnamon, and afterward mixed with the remaining powders. The British Pharmacopœia omits the nutmeg, and directs powdered cinnamon, cardamom, and ginger, of each 1 ounce, to be thoroughly mixed, sifted, and lightly rubbed in a mortar.

Pharmaceutical Preparations.—CONFECTIO AROMATICA, Electuarium aromaticum.—Aromatic confection, *E.;* Electuaire (Confection) aromatique, *Fr.;* Aromatische Latwerge, Gewürzlatwerge, *G.*—Rub aromatic powder 4 ounces with clarified honey 4 ounces or a sufficient quantity, until a uniform mass of the proper consistence is obtained. —*U. S.* 1870.

The absorption of the moisture by the vegetable tissue will render this confection gradually crummy, and necessitate the further addition of honey. If properly prepared, it will, though dry in appearance, become pliable and adhesive under the pestle.

Off. Prep.—Extractum aromaticum fluidum, *U. S.*

Medical Action and Uses.—Aromatic powder may be given internally for the relief of *nausea, flatulence, colic,* or *diarrhœa,* in the dose of 10 grains (Gm. 0.66) and upward, for which purposes it should be mixed with syrup. The now disused aromatic confection was similarly employed. The powder is an excellent stimulant and anodyne in the cases named when it is applied enclosed in a flannel bag and saturated with a hot alcoholic liquor. In this way it is singularly efficient in allaying nausea and colic. Laudanum may be added to it in appropriate cases. Care should be taken to protect the linen from its stain, which is indelible. Instead of the officinal ingredients of this aromatic fomentation, the following will be found more efficient: equal parts of powdered cinnamon, ginger, allspice, and cloves, to which some add black pepper.

PULVIS CATECHU COMPOSITUS, *Br.*—COMPOUND POWDER OF CATECHU.

Preparation.—Take of Pale Catechu, in powder, 4 ounces; Kino, in powder, Rhatany-Root, in powder, each 2 ounces; Cinnamon-Bark, in powder, Nutmeg, in powder, each 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Medical Uses.—This powder is especially useful in *diarrhœa* produced by debility or by cold after fever has subsided. *Dose*, from 10 grains to a drachm (Gm. 0.60–4).

PULVIS CRETÆ AROMATICUS, *Br.*—AROMATIC POWDER OF CHALK.

Confectio aromatica, Lond.—*Poudre de craie aromatique*, Fr.; *Gewürztes Kreidepulver*, G.

Preparation.—Take of Cinnamon-Bark, in powder, 4 ounces; Nutmeg, in powder, Saffron, in powder, each 3 ounces; Cloves, in powder, 1½ ounces; Cardamom-Seeds, in powder, 1 ounce; Refined Sugar, in powder, 25 ounces; Prepared Chalk 11 ounces. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Medical Uses.—Aromatic powder of chalk is an excellent preparation for the cure of accidental *diarrhœas* produced by cold, or even by crude ingesta, provided that the offending substance has been discharged. As the symptoms corrected by chalk and those relieved by the aromatic powder are in a great measure independent of each other, the proportion of these ingredients should vary, and hence their association in fixed proportion and in an officinal formula is unnecessary. The *dose* of the preparation is from 30 to 60 grains (Gm. 2–4).

PULVIS CRETÆ AROMATICUS CUM OPIO, *Br.*—AROMATIC POWDER OF CHALK AND OPIUM.

Poudre de craie opiacée, Fr.; *Kreidepulver mit Opium*, G.

Preparation.—Take of Aromatic Powder of Chalk 9¾ ounces; Opium, in powder, ¼ ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Medical Uses.—This preparation is the same as the last, except that it contains 1 grain of opium in every 40 grains of the powder. It is therefore more efficient in the same class of cases. From 10 to 20 grains (Gm. 0.60–1.30) may be given at a *dose*.

PULVIS CRETÆ COMPOSITUS, *U. S.*—COMPOUND CHALK POWDER.

Poudre de craie composée, Fr.; *Kreidepulver mit Gummi*, G.

Preparation.—Prepared chalk 30 parts (3 oz.); Acacia, in fine powder, 20 parts (2 oz.); Sugar, in fine powder, 50 parts (5 oz.); to make 100 parts (10 oz.). Mix them intimately.—*U. S.*

This has been introduced with the view of preparing from it the chalk mixture as wanted.

Off. Prep.—Mistura cretæ, *U. S.*

Dose, from 20 to 60 grains (Gm. 1.30–4).

PULVIS EFFERVESCENS COMPOSITUS, *U. S.*—COMPOUND EFFERVESCING POWDER.

Pulveres effervescentes aperientes, U. S. 1870; *Pulvis aërophorus laxans*, *s. P. aërophorus Seydlitzensis*, P. G.—*Aperient effervescing powders*, *Seidlitz powders*, E.; *Poudre gazifère purgative*, *Poudre de Sedlitz*, Fr.; *Abführendes Brausepulver*, *Seidlitzpulver*, G.

Preparation.—Bicarbonate of Sodium, in fine powder, 480 grains (31 Gm.); Tartrate of Potassium and Sodium, in fine powder, 1440 grains (93 Gm.); Tartaric Acid, in fine powder, 420 grains (27 Gm.). Mix the bicarbonate of sodium intimately with the tartrate of potassium and sodium, and divide the mixture into 12 equal parts. Then divide the tartaric acid into 12 equal parts. Lastly, keep the parts, severally, of the mixture and of the acid in separate papers of different colors.—*U. S.*

The alkaline powder is usually put into a blue paper, each containing of sodium bicarbonate 40 grains or 2.58 Gm. (2.5 Gm. *P. G.;* 2.0 Gm. *F. Cod.*), and of potassium and sodium tartrate 120 grains or 7.75 Gm. (7.5 Gm. *P. G.;* 6 Gm. *F. Cod.*). The tartaric acid is wrapped in white paper, and weighs 35 grains or 2.25 Gm. (2.0 Gm. *F. Cod.*, *P. G.*). On mixing the solutions of the contents of the two papers, Mr. Wm. Gilmour (1881) observed the formation of potassium bitartrate even in the presence of insufficient tartaric acid for producing neutral sodium tartrate; this effect is due to the liberated carbonic acid.

Allied Preparations.—PULVERES EFFERVESCENTES, *U. S.* 1870; Pulvis aërophorus anglicus, *P. G.*—Effervescing powders, Soda powders, *E.;* Poudre gazeuse, P. gazogène, P. aërophore, P. de Seltz, *Fr.;* Englisches Brausepulver, G.—Take of bicarbonate of sodium, in fine powder 360 grains; tartaric acid, in fine powder, 300 grains. Divide each of the powders into 12 equal parts, and keep the parts, severally, of the bicarbonate and of the acid in separate papers of different colors.

PULVIS AËROPHORUS, *P. G.*, is composed of 10 parts of bicarbonate of sodium, 9 parts of tartaric acid, and 19 parts of white sugar. Each substance is finely powdered and well dried before the three are mixed, when the powder may be kept unaltered in well-closed vessels. But if these are opened, and from the deposition of moisture decomposition begins to take place, the change proceeds more rapidly in a closed than in an open vessel should the latter be kept in a dry and airy place. The powder keeps much better if granulated as described above. Either form of powder may serve as a vehicle for the convenient and pleasant administration of other medicines, such as salts of iron, quinine, etc.. which should not be mixed with the bicarbonate of sodium alone.

(See this subject treated in *Proceedings Amer. Phar. Assoc.*, 1856, p. 49.)

Medical Action and Uses.—The compound effervescing powder is convenient for administering tartrate of potassium and sodium in a state of effervescence. The acid powder should be dissolved in 1 or 2 fluidounces, and the saline in about 6 fluidounces, of water; the liquids should then be gradually mixed and drunk while effervescing. Seidlitz powders are very commonly employed to relieve moderate *constipation* and the *feverishness* that attends the first stage of many slight disorders, especially those produced by "taking cold" or by an imprudent and excessive use of food and alcohol. Like other saline laxatives, this one is more appropriate in warm than in cold weather. If a very active operation is desired, one and a half or even two pairs of powders may be given at once, or, on the other hand, they may be administered in divided portions as a febrifuge medicine.

The carbonic acid disengaged during the administration of soda powders is a direct stimulant to the stomach and nervous system, while it creates an agreeable sense of coolness in the abdomen. The tartrate of sodium formed in the process is diuretic, antacid, and slightly laxative, and probably during *fever* is diaphoretic also. Soda powders are much used to relieve the feverish effects of imprudent eating and to remove constipation. Each powder should be dissolved in about 4 ounces (Gm. 120) of water flavored with syrup if preferred, and the solutions, being mixed, should be taken while effervescing.

PULVIS ELATERINI COMPOSITUS, *Br.*—COMPOUND POWDER OF ELATERIN.

Preparation.—Take of Elaterin 5 grains; Sugar of Milk 195 grains. Rub them together in a mortar until they are reduced to fine powder and intimately mixed.—*Br.*

Medical Action and Uses.—This preparation is a convenient one for the administration of elaterin. *Dose*, from ½ grain to 5 grains (Gm. 0.03–0.33).

PULVIS GLYCYRRHIZÆ COMPOSITUS, *U. S.*, *Br.*—COMPOUND POWDER OF GLYCYRRHIZA (LIQUORICE).

Pulvis liquiritiæ compositus, s. P. pectoralis Kurellæ, P. G.—*Poudre pectorale, Poudre de réglisse composée,* Fr.; *Brustpulver,* G.

Preparation.—Senna, in No. 60 powder, 18 parts (90 grains); Glycyrrhiza, in No. 60 powder, 16 parts (80 grains); Fennel, in No. 60 powder, 8 parts (40 grains); Washed

Sulphur 8 parts (40 grains); Sugar, in fine powder, 50 parts (250 grains); to make 100 parts (500 grains). Rub them together until they are thoroughly mixed.—*U. S.*

Powdered senna 2 parts; powdered liquorice-root 2 parts; powdered fennel 1 part; washed sulphur 1 part; powdered sugar 6 parts.—*P. G., Br.*

The first formula has been adapted from that of the German Pharmaeopœia, and is practically identical with it and with that of the British Pharmacopœia. The powder is of a greenish-yellow color. The British Pharmacopœia of 1867 omitted the fennel and sulphur.

Medical Action and Uses.—This preparation is a mild but efficient aperient in the *dose* of from 30 to 60 grains (Gm. 2–4). A better form of it is essentially that of the German Pharmacopœia, and is composed as follows: ℞. Senna, liquorice-root, in fine powder, of each ℥j; fennel-seed, washed sulphur, in fine powder, of each ℥ss; white sugar, in fine powder, ℥iij. Mix thoroughly, pass through a fine sieve, and rub lightly in a mortar. S.—A teaspoonful in a glass of water at bedtime for the relief of habitual *constipation.*

PULVIS IPECACUANHÆ ET OPII, *U. S.*—Powder of Ipecac and Opium.

Pulvis ipecacuanhæ compositus, U. S. 1870, Br.; *Pulvis ipecacuanhæ opiatus, s. Pulvis Doweri*, P. G.—*Compound powder of ipecacuanha, Dover's powder*, E.; *Poudre de Dower*, Fr.; *Dower'sches Pulver*, G.

Preparation.—Ipecac, in No. 60 powder, 10 parts (50 grains); Powdered opium 10 parts (50 grains); Sugar of Milk, in No. 30 powder, 80 parts (400 grains); to make 100 parts (500 grains). Rub them together into a very fine powder.—*U. S.*

In this formula the milk-sugar is directed to be used in a rather coarse powder: the fragments of the crystals, being very hard, serve to grind the vegetable powders still finer during the necessarily prolonged trituration. The German Pharmacopœia orders the same ingredients in the same proportions as given above, but directs all three to be separately very finely powdered, and then to be intimately mixed. Both these pharmacopœias have, without any urgent reason, substituted milk-sugar in the place of potassium sulphate, which was formerly employed in the same proportion, and is still ordered by the British Pharmacopœia. Both powders are of a pale-brown color and have the odor of opium, somewhat modified by that of ipecac; they differ but slightly in taste, that of the Br. P. being somewhat saline in addition to the bitter and nauseous taste of the other ingredients, which predominates in the powder prepared by the above formula. The Dover's powder of the French Codex is nearly the same as that originally used by Dr. Dover, the chief difference being the substitution of dry extract of opium for opium; it is composed of sulphate and nitrate of potassium, each 40 parts, and dry extract of opium, ipecacuanha, and liquorice-root, each 10 parts, the whole to be made into a homogeneous powder.

Medical Action and Uses.—Dover's powder contains in every 10 grains 1 grain each of opium and ipecacuanha and 8 grains of sugar of milk. Its physiological effects are sleep and diaphoresis. The latter is perhaps favored by the ipecacuanha, but is essentially produced by the opium. If Dover's powder has the advantage of readily causing diaphoresis, it has the disadvantage of sometimes producing nausea and leaving the mouth more pasty than opium does alone.

This preparation is of peculiar value in the forming stages of *muscular rheumatism*, for if it occasions sweating it often terminates the attack. The use of hot drinks about an hour after the powder is administered will greatly promote its operation. A similar statement may be made of its use at the commencement of acute *inflammations*, such as coryza, sore throat, laryngitis, bronchitis, pleurisy, pneumonia, etc. It is of use in *hæmorrhage* from internal organs, and especially from the uterus; in *diarrhœa* from transient causes or from intestinal disease, as in typhoid fever, tuberculosis, dysentery, etc.; in profuse *sweats* from phthisis or other debilitating causes. It has been recommended in *diabetes*, *Bright's disease*, and *calculous affections*, but in them it is less appropriate than opium alone.

The ordinary *dose* of Dover's powder is 10 grains (Gm. 0.60), but in many cases doses only half as large, and repeated at longer or shorter intervals, are preferable. When full diaphoresis is desired the dose may be 15 or 20 grains (Gm. 1–1.30), and its operation may be promoted by hot drinks, thick bed-clothes, etc.

PULVIS JALAPÆ COMPOSITUS, *U. S.*, *Br.*—COMPOUND POWDER OF JALAP.

Pulvis jalapæ tartaratus, Pulvis catharticus.—Poudre de jalap composée, Fr.; *Jalapenpulver mit Weinstein*, G.

Preparation.—Take of Jalap, in No. 60 powder 35 parts (175 grains), Bitartrate of Potassium, in fine powder, 65 parts (325 grains); to make 100 parts (500 grains). Rub them together until they are thoroughly mixed.—*U. S.*

Take of jalap, in powder, 5 ounces; acid tartrate of potash 9 ounces; ginger, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar.—*Br.*

Medical Action and Uses.—This is an efficient hydragogue cathartic, particularly applicable to cases of hepatic and splenic obstruction with abdominal *dropsy*, and to other forms of dropsy in which the amount of the effusion constitutes an immediate source of danger. In the latter case the proportion of the bitartrate should be increased from 60 to 120 grains, and of the jalap to 10 or 15 grains. The *dose* of the compound powder of jalap is from 10 to 30 grains (Gm. 0.60–2).

PULVIS KINO COMPOSITUS, *Br.*—COMPOUND POWDER OF KINO.

Pulvis kino cum opio.—Poudre de kinoopiacée, Fr.; *Kinopulver mit Opium*, G.

Preparation.—Take of Kino, in powder, 3¾ ounces; Opium, in powder, ¼ ounce; Cinnamon-Bark, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep in a stoppered bottle.—*Br.*

Medical Action and Uses.—This preparation is one of the many in which opiates and astringents are associated, and which are chiefly used in cases of excessive *gastric* or *intestinal secretion*, including *diarrhœa*; it is also employed in the various *dyspeptic* derangements for which kino itself is used, and for lessening the secretion of urine in *diabetes* and of perspiration in various forms of *hectic fever*. The *dose* is from 5 to 20 grains (Gm. 0.30–1.30).

PULVIS MORPHINÆ COMPOSITUS, *U. S.*—COMPOUND POWDER OF MORPHINE.

Pulvis camphoræ compositus Tully.—Tully's powder, E.; *Poudre de Tully*, Fr.; *Tully'sches Pulver*, G.

Preparation.—Sulphate of Morphine 1 part (3 grains); Camphor 20 parts (60 grains); Glycyrrhiza, in No. 60 powder, 20 parts (60 grains); Precipitated Carbonate of Calcium 20 parts (60 grains); Alcohol a sufficient quantity. Rub the camphor with a little alcohol, and afterward with the glycyrrhiza and precipitated carbonate of calcium, until a uniform powder is produced. Then rub the sulphate of morphine with this powder, gradually added, until the whole is thoroughly mixed.—*U. S.*

This formula originated with Dr. William Tully of New Haven, Con. The powder should be very carefully prepared, so that the morphine salt may be uniformly incorporated with the other ingredients. Owing to the volatilization of camphor, it is best to prepare the powder in a small quantity only, and to preserve it in a well-stopped bottle kept in a cool place.

Medical Action and Uses.—The evaporation of the camphor from this powder causes it to deteriorate constantly, and therefore to cease to be what it originally was. Doubtless, the combination of camphor and opium, as it is constantly used in nervous affections, with different proportions of the two ingredients, is a most valuable one, and is recognized as such in the ancient liquid preparation paregoric elixir. The addition to ordinary Dover's powder of whatever dose of camphor may be required for individual cases appears to us preferable to so unstable a preparation as this. The *dose* of it may be stated at from 5 to 10 grains (Gm. 0.30–0.60).

PULVIS OPII COMPOSITUS, *Br.*—COMPOUND POWDER OF OPIUM.

Preparation.—Take of Opium, in powder, 1½ ounces; Black Pepper, in powder, 2 ounces; Ginger, in powder, 5 ounces; Caraway-Fruit, in powder, 6 ounces; Tragacanth, in powder, ½ ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep in a stoppered bottle.—*Br.*

This powder contains 10 per cent. of powdered opium.

Medical Uses.—This powder contains the ingredients, in a dry state, of the confection of opium, and may be used for the same purposes. *Dose*, from 2 to 5 grains (Gm. 0.10–0.30).

PULVIS RHEI COMPOSITUS, *U. S., Br.*—COMPOUND POWDER OF RHUBARB.

Pulvis magnesiæ cum rheo, s. P. infantum, s. P. antacidus, P. G.—*Magnesia and rhubarb, Gregory's powder*, E.; *Poudre de rhubarbe composée*, Fr.; *Kinderpulver*, G.

Preparation.—Take of Rhubarb, in No. 60 powder, 25 parts (2½ oz.); Magnesia 65 parts (6½ oz.); Ginger, in No. 60 powder, 10 parts (1 oz.); to make 100 parts (10 oz.). Rub them together until they are thoroughly mixed.—*U. S.*

The British Pharmacopœia has adopted Dr. Gregory's formula: powdered rhubarb 2 oz., light magnesia 6 oz., powdered ginger 1 oz.; the mixed powder is to be passed through a fine sieve. Mr. Gilmour (1881) observed that in order to render this powder readily miscible with water the rhubarb and ginger should first be triturated with about 5 per cent. of magnesium carbonate, and the calcined magnesia afterward added.

The formula of the German Pharmacopœia is as follows: carbonate of magnesium, 60 parts; oil-sugar of fennel (1 drop of oil of fennel to 2 Gm. of sugar) 40 parts; powdered rhubarb 15 parts. Mix.

These powders, when freshly prepared, have a yellowish color, but on keeping gradually assume a reddish tint from the absorption of moisture and the reaction of the magnesia with the constituents of rhubarb; in the presence of water or of alcohol they become deep-red.

Medical Action and Uses.—There does not appear to be any reason for the existence of this compound powder, the ingredients of which may very well be mixed extemporaneously in proportions adapted to the peculiarities of each case. It is a good laxative in cases of acid *dyspepsia* with constipation, and of *diarrhœa* with acid stools, especially as it is apt to occur in children. The *dose* for an adult is from 20 to 60 grains (Gm. 1.30–4), and for a child from 5 to 10 grains (Gm. 0.30–0.60).

PULVIS SCAMMONII COMPOSITUS, *Br.*—COMPOUND POWDER OF SCAMMONY.

Preparation.—Scammony Resin, in powder, 4 ounces; Jalap, in powder, 3 ounces; Ginger, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar.—*Br.*

Medical Action and Uses.—The close resemblance of scammony to jalap in its mode of action in all useful respects, and its harsh and irritating operation in others, render the conjunction of the two purgatives apparently superfluous. It is possible, however, that cases may occur in which the ruder action of scammony upon the bowels may be useful as a derivant from the brain. The *dose* of the powder is from 10 to 20 grains (Gm. 0.60–1.20).

PULVIS TRAGACANTHÆ COMPOSITUS, *Br.*—COMPOUND POWDER OF TRAGACANTH.

Preparation.—Take of Tragacanth, in powder, Gum-Arabic, in powder, Starch, in powder, each 1 ounce; Refined Sugar, in powder, 3 ounces. Rub them well together.—*Br.* It is a white powder, having a sweet, mucilaginous taste.

PULVIS GUMMOSUS, *P. G.*, is used for similar purposes, but has the following composition: Powdered gum-acacia 15 parts; powdered liquorice-root 10 parts; powdered sugar 5 parts. It is a yellowish-white powder, having the odor of liquorice-root and a sweet, mucilaginous taste.

Medical Uses.—This association of demulcents is hardly worthy of an officinal rank. It forms a dense mucilage used to suspend heavy powders, such as subnitrate of bismuth, etc.

PYRETHRUM, *U. S.*—Pellitory.

Pyrethri radix, Br.; *Radix pyrethri romani.*—*Pellitory-root, Pellitory of Spain*, E.; *Pyrèthre, Salivaire*, Fr.; *Römische Bertramwurzel*, G.

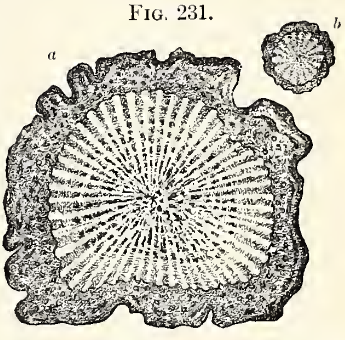
The root of Anacyclus (Anthemis, *Linné*) Pyrethrum, *De Candolle.* Woodville, t. 20; Bentley and Trimen, *Med. Plants*, 151.

Nat. Ord.—Compositæ, Anthemideæ.

Origin.—The pellitory is a procumbent or ascending perennial which is indigenous to North-western Africa and is occasionally cultivated in gardens. It resembles the chamomile, but has broadly oval, three-toothed, white ray-florets tinged with red beneath, and compressed obovate akenes, which have a short denticulate pappus; those of the outer rows have also a narrow wing, The root is shipped from Algiers and Tunis to Italy and France, and large quantities are sent to India by way of Egypt.

Description.—Pellitory-root is nearly simple, 2 to 4 inches (5–10 Cm.) long, ¼ to ½ inch (6–12 Mm.) thick, somewhat fusiform, and occasionally beset with a tuft of the hairy base of stem and leaves, annulate above, deeply wrinkled below, of a grayish or blackish-brown color externally and brownish-white internally. It breaks with a short fracture, and presents a bark about one-eighth the thickness of the root, and a radiated meditullium containing slender ligneous and medullary rays. The bark contains about two, and the medullary rays four or six, irregular circles of shining resin-cells. The root is inodorous, and has an aromatic and acrid taste, exciting a prickling sensation in the lips and tongue and a glowing heat.

Fig. 231.



Transverse sections, magnified three diameters, of the roots of—*a*, Anacyclus pyrethrum, *D. C.*; *b*, Anacyclus officinarum, *Hayne*.

Constituents.—Pellitory-root was analyzed by John, Gautier (1823), Parisel (1832), and Koene (1835); its acridity appears to reside in a brown *resin* and in two *fixed oils*, one having a dark-brown, the other a yellow, color. Buchheim (1876) asserts that the active principle is an alkaloid, *pyrethrine*, which under the influence of alcoholic solution of potassa yields *pyrethric acid*, resembling piperic acid. The root contains considerable inulin, a trace of tannin, mucilaginous matter, and other common constituents. Parisel's pyrethrin was a mixture of resin and fat.

Pharmaceutical Preparations.—Pilulæ odontalgicæ, Toothache pills. Beat together in a warm mortar powdered pellitory, belladonna-root, and opium, each 5 Gm.; yellow wax 7 Gm.; expressed oil of almond 2 Gm.; oil of cajuput and oil of cloves, each 15 drops. Divide the mass into pills each weighing 0.05 Gm., and dust them with powdered cloves.—*P. G.*, 1872.

Off. Prep.—Tinctura pyrethri, *Br.*

Allied Plants.—Radix pyrethri germanici.—German pellitory, *E.;* Pyrèthre allemande, *Fr.;* Bertramwurzel, *G.*—This is obtained from Anacyclus officinarum, *Hayne* (Bentley and Trimen. 152), which is not known in the wild state, but has been long cultivated near Magdeburg and in Saxony; some botanists regard it as an annual form of the above species. It is an erect annual, resembling the preceding species in foliage and flowers, but the latter have a very convex disk. The root is from 4 to 6 inches (10–15 Cm.) long, about ⅛ inch (3 Mm.) thick, has few rootlets, is externally brown-gray and internally dingy white. The bark is rather thick, and contains one irregular circle of rather large resin-cells; the meditullium consists of slender brownish wood-wedges and whitish medullary rays, which are free from resin-cells. The root is inodorous and agrees in taste with the preceding.

Pyrethrum (Chrysanthemum) roseum and P. carneum, *Bieberstein.*—Persian Pellitory, Persian insect-flowers, *E.;* Camomille de Perse, *Fr.;* Persische Bertramblumen, *G.*—Both plants are hardy perennials, resembling chamomile in appearance, and indigenous to Western Asia from Persia to the Caucasus Mountains. The flowers are the parts employed, and are used in the form of powder for killing insects. The flower-heads are about 1½ inches (38 Mm.) broad, and have an imbricate involucre, with a brown scarious margin, a convex naked and solid receptacle, about twenty-four ray-florets, and a large number of yellow disk-florets. The ray-florets are ligulate, nerved and three-toothed, the disk-florets tubular and five-toothed. The akenes are dark-brown, angular, not winged, and crowned with a short membranous pappus. Pyrethrum roseum has rose-colored ray-florets and anthers included in the tube of the corolla. Pyr. carneum has purplish ray-florets, and anthers projecting with their appendages from the floret-tube. The flowers have a peculiar not very strong odor and an acrid taste. The flowers of Pyr. cinerariæfolium, *Treviranus*, of Dalmatia, possess similar properties. Hanaman and Koch (1863) ascribed the insecticide effects of the flowers to the volatile oil. Rother (1876) announced the isolation from insect-flowers of an oleoresinous acid, *persicein*, another acid resinous substance, *persiretin*, and a readily soluble glucoside, *persicin*, yielding persiretin when boiled with acids. He ascribes the effects of the flowers to persicin. Semenoff (1876) claimed to have obtained from them a volatile substance, which is probably an alkaloid, and Jousset de Bellesme (1876) regarded a crystalline *alkaloid* as the active principle. Oscar Textor (1881) found neither volatile oil nor alkaloid: he attributes the poisonous action to a soft resin, which is readily extracted by benzol, is soluble in alcohol and in potassa, is reprecipitated by an acid, and mixes readily with strong sulphuric acid, but is reprecipitated by a little water. Dal Sie (1879) believes a volatile crystallizable acid to be the active principle of Dalmatian insect-powder.

The *quality* of insect powder, according to Kalbrunner (1874), is best ascertained by sprinkling 4 grains of it upon a fly contained in a vial, which should be stupefied in 1 minute and killed in 2 or 3 minutes. Experiments demonstrating the fatal action upon insects of Persian pellitory have been published by Carpenter (*Am. Jour. Phar.*, May, 1879, p. 246).

Medical Action and Uses.—Pellitory is a powerful irritant, and acts as a rubefacient upon the skin. When chewed it has an acrid taste, and excites a burning and prickling sensation in the mouth and fauces and a copious flow of saliva. A child three and a half years old one evening swallowed about 50 minims of tincture of pyrethrum. During the night no symptoms occurred except soreness of the tongue, restlessness, and profuse perspiration. At five o'clock the next morning diarrhœa commenced with pain, and at eleven the child lay in a semi-stupor, the pupils natural, the pulse 120 and feeble; twitching of the muscles of the limbs, the tongue swollen and of a drab color; no vomiting, but profuse diarrhœa with tenesmus, and involuntary evacuations of bloody mucus. At 12.30 violent convulsions followed by profound stupor; at three o'clock and later tetanoid spasms and mental excitement with incessant talking. The next morning the intestinal disorder and the spasms had subsided, but the pulse continued frequent for 2 days. Laudanum, wine, and coffee were administered, and ice was applied to the forehead and spine (Browne). Its sialagogue properties have caused it to be used for the relief of *pains* about the *face* and *head*. Boiled in vinegar and applied to carious cavities in teeth, it is used to relieve *toothache*. In *paralysis* of the tongue or pharynx and in relaxation of the *uvula* it may be employed as a masticatory or in a gargle. Its powder has been recommended as a sternutatory in chronic inflammation of the *frontal sinuses*. Its *dose* as a masticatory is from 30 to 60 grains (Gm. 2–4).

PYROXYLINUM, *U. S.*—PYROXYLIN.

Pyroxylin, Br.; *Lana collodii.*—*Soluble gun-cotton*, *Collodion cotton*, E.; *Fulmicoton soluble*, Fr.; *Collodiumwolle*, G.

Preparation.—Cotton 1 part (1 oz. av.); Nitric Acid 10 parts (10 oz. av. or 6¾ fluidounces); Sulphuric Acid 12 parts (12 oz. av. or 6¼ fluidounces); Alcohol, Stronger Ether, Water, each a sufficient quantity. Mix the acids gradually in a glass or porcelain vessel, and when the temperature of the mixture has fallen to 32° C. (90° F.) add the cotton. By means of a glass rod imbue it thoroughly with the acids, and allow it to macerate for 10 hours, or until a small sample of the cotton, taken out, thoroughly washed with a large quantity of water and subsequently with alcohol, and pressed, is found to be soluble when shaken in a test-tube with a mixture of 1 volume of alcohol and 3 volumes of stronger ether. Then remove the cotton from the acids, transfer it to a larger vessel, and wash it first with cold water until the washings cease to have an acid taste, and afterward with boiling water. Finally, drain the pyroxylin on filtering-paper and dry it in small, detached pellets by means of a water-bath. Pyroxylin should be kept loosely packed, in well-closed vessels containing not more than about 31 Gm. (or about 480 grains), in a cool and dry place remote from lights or fire.—*U. S.*

Take of cotton 1 ounce; sulphuric acid, nitric acid, each 5 fluidounces. Mix the acids in a porcelain mortar, immerse the cotton in the mixture, and stir it for 3 minutes with a glass rod until it is thoroughly wetted by the acids. Transfer the cotton to a vessel containing water, stir it well with a glass rod, decant the liquid, pour more water upon the mass, agitate again, and repeat the affusion, agitation, and decantation until the washing ceases to give a precipitate with chloride of barium. Drain the product on filtering-paper and dry in a water-bath.—*Br.*

The French Codex has a similar formula, but somewhat different proportions; it directs the maceration of 55 parts of well-dried cotton in a mixture of 1000 parts sulphuric acid specific gravity 1.84 and 500 parts nitric acid specific gravity 1.42, which has been cooled to 30° C. (86° F.). The German Pharmacopœia directs a mixture of 1000 parts of crude sulphuric acid sp. gr. 1.830 and 400 parts of crude nitric acid sp. gr. 1.380; when cooled to 20° C. (68° F.), 55 parts of purified cotton are to be macerated in the mixture for 24 hours at a temperature of 15–20° C. (59°–68° F.).

A large number of formulas for preparing collodion cotton have been published, many with the nitric acid replaced by a nitrate, and the sulphuric acid correspondingly increased in quantity. Such mixtures may be made to yield as good results as the mixture of the two acids, but, owing to the separation of crystalline sulphates, it is more difficult to imbue the cotton thoroughly and uniformly with the mixture. Mann (1853) found the following proportions serviceable for 1 part of cotton: 20 parts potassium nitrate and 31 parts sulphuric acid specific gravity 1.830 to 1.835, or 10 parts potassium nitrate and 33 parts sulphuric acid specific gravity 1.80; the mixture is cooled to 30° C. (86° F.), and the cotton macerated at the same temperature for not less than 1 day or more than 6 days. Good results will also be obtained with a mixture of 17 parts sodium nitrate and 68 parts sulphuric acid specific gravity 1.78, or of 34 parts sodium nitrate and 66 parts sulphuric acid specific gravity 1.80; the cotton is introduced after 24 hours and macerated for 5 days. Klie (1877) succeeded with proportions nearly identical with those of Mann's first formula.

In making collodion cotton it is essential that due attention be paid to the strength of the acids, or, if a nitrate is used, to its freedom from chloride; likewise, that the temperature be permitted to fall as indicated before the cotton, which should be free from fat, is introduced, and that the cotton be thoroughly imbued with the acid mixture. If introduced at too high a temperature other insoluble nitro-compounds will be produced or the cotton will dissolve, and portions not moistened with the liquid will not be acted on, and likewise remain insoluble. Small portions of the cotton may from time to time be examined, thoroughly washed with water, afterward with alcohol, pressed, and then examined as to their solubility in a mixture of ether and alcohol. When these are found to be soluble, the cotton is withdrawn or the whole mixture added to a large bulk of water, the cotton washed with water until free from acid taste, then pressed to free it from water, steeped in alcohol, and again pressed, after which it may be dried by exposure at a moderate temperature (25° C. *P. G.*). The yield is usually about 140 per cent.

Properties and Composition.—Pelouze (1838) obtained explosive nitro-compounds by treating cotton, hemp, and paper with strong nitric acid. In 1846, Schoenbein announced the discovery of *gun-cotton*, and in the same year Otto published a process for preparing it by maceration in fuming nitric acid. In 1848, Maynard employed *collodion*. That gun-cotton is a nitrated substitution-compound of cellulose was recognized at an early day, and that the weight of the product is greater than that of the cotton employed. Regarding cellulose as the triatomic alcohol $C_6H_7O_2(OH)_3$, three nitric ethers of it may be prepared—namely, *pyroxylin* or *gun-cotton*, $C_6H_7O_2(NO_3)_3$, which is violently explosive and is insoluble in ether; *collodion cotton* or *colloxylin*, $C_6H_7O_2(OH)(NO_3)_2$, which is soluble in ether; and $C_6H_7O_2(OH)_2(NO_3)$, which is insoluble in ether. Hadow (1855) distinguished (1) *pyroxylin*, $C_{18}H_{21}(NO_2)_9O_{15}$; (2) the compound $C_{18}H_{22}(NO_2)_8O_{15}$; and (3) $C_{18}H_{23}(NO_2)_7O_{15}$, of which the latter was called by Gladstone *cotton xyloidin*, and has also been named *colloxylin*. The first weighs about 81 per cent. more than the cotton, is highly explosive, insoluble in ether and alcoholic ether, but soluble in acetic ether. The second shows an increase in weight of about 71 per cent., is soluble in ether-alcohol, but insoluble in glacial acetic acid. The third shows an increase of about 64 per cent., and is soluble in ether and glacial acetic acid, and is the variety aimed at in the preparation of collodion. Usually two, or occasionally all three, compounds are obtained at the same time. The cotton is apparently not altered in structure or appearance, and when these nitrated compounds are digested with sulphydrate of potassium they are again converted into cotton.

Similar nitrated compounds are also obtained from other carbohydrates; thus starch yields with concentrated nitric acid a transparent jelly of *xyloidin*, $C_6H_9(NO_2)O_5$, and a similar change is produced in paper by dipping it into strong nitric acid and afterward washing with water.

Preservation.—When collodion cotton, particularly in the moist state, is kept in well-stopped bottles, it undergoes decomposition, frequently accompanied with the evolution of nitrous vapors or with ignition and explosion. It is best preserved in a dry atmosphere and enclosed in vessels which permit the free access of air.

Off. Prep.—Collodium, *U. S.*, *Br.*

Medical Uses.—This article is not used medicinally.

QUASSIA, *U. S.*—Quassia.

Quassiæ lignum, Br.; *Lignum quassiæ*, P. G.—*Quassia-wood, Bitter-wood, Bitter ash*, E.; *Quassie, Bois amer*, Fr.; *Quassienholz, Fliegenholz*, G.

The wood of Picræna excelsa, *Lindley*, s. Quassia (Simaruba, *De Candolle*, Picrasma, *Planchon*) excelsa, *Swartz*. Steph. and Church, *Med. Bot.*, t. 173; Bentley and Trimen, *Med. Plants*, 57.

Nat. Ord.—Simarubaceæ.

Origin.—This is a large tree common in the island of Jamaica and in some other West Indian islands. It attains a height of 60 to 80 feet (18–24 M.) and a diameter of 2 to 3 feet (.6–.9 M.) and in aspect resembles the common ash. It has imparipinnate leaves, with short-stalked oval-lanceolate entire leaflets, and dense cymes of small white polygamous flowers, followed by black subglobular drupes of the size of a pea.

Description.—Jamaica quassia-wood is imported in billets varying in length from 3 to 6 feet (.9–1.8 M.) and in thickness from a few to 10 or 20 inches (25–50 Cm.). It is usually deprived of the bark, is dense, tough, of medium hardness, yellowish-white in color, splitting lengthwise coarsely splintery, and is frequently marked with irregular black lines or patches, due to the mycelium of a fungus. On a transverse section are seen a minute central pith, numerous narrow medullary rays composed of two or three rows of cells, wood-tissue containing large vessels, and irregular wavy concentric circles resembling annual rings. The wood is inodorous and has an intensely and purely bitter taste. In the shops it is usually found in raspings or chips, and the wood is turned into cups which are sold as *bitter cups* or *quassia cups*.

Constituents.—Winckler (1835) isolated the bitter principle *quassiin* or *quassin* from the concentrated decoction by precipitating pectin with lime, evaporating the filtrate, exhausting the residue with alcohol, mixing with ether, filtering, and evaporating spontaneously. A. Christensen (1882) prepared it by neutralizing the infusion of quassia with soda, precipitating with tannin, and decomposing the precipitate with lead oxide or lime. Quassin has the composition $C_{31}H_{42}O_9$ (Christensen)—according to Wiggers (1837), $C_{10}H_{12}O_3$. It crystallizes in thin rectangular plates, in small prisms, or in silky needles of a very bitter taste, is easily soluble in hot alcohol and in chloroform, sparingly soluble in ether and benzin, and dissolves slowly in cold water. Acids, alkalies, and certain salts increase the solubility of quassin in water. By treatment with warm diluted sulphuric acid it is converted into a resin and a compound which has the formula $C_{31}H_{38}O_9$, reduces silver nitrate, and is not precipitated by tannin. The yield of quassin is .05 to .15 per cent.

Allied Drugs.—Surinam Quassia, which is used on the continent of Europe, is the wood of Quassia amara, *Linné*, a large shrub or small tree indigenous to Surinam. It is met with in commerce in billets about 1 to 4 inches (2–10 Cm.) in diameter or in pieces not thicker than a finger; it has very fine, almost obscure, one-rowed medullary rays and smaller vessels, and is therefore apparently less porous; otherwise, it closely resembles the preceding. The German Pharmacopœia permits the use of this and the preceding variety of quassia.

Quassia-Bark of Surinam is about $\frac{1}{30}$ to $\frac{1}{12}$ inch (.8–2 Mm.) thick, very fragile, externally of a gray color and nearly smooth, internally whitish and smooth.

Quassia-Bark of Jamaica varies from about $\frac{1}{6}$ to $\frac{1}{3}$ inch (4–8 Mm.) in thickness, is externally blackish-gray, longitudinally furrowed and verrucose, and on the inner surface yellowish-white and smooth. When broken transversely the fracture is smooth in the outer and tough and fibrous in the inner layer; the latter portion is seen to be radially striate. Both quassia-barks are easily removed from the wood, with the bitter taste of which they agree.

Off. Prep.—Extract. quassiæ fluid., *U. S.*; Extract quassiæ, Tinct. quassiæ, *U. S.*, *Br.*; Infus. quassiæ, *Br.*

Physiological Action.—Quassia is fatal to flies, and is sometimes used to preserve botanical collections from the ravages of insects. Rabbits and dogs have been killed by a concentrated preparation of the drug, the latter even by its application to the raw skin, and when its effects were not fatal it produced a partial paralysis of the limbs. Its bitter taste is more intense than that of most other stomachic tonics; like them, it excites the appetite for food and quickens digestion, but if too long continued it produces derangement of the stomach. Quassia may exhibit poisonous qualities, as in the following case: A concentrated infusion of the drug was by mistake given in enema to a child four years old. Within an hour the child became unconscious and collapsed, the head was thrown back and the pupils were contracted, the respiration was inaudible, and the pulse could not be felt. It was restored by alcohol, ether, and ammonia (*Med. Record*,

xviii. 404). The following conclusions were reached by Campardon in regard to quassin, crystallized and amorphous (*Bull de thér.*, ciii. 385): In moderate doses it increases the secretion of the saliva, the bile, the urine, and perhaps of the milk. It stimulates the excretory ducts of the several organs producing these secretions. In appropriate cases of sickness it quickens the appetite, renews the strength, facilitates the excretions, renders defecation easier, and hastens the expulsion of renal and biliary calculi. Its toxical action resembles that of the convulsing poisons. 2½ grains (Gm. 0.15) of amorphous, or ¼ grain (Gm. 0.015) of crystallized quassin will occasion the following symptoms: a burning in the throat and œsophagus and a sense of constriction in the former; frontal headache; epigastric weight and pain; nausea, vertigo; confused vision, extreme restlessness, and feverish impatience; unsteadiness of mind; frequent urination, loose stools, and vomiting; cramps and spasms in the muscles of the lower limbs.

Medical Uses.—In debilitated states of the digestion quassia enjoys a merited reputation, especially in *dyspepsia* with regurgitation or vomiting of the food, produced by an exhausted condition of the stomach and accompanied more or less frequently with sick headache. Especially is it of use in *gastric vertigo* when associated with bicarbonate of sodium. In atonic *diarrhœa* due to irritation of the colon by accumulated feces the medicine is also beneficial. Quassia was once held to be a remedy for *lumbricoid worms*, which it is, partly because it improves the digestive powers. Enemas of infusion of quassia are efficient remedies for *ascarides* of the rectum.

The *dose* of the powder is stated at 20 or 30 grains (Gm. 1.30–2), but it is seldom administered in this manner. The most appropriate form of the medicine is the infusion made with cold water. Quasin is best administered in pill made with the amorphous preparation and containing from ⅜ to 1 gr. (Gm. 0.025–0.06). Crystallized quassin is given in doses of $\frac{1}{30}$ to $\frac{1}{10}$ grain (Gm. 0.002–0.006). Campardon prefers the former, and states that the medicine does not occasion tolerance, and that its characteristic action is sometimes seen for a month after its disuse in salivation, increased flow of urine, and regularity of the stools.

QUEBRACHO.—QUEBRACHO.

Quebracho, E., Fr., G.

The bark of Aspidosperma Quebracho, *Schlechtendal.*
Nat. Ord.—Apocynaceæ.

Origin.—The term *quebracho* (*quebrar hacho*) signifies "breaking the axe," and is applied in South America to trees having a very hard wood. The above species is called *quebracho blanco*, on account of its light-colored wood. It is a large evergreen tree, having thin drooping branchlets. The leaves are small, opposite, or in whorls of three, nearly sessile, elliptic-lanceolate, sharply pointed, and with an entire and callous margin; the small yellow flowers are in axillary cymes, and produce woody somewhat compressed capsules with broadly-winged seeds. The plant was discovered by Burmeister (1860); specimens of the bark were sent to Europe by Schickedanz (1878), and chemically examined by Fraude and Hesse. A thorough histological examination of the bark was made by A. Hansen (1880). The bark is collected from old trees after the corky layer has been well developed; though it contains only 3.48 per cent. of tannin, according to Paschkins, it is used in the Argentine Republic to some extent for tanning.

Description.—Quebracho-bark is seen in flattish or curved pieces varying in size and having a thickness of ½ to 1⅕ inches (12–30 Mm.). The outer surface is deeply fissured and warty, dingy ochre-colored or pale-brownish, or, after abrasion of this layer, brownish-red or of a bright orange-brown color; the inner surface is usually deep-brown, but occasionally pale-colored. The bark is nearly inodorous, has a bitter and slightly aromatic taste, and breaks in the outer layer with a short granular, and in the inner layer with a fibrous, fracture. Upon transverse section about one-half or more of the bark is seen to consist of an irregular corky layer, orange-brown in the interior, marked with irregular tangential lines of alternating suberous bands and parenchyma, and in the latter with numerous whitish dots formed by groups of stone-cells. The inner bark forms a brown (or yellowish) layer nearly uniform in thickness, having narrow medullary rays, numerous whitish dots of stone-cells in groups, and scattered bast-fibres, each being almost completely enveloped in a sheath of small crystal-cells.

Constituents.—Schickedanz isolated a crystalline alkaloid, which Fraude named *aspidospermine;* Hesse found in addition five other alkaloids, one of which (*quebracha-*

mine) appears to be sometimes wanting. The extract, prepared with hot alcohol, is treated with soda and chloroform, the latter solution evaporated, the residue taken up with diluted sulphuric acid, and the filtrate precipitated by soda. On dissolving the mixed alkaloids in a little boiling alcohol, aspidospermine, quebrachine, and quebrachamine will crystallize on cooling, and are separated by crystallization from diluted hydrochloric acid, aspidospermine remaining in the mother-liquor. The alcoholic mother-liquor contains the remaining three bases, which are combined with acetic acid; from this solution ammonia precipitates aspidosamine; aspidospermatine and hypoquebrachine are precipitated by soda and separated by boiling benzin, in which the latter is nearly insoluble. All these alkaloids are more or less soluble in alcohol, ether, and chloroform. *Aspidospermine*, $C_{22}H_{30}N_2O_2$, melts at 205° C. (401° F.), and is a weak base, forming mostly amorphous salts; warm perchloric acid colors the solution permanently deep-red; platinic chloride gives a blue precipitate; sulphuric acid and lead peroxide (or potassium bichromate) color the alkaloid brown, afterward cherry-red or purplish. *Aspidospermatine*, $C_{22}H_{28}N_2O_2$, melts at 162° C. (324° F.), is a strong base, and yields amorphous salts; it is colored, like the preceding, by perchloric acid, but not by sulphuric acid and chromate. *Aspidosamine*, $C_{22}H_{28}N_2O_2$, melts near 100° C. (212° F.), is a strong base, is colored blue by sulphuric acid and chromate, and gives with boiling perchloric acid a fuchsine-red liquid. *Quebrachine*, $C_{21}H_{26}N_2O_3$, melts at 215° C. (419° F.), yields crystallizable salts, is colored yellow by sunlight, also by warming with perchloric acid, and gives with sulphuric acid a colorless solution becoming blue on standing or more rapidly by lead peroxide or potassium chromate, the color produced by the latter changing to red-brown. *Quebrachamine* resembles the preceding, but melts at 142° C. (288° F.), and is freely soluble in cold alcohol and ether. *Hypoquebrachine* is yellow, amorphous, melts near 80° C. (176° F.), and gives in solution a cherry-red color with ferric chloride.

Tests.—For recognizing quebracho-bark Fraude recommends the following: Boil 5 Gm. of the bruised bark with 25 Gm. of benzin; filter while hot, agitate the liquid with 10 Ccm. of diluted sulphuric acid, separate the aqueous solution, supersaturate with ammonia, agitate with ether, evaporate the ethereal solution, and boil the residue with perchloric acid; or, dissolve it in a little water with 4 drops of sulphuric acid, add a minute crystal of potassium chlorate, and boil; the solution should acquire a fuchsine-red color.

Pharmaceutical Preparations.—Tinctura quebracho. Quebracho-bark 1 part; diluted alcohol sufficient for obtaining 5 parts of tincture.

Vinum quebracho. Quebracho-bark 1 part; diluted alcohol 2 parts; white wine sufficient for obtaining 15 parts of liquid.

Allied Drugs.—Loxopterygium Lorentzii, *Grisebach* (nat. ord. Terebinthaceae, Anacardieæ). This tree is known in the Argentine Republic as *quebracho colorado*, the wood of which is red-brown and contains about 20 per cent. of tannin. Hansen (1880) describes the bark as being externally dingy-yellow or brown, usually covered with lichens; the transverse section is light-brown, and shows numerous parallel dark-colored corky bands, which are traversed at right angles by many fine light-colored medullary rays; between the latter are regular tangential rows of groups of stone-cells, imparting to the tissue a checkered appearance; the bast-fibres are the same as in white quebracho-bark, surrounded by a sheath of crystal-cells, but they are always much smaller, and are arranged in nearly rectangular groups. Hesse considers its tannin to be very similar to that of catechu, and has obtained two bitter alkaloids: *loxopterygine* is very soluble in alcohol, ether, and chloroform, and is colored blood-red by nitric acid: the second alkaloid is very easily decomposed, and yields with diluted sulphuric acid a beautiful blue solution. The resinous exudation of the bark resembles kino in appearance and taste, and, according to Arate (1878), is soluble in alcohol, amylic alcohol, acetone, acetic ether, acetic acid, and hot water.

Iodina rhombifolia, *Hooker et Arnott* (nat. ord. Aquifoliaceæ), is known as *quebracho flojo*, and Machærium fertile, *Grisebach* (nat. ord. Leguminosæ), as *tipa*. The wood and bark of both species are used like the preceding, and occasionally collected with it.

Copalchi-bark (see page 396) has been sold as quebracho.

(See also *paytine*, page 465, and Geissospermum, page 1034.)

Physiological Action.—The experiments of Penzoldt led him to formulate distinctly the conclusion that the action of quebracho is upon the blood alone: in medicinal doses, he said, it enables the blood to take up more than its normal proportion of oxygen and convey it to the tissues; and in poisonous doses it probably enables the blood to retain that oxygen in itself, and not yield it to the tissues, so that dyspnœa from a deficiency of oxygen in the medulla ensues (*Die Wirkungen der Quebrachodroguen*, 1881, pp. 23, 25). Gutmann, on the other hand ("Die Aspidosperminpräparate," *Archiv f.*

exper. Pathol. u. Pharm., 1881, xiv. 451), concluded that aspidospermin is both a respiratory and a cardiac poison; that in cold-blooded animals it paralyzes respiration and destroys life by its action on the "noeud vital;" that respiration paralysis is accompanied with sedation of the heart "from paralysis of the automatic heart-ganglia of the sympathetic," the temperature declining and the dyspnœa increasing; that it causes death by heart paralysis and venosity of the blood, without previous convulsions; and that while in frogs death is preceded by paralysis of the voluntary muscles, no such paralysis can with certainty be observed in warm-blooded animals. The antagonism of these two theories is apparently absolute. *Non nobis tantas componere lites.* As in other cases of such dissidence, we are obliged to turn to clinical observation, not to explain the action of the drug, but, for the only purpose that concerns practical physicians, to justify its use as a medicine.

Medical Uses.—In 1879, Penzoldt described quebracho as a medicine that without any injurious collateral effects promptly diminishes or removes sundry forms of dyspnœa in various diseases of the respiratory and circulatory apparatus. He observed a reduction of the respiration-rate under its influence, without any corresponding lowering of the pulse-rate. It seemed to produce a sense of warmth in the head, but neither vertigo nor somnolence. Sometimes it excited diaphoresis, sometimes also salivation, and in some cases of pulmonary disease the cough and expectoration grew less. Penzoldt saw no bad consequences from its use, but other physicians have noted its disagreeable taste and the nausea it is apt to cause. According to Laquer, if the use of the medicine is prolonged it is apt to occasion headache, dulness of the senses, vertigo, and salivation, and the patients acquire an extreme disgust for it (*Bull. de thérap.*, xcviii. 379). Picot assures us that it enabled him to ascend a mountain without shortness of breath—a feat which he could not otherwise accomplish (*Bull. de thérap.*, xcviii. 379).

Penzoldt states that of all diseases *asthma* with emphysema is most benefited by it, and that it did not fail of its effect even when pleurisy or bronchitis was also present. In *phthisis*, *bronchial asthma*, and diseases of the *heart* its palliative action was marked, and was also evident in a case of pulmonary embolism; but when the heart-muscle was weak the influence of the medicine was not salutary, nor indeed in any case in which the condition of the heart was the primary cause of the dyspnœa. In this respect it is no substitute for digitalis. In a case of uræmic asthma it was very efficient. In opposition to one of these statements, Berthold reports two cases of fatty degeneration of the heart in which the dyspnœa was greatly relieved by the medicine (*Bull. de thérap.*, xcviii. 379), but it is probable that the dyspnœa arose from some other cause added to the degeneration of the heart-tissue. In a word, the medicine appears to be a palliative for the symptom dyspnœa; the degree and the duration of the relief which it affords will in each case depend upon the nature and the degree of the physical cause of that symptom. In this country we have the statement that Dr. Austin Flint tried quebracho in several cases of dyspnœa from phthisis and pneumonia without avail, but that in an extreme case of dyspnœa from mitral regurgitation it was very efficacious (*Med. News*, May, 1881, p. 273). Dr. Andrew H. Smith has reported the results of his use of the medicine in thirty-two cases of various diseases, including eleven of *spasmodic asthma*. Of the latter, nine cases were relieved, and of the total number of cases, including diseases of the lungs, heart, and kidneys, twenty-two were benefited more or less (*Med. Record*, xx. 559). Quite a similar result is reported by Gottheil (*Ibid.*, xxiv. 259), by Mariasi (*Bull. de thér.*, cv. 311), by Da Costa (*Boston Med. and Surg. Jour.*, Dec. 1883, p. 620), and by Maragliano (*Centralblatt f. d. g. Therapie*, ii. 63). It is difficult to assign to the medicine its precise clinical value, but the general impression conveyed by a study of its effects is, that the more nearly the symptom dyspnœa is independent of an organic cause the better will be the influence of the medicine upon it.

The preparation recommended by Penzoldt is as follows: Take 10 parts of the powdered bark; treat for several days with 100 parts of alcohol; evaporate the latter, and dissolve the extract in 20 parts of warm water. *Dose*, 1 or 2 teaspoonfuls three times a day. The solution, he says, is of a clear sherry color, has a slightly astringent and aromatic taste, and is not hard to take. Maragliano states that quebrachin and aspidospermin act in about half an hour by the mouth, and in from 5 to 10 minutes hypodermically. For the latter purpose he employed the sulphate in doses of 1 or 2 grains (Gm. 0.05–0.10), and a solution of 1 grain in 15 grains of water caused neither local nor general disturbance.

QUERCUS ALBA, *U. S.*—White Oak.

Cortex quercûs.—Oak-bark, E.; *Écorce de chêne*, Fr.; *Eichenrinde*, G.

The bark of Quercus alba, *Linné* (*U. S.*), Q. Robur, *Linné* (*Br., P. G.*). Bentley and Trimen, *Med. Plants*, 248, 250, 251.

Nat. Ord.—Cupuliferæ.

Origin.—The oaks are shrubs or trees growing chiefly in the temperate zone, and often forming extensive forests. They have monœcious flowers, the staminate ones in slender and naked catkins, and the pistillate flowers either single or in small groups, and followed by a one-seeded nut, the *acorn*, which is enclosed at the base by a *cup* formed by the indurated scaly involucre. The leaves of some species are entire or nearly so, but most species have sinuately toothed or lobed or even pinnatifid leaves, which are coriaceous and evergreen or mostly deciduous.

The white oak is a stately tree, 60 to 80 feet (18–24 M.) high and 6 to 8 feet (1.8–2.4 M.) thick. It grows from Canada to Northern Florida, and west to Wisconsin and Eastern Texas. The wood is light-colored, strong, and durable; the leaves are sinuately-lobed, smooth, and on the lower side pale glaucous; the cup is saucer-shaped, tuberculate, and much shorter than the oblong acorn.

The European oak, which somewhat resembles the white oak, grows to the height of 100 or 120 feet (30 or 40 M.). Three varieties are known, which are regarded by some botanists as distinct species; in the variety pubescens the old leaves remain hairy, in sessiliflora they are smooth, and both have the pistillate flowers and fruit sessile, while in the variety pedunculata they are raised upon a long peduncle. The European pharmacopœias usually direct the bark to be collected from the branches or young stems.

Description.—The bark is collected early in spring, and is deprived of the greater portion of the longitudinally fissured thick suberous layer. It is in nearly flat pieces, about ¼ inch (6 Mm.) or more thick, of a pale-brown color externally, with occasional patches of the gray scaly cork; the inner surface is somewhat lighter in color, and marked with sharp longitudinal ridges, produced by the bast-bundles projecting from the shrunken parenchyma. The bark is tough, breaks with a coarse fibrous fracture, and has a faint tan-like odor and a strongly astringent taste. It is kept in the shops in the form of an irregular coarse and fibrous powder, which scarcely tinges the saliva. The tissue contains groups of stone-cells and crystals of calcium oxalate.

Oak-bark as used in Europe is in quills, the bark being about $\frac{1}{12}$ inch (2 Mm.) thick; the outer surface is gray or brown-gray, glossy, and smooth or somewhat fissured; the inner surface is cinnamon-colored and somewhat ridged. The bark breaks with a smooth, and in the inner layer with a fibrous, fracture, and in odor and taste resembles the preceding.

Constituents.—The important constituent of oak-bark is tannin; gallic acid does not appear to be present. The tannin produces with ferric salts a dark blue-black precipitate, but it is not identical with gallotannic acid, since, according to Stenhouse (1842), it is incapable of being converted either into gallic or pyrogallic acid. This *quercitannic acid* is yellowish-brown, amorphous, yields a brown precipitate with acetate of lead, and was found by Stenhouse (1862) to yield sugar when boiled with dilute sulphuric acid. But, according to J. Löwe (1881), this tannin is not a glucoside; it is separated anhydrous, $C_{28}H_{24}O_{12}$, by saturating its solution with sodium chloride; it is almost insoluble in ether, but dissolves readily in acetic ether; it gives yellowish-white precipitates with gelatin, albumen, tartar emetic, and the alkaloids, and when heated with dilute acids under pressure yields *oak-red*, $C_{28}H_{22}O_{11}$. The infusion of oak-bark yields to ether a little gallic and ellagic acids. It is not known whether the tannins of the different oak-barks are alike. Bowman (1869) determined the amount of tannin in young white-oak bark, by means of gelatin, to be 11.21 per cent., and in the bark from older trunks only 6.34 per cent. Gerber (1843) obtained from the bark of the European oak a bitter principle which may also be present in the bark of other species. A decoction of the bark of older branches with very dilute sulphuric acid is mixed with lime, precipitated with potassium carbonate, evaporated, and extracted with alcohol, on the evaporation of which *quercin* remains behind in white bitter crystals.

Other Products of Oak. (See also Gallæ, pp. 721, 722.)

Quercus tinctoria, *Bartram* (s. Q. velutina, *Lamarck*). This is the *black oak*, the bark of which was formerly officinal, and is largely employed in the arts under the name of *quercitron-bark*. The tree grows from Canada and the New England States to Alabama and beyond the Mississippi. It is 80 to 100 feet (24–30 M.) high, and has a close-grained and strong wood. The leaves are somewhat pubescent on the lower surface and bristle-pointed on the lobes; the cup is coarsely scaly, hemispherical, conical at the base, and covers fully one-half of the globular-ovate acorn. Gray regards it as a variety of Qu. coccinea, *Wangenheim*, the *scarlet oak*. The bark resembles that of the white oak, but the suberous layer, which is generally removed, is of a blackish-brown color, and the inner bark of a deep reddish-brown with a yellowish tint. Like the preceding, it is usually kept as a coarse powder; when masticated it tinges the saliva bright brownish-yellow, due to the presence of *quercitrin*, which has been met with in many plants. This is deposited from the decoction of black-oak bark on cooling, forms when pure a yellow crystalline, inodorous, and nearly tasteless powder, which is sparingly soluble in hot and nearly insoluble in cold water, dissolves in about 5 parts of alcohol, slightly in ether, is colored dark-green by ferric chloride, and dissolved in alkalies becomes dark-brown on exposure. Its formula is $C_{33}H_{30}O_{17}$ ($C_{36}H_{38}O_{20}$, Liebermann, 1879). Treated with acids, it splits into the crystalline unfermentable sugar *isodulcit*, $C_6H_{14}O_6$, and into *quercetin*, $C_{27}H_{18}O_{12}$ ($C_{24}H_{16}O_{11}$ Liebermann); the latter is likewise yellow and crystalline, is found ready formed in a number of plants, is colored dark-green by ferric chloride, precipitated brick-red by acetate of lead, sublimable, by alkalies resolved into phloroglucin and *quercetic acid*, $C_{15}H_{10}O_7$, and with fusing potassa yields protocatechuic acid.

Quercus falcata, *Michaux*, s. Q. elongata, *Willdenow*. This is the *Spanish oak* of the Southern and Middle United States. It grows to the height of 70 feet (21 M.), has a reddish coarse-grained wood, and yields a thick bark rich in tannin.

Quercus nigra, *Linné*, s. Q. ferruginea, *Michaux*, is the *black jack* of the Middle and Southern States; it is a small tree, growing in barren soil, and is of little value.

Quercus virens, *Aiton*, the *live-oak*, is about 50 feet (15 M.) high, and has a yellowish, very compact, and fine-grained valuable wood, and a bark rich in tannin. The live-oaks of the Pacific coast are Quercus chrysolepis, *Liebman*, Q. agrifolia, *Née*, and Q. oblongifolia, *Torrey*, the latter occurring principally in Southern California.

Quercus Suber, *Linné*, the *cork-oak*, grows in the basin of the Mediterranean, and has been introduced into the Southern United States. It grows 40 to 50 feet (12–15 M.) high; has evergreen elliptic or ovate mostly sharp-toothed leaves, and produces an elastic suberous layer 1¼ to 2 inches (3–5 Cm.) thick, which is collected every eight or ten years and constitutes the cork of commerce. Kügler (1884) obtained from air-dry cork about .6 per cent. of ash rich in manganese, a little coniferin, about 5 per cent. of tannin and derivatives, and about 12 per cent. of chloroformic extract, including the crystallizable *cerin*, $C_{20}H_{32}O$; the fat *suberin* cannot be extracted by simple solvents, but is saponified by potassa, yielding glycerin and stearic and *phellonic acids*, the latter having the composition $C_{22}H_{42}O_3$. Finely-powdered cork has been employed as an absorbent dusting powder under the name of *suberin*.

Semen quercus tostum. Acorns are roasted in the same manner as coffee until they have acquired a brown color, when they are coarsely powdered. This is used as *acorn coffee* (Eichelkaffee, *G.*). According to Braconnot's analysis (1849), acorns contain starch, fixed oil, citric acid, uncrystallizable sugar, and another sugar which Dessaigne (1851) named *quercit*, $C_6H_{12}O_5$.

Off. Prep.—Decoctum quercûs, *Br.*

Medical Action and Uses.—In ancient times oak-bark was used in the treatment of *hæmoptysis* and *dysentery*, and pessaries made of the bruised bark were employed to restrain *uterine hemorrhage*. The crushed leaves were applied to strengthen relaxed parts. In modern times it has been resorted to for the same purposes, and also to cure *bronchial flux*. It has been maintained that persons who work in tan-pits are never attacked with *intermittent fever*, and that they enjoy a like immunity from *phthisis*. Externally, the decoction, which is officinal, has been applied to all the purposes of vegetable astringents; indeed, oak-bark is rarely used except in the form of decoction. Cases are reported in which vaginal injections of a decoction of oak-bark were followed by symptoms of peritonitis (*Boston Med. and Surg. Jour.*, Oct. 1879, p. 523). *Suberin*, above referred to, is used as a dressing for *chapped nipples* and similar lesions in the same manner as lycopodium, to which it is preferable on account of its astringency. In many parts of England grated acorns are in common use by the rustic population as a medicine for diarrhœa. This custom, which is a survival of ancient medicine, also prevails in various parts of France. Roasted acorns are likewise used for this purpose, as well as in the treatment of flatulent dyspepsia and of scrofula.

QUILLAIA, *U. S.*—Quillaia-Bark.

Soap-bark, E.; *Écorce de quillaya*, Fr.; *Seifenrinde*, G.

The inner bark of Quillaia Saponaria, *Molina*.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The tree yielding quillaia-bark is indigenous to Peru and Chili, and has evergreen, leathery, entire leaves, and small umbels of four diœcious flowers, producing five many-seeded capsules.

Description.—The bark comes in flat pieces, sometimes 2 or 3 feet (60–90 Cm.) long, several inches wide, and about ¼ inch (6 Mm.) thick. The thick brown corky layer is usually removed, small patches of it merely adhering to the outer surface, which is otherwise nearly smooth and pale-brownish white, like the inner surface. The bark is hard and tough, breaks with a splintery fracture, and shows upon transverse section a checkered appearance, due to the tangential arrangement of the light-brown bast-fibres and white bast-parenchyma, and to the white narrow radial lines of the medullary rays. The bark has no odor, but its dust is acrid and sternutatory; it has a persistent acrid taste and its infusion foams like a solution of soap.

Constituents.—Quillaia-bark contains numerous minute crystals of sulphate of calcium, a small quantity of starch, and considerable *saponin*. The latter principle was isolated from quillaia-bark by Le Bœuff (1850), and may be obtained by displacing the powder with hot alcohol and allowing the tincture to cool. The cold tincture retains some saponin in solution, together with resinous and oily matters, and, when evaporated and agitated with water yields a permanent emulsion. In its pure state saponin is a white amorphous powder which causes sneezing, is nearly inodorous, has a sweetish afterward acrid taste, is soluble in 4 parts of water, more soluble in weak than in strong alcohol, and insoluble in ether and volatile oils. Its aqueous solution is precipitated by baryta-water, the precipitate being soluble in pure water, but not in baryta-water (Rochleder). It has the composition $C_{32}H_{54}O_{18}$, and when treated with acids yields a saccharine body and a series of decomposition-products, the final one being *sapogenin*, $C_{14}H_{22}O_2$, a sparingly soluble, white crystalline compound. (See also SAPONARIA.)

Pharmaceutical Uses.—TINCTURE QUILLAIÆ is made by exhausting 1 part of the bark with sufficient alcohol to obtain 5 parts of tincture. 1 part of it will emulsionize from 1 to 3 parts of volatile oil or oleoresin and 8 or 10 parts of fixed oil.

EXTRACTUM QUILLAIÆ, also called *quillain*. Prepared with hot water, S. A. McDonnell obtained 20 to 25 per cent. of a brown not hygroscopic extract, of which 1 grain dissolved in 1 oz. of water will yield a tolerably permanent emulsion with 1 oz. of fixed oil or 1 drachm of oleoresin.

Medical Action and Uses.—Soap-bark owes its name and the property of causing water in which it is macerated to froth to the presence of saponin. Whether it possesses any of the virtues of other plants containing this principle (senega, saponaria) does not clearly appear. It has, however, been used with alleged advantage in *dropsy* and in chronic *bronchitis*, and is reported to be a sternutatory and useful in *coryza*, and also as a febrifuge. It may be administered in an infusion made with an ounce of the bark and a pint of water (Gm. 32 in Gm. 500), to be taken during a day. The dry aqueous extract dissolves readily in water, and such a solution may be employed for making emulsions of castor, cod-liver, and other oils. The external uses of the bark appear to be the most important. It may be used instead of soap for washing the hairy scalp and other parts of the skin affected with *eruptions*, *ulcers*, etc., for removing the greasy coating which some skins exude, and for correcting the fetor which the feet, armpits, etc. in other persons exhale. For the latter purposes a saturated tincture may be added to water until it acquires the proper saponaceous quality. The tincture has also been used to promote the renewal of the hair in alopecia (*Phila. Med. Times*, xi. 29).

QUINIDINÆ SULPHAS, *U. S.*—SULPHATE OF QUINIDINE.

Chinidinum (Conchininum) sulfuricum.—*Sulphate of conquinine*, E.; *Sulfate de quinidine*, Fr.; *Schwefelsaures Chinidin*, *Conchininsulfat*, G.

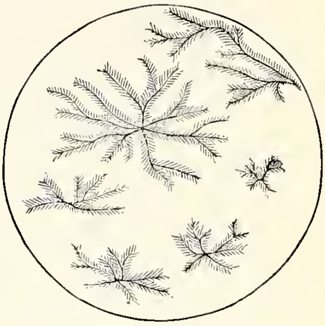
Formula $(C_{20}H_{24}N_2O_2)H_2SO_4.2H_2O$. Molecular weight 782.

Preparation.—The mother-liquors from the recrystallization of sulphate of quinine yield on concentration a crop of crystals consisting chiefly of this salt, which is purified by treatment with animal charcoal and by recrystallizing it. On adding to the mother-liquors a considerable excess of ammonia, cinchonine will be precipitated and quinidine dissolved; the solution deposits the alkaloid quinidine, together with impurities, on the addition of soda. The alkaloid may then be dissolved in dilute sulphuric acid, and the salt purified by recrystallization. Since quinidine enters the mother-liquors containing the amorphous alkaloids, and is precipitated with chinoidine, it may be prepared from the latter, according to Hesse (1868), by exhausting it with ether, converting the dissolved alkaloids into sulphates, precipitating quinine and cinchonidine with Rochelle salt, purifying the filtrate with animal charcoal, and precipitating the quinidine with potassium iodide;

the alkaloid is then liberated by ammonia, combined with sulphuric acid, and the salt crystallized.

Properties.—Sulphate of quinidine (or of *conquinine*, according to Hesse) crystallizes in white, silky needles which resemble those of the quinine salt, but are less matted and do not effloresce on exposure even when heated to 80°C. (176° F.); when heated to 120° C. (248° F.) they part with their water of crystallization (4.6 per cent.). The solution in dilute sulphuric acid shows the blue fluorescence of quinine solutions and strikes an emerald-green color on the successive addition of chlorine-water and ammonia, and a red color on the successive addition of chlorine-water, potassium ferrocyanide, and ammonia. The salt has also, like the corresponding quinine salt, a very bitter taste and a neutral reaction. It dissolves at 10° C. (50° F.) in 108 parts (Hesse), at 15° C. (59° F.) in 98 parts (Kerner), and at the boiling-point in 7 parts of water; also in 8 parts of alcohol at 15° C. (*U. S.*), and when anhydrous in 105 parts of chloroform. The salt is freely soluble in hot alcohol, but is nearly insoluble in ether. The chloroform solution on evaporation leaves the salt in an amorphous state, and on exposure to diffused daylight gradually acquires a green color, but the alkaloid is not perceptibly affected thereby (Hesse, 1879). The aqueous solution yields with barium chloride a white precipitate which is insoluble in hydrochloric acid; with ammonia, a white precipitate, soluble in a large excess of ammonia and in thirty times its weight of ether; with potassium ferrocyanide, golden-yellow prisms or a yellow crystalline precipitate; and with potassium iodide from neutral solution, a white, and from acid solution a reddish-yellow, crystalline precipitate. When a drop of the solution is mixed with a drop of solution of potassium sulphocyanide, the microscope reveals groups of radiating feathery crystals; this sulphocyanide of quinidine requires 1477 parts of water for solution. (For the characteristics of the alkaloid see page 466).

Fig. 232.



Quinidine sulphate with KSCy: microscopic crystals.

Tests.—When heated on platinum-foil the salt should burn without leaving any residue. Neither sulphuric nor nitric acid should impart any color to the dry salt. De Vrij (1878) advises testing this salt as follows: 1 Gm. of it is dissolved in 50 Gm. of hot water, and 0.5 Gm. potassium iodide added; a sandy crystalline precipitate must fall, and after some hours the mother-liquor, on being tested with ammonia, should not produce an appreciable precipitate. This test has been formulated as follows: "If 0.5 Gm. each of sulphate of quinidine and of iodide of potassium (not alkaline to test-paper) be agitated with 10 Ccm. of water at about 60 C. (140° F.), the mixture then macerated at 15 C. (59° F.) for half an hour, with frequent stirring, and filtered, the addition to the filtrate of a drop or two of water of ammonia should not cause more than a slight turbidity (absence of more than small proportions of cinchonine, cinchonidine, or quinine)."—*U. S.*

Allied Salts.—Quinidinæ bisulphas, Acid sulphate of quinidine, $C_{20}H_{24}N_2O_2.H_2SO_4.4H_2O$; mol. weight 494. It is obtained by dissolving the sulphate in sufficient diluted sulphuric acid, and evaporating. It forms long colorless prisms of an asbestos-like appearance, soluble in 8.7 parts of water at 10° C. (50° F.) and losing 14.57 per cent. of water at 120° C. (248° F.).

Quinidinæ hydriodas, $C_{20}H_{24}N_2O_2HI$. It is obtained by double decomposition of neutral solutions of quinidine sulphate and potassium iodide as a white crystalline powder, or from warm and somewhat diluted solutions in colorless scaly prisms. It is slightly soluble in alcohol and in hot water, and requires at 10° C. (50° F.) 1270 parts, and at 15° C. (59° F.) 1250 parts, of water for solution. The salt is anhydrous and contains 28.09 per cent. of iodine.

Quinidinæ bihydriodas, $C_{20}H_{24}N_2O_2(HI)_2.3H_2O$. It is prepared like the preceding salt, using, however, a warm acidulated solution of quinidine sulphate. It forms an orange-colored crystalline powder or glossy golden-yellow prisms, turns brown-yellow at 120° C. (248° F.) from loss of water, which is absorbed again on exposure to moist air, and is soluble in 90 parts of cold water, and more freely soluble in alcohol and in hot water. The salt contains 8.5 per cent of water and 43.77 per cent. of iodine.

Medical Action and Uses.—As an anti-periodic in *malarial affections*, and as an anti-pyretic in *fever* generally, sulphate of quinidine is equal to sulphate of quinine, and may be used in similar doses. It has been thought less apt to disagree with the stomach and to cause unpleasant nervous symptoms (Peacock); on the other hand, "the greatest drawback to its use, especially with typhoid patients, is the subsequent vomiting which often occurs" (Strümpell, *Practitioner*, xxiii. 128).

QUININA, *U. S.*—QUININE.

Chininum.—*Quinine*, Fr.; *Chinin*, G.
Formula $C_{20}H_{24}N_2O_2.3H_2O$. Molecular weight 378.

An alkaloid prepared from different species of Cinchona and Remijia.

Preparation.—On precipitating a solution of quinine sulphate in acidulated water with an alkali, a curdy, amorphous, white precipitate is obtained, consisting of the anhydrous alkaloid, which if kept under the liquid is gradually changed to the crystalline hydrate of the above formula. It requires to be washed with distilled water and dried at a low temperature. The same hydrate may also be obtained from the solution of the alkaloid in diluted alcohol by crystallizing at a low temperature, while at 30° C. (86° F.) silky needles of anhydrous quinine are separated (Hesse). On concentrating a solution of quinine in ammonia-water the hydrate crystallizes. The precipitation of quinine should be effected without heat, and only a slight excess of ammonia should be used to prevent loss of the alkaloid.

Properties.—Hydrate of quinine forms long, colorless, silky needles, or more frequently a white crystalline powder; the Pharmacopœia describes it also as flaky and amorphous. In dry air the crystals become opaque, and when kept over sulphuric acid it readily parts with $2H_2O$ (9.5 per cent.), but very slowly with the remaining 4.8 per cent. of water of crystallization. The alkaloid, like its salts, is inodorous, and has a persistently bitter taste, which, owing to its sparing solubility, is slowly developed. The powder and its solutions in water and alcohol have an alkaline reaction. The hydrate melts at a temperature of 57° C. (134.6° F.); on continuing and slowly increasing the heat it loses its water of crystallization, then becomes solid, melts again at 176° C. (347.4° F.), and at a higher heat burns slowly, without leaving any residue. Anhydrous quinine requires at 15° C. (59° F.) 1960 parts of water for solution, but the hydrate dissolves at 15° C. in 1670 parts (Hesse), at 20° C. (68° F.) in 1428 parts, and at the boiling-point in 773 parts, of water (Sestini); these solutions on being evaporated between 60° and 80° C. (140° and 176° F.) separate the hydrate in the form of oily drops. According to Regnauld, quinine is soluble at 15° C. (59° F.) in 1.134 parts of absolute alcohol, in 1.93 parts of chloroform, and in 22.63 parts (16 to 25.5 parts, Hesse) of ether. It is soluble in 6 parts of alcohol, in about 200 parts of glycerin, and in 2 parts of boiling alcohol (*U. S. P.*); dissolves freely in carbon disulphide, more sparingly in fixed and volatile oils; also in benzin and in benzol; the latter solution leaves on spontaneous evaporation a crystalline compound of quinine and benzol, which is decomposed at a moderate heat. The solutions turn polarized light to the left.

Quinine is a strong base, neutralizes the strongest acids, forming crystallizable salts which, if soluble, have an intensely bitter taste, and displaces ammonia from its salts on being heated with their solutions. The acidulated solutions show a vivid blue fluorescence, which disappears on the addition of hydrochloric, hydriodic, and sulphocyanic acids and of hyposulphites. On passing chlorine gas into water containing quinine in suspension, the liquid acquires a reddish color, changing to violet and dark-red, and then becomes lighter, with the separation of a red compound (Pelletier). But if the acid solution is mixed first with sufficient chlorine-water (or bromine-water), and then with an excess of ammonia, the solution becomes emerald-green from the production of *thalleioquin* or *thalleiochin* (Brandes), the color being observable in a solution containing $\frac{1}{5000}$ part of quinine; on carefully neutralizing the liquid the color changes to blue, and with an excess of acid to purplish or red; the addition of an excess of ammonia restores the green color. If to the quinine solution be added chlorine-water, then potassium ferrocyanide, and finally ammonia, a deep-red color is produced.

Quinine heated with glycerin to about 190° C. (374° F.) is converted into the isomeric base *quinicine*, which was discovered by Pasteur (1853), and may be obtained from most acid quinine salts by heating them to about 130° C. (266° F.); the salts of this base are readily crystallizable, are colored green by chlorine-water and ammonia, and yield with hypochlorites white precipitates which are turned green by ammonia.

Tests.—For the detection of other cinchona alkaloids the Pharmacopœia has adopted Kerner's test. (See QUININÆ SULPHAS.) "Quinine should afford no color, or none darker than a pale-yellow, with undiluted sulphuric acid (absence of foreign organic matters), nor should it be reddened by nitric acid (difference from morphine). If 1 Gm of quinine be mixed in a mortar with 0.5 Gm. of sulphate of ammonium and 5 Ccm. of distilled water, the mixture thoroughly dried on the water-bath, the residue (which should be neutral to test-paper) agitated with 10 Ccm. of distilled water, this mixture macerated at 15° C. (59° F.) for half an hour, then filtered through a small filter, 5 Ccm. of the filtrate taken in a test-tube, and 7 Ccm. of water of ammonia (sp. gr. 0.960) then added, on closing the test-tube with the finger and gently turning it until the ammonia is fully intermixed, a clear liquid should be obtained. If the temperature of maceration has been 16° C. (60.8 F.), 7.5 Ccm. of the water of ammonia may be added; if 17° C. (62.6° F.), 8 Ccm. may be added. In each instance a clear liquid indicates the absence of more than about 1 per cent. of cinchonidine and quinidine, and of more than traces of cinchonine."—*U. S.*

Off. Prep.—Ferri et quininæ citras, Liquor Ferri et quininæ citratis, Syrupus ferri, Quininæ et strychninæ phosphatum, *U. S.*

QUININÆ BISULPHAS, *U. S.*—BISULPHATE OF QUININE.

Chininum bisulfuricum, P. G.; *Quininæ sulphas acidus.*—*Acid sulphate of quinine*, E.; *Sulfate acide (Bisulfate) de quinine*, Fr.; *Saures Chininsulfat*, *Chininbisulfat*, G.

Formula $C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$. Molecular weight 548.

Preparation.—Mix 100 grains of ordinary quinine sulphate with about 500 grains (9 fluidrachms) of warm distilled water; add to the mixture 115 grains of officinal diluted sulphuric acid; filter if necessary, and set aside in a moderately warm place to crystallize; dry the crystals over sulphuric acid at a temperature of 10° or 15° C. (50°–59° F.), and preserve them in a well-stopped bottle in a cool and dark place. The yield is 125 grains.

A solution of the salt may be prepared extemporaneously by dissolving 8 grains of quinine sulphate in water with the aid of 9 minims (or 9½ grains) of diluted sulphuric acid; the solution will contain 10 grains of the acid sulphate of quinine.

Properties.—The salt crystallizes in colorless rhombic prisms or plates, or it forms small needles which on exposure to light become yellowish, are free from odor, and have a strong bitter taste and a decided acid reaction. At 25° C. (77° F.) it loses water, the crystals becoming opaque; but the last molecule of water is not expelled until heated to about 100° C. (212° F.). The salt fuses in a glass tube at 80° C. (176° F.) (*P. G.*), but heated in the air it melts near 135° C. (275° F.), and is converted into acid *quinicine sulphate*, which is easily soluble in alcohol and water, and crystallizes in long yellow prisms. According to Hesse (1873), acid sulphate of quinine dissolves at 13° C. (55.4° F.) in 11 parts, and at 22° C. (71.6° F.) in 8 parts, of water, but it requires more alcohol (32 parts *U. S.*, *P. G.*) for solution, and is very soluble in both liquids heated to boiling. The solutions have a decided blue fluoresence, which may be observed in water containing $\frac{1}{100000}$ part of the salt. The aqueous solution becomes emerald-green on the addition of chlorine-water and ammonia, and behaves to ammonia-water and barium chloride like sulphate of quinine, giving white precipitates with both reagents, of which the former is easily soluble in excess of ammonia and in ether, and the latter is insoluble in hydrochloric acid.

This pharmacopœial salt should not be confounded with the true *bisulphate of quinine*, $C_{20}H_{24}N_2O_2(H_2SO_4)_2.7H_2O$, which is obtained from 100 grains of quinine sulphate and 350 grains of diluted sulphuric acid, the solution being crystallized over sulphuric acid. It contains 19.5 per cent. of water, readily acquires a brown-red color on exposure to light, is easily soluble in water with a strong blue fluorescence, and separates from boiling alcohol on cooling as a gelatinous mass, which on drying forms minute prisms.

Tests.—The salt should not be (or at most but very slightly, *U. S.*) colored by sulphuric acid (absence of sugar, salicin, etc.), nor by nitric acid (morphine, brucine, etc.). 1 Gm. of the salt dried at 100° C. should leave a residue weighing 0.77 Gm. (absence of water and of other quinine sulphates, the latter leaving 80 and 85 per cent. of residue).—*U. S.*, *P. G.* The aqueous solution should not be precipitated by silver nitrate (absence of hydrochlorate). The absence of an excess of other cinchona alkaloids is determined by Kerner's test, as follows: "If 1 Gm. of the salt, previously dried at 100° C. (212° F.), be agitated with 8 Ccm. of distilled water, the mixture made exactly neutral to test-paper by the cautious addition of water of ammonia, then increased by the addition of distilled water to 10 Ccm., and macerated at 15° C. (59° F.) for half an hour, upon proceeding further, as directed for the corresponding test under quinine (see QUININA), the results given for the latter should be obtained."—*U. S.* Or, "an intimate mixture of 1 Gm. of the salt and of 0.5 Gm. of ammonia-water is well dried in a water-bath, the residue treated with 10 Ccm. of distilled water and further tested with ammonia-water, as directed for Kerner's test."—*P. G.*

Medical Action and Uses.—When sulphate of quinine is given in solution, it is generally converted into the bisulphate by the addition of aromatic sulphuric acid. The *dose* of the two salts is practically the same.

QUININÆ HYDROBROMAS, *U. S.*—HYDROBROMATE OF QUININE.

Chininum hydrobromicum, s. hydrobromatum.—Bromhydrate de quinine, Fr.; *Chininhydrobromat*, G.

Formula $C_{20}H_{24}N_2O_2HBr.2H_2O$. Molecular weight 440.9.

Preparation.—This salt is prepared by double decomposition of quinine sulphate with barium bromide. A mixture of 100 grains of quinine sulphate and 1400 grains (3 fluidounces) of water is heated to boiling, and gradually mixed with a solution of 34 grains of barium bromide in 225 grains (½ fluidounce) of water; the precipitate is allowed to settle, and the clear hot liquid is tested for barium salt with a cold solution of quinine sulphate prepared without the aid of additional acid, and if free from barium is filtered and evaporated to crystallize. The yield is about 100 grains. Owing to the insolubility of barium chloride and the ready solubility of barium bromide in absolute alcohol, Boille (1874) recommends dissolving both the barium and the quinine salts in strong alcohol; the solutions are then mixed, taking care that the quinine sulphate is in slight excess; after filtering water is added, the alcohol distilled off, the liquid cooled, filtered from any quinine sulphate which may crystallize out, and evaporated to crystallize. If the salt be not quite white it should be recrystallized from water.

The salt may also be prepared by dissolving quinine in warm diluted hydrobromic acid until the acid reaction has completely disappeared. Or, according to Hager, 100 parts of quinine sulphate and 27.5 parts of potassium bromide are well triturated with 100 parts of water; the mixture is moderately heated, mixed with 400 parts of alcohol, the whole digested for an hour, filtered while warm from the precipitated potassium sulphate, and crystallized. Leger's process (1880) is similar to this.

Properties.—Quinine hydrobromate is in "colorless, lustrous needles, permanent in ordinary air, but readily efflorescing with a gentle heat, odorless, having a very bitter taste and a neutral or slightly alkaline reaction; soluble in about 16 parts of water and in 3 parts of alcohol at 15° C. (59° F.), in 1 part of boiling water, and in less than 1 part of boiling alcohol, in 6 parts of ether, in 12 parts of chloroform, and moderately soluble in glycerin. On ignition the salt burns slowly without leaving a residue. The aqueous solution, when acidulated with sulphuric acid, has a blue fluorescence, and when treated first with fresh chlorine-water and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution throws down a white precipitate easily soluble in an excess of water of ammonia, as well as in ether. Test solution of nitrate of silver produces a white precipitate which is insoluble in diluted nitric acid, and when filtered off and washed insoluble in solution of carbonate of ammonium. The aqueous solution, unless very much diluted, is precipitated by solutions of (neutral) sulphates."—*U. S.*

Composition.—The U. S. Pharmacopœia has adopted the formula of Hager, which requires 8.19 water, 18.10 bromine, and 73.49 per cent. of quinine. Boille (1874), however, found of these constituents respectively 4.80, 18.26, and 75.20 per cent., which closely corresponds with the formula $C_{20}H_{24}N_2O_2HBr.H_2O$.

Tests.—"The salt should not be colored, or at most but very slightly colored, by undiluted sulphuric acid (absence of foreign organic matters), nor be reddened by nitric acid (difference from morphine). If a small portion of the salt be dried on the water-bath until it ceases to lose weight, and the residue cooled in a desiccator, the loss of weight should not exceed 8.2 per cent. The aqueous solution should not be rendered turbid by diluted sulphuric acid (absence of barium), and not more than slightly turbid by test solution of chloride of barium (limit of sulphate). If 1.5 Gm. of the salt be dissolved in 15 Ccm. of hot distilled water, the solution stirred with 0.6 Gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour, and then drained through a filter only large enough to contain it until 5 Ccm. of filtrate are obtained, upon treating this liquid as directed for the corresponding test under quinine (see QUININA) the results given for the latter should be obtained."—*U. S.* The filtrate obtained in the last test is a solution of quinine sulphate saturated at 15° C., and should at the same temperature yield a clear liquid on being mixed with 7 Ccm. of ammonia-water.

Allied Salts.—Quininæ hydrobromas acidus, Acid hydrobromate of quinine, $C_{20}H_{24}N_2O_2(HBr)_2.3H_2O$. Quinine sulphate is dissolved in water with the aid of sufficient dilute sulphuric acid, completely precipitated with a solution of a barium bromide, avoiding an excess of the latter, the solution filtered from the barium sulphate, and evaporated to crystallize. This salt is soluble in 6 parts of water and is freely soluble in alcohol.

Quininæ bromas, Bromate of quinine, $C_{20}H_{24}N_2O_2.HBrO_3$, is prepared by C. A. Cameron (1882) either by neutralizing quinine with bromic acid or by precipitating barium bromate with quinine sulphate. It forms asbestos-like masses consisting of long needles, dissolves in 250 parts of cold water, freely in warm water, in diluted acids, and in alcohol; it is not decomposed at a moderate heat, but detonates in contact with strong sulphuric acid.

Medical Action and Uses.—The officinal position of this salt is not justified by the small proportion of hydrobromic acid contained in an average dose of it. It was proposed by Gubler for hypodermic use on account of its solubility, its freedom from irritating qualities, and its richness in quinine. It does not appear, however, to have been extensively used. Its *dose* is about the same as that of the sulphate.

QUININÆ HYDROCHLORAS, *U. S., Br.*—Hydrobromate of Quinine.

Chininum hydrochloricum, P. G.—*Muriate of quinine*, E.; *Chlorhydrate de quinine*, Fr.; *Chininhydrochlorat*, *Salzsaures Chinin*, G.

Formula $C_{20}H_{24}N_2O_2HCl.2H_2O$. Molecular weight 396.4.

Preparation.—This salt is best obtained by dissolving quinine in warm diluted hydrochloric acid until the solution is neutral, and crystallizing. On a small scale it may be prepared by double decomposition. A solution of 100 grains of quinine sulphate in hot distilled water is precipitated by a solution of 28 grains of crystallized barium chloride or of 15 grains of anhydrous calcium chloride; the filtrate is tested with quinine sulphate, evaporated to dryness, redissolved in diluted alcohol to separate calcium sulphate, and evaporated to crystallize. Rother (1883) recommends for the same amount of sulphate 13½ grains of sodium chloride and 350 grains (7½ fluidrachms) of alcohol; after sufficient digestion the filtrate is mixed with water and evaporated. The yield is 90 grains.

Properties.—Quinine hydrochlorate forms colorless needles, appearing white in mass, usually united to stellate groups, of a silky lustre, inodorous, and having a very bitter taste and a neutral (or faintly alkaline, *U. S.*) reaction. The salt is permanent in the air at low temperatures, but at a moderate heat effloresces, parting with a portion of its water, and at 100° C. (212° F.) loses all the water of crystallization, amounting to 9.08 per cent. The crystallized salt requires at 10° C. (50° F.) 35 parts of water (Hesse), at 15° C. (59° F.) 34 parts of water or 3 parts of alcohol (*U. S., P. G.*), for solution, and is very freely soluble in boiling water and in boiling alcohol. The anhydrous salt forms a permanent solution with 1 part of chloroform, and differs in this respect from the concentrated solutions of the hydrochlorates of cinchonine and cinchonidine, which after a short time become thick and crystalline, owing to the formation of more sparingly soluble compounds of the salts with the solvent (Hesse, 1873). The solution in alcohol or water is free from fluorescence, and the slight one appearing on dilution is removed by the addition of sulphuric or other acids. The hydrochlorate being much more soluble in water than sulphate of quinine, the latter salt is precipitated in needles on adding to a rather concentrated solution of the former a solution of a neutral sulphate. Quinine hydrochlorate on being exposed to the light gradually acquires a yellowish color, and should therefore be kept in a dark place. Its solution likewise becomes yellowish or brownish on keeping; with chlorine-water and ammonia it yields emerald-green thalleioquin; with ammonia a white precipitate is produced, soluble in an excess of ammonia and in ether; and with silver nitrate a white precipitate is obtained soluble in ammonia, but insoluble in nitric acid.

Tests.—The salt on being ignited upon platinum-foil should burn without leaving any residue (absence of inorganic matter). Heated with milk of lime or with dilute potassa solution, the odor of ammonia should not be given off (ammonium salts). Treated with strong sulphuric acid, the salt should at most be colored yellowish (absence of salicin, sugar, etc.). "With concentrated nitric acid it should not be colored red (morphine). 1 Gm. of the salt, heated in a water-bath to 100° C. until it ceases to lose weight, should leave a residue weighing .91 Gm. (difference = water of crystallization). The solution of the salt in (100 parts, *P. G.*) water should not become turbid by dilute sulphuric acid (absence of barium), nor more than slightly turbid with barium chloride (limit of sulphate)."—*U. S.*, *P. G.* "If 2 Gm. of the salt, 1 Gm. of sodium sulphate, and 20 Gm. of water be evaporated to dryness, the residue boiled with 12 Gm. of alcohol, and the filtrate evaporated, the resulting quinine sulphate should respond to the tests for this salt."—*P. G.* For the application of Kerner's test this process can be shortened as proposed by Hager and directed as follows: "If 1.5 Gm. be dissolved in 15 Ccm. of hot distilled water, the solution stirred with 0.75 Gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour, and then drained through a filter only large enough to contain it until 5 Ccm. of filtrate are obtained, upon treating this liquid as directed for the corresponding test under quinine (see QUININA), the results given for the latter should be obtained."—*U. S.*

Allied Salts.—QUININÆ HYDROCHLORAS ACIDUS, Acid hydrochlorate of quinine, is either amorphous or in white or yellowish crystalline masses, which are very soluble in water and readily darkened by light.

QUININÆ IODAS, Iodate of quinine, $C_{20}H_{24}N_2O_2.HIO_3$, according to C. A. Cameron (1882), is best prepared by digesting freshly-precipitated quinine in a molecule of iodic acid previously dissolved in 10 parts of warm water; the soft mass should be evaporated at 15.5° C. (60° F.) and dried over sulphuric acid. The salt is in minute white pearly needles, is readily soluble in alcohol, soluble in 700 parts of cold water, and is not decomposed by boiling water.

QUININÆ HYDRIODAS, Acid hydriodate of quinine, $C_{20}H_{24}N_2O_2(HI)_2.5H_2O$. This salt crystallizes from a warm acidulated solution of quinine on the addition of potassium iodide. It forms glossy transparent prisms or scales, becomes opaque at 30° C. (86° F.), melts at 100° C. (212° F.) in its water of crystallization, and becomes completely anhydrous at 120° C. (248° F.): when exposed to a damp atmosphere the anhydrous salt combines again with $2H_2O$ (Hesse, 1865).

Medical Action and Uses.—Hydrochlorate of quinine was early made officinal by the Dublin Pharmacopœia, and Neligan (1854) remarked of it, "It is preferred by many practitioners to the disulphate, but is much more expensive, and the dose is the same." In 1855, Briquet, in his great work on *Cinchona*, said of it, "Being very liable to change by keeping, it cannot be depended upon, so that with good reason it is entirely disused." In the same year Trousseau and Pidoux mentioned the muriate along with several other salts as being inferior to the sulphates. In 1857, Pereira's *Materia Medica* said of it only that "it is employed in the preparation of the valerianate of quinine." In 1864, Guibert merely stated that "German physicians set great store by this medicine;" and one of the latest German writers, Bernatzik, says of it that its uses are those of the sulphate of quinine, but refers to its solubility and the relatively large proportion of quinine it contains. According to this authority, the dose should be one-sixth less than that of the sulphate, 100 parts by weight of muriate of quinine containing as much quinine as 121 parts of the sulphate. Binz refers to pure amorphous hydrochlorate of quinine as being especially adapted for subcutaneous injection, its advantages being not only that it is "very cheap," but that it dissolves in an equal weight of water, and as a rule does not give rise to abscesses. Probably it was for use in hypodermic injections that the salt was made officinal. From 2 to 4 grains (Gm. 0.12–0.24) may be stated as the average dose administered in this manner.

QUININÆ SULPHAS, *U. S., Br.*—SULPHATE OF QUININE.

Quiniæ sulphas, U. S. 1870, Br.; *Chininum sulfuricum*, P. G.; *Sulfas quinicus.—Sulphate of quinia*, E.; *Sulfate de quinine*, F.; *Chininsulfat, Schwefelsaures Chinin*, G.

Formula $(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$. Molecular weight 872.

Preparation.—Take of Yellow Cinchona-Bark, in coarse powder, 1 pound; Hydrochloric Acid, 3 fluidounces; Distilled Water a sufficiency; Solution of Soda 4 pints; Diluted Sulphuric Acid a sufficiency. Dilute the hydrochloric acid with 10 pints of the water. Place the cinchona-bark in a porcelain basin, and add to it as much of the diluted hydrochloric acid as will render it thoroughly moist. After maceration with occasional stirring for 24 hours place the bark in a displacement apparatus, and percolate with the diluted hydrochloric acid until the solution which drops through is nearly destitute of bitter taste. Into this liquid pour the solution of soda, agitate well, let the precipitate completely subside, decant the supernatant fluid, collect the precipitate on a filter, and wash it with cold distilled water until the washings cease to have color. Transfer the precipitate to a porcelain dish containing a pint of distilled water, and, applying to this the heat of a water-bath, gradually add diluted sulphuric acid until very nearly the whole of the precipitate has been dissolved and a neutral liquid has been obtained.

Filter the solution while hot through paper, wash the filter with boiling distilled water, concentrate till a film forms on the surface of the solution, and set it aside to crystallize. The crystals should be dried on filtering-paper without the application of heat.—*Br.* 1867.

The preparation of sulphate of quinine from cinchona-bark involves the following processes: 1, extraction of the alkaloids in the form of a compound soluble in cold water; 2, precipitation of the alkaloids; and, 3, combination with sulphuric acid and separation of the various sulphates from one another and from coloring matter and other foreign principles. The alkaloids are easily extracted from the bark by water acidulated with hydrochloric or sulphuric acid, and are then in solution as hydrochlorates or sulphates. If an elevated temperature has been resorted to, derivatives of tannin and other principles will separate on cooling, and must either be filtered off or converted into insoluble compounds, which takes place on the addition of lime; this decomposes likewise the salts of the alkaloids, chloride or sulphate of calcium being formed, while the alkaloids are precipitated, together with the excess of lime employed, and the kinic acid remains in solution as kinate of calcium. The alkaloids are taken up from the lime precipitate by boiling alcohol, and left behind in an impure condition on the evaporation of the solvent. Soda cannot be profitably employed for precipitating the acid decoction unless it has been allowed to cool and filtered from the precipitate; or, still better, the bark is exhausted in the cold and the acid infusion rendered very slightly alkaline by caustic soda. The precipitate thus obtained will be less deeply colored than the residue left on the evaporation of the alcohol, as described before, and consists mainly of the mixed cinchona alkaloids. As obtained by one or the other process, the impure alkaloids are mixed with water, heat is applied, and sulphuric acid is dropped in, care being taken to leave a portion of the alkaloids and much coloring matter undissolved, which are removed by filtration; the hot filtrate may be treated with purified animal charcoal to remove remaining coloring matter, or even without this treatment will deposit crystals of the desired salt. If, however, sufficient sulphuric acid has been used to dissolve the whole of the impure alkaloids, the excess of the former has formed freely soluble sulphates, which would not crystallize on cooling. It is then necessary to remove not only coloring matter, but likewise the excess of sulphuric acid, which is accomplished by treatment with unpurified animal charcoal, the calcareous matter of which combines with the excess of the sulphuric acid, and on cooling the filtrate the same sulphate will crystallize that is obtained by the action of an insufficient quantity of the acid upon an excess of the impure alkaloids. The crystals of the first crop are neither sufficiently white nor free from other cinchona alkaloids, and require to be purified by three or four recrystallizations, when the sulphate of quinine, being the least soluble of the corresponding salts of the cinchona alkaloids, will crystallize first, leaving the coloring matter in the mother-liquor with the remaining alkaloids.

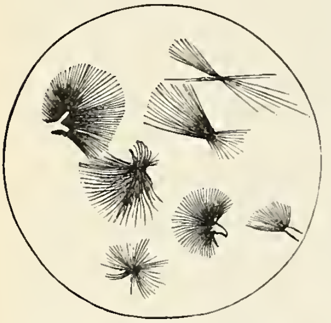
Numerous modifications of the processes described have been proposed, and are probably used by the manufacturers of cinchona alkaloids; and since it is often more economical, in the manufacture of quinine, not to use a costly bark rich in this alkaloid, but rather a cheaper one containing a smaller percentage of quinine, and in addition thereto a larger proportion of the other alkaloids, it is obvious that modifications of the processes will not unfrequently be found necessary. Of late years the so-called cuprea-bark (see page 462) has been extensively employed.

Instead of exhausting the bark with acidulated water, the natural combination of the alkaloids is sometimes broken up by a base, for which purpose ammonia, soda, and lime have been proposed. The two former remove tannin, kinic acid, cinchona-red, and other colored compounds, but at the same time dissolve a portion of quinine and the other alkaloids. By digesting the bark with lime-water some of the principles mentioned are dissolved, and the liquid may be utilized for preparing kinic acid; or milk of lime may be mixed with the powdered bark, and the mixture digested for some time, dried, and powdered. It contains then the calcium compounds of kinic acid, etc., which are nearly insoluble in strong alcohol and methylic and amylic alcohol, either of which solvents may be used in extracting the liberated alkaloids, which are then converted into sulphates and purified as stated above.

Most of the quinine consumed in the United States was formerly manufactured here; in the year 1876–77 the importation amounted to 75,804 ounces, and in 1883 to 1,055,764 ounces.

Properties.—Sulphate of quinine crystallizes in thin, snow-white, flexible, inodorous, monoclinic needles, which form a loose, voluminous, and easily compressible mass, and have a silky lustre or frequently are somewhat opaque in consequence of superficial efflorescence. The salt has a persistent and purely bitter taste, and does not affect moist litmus-paper. A drop of a concentrated solution evaporated on the slide of a microscope crystallizes in stellate groups of thin needles or spikes. It effloresces rapidly on exposure, and when kept over sulphuric acid loses all except 2 molecules of water; the same loss occurs in dry air at a temperature of 25° to 30° C. (77°–86° F.), and more rapidly at the summer temperature. The remaining water, amounting to 4.60 per cent. of the effloresced salt, is expelled at and above 100° C. (212° F.), and rapidly absorbed again in a damp atmosphere at ordinary temperatures. Quinine sulphate should be kept in well-stopped bottles, but when these are occasionally opened loss of water is unavoidable, and the salt becomes correspondingly richer in quinine. In the sunlight it acquires a yellowish color. At 160° C. (320° F.) it becomes phosphorescent on trituration, and at a red heat it is decomposed, and burns slowly without leaving any residue. It requires, according to Van Heijningen, 740 (according to Jobst and Hesse, 788) parts of water for solution at 10° C. (50° F.), and at the boiling temperature about 30 parts. The pharmacopœias state it to be soluble at 15° C. (59° F.) in 740 parts (*U. S.*), 800 parts (*P. G.*), of water and in 65 parts of alcohol (*U. S.*), and at the boiling temperature in about 30 parts (*U. S.*), in 25 parts (*P. G.*) of water, and in 3 parts (*U. S.*), in 6 parts (*P. G.*) of alcohol. It dissolves in 40 parts of glycerin, is insoluble in fixed oils, and is nearly insoluble in ether. When anhydrous it requires 1000 parts of chloroform for solution. Chloride of ammonium, nitrate of potassium, and some other salts increase its solubility in water, while it is less soluble in the presence of sodium sulphate and magnesium sulphate or neutral tartrates. The solubility in water is very materially increased by most acids, owing to the formation of soluble acid salts. The solution in water is not fluorescent, but on the addition of sulphuric acid the characteristic blue fluorescence of quinine salts is observed. On adding to its solution an excess of chlorine-water, followed by ammonia, an emerald-green color is produced; and if, after chlorine-water, ferrocyanide of potassium is added, and then ammonia, the solution turns of a deep-red. (See QUININA.) Dissolved in distilled water, it yields white precipitates with nitrate or chloride of barium and with ammonia, the former precipitate being insoluble in hydrochloric acid, while the latter is easily soluble in an excess of the reagent and in about twenty times its weight of ether. It is likewise precipitated by potassa and soda, their carbonates and bicarbonates, by lime-water, tannin, and the other general reagents for alkaloids, and it is incompatible in solution with acetates, tartrates, and with liquids containing iodine (potassium iodide and ferric salts). Its solution in water or dilute acid remains unchanged when kept in the dark, but exposed to sunlight it turns yellowish and brown. Flückiger (1878) named this brown product *quiniretin*, and found it to be of the same composition as quinine, but destitute of alkaline reaction, and, though soluble in acids, it is not able to neutralize them, and is not precipitated by tannin; it has, however, a bitter and somewhat aromatic taste.

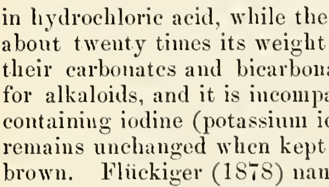
FIG. 233.



Quinine Sulphate: microscopic crystals.

Composition.—The formula of crystallized sulphate of quinine has been given above; it is the one recognized by the pharmacopœias, and represents (in 100 parts) 74.31 anhydrous quinine, 11.24 sulphuric acid and 14.45 water. It is *diquinine sulphate*, but was formerly often described as *neutral* or *basic sulphate of quinine*. On drying the salt completely above 100° C. (212° F.) the residue, cooled in a desiccator, weighs theoretically 85.55 per cent., and is required to weigh not less than 85.6 (*Br.*), 85 (*P. G.*), 83.8 (*U. S.*) parts. The salt crystallizes from water with $8H_2O = 16.18$ per cent., which is the water permitted by the U. S. P., although the formula with $7H_2O$ has been adopted as the correct one. But, according to Kerner (1880), 16 per cent. of water indicates superficially adhering moisture, and, according to Jobst and Hesse, the salt should contain at most $7\frac{1}{2}H_2O$, or 15.3 per cent. After complete efflorescence the formula is $(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O$, and a salt of this composition will crystallize from alcohol in white permanent needles; it contains 82.87 per cent. quinine, 12.53 per cent. H_2SO_4, and 4.6 per cent. water of crystallization.

FIG. 234.



Quinine Sulphate with KSCy: microscopic granules.

Tests.—In examining the purity of sulphate of quinine the following tests are of service: A drop of an aqueous solution of a quinine salt mixed with a drop of a solution of potassium sulphocyanide will at once become turbid, and under the microscope show a large number of minute globules, which even after a day are not aggregated into groups or crystals. According to Hesse (1878), sulphocyanide of quinine is insoluble in solution of potassium sulphocyanide, and more soluble in water than quinine sulphate; the microscopic test must therefore vary with the quantities used; he also observed that the minute globules are usually followed in a few minutes by many-rayed stellate groups of needles. The test proposed by Liebig depends upon the greater solubility of quinine in ether as compared with quinidine, cinchonine, and cinchonidine; modified by Hesse (1878), it is very delicate: 0.5 Gm. of quinine sulphate is well agitated with 10 Ccm. of water warmed to between 50° and 60° C. (122° and 140° F.); after 10 minutes the cooled liquid is filtered and 5 Ccm. of it are slowly agitated with 1 Ccm. (1 Gm., Rump) of ether and 5 drops of ammonia-water; after the separation of the ether both strata should be clear, even after the expiration of 2 hours. The Br. P. directs to recrystallize 100 gr. of the salt from 5 or 6 oz. boiling water with 3 or 4 drops diluted sulphuric acid. Use the mother-liquor for the test just described, and weigh any separated alkaloid, as *cinchonidine* or *cinchonine.* Shake the recrystallized salt with ether 1 fl. oz. and ammonia ¼ oz., and add ethereal liquid from preceding test; now shake with caustic soda (10 per cent.) solution 1 fl. oz., adding water if solid matter separates; wash with ether, heat aqueous liquid to boiling, neutralize exactly with sulphuric acid, and cool, when *cupreine sulphate* will crystallize, resulting from the decomposition of *homoquinine* if present. *Quinidine* is separated as hydriodate from concentrated quinine solution by potassium iodide in the presence of a little alcohol.

Another test proposed by Hesse has been adopted by the German Pharmacopœia, as follows: 1 Gm. of quinine sulphate, on being warmed for a short time to between 40° and 50° C. (104° and 122° F.) with 7 Ccm. of a mixture composed of 2 volumes of chloroform and 1 volume of absolute alcohol, should yield a perfect solution, which should remain clear after cooling. Sulphates of other cinchona alkaloids and various organic and inorganic impurities are thus detected. The following is a similar but less delicate test: "20 Ccm. of absolute alcohol should dissolve 0.2 Gm. of the salt, forming a clear liquid."—*U. S.*

Kerner's test (1862), which depends upon the greater solubility of quinine in ammonia-water than the other cinchona alkaloids, is applied as follows: 2 Gm. of the salt are agitated, and then macerated for half an hour at 15° C. with 20 Ccm. of distilled water; of the filtered solution 5 Ccm. are introduced into a test-tube, and upon the surface of this liquid are carefully poured 7 Ccm. of ammonia-water sp. gr. .960; the test-tube is then closed with the finger and gently agitated, so as to mix the liquids, and the result should be a perfect solution free from any deposit. In order to succeed with this test it is necessary that the temperature and strength of ammonia solution should be strictly adhered to. Since 20 Gm. of water are unable to dissolve 2 Gm. of officinal sulphate of quinine, and since the sulphates of the other alkaloids are more freely soluble in water, it is obvious that the solution prepared as directed does not represent the quinine salt, but contains a much larger proportion of the other sulphates if they are present. Kerner required for 5 Ccm. of pure quinine sulphate 6.8 Ccm., of quinidine sulphate 78 Ccm., and of cinchonidine sulphate 81 Ccm. of ammonia-water sp. gr. .960, while 0.5 Ccm. of the solution of cinchonine sulphate remains turbid after the addition of 150 Ccm. of ammonia-water. A minute quantity of cinchonine present with the quinine sulphate may at first dissolve in the ammonia, but will separate in flakes on standing. This test has been adopted in the manner described by the German Pharmacopœia. The U. S. P. operates with one-half the quantity (1 Gm.) of the quinine salt, and directs it to be previously dried at 100° C.; for which there does not appear to be any necessity. It is macerated with 10 Ccm. of water, and further treated as just described. A valuable addition to the directions is the influence of temperature, as follows: "If the temperature of maceration has been 16° C. (60.8° F.), 7.5 Ccm. of the water of ammonia may be added; if 17° C. (62.6° F.), 8 Ccm. may be added; in each instance a clear liquid indicates the absence of more than about 1 per cent. of cinchonidine or quinidine, and of more than traces of cinchonine."—*U. S.* Kerner has recently (1881) modified his test as follows: The salt (2 Gm.) is well agitated with lukewarm water (20 Gm.); after about 1½ hours the liquid is cooled to exactly 15° C., filtered, and treated as before.

Hydrochlorate of cinchonine resembles sulphate of quinine in appearance, and has been occasionally substituted for it. It is easily detected by the aqueous solution yielding a curdy precipitate with nitrate of silver and a voluminous precipitate with ammonia, which is not dissolved by an excess of the precipitant or on being agitated with ether.

Other fraudulent admixtures or substitutions are recognized as follows: *Mineral impurities* by the fixed residue left on igniting a portion of the salt upon platinum-foil; *ammonia salts* by the ammoniacal odor given off on heating a portion of the salt with dilute potassa solution or milk of lime; *stearic acid, starch, cotton fibre*, and similar insoluble substances by their insolubility in dilute sulphuric acid; *gum* by its insolubility in alcohol; *salicin, phlorizin, sugar*, and other organic compounds by the red or brown color occasioned with warm concentrated sulphuric acid (a slight yellowish color is admissible for quinine); *morphine* as an accidental impurity by the red or orange color produced with strong nitric acid (several other alkaloids yield a similar color); *mannit* and other substances soluble in water by boiling a portion of the suspected salt with solution of baryta, passing carbonic acid gas into the mixture, and evaporating the filtrate; pure sulphate of quinine thus treated will leave only an insignificant residue.

According to the above-described tests, the purity of quinine sulphate is directed to be determined (1) by sulphuric acid (*U. S., Br., P. G.*); (2) by nitric acid (*U. S., P. G.*); (3) by absolute alcohol (*U. S.*); (4) by a mixture of chloroform and absolute alcohol (*P. G.*); (5) by milk of lime (*U. S.*); (6) by exsiccation (*U. S., Br., P. G.*); (7) by Kerner's test (*U. S., P. G.*); (8) by ether (*Br.*); (9) by potassium iodide (*Br.*).

"Sulphate of quinine should not contain much more than 5 per cent. of sulphates of other cinchona alkaloids."—*Br.*

Medical History.—A knowledge of the curative powers of Peruvian bark was not due to sagacious prescience or scientific investigations, but to the simple fact that in the early part of the seventeenth century the Spanish conquerors of Peru learned its virtues from the native Indians. Carried to Europe, learned bigotry condemned what unenlightened savages had discovered, and one religious body zealously spurned a priceless boon that had been introduced by another whose form of faith they derided. About the middle of the seventeenth century a large quantity of the bark was brought from America, and at a great council of the Jesuits at Rome was distributed to the members, who afterward carried it all over Europe; hence it was called Jesuits' bark. But it had still to encounter the sneers of the learned and the hate of bigotry, and it was not until an English quack succeeded in curing by its means men of high rank that fashion broke down the prejudices which reason could not remove. Thenceforth cinchona was everywhere applied to the cure of malarial fevers and fevers of a typhoid type, as well as to various other diseases.

The discovery of the active principles of cinchona, imperfectly made by Duncan in 1803, was perfected by Pelletier and Caventou in 1820, as far as regards quinine and cinchonine. Quinidine was discovered partially in 1833, but perfectly isolated in 1852. The introduction into practice of quinine and cinchonine dates from 1820–21.

Physiological Action.—The earlier experimenters with quinine upon the lower animals and upon man concluded that in small doses it acts as a stimulant of the nervous and circulatory systems, and in large doses as a direct sedative, producing general muscular and cardiac debility, and, when poisonous doses are given, great acceleration of the pulse, coma, and stertorous breathing. After death the lungs and brain were found engorged with blood. Later investigations have furnished minuter and more extensive information, according to which the action of quinine upon the economy may be described.

Small and frequently-repeated doses given to animals increase the *pulse-rate* even until death; at first they augment the force of the heart's contraction and then diminish it, although the rate of its movements progressively increases. Poisonous doses, especially when injected into the veins, annihilate the heart's contractility, producing rapid death, yet if the operation is not promptly fatal the respiratory movements cease before those of the heart. In such cases the blood-current is retarded, whether the observation be made in the first stage of action of the medicine, when the blood-vessels are contracted, or subsequently, when, under its prolonged influence, they have become dilated. The experiments, among others, of Cerna (*Phila. Med. Times*, x. 493) confirm these conclusions, and those of Panteljeff, showing the physiological antagonism of quinine and atropine, are to the same effect (*Practitioner*, xxv. 205). In the theoretical language of the day, the increased pulse-rate in the first or lower grade of action is due to stimulation of the excito-motor centre of the heart and paralysis of its regulating apparatus. According to some, the increase, and afterward the decline, in the heart's force should be ascribed to paralysis of the vagi and an action upon the nerve-centres controlling the blood-vessels, first stimulating and then paralyzing them. According to others, they do not depend upon any action upon the vagi, but solely upon an influence directly exerted on the intra-cardiac ganglia.

Whatever be the physiological explanation of the fact, there can be no doubt that in the greater number of experiments on man the pulse-rate falls under the full influence of quinine, whether in health or in disease, and that at the same time its force is diminished. This action is generally believed to be attended with a fall of temperature as its necessary consequence; but, although such is probably the case, it occurs by no means uniformly unless the dose be very large. In the latter case it appears to depend in part and on the one hand upon the slowness, and on the other hand upon the hurried and inefficient character, of the respiratory movements, as well as upon a like action of the heart. (Compare Sée et Rochefontaine, *Archives gén.*, Mars, 1883, p. 374.) Theoretically, in moderate doses quinine stimulates the trophic centres and quickens tissue-change, but in larger doses it has the opposite effect. The important sphygmographic experiments of Dr. Mary Putnam Jacobi upon a human brain exposed by an opening in the cranium confirm these statements, and prove that "by a tonic dose of quinine (5 grains) the energy of the cardiac systole is increased; the tonus and elasticity of the walls of cerebral vessels are also increased, so that the blood is forced rapidly on through the capillaries, thus diminishing the resistance to the cardiac systole. More blood is admitted to the brain, but the intercranial pressure is lessened." But after a sedative dose of 20 grains there resulted "diminished energy of the cardiac contractions, unfilled cerebral arteries, and great diminution in intercranial pressure."

Numerous observations concur in rendering it probable that in very large doses quinine may lessen the coagulability of the *blood*, and that this effect is sometimes produced by medicinal doses. A case is recorded in which a neuralgic woman suffered an attack of purpura from taking a very small dose of quinine (*Boston Med. and Surg. Jour.*, Dec. 1883, p. 587). It has also been affirmed, and on the other hand denied, that the number of the white blood-cells and their power of emigration are diminished by the operation of quinine. The affirmative proposition seems to be the more probable. It has been maintained by Binz and Scharrenbroich, who state that quinine reduces the amœboid activity of the white corpuscles, and that these elements are actually killed in solutions of 1 part of sulphate or muriate of quinine in 3000, or even 4000, parts of blood-serum. Quinine salts also diminish, or even arrest, the migration of these corpuscles. It also appears that the white corpuscles which emigrate have, for the most part, a single nucleus, while previously the greater number are multinucleated; and further, that the red corpuscles become larger under the influence of quinine. Cutler and Bradford (1878) found that after a large dose of sulphate of quinine there is in health a slight diminution of the red, and a marked increase in the number of the white, corpuscles. Binz and Ransonné state that while quinine does not alter the shape or size of the red corpuscles, it lessens their power of absorbing oxygen (Husemann, etc., *Die Pflanzenstoffe*, 1884, p. 1439).

In regard to the action of quinine upon the *nervous system*, experiments upon animals demonstrate that in large doses it deranges, enfeebles, and finally extinguishes, nervous action. The animal subjected to observation staggers, becomes agitated, and sometimes convulsed, and then assumes a dull, inanimate expression and subsides into a state of apparent debility and torpor, with impaired vision and widely-dilated pupils. According to Chirone, there is also progressive anæsthesia, which is produced about equally by quinine, cinchonine, and cinchonidine (*Med. News*, xl. 406). When 5 or 6 grains of sulphate of quinine are taken by an adult man at a single dose, or two or three times that quantity in the course of 12 hours, there is apt to be some heaviness and confusion of thought, headache, buzzing in the ears, vertigo, and unsteadiness of gait. Larger doses occasion, in addition, a sense of fulness, tension, and pulsation in the head; the face becomes suffused and animated; the eyes are bright; epistaxis sometimes occurs; the patient is restless and agitated, and complains of muscular twitching in the limbs. After several hours these phenomena are followed by some degree of exhaustion and a disposition to sleep, with slight torpor and muscular debility. If as much as 30 grains are given daily for several days, in divided doses, there may be observed great depression, apathy, somnolence, unsteadiness of gait, impaired sight and hearing, and dilatation of the pupils; the general sensibility is obtuse and the limbs tremulous. If, finally, the dose has been excessive, complete loss of consciousness may occur, the sight and hearing fail, the skin loses its sensibility, and the limbs their power of motion.

The usual and most probable interpretation of these phenomena is that quinine in moderate doses primarily stimulates the nervous centres and increases the amount of blood circulating in them; that in excessive doses it diminishes the supply of blood to the same parts; and that this diminution results mainly from the depressed power of the heart. The most important fact in support of this view is that the giddiness, confusion of sight, and faintness caused by quinine subside as soon as the patient lies down.

On the *respiratory organs* the primary action of quinine is stimulant, slightly increasing the rate of breathing. Poisonous doses occasion dyspnœa and noisy respiration, which is also jerking, interrupted, retarded, and finally arrested, death taking place with symptoms of asphyxia. In some cases the sputa have been bloody. Doubtless the latter phenomena are due to a paralyzing influence exerted by quinine upon the respiratory nervous centres, coupled with an analogous action of the drug upon the cardiac nerves and ganglia. According to certain experiments upon rabbits (Strassburg), quinine does not diminish the exhalation of carbonic acid, even while it lowers the temperature.

On the *digestive organs* small doses of quinine, as of all pure bitters, stimulate the appetite and digestion, but in large and continued doses it irritates the stomach and confines the bowels at first, although it may afterward cause diarrhœa.

The fact that when quinine cures intermittent fever it also contracts the *spleen*, if that organ is enlarged, is a familiar one. It is also known that when quinine is largely administered to animals for various experimental purposes the spleen is found pale and hard and its capsule wrinkled. These effects occur even when all the nervous trunks supplying the organ are divided. Hence, it is concluded that quinine must act upon the internal nervous system of the spleen (Binz). The function of the organ, it is added, being to form the white corpuscles of the blood and to prepare various oxidized substances, and especially uric acid, for excretion, and quinine having the power of restraining both of these operations, necessarily the organ appropriated to them must contract in proportion to the restriction of its functions.

Quinine, being excreted with the *urine* to the extent of at least one-half, sometimes occasions irritation of the urinary passages, causing in different cases micturition, retention of urine, and even hæmaturia. Karamitsas, a Greek physician, relates (*Bull. de thérap.*, xcvii. 53, 108, 149) seven cases of hæmaturia attributed by him to this cause. One was in a girl whose skin had merely been bathed with a solution of quinine (?); in the other six cases the hæmorrhage occurred independently of malaria, and usually two or three hours after the medicine had been taken. The connection between the alleged cause and the hæmaturia in these and other similar cases has been called in question, and the bloody urine has been regarded as merely symptomatic of hæmoglobinuria. If irritation already exists in the bladder, quinine usually appeases it. These facts tend to explain the occasional occurrence of *abortion* or premature labor in females taking very large doses of quinine for the cure of periodical fevers, particularly when the tendency to the accident is increased by general ill-health or malarial cachexia. There is more reason to apprehend abortion or premature labor from such causes than from the use of moderate doses of quinine, which rather tend to counteract their injurious action. When, under such bad conditions of health, labor sets in with feeble and ineffectual pains, quinine in moderate doses will, like other spinal nerve-stimulants, often render the contractions of the uterus more energetic and efficient. That there is no tendency in quinine to bring on contractions in the gravid and quiescent uterus has been proved by abundant experience. Burdel reports several cases which demonstrate that enormous doses of it can be taken without injury to the embryo and without shortening the duration of pregnancy, and is supported by experiments upon animals with young and near the end of gestation. Among the latter must be included the case of a gravid cat that died of direct poisoning by quinine without a sign of labor.

Quinine and cinchonine both occasionally produce erythematous or papular *eruptions* (urticaria, roseola) of the skin, which sometimes are followed by exfoliation of the cuticle. A very large number of cases illustrative of this subject have been published in the last few years. In some of them the eruption constituted the chief phenomenon of the attack; in others, numerous severe symptoms of a different nature occurred. Of the latter class the following case will serve as an example: A lady who had on a previous occasion been afflicted in the same manner took 5 grains of sulphate of quinine for a quotidian intermittent fever. "The exanthema was vivid red and of an urticarious character, extending over the entire surface, with wheals on the chest, sides, and flexures of the joints coalescing and running together, covering large spaces of integument. . . . . Her face, eyelids, and neck were puffy and œdematous, there was great dyspnœa and præcordial oppression, the fauces were swollen and inflamed, with dysphagia and sensations of choking, a very rapid pulse, much febrile disturbance, considerable deafness, dilated pupils, severe headache, a wild expression of countenance, extreme restlessness, and intolerable itching" (King). A case almost identical in its phenomena occurred to Köbner. In it also the patient had been similarly affected by quinine several years before. (Compare Farquharson, *Trans. Clin. Soc.*, xii. 25; Franck, *Med. Record*, xxi. 627.) As exanthems of an analogous character sometimes accompany the first stage of a paroxysm of intermittent fever, it has been suggested that malaria, and not quinine, might be their cause. A sufficient answer is that in Köbner's case there was no malarial disease whatever, and the same is true of many cases that have occurred since the administration of quinine in various febrile diseases has been in vogue. Moreover, it has been observed that in manufactories of quinine such eruptions are not uncommon. A lichenoid eruption has been produced by a bath containing sulphate of quinine. When this salt is applied to the denuded cutis it occasions severe burning and smarting pain, and sometimes forms a superficial eschar. It is declared by Giulio not to be absorbed by the skin, even under the most favorable circumstances (*Phila. Med. Times*, xi. 403).

Quinine in excessive doses may be dangerous, and even fatal, to life. A description of the symptoms in one or two cases will include all that is important. In 9 hours after 3 drachms of sulphate of quinine had been taken at a single dose the patient, an adult male, lay motionless and pallid, the fingers were bluish and cold, and the whole surface cool, the respiration slow and suspirious, the pulse regular, but slow and hardly perceptible, the pupils widely dilated, the sight and hearing almost extinct, and the voice extremely feeble; the thirst was great, the tongue pale and moist, and the breath cold. In another case (Vorhies, *Trans. Amer. Med. Assoc.*, xxx. 411) a woman threatened with a congestive chill took more than 1300 grains of quinine within 3 days. On the second day she became blind. A week afterward she was extremely weak, almost pulseless, and barely able to comprehend questions, but her hearing was only slightly impaired. The face was pale, the conjunctiva anæsthetic, and there was no perception of light. The interior of the eyes showed no trace of blood-vessels. Three months later the condition of the eyes was nearly stationary, but the health in other respects was good. The ocular phenomena in this case are similar to those observed by Grüning, Michel, and others. It is said that no case of permanent blindness from quinine has been recorded (*Edinb. Med. Jour.*, xxvii. 942). A case is related by Grüning (*Med. Record*, xviii. 608) in which 80 grains of quinine produced deafness and blindness. The condition of the eye resembled that just described, and vision was not fully regained for several months. Others have been published by Michel and by Knapp (*Amer. Jour. of Med. Sci.*, Oct. 1882, p. 616). It has been disputed whether the deafness due to quinine is accompanied by an anæmic or a congested state of the internal ear (*Boston Med. and Surg. Jour.*, Mar. 1883, p. 220), and the highest authority is upon the side of the latter opinion. It seems singular that the drug should congest the ear and anæmiate the eye. It indeed has been alleged that the eye is congested primarily by the medicine, but of this statement the evidence is insufficient (Roosa, *Med. Record*, xxiii. 145). Although it has been alleged that no case of death from quinine has occurred (Binz), these symptoms were observed in four recorded fatal cases. One, a child of eight years, died from taking 8 grains of this salt in two doses within three hours. In other cases partial loss of hearing or of sight has followed the use of the medicine, and lasted for several weeks. On the other hand, enormous doses have sometimes been used without any serious consequence.

Sensible physiological effects are seldom observed when the dose of sulphate of quinine is less than 4 grains; those produced by a dose of 6 grains may be expected in about an hour, and by 15 grains in about a quarter of an hour. The duration of the sensible effects is in the direct ratio of the dose administered; those from 6 to 8 grains may last for two or three hours, and from 15 grains for four or five hours. Larger doses maintain their action for a proportionately longer period.

Other things being equal, the functional disturbance is of shorter duration in children than in adults, but in old age they are apt to be both more decided and more prolonged. These facts depend probably upon the more rapid elimination of quinine by the kidneys in young than in old persons. It is more operative, in the same dose, in females than in males. Burdel, who studied the action on the new-born child of the milk of a woman who was taking sulphate of quinine, states that he has known infants to be fatally poisoned in this manner. He holds, what is very probable, that the danger is greatest when the medicine is taken upon an empty stomach and during the first four or five months of the infant's life. He adds that when it becomes necessary to administer quinine soon after delivery the injurious effects upon the child may be prevented by giving it with the meals, and by emptying the mother's breast artificially 3 hours after its administration.

Neither Dolan nor Bunge, on the other hand, could find any of the drug in the milk of a nursing woman who was taking it (*Practitioner*, xxvi. 57; xxvii. 168).

Like many other medicines, quinine is stimulant in small but sedative in large doses; but it differs from other stimulants in the duration of its action, which is long sustained, and entitles it to be called a tonic stimulant. In the smallest medicinal doses it is purely tonic, in larger doses stimulant, and in the largest sedative, acting in each case upon the cerebro-spinal nervous system and through the ganglionic nervous system upon the heart. It possibly also modifies the vital elements of the blood, in large doses checking their development. It appears, therefore, that by its combined influence upon the nervous system and upon the blood it is capable of restraining all the processes which develop heat, organic changes, and muscular motion.

The experiments and observations made during the last century gave rise to a belief that cinchona had a special power of correcting or limiting putrefaction and fermentation, and hence it was employed as a specific remedy for all diseases in which these processes were conceived to be taking place in the blood. Among them were the continued and periodical fevers. Modern doctrines regarding these diseases involve a similar idea, and the efficacy of quinine in curing them is attributed to its power of destroying and disintegrating vibriones, bacteria, and analogous organisms. It is in fact "a powerful anti zymotic" (Binz). 1 part of quinine dissolved in 20,000 parts of water will in a few minutes begin to enfeeble parameciæ, in two hours will destroy their vitality, and in a few hours more cause their disintegration. Quinine retards or arrests the alcoholic and other fermentative processes, including putrefaction and certain morbid ferments. This action it is claimed to possess upon diphtherial exudations and upon the sputa of pulmonáry gangrene. Gieseler determined that fresh muscle could be preserved in a solution of $\frac{4}{5}$ of 1 per cent. of quinine sulphate, and Binz that such a solution exhibited more power of preventing the formation of new bacteria than in destroying those already existing. It appears probable that no amount of quinine capable of destroying micro-organisms in the blood of man could be taken by him without endangering life. Such, at least, is the conclusion of Vulpian and Rochefontaine, Baxter, Binz, Fickert, and others (Husemann, *Die Pflanzenstoffe*, 1884, p. 1437).

There appears to be some differences between quinine and cinchonine in their mode of action. Thus the latter is said to be more poisonous to frogs and dogs than the former. In man also sulphate of cinchonine does not so speedily produce buzzing in the ears and disordered action, but, on the other hand, it more constantly occasions, and in smaller doses, a peculiar pain and sense of oppression in the frontal region, distress about the præcordia, subsultus tendinum, general debility, and faintness.

Medical Uses.—*Malarial Diseases:* The anti-zymotic doctrine above described is thought to be supported by the power of quinine to prevent and cure malarial diseases, which are assumed to depend directly upon the introduction into the blood either of certain low and extremely minute organisms, or of a specific poison which accumulates in the system and tends to destroy its albuminous elements with the production of fever. This doctrine is at present only probable, perhaps only hypothetical, and yet none other so well explains the fundamental practical rule that the paroxysm of fever is not directly prevented by the primary action of quinine, whose phenomena are evident, but that the curative operation is developed hours or even days after those sensible phenomena have disappeared. No medicine which operates simply by exalting or depressing the organic actions so distinctly possesses this peculiarity, which is difficult to comprehend except upon the supposition that its eliminative or antidotal, and not its dynamical, action is the chief agent in the cure of miasmatic diseases. Moreover, the efficient dose of quinine in these diseases bears no relation to the sensible effects which it produces; indeed, in all simple intermittents, and in the great majority of other forms of periodical fevers, the cure is effected without the necessity of inducing the slightest degree of quinine intoxication. It is possible that in addition to the modes of action here alluded to quinine may be curative of malarial diseases by directly supplying to the blood that peculiar constituent upon which animal fluorescence depends, and which is found to be greatly diminished at least in chronic intermittent fever, and to regain its normal proportion as the patient renews his health. (Rhoads and Pepper, *Penna. Hosp. Rep.*, 1868, p. 269; Binz, *Amer. Jour. of Med. Sci.*, Oct. 1881, p. 552). While, as we think, the antidotal power of quinine cannot be refused the chief place in the cure of periodical fevers, we must not lose sight of the fact that they were cured from the beginning of time down to the discovery of cinchona by a great number of agents, and that they continue to be so cured even in cases where quinine has failed of its expected effect. It is equally certain that periodicity, and not malarial periodicity, is the essential condition of its curing a number of diseases which assume that type, as is more fully set forth in a subsequent paragraph.

But whether the salts of cinchona act by modifying the powers of the nervous system or as antidotes to a material morbific cause, they are efficient in *preventing* as well as *curing periodical fevers.* Their power has been tested in all parts of the world; and it is now certain that a person under the impression of a dose of quinine or cinchonine, even within the limits of sensible cinchonism, may be exposed to malarial influences without danger. Indeed, a dose of from 2 to 5 grains (Gm. 0.12–0.30) once or twice a day has been found sufficient for this purpose.

Formerly the notion prevailed that in order to render the treatment even of simple periodical fevers efficient the gastro-intestinal tube should be thoroughly cleansed by emetics and cathartics, and that sometimes mercury should be exhibited. Experience has proved that these methods, founded upon theory for the most part, are generally unnecessary and sometimes injurious, the conditions they are intended to remove depending mainly upon the malarial poisoning for which quinine is the specific cure. It may, as a rule, be administered without preliminary medication in the dose of from 5 to 8 grains (Gm. 0.30–0.50) during the intermission in *simple intermittents.* The result of a careful observation of different methods of administering the medicine has been clearly to prove that the anti-febrile influence of quinine does not coincide with its physiological operation either in time or degree. A period of at least 12 hours should, if possible, intervene between the last dose of the medicine and the hour of the expected attack, and according to the severity of the paroxysms the dose should be large or small, single or divided. When once the paroxysms have been arrested, the medicine should be suspended until 24 or 36 hours before the seventh day, reckoning from the beginning of the last paroxysm, when it should be repeated in the original dose. At the next hebdomadal period it should be prescribed in half the quantity, and still further diminished in the third week. In *congestive intermittents*, while it may be necessary sometimes to employ depletion, evacuants, and revulsives and the stimulant shock of the cold dash, these and all other agents are comparatively worthless without quinine. It must be administered to the extent of not less than 30 grains (Gm. 2) during the intermission—by the mouth preferably, but if this cannot be, by the rectum, or even hypodermically. Immediate effects are not to be expected.

Hæmorrhagic malarial fever is alleged by Dr. McDaniel to be by no means as amenable to the treatment by quinine as other malarial fevers. From a large basis of observation by himself and others he draws the conclusion, "that quinine is not only not the effective and reliable remedy as is now widely taught, believed, and practised, but that it is, on the contrary, an uncertain, and even a dangerous, agent in this disease, and often seems to determine an unfavorable result" (*Medical News*, xliii. 561). This judgment, which is apparently borne out by the facts adduced in its support, is nevertheless impugned by Dr. Webb, a colleague of the reporter, who is also in full accord with the general medical experience of the region in which this disease occurs.

In *remittent fever* a preparatory emeto-cathartic treatment appears to be more distinctly indicated by the gastro-hepatic symptoms than in intermittent fever; yet observation proves that in this case also the local disorders are under the control of the miasmatic poison, and that when it is eliminated or neutralized they cease. If the physician is able to choose his time, the medicine should be administered as soon as the remission sets in, and from 12 to 18 grains (Gm. 0.80–1.20) of quinia should be given in two or three doses at intervals of an hour; but if the paroxysm has already begun and if the symptoms are urgent, as occurs in the congestive forms of the disease, no time should be lost; the medicine should be administered in doses twice as large as those just named, and at shorter or longer intervals according to the duration of the remission. After control has been obtained over one paroxysm, the medicine may be exhibited in half the original doses, or less, for several periodical revolutions.

The prevalence of *yellow fever* in certain localities where periodical fevers also prevail gave rise to the grave error that its nature is the same as theirs, and that it may be cured by their specific remedy. The experience of competent judges has led to the following conclusions: 1. That quinine is not a specific for yellow fever, as it is for periodical fevers of every type; 2, that in mild cases, which would probably recover under good nursing and an expectant treatment, the medicine may sometimes hasten recovery; 3, that, on the whole, the results depending upon quinine are no better than—if, indeed, they are as good as—those of the treatment of symptoms which is sanctioned by general experience, and which the skill of the physician must modify to suit the genius of each epidemic of the disease.

Various *inflammatory affections* assuming a periodical type under the miasmatic influence are more successfully treated by quinine than by any other means. The more important of such affections are *pneumonia* and *dysentery*. In like manner, accidental periodical *hæmorrhages* have ceased under the influence of quinine, including even *epistaxis* (*Bull. de thérap.*, xcvii. 373; *Med. Record*, xxi. 541).

Many functional disorders of the spinal nervous system assume more or less distinctly a periodical type, quite independently of a specific poison. Among these may be enumerated *spasmodic asthma*, *laryngismus stridulus*, *whooping cough*, periodical *palpitation of the heart*, *hiccough*, and, above all, *neuralgia*. In the last-named disorder quinine divides with arsenic the honor of the greatest number of cures, as it also does in malarial fevers and other diseases of like origin. Cases of intermittent *paralysis* of the hemiplegic form, and also of periodical *aphonia*, have been cured by the same means; but they were miasmatic in nature. In these cases the operation of the remedy was generally stimulant and not sedative, since they were cured by comparatively small doses of quinine. But in some of the above, and still other affections of the nervous system, the cure has been brought about by large or sedative doses of quinine. Thus, in *whooping cough* it is claimed that when muriate of quinine is prescribed in doses of as many times a grain and a half as the patient numbers years, and especially when it is administered in the evening, unless it is carelessly given, it never fails either to cure the disease absolutely or to render it mild and innocuous, provided serious complications do not exist.

The curative effects of quinine in *sunstroke* are attested by numerous physicians, especially in the East Indies, where this accident is of more frequent occurrence than elsewhere. It is claimed that, whereas the mortality from heat-apoplexy in that country was formerly more than 50 per cent., the success of the treatment by quinine has been constant. The medicine is most effectually administered hypodermically by several punctures, in each of which 1½ grains (Gm. 0.10) is introduced.

The history of the treatment of *acute articular rheumatism* by cinchona and by quinine is instructive, for it leads one to entertain serious doubts concerning the mode of action of these medicines. More than a century ago bark came into vogue for the cure of rheumatism, and was administered in doses representing not more than 2 or 3 grains of quinine, after depletion, emesis, and purgation. Until the introduction of quinine its efficacy was almost unquestioned, yet nothing can be plainer than that bark as formerly used can produce no such effects as quinine employed according to the fashion of the present day. The former could only act as a stimulant, the latter only as a sedative. This was the first disease in which the modern doctrine of treating febrile affections was applied—a doctrine which would seem to teach that disease is in its phenomena alone, and not in the organic condition out of which they spring. Enormous doses of the medicine were given, even to the amount of 200 grains in one day; but although far smaller and less poisonous doses were usually administered, and marvellous cures were fully set forth, the common sense of physicians revolted against the method, and it is now practically abandoned. Quinine, however, in tonic doses is of service in that condition of debility which is apt to follow or accompany the use of the most efficient treatment for acute articular rheumatism—the alkaline. It prevents the development of the scorbutic cachexia, and an increase of the weakness that denotes a tendency to such a result. It is also indicated, but less strongly, after the treatment by salicylic acid or the salicylates.

A precisely similar succession and antagonism of opinions to that which has just been sketched occurred in the history of the use of bark in *typhus*. Originally employed to counteract "putridity," it was used beneficially, because it acted as a stimulant, and was combined with other stimulants, as in the famous and still officinal "Huxham's tincture." In more recent times quinine was employed as an antiphlogistic and sedative in very large doses, and not a few witnesses were found to give the most positive testimony in its favor. That they were utterly mistaken is now certain. Quinine has not been shown to be of any service in typhus except at the critical stage, when a full *tonic* dose may reduce the pulse and give a favorable turn to the disease.

One of the latest and highest authorities in medical science uses the following language: Quinine does not put an end to an attack of *typhoid fever*, as it does to one of intermittent fever. In the first-named disease it has no specific operation, but only so weakens the putrid ferments that they run their career less destructively. . . . When quinine is useless, the disease must either have assumed an exceptional and complicated form or the medicine must have been imperfectly administered (Binz). This author reproaches those physicians who treat typhoid fever expectantly, and wait and watch who will hold out longest, the patient or the fever. Perhaps it may be better so to wait than to make use of means which tend to aggravate the patient's danger as well as to increase his discomfort, and which lessen neither the duration of the disease nor its rate of mortality; and quinine does neither. The error of practice in using this treatment is, that its results are the reverse of flattering to the sagacity of its promoters, or of being satisfactory to the philanthropic feelings we must give them the credit of possessing; the error in theory consists in treating fever as if it were absolutely limited by temperature and pulse-frequency, and as if nothing more essential lay behind these symptoms of the process. The mischievous results of treating typhoid fever with sulphate of quinine appear to be explicable by the large doses of it administered, or as much as 35 or 40 grains for an adult man given in three or four doses in less than an hour. In December, 1882, Hardy called the attention of the Paris Academy of Medicine to the fact that within three months four cases of sudden death had occurred in the hospitals among patients treated with large doses of quinine (*Archives gén. de Méd.*, Jan. 1883, p. 114). It is greatly to be apprehended that a portion of the quinine may reach and irritate the intestinal ulcers and increase the risk of perforation, one of the gravest dangers of the disease.

What has been said concerning typhus and typhoid fevers is equally applicable to *puerperal fever*, *scarlet fever*, *small-pox*, and *erysipelas*. There is very little doubt that tonic and stimulant doses of quinine are serviceable in them, and that sedative doses of the medicine are mischievous. In each affection it is useful in proportion as the symptoms assume a typhoid character; thus it is advantageous in all cases of *septicæmia*, whether arising from primary blood diseases or from traumatic causes, but in this, as in the other affections enumerated, only in small and repeated doses. It has even been employed before and after surgical operations to prevent *septicæmia*, but evidently its influence, if any, would be extremely difficult to determine. This medicine has also been alleged to be more efficacious than any other in the radical treatment of *diphtheria*, but as yet satisfactory clinical proof of the statement has not been furnished. As a tonic in this disease its utility is generally recognized. The same may be said of its use in the treatment of *asthenic pneumonia*, and of *hectic fever* from whatever cause it may arise. In the numerous allied cases also of *profuse sweating* connected with general debility from exhausting diseases, whether during their progress or following their active symptoms into convalescence, quinine, especially with aromatic sulphuric acid, is one of the most reliable remedies that can be employed.

We have not in the preceding paragraphs alluded to the employment of sulphate of quinine in purely inflammatory diseases—those of all others, one would suppose, which would illustrate the sedative virtues of the medicine. But neither in meningitis, pleuritis, pericarditis, or peritonitis, nor in any mucous inflammation, does it appear to have been put to the test. There remains *pneumonia*, which has long been the *pièce de résistance* upon which the virtues of active medicines have been tested. It has not escaped the administration of heroic doses of quinine. In Stockholm, Jürgensen (1871) stated that in a series of 200 consecutive cases twenty-four were fatal, or a mortality of 12 per cent. But his own statistics of the same city for 1851, when certainly the quinine treatment had not been devised, present a mortality of only 9.8 per cent., and in five of the sixteen years from 1840–55 the mortality was less than 12 per cent. This distinguished physician gave "in highly febrile states to an adult 77 grains (Gm. 5), and to a child under one year 15 grains (Gm. 1), and always in one dose." It is very desirable that a medicine as precious and costly as quinine should not be squandered, and it certainly seems to be wasted when it is administered so profusely with no better results than these. In this country a similar, but a somewhat less extreme, method has been recommended by Palmer (1877), who gave, as near as possible to the beginning of the attack, from 6 to 10 grains of quinine with from $\frac{1}{4}$ to $\frac{1}{3}$ grain of morphine, repeating the quinine in doses of from 4 to 8 grains once in from two to three hours, and continuing them until from 30 to 50, and sometimes 60, grains were given. Of this treatment we are told: "The effects desired, and certainly as a rule produced, are a decided reduction of temperature, a marked diminution in the frequency of the pulse, a decided moisture of the skin or free sweating, a slower and more easy respiration, or relief from pain and the feeling of fulness of the chest, a diminution of the cough and of the tenacious and bloody character of the expectoration; and, in short, not only is there a checking of the fever, but of all evidences, general and local, of the pulmonary engorgement and inflammation." These are very remarkable effects, and the statement of them would have acquired a much higher value if it had also included the number of cases for which the treatment was used, the ages of the patients, the type and grade of the disease, its mortality-rate, and the other remedies besides quinine and morphine that were employed. Meanwhile, so far as we can learn, since the original recommendation of this method by Jürgensen, no other reports proceeding from an authoritative source have been published to confirm it.

In close pathological relation with the above-mentioned asthenic states are numerous local affections in which quinine is of great value. Such are *scrofulous ulcers* and *abscesses*, *scrofulous inflammations of the eye*, chronic *mucous fluxes* of the *pharynx*, *larynx*, *bronchia*, *stomach*, *bowels*, and *urinary organs*. It is one of the best remedies for scarlatinous and other forms of *albuminuria*, especially when it is associated with tincture of chloride of iron.

In auditory *vertigo* (mal de Ménière) the persistent use of quinine has in several cases removed the complaint entirely. Charcot, who proposed this method, insists on the administration of 10 or 12 grains of quinine daily for at least a month, although it is apt at first to aggravate the symptoms, and then the resumption of the medicine after its suspension for a week or two (*Med. Record*, xviii. 602). Ménière himself found that it lessened or removed the vertigo and modified the deafness, but does not profess that quinine, more than any other medicine, is a cure for the disease (*Monthly Abstract*, July, 1881, p. 407). These results are confirmed by Féré and Démars (*Bull. de thérap.*, cii. 133). Although quinine has no power of originating contractions in the gravid uterus, it undoubtedly during *slow labor*, with insufficient expulsive pains and an exhausted condition of the system, revives the uterine energy, favors the rapid and safe termination of labor, and tends to prevent exhausting hæmorrhages. The dose should not exceed 10 grains (Gm. 0.60). Le Diberder claims that sulphate of quinine in the dose of 6 grains (Gm. 0.36) twice a day is an efficient remedy for *fissures of the nipples*, and that no active local treatment need be employed at the same time.

The state of muscular debility and nervous excitability which often occurs during the second stage of *whooping cough* is apt to be improved under the influence of bark or quinine, as has been well known since the time of Cullen. More recently, sulphate of quinine has been used in free solution as a draught, or else atomized, under the impression that its curative action was local; indeed, the tannate of quinine has been recommended especially (Binz) for its topical influence on the fauces and larynx. But equally good results have been obtained from the sulphate when administered by the rectum. It is apt to fail in severe cases and when complications exist. The dose by the mouth should be from $\frac{1}{2}$ grain to 3 grains three times a day.

Hay fever has been treated successfully with injections into the nasal passages of a warm watery solution of quinine of the strength of from $\frac{1}{2}$ to $\frac{1}{10}$ of 1 per cent. At the same time it should be given internally in doses of not less than 5 grains (Gm. 0.30) three times a day.

A solution of quinine of the strength of 2 or 3 grains in an ounce (Gm. 0.13–0.20 in Gm. 32) of water has been used with advantage as an injection for *gonorrhœa*. Probably by a similar mode of action it has been found to greatly relieve the *tenesmus* attending micturition in cases of *vesical catarrh* and *villous growths* near the neck of the bladder, whether injected into that organ or administered by the mouth. It will be remembered how large a proportion of sulphate of quinine is eliminated with the urine, Most probably it acts both substitutively and by limiting the putrefaction of the mucus in the bladder. It has also been injected into the pleural cavity in cases of *empyema*, and applied as a dressing to *ulcers* and suppurating *sinuses*. A solution of 4 grains to the ounce has been applied with alleged advantage in the treatment of pseudo-membranous *conjunctivitis* (Tweedy, *Amer. Jour. of Med. Sci.*, Apr. 1882, p. 592). A strong solution of the salt is said to relieve *pruritus ani* and *pruritus vulvæ*. In these cases there is no sufficient reason for believing that it acts otherwise than as a substitutive irritant.

Warburg's Tincture is the name of a preparation which was for a long time famous as a nostrum, the secret of which was obtained by Prof. Maclean of the Army Medical School in England. This distinguished physician had on many occasions witnessed the efficacy of the medicine in India when quinine had proved unavailing. Its composition is as follows: ℞. Aloes (Socot.) lb.j; Rad. rhei (chinens.), Sem. angelicæ, Confect. Damocratis, āā ℥iv; Rad. helenii (s. enulæ), Croci sativi, Sem. fœniculi, Cretæ ppt., āā ℥ij; Rad. gentianæ, Rad. zedoariæ, Pip. cubebæ, Myrrhæ elect., Camphoræ, Bolet. laricis, āā ℥j. These ingredients are to be digested with 500 ounces of proof spirit in a water-bath for 12 hours; then expressed, and 10 ounces of disulphate of quinine added to the mixture, which is then replaced in the water-bath until all the quinine is dissolved. The liquor when cool is to be filtered, and is then fit for use. The tincture is administered in the following manner: "½ ounce (half a bottle) is given alone without dilution, after the bowels have been evacuated by any convenient purgative, all drink being withheld. In three hours the other half of the bottle is administered in the same way. Soon afterward, particularly in hot climates, profuse but seldom exhausting perspiration is induced. This has a strong aromatic odor, which is often detected about the patient and his room on the following day. With this there is a rapid decline of temperature and immediate abatement of frontal headache—in a word, complete defervescence—and it seldom happens that a second bottle is required; if so, the dose must be repeated as above." To the anticipated objection that, after all, the compound is "merely quinine concealed in a farrago of inert substances," the reply of Dr. Maclean is: "I have treated remittent fevers of every degree of severity contracted in the jungles of the Deccan and Mysore and at the base of mountainous ranges in India, on the Coromandel coast, in the pestilential highlands of the northern division of the Madras Presidency, on the malarial rivers of China, and in men brought to Nettley Hospital from the swamps of the Gold Coast, and I affirm that I have never seen quinine, when given alone, act in the manner characteristic of this tincture. And although I yield to no one in my high opinion of the inestimable value of quinine, I have never seen a single dose of it given alone, to the extent of 9½ grains, suffice to arrest an exacerbation of remittent fever, much less prevent its recurrence; while nothing is more common than to see the same quantity of the alkaloid in Warburg's tincture bring about such results (*Med. Times and Gaz.*, Nov. 1875, p. 540).

Administration.—The *dose* of sulphate of quinine as a tonic is 1 grain (Gm. 0.06) three or four times a day. More than this is likely to act as a sedative rather than as a tonic. In simple intermittent or mild remittent fever 6 or 8 grains (Gm. 0.40–0.50) are sufficient to avert the paroxysm; in severer cases of these affections the dose must be raised to 15 or 20 grains (Gm. 1–1.30), and in those of a malignant type to 30, 40, or even 60 grains (Gm. 2–4), given, in both of the latter cases, in divided doses. In all cases of periodical fever it should be administered *as long as possible before the expected paroxysm*, and generally in regular types as soon after a paroxysm as the stomach is able to retain it. Intermittent neuralgia requires doses sufficient to produce the physiological effects of the medicine in a marked degree, and the same is true of the various febrile and inflammatory affections in which the medicine is intended to produce sedation.

The most usual and efficient mode of administering sulphate of quinine in small doses is in solution, rendered more perfect and stable by the addition of aromatic sulphuric acid, in the proportion of 1 drop of the acid to each grain of the sulphate. It is also administered in powder enveloped in a wafer or in a thick mucilage, white of egg, or jelly, or in pills coated with gelatin or gold or silver leaf, in capsules, or, finally, in the form of compressed lenticular pills of disulphate of quinine. In all of these forms the concentrated action of the medicine upon the stomach tends to irritate it, and hence the solution already mentioned should be preferred. Its bitter taste may be masked by the addition of a little chloroform, and the mixture should be flavored with syrup or tincture of orange-peel, with extract of liquorice, or with syrup or fluid extract of liquorice-root. Tannic acid has been used to mitigate the bitterness of quinine in solution; it does so, indeed, but at the expense of rendering the medicine almost inert by forming with it a tannate. Moreover, it contains but 42 per cent. of quinine, whereas the sulphate contains 73.5 per cent. and the hydrochlorate 82 per cent. The last-mentioned salt is much less stable than the sulphate, but when freshly prepared is preferable on account of its superior solubility. It is a convenient associate for tincture of chloride of iron in solution. Spirit of nitrous ether is said to dissolve "quinine" in the proportion of about 2 drachms of the latter to an ounce of the former. By the rectum sulphate of quinine may be exhibited in the same doses and with nearly the same effect as by the mouth, provided it be given in watery solution. Probably the muriate is to be preferred for this purpose.

The hypodermic injection of a solution of sulphate of quinine has been extensively practised, but its tendency to cause pain, inflammation, abscess, gangrene, and even fatal tetanus (Ady), more than counterbalances the advantages derived from the facility of its administration and the promptness of its effect. The risks alluded to should restrict the use of this method to cases in which delay may be dangerous. It is claimed that if the solution be thrown into loose subcutaneous connective tissue this accident is not apt to occur, but sufficient proof of this claim is wanting. The bromohydrate of quinine is very soluble in water, and is alleged to be entirely unirritating, and therefore to be well adapted for hypodermic use. It contains a larger proportion of quinine than the sulphate. It was, however, the use of this very preparation that caused the death above referred to. The dose for hypodermic injection of sulphate of quinine may be stated at from 2 to 4 grains.

QUININÆ VALERIANAS, *U. S.*—VALERIANATE OF QUININE.

Quiniæ valerianas, U. S. 1870; *Chininum valerianicum.*—*Valerianate de quinine*, Fr., *Baldriansaures Chinin*, G.

Formula $C_{20}H_{24}N_2O_2.C_5H_{10}O_2.H_2O$. Molecular weight 444.

Preparation.—Wittstein (1845) gives the following directions: Dissolve 1 part of valerianic acid in 60 parts of water; add to the solution 3 parts of quinine (recently precipitated alkaloid is preferable); heat the mixture to near boiling, filter when neutral and while hot, and set aside in a cool place. After several days decant the mother-liquor, evaporate at a temperature not exceeding 50° C. (122° F.), and dry the salt at a very moderate temperature. At a higher temperature the solution separates oily drops, which on cooling form an amorphous resinous mass dissolving with difficulty in water.

The salt was medicinally employed in 1843 by Castiglioni, and was in the same year prepared by Lucien Bonaparte from the sulphate by decomposing it with a valerianate. Stalmann (1868) used for this purpose sodium valerianate; the quinine salt is taken up with alcohol.

Properties.—Valerianate of quinine crystallizes in colorless, pearly, rhomboidal tables or in white triclinic needles having a weak odor of valerianic acid, a bitter somewhat valerian-like taste, and a neutral reaction. The salt dissolves in 110 parts of cold and 40 parts of boiling water, in 6 parts of cold and 1 part of boiling 80 per cent. alcohol, and is easily soluble in ether (Wittstein). At 15° C. (59° F.) 1 part of the salt is stated to be soluble in 100 parts of water (*P. G.* 1872, *U. S.*) and in 5 parts of alcohol (*U. S.*); at 20° C. (59° F.) in 70 parts of water (Flückiger). The statement that the salt is slightly soluble in ether (*P. G.* 1872, *U. S.*) is an error. On adding dilute sulphuric acid to the aqueous solution it becomes fluorescent, and the odor of valerianic acid is rendered more apparent. Ammonia gives a white precipitate soluble in an excess of the precipitate and in ether, and with chlorine-water and ammonia an emerald-green color is produced. The salt is permanent in the air; it melts at 85° C. (185° F.), losing a portion of its acid (Stalmann), and on cooling congeals to a glass-like mass; when strongly heated on platinum-foil it is decomposed, and burns slowly without leaving any residue.

Composition.—Wittstein obtained nearly 5 parts of valerianate from 3 parts of quinine, and determined the water to be over 33 per cent. = $12H_2O$, and the quinine to be 51.355 per cent. L. Bonaparte regarded the loss in weight, ascertained by fusing the salt, to be water, and suggested the above formula. Stalmann, by elementary analysis, found the crystallized salt to yield carbon, corresponding with the formula $C_{20}H_{24}N_2O_2.C_5H_{10}O_2$ (mol. weight 426), equal to 76.06 per cent. of anhydrous quinine.

Tests.—The aqueous solution should remain clear or become merely turbid (produce not more than a slight precipitate, *U. S.*) on the addition of test solution of barium chloride. The precipitate occasioned by ammonia-water should be readily dissolved on adding an excess of the latter (absence of cinchonine). The salt is tested for fixed impurities by incineration, for ammonia salt by lime or potassa, and for organic impurities, morphine, and other alkaloids by strong sulphuric and nitric acid, as described under QUININÆ SULPHAS.

Other Salts of Quinine.—QUININÆ ACETAS. Acetate of quinine crystallizes in long white needles on mixing hot solutions of sulphate of quinine (17 parts of the effloresced salt) and acetate of sodium (6 parts), and allowing to cool. It is sparingly soluble in cold water, but freely soluble in boiling water and in dilute acids. It contains 84 per cent. of quinine.

QUININÆ ARSENIAS, Arseniate of quinine, $(C_{20}H_{24}N_2O_2)_2.AsH_3O_4.8H_2O$. It is obtained in long white prisms by saturating hot solution of arsenic acid with quinine. The salt is freely soluble in hot but sparingly soluble in cold water, and contains 74 per cent. of quinine and 10.6 per cent. of As_2O_5.

QUININÆ ARSENIS, Arsenite of quinine, $(C_{20}H_{24}N_2O_2)_3As_2O_3.3H_2O$. Adler (1879) proposed the following process: 1 part of silver arsenite (prepared from sodium arsenite and silver nitrate) is mixed with 3 parts of hydrochlorate of quinine, and the mixture digested for a day with 70 per cent. alcohol. On spontaneous evaporation the salt crystallizes in white needles which are slightly soluble in water, but dissolve in 15 parts of cold and 6 of boiling alcohol, in 8 parts of chloroform, in 25 parts of ether, and in 20 parts of benzol.

Quininæ benzoas, Benzoate of quinine, $C_{20}H_{24}N_2O_2.C_7H_6O_2$. It is obtained by dissolving 3 parts of benzoic acid and 8 parts of quinine in hot alcohol and crystallizing. It forms small prisms containing 72.6 per cent. of quinine and requiring at 10° C. (50° F.) 373 parts of water for solution.

Quininæ citras, Citrate of quinine. On saturating a warm solution of citric acid, or on decomposing a solution of quinine hydrochlorate by a solution of sodium citrate acidulated with citric acid, the salt, $(C_{20}H_{24}N_2O_2)_2.C_6H_8O_7.7H_2O$, is obtained. It crystallizes from boiling water in small white prisms which at 12° C. (53.6° F.) require 806 parts of water for solution, and which contain 67.08 per cent. of quinine. The monobasic salt has a strongly acid reaction, and at 15° C. requires 650 parts, and at 100° C. 38.5 parts, of water for solution.

Quininæ lactas crystallizes in silky needles on evaporating a solution of quinine in lactic acid; it is soluble in water and alcohol.

Quininæ phenyl-sulphas, Phenylated (carbolated) sulphate of quinine, $(C_{20}H_{24}N_2O_2)_2SO_3.C_6H_6O.2H_2O$. 10 parts of crystallized sulphate of quinine are dissolved in boiling water or in alcohol, and an equivalent quantity (nearly 1 part) of carbolic acid is added to the solution. The salt contains 75.5 per cent. of quinine, crystallizes in needles, and, after having been washed with ether and recrystallized, has neither the odor nor caustic taste of phenol, is insoluble in ether and chloroform, but dissolves freely in alcohol and in a mixture of 2 volumes of chloroform to 1 of strong alcohol, and is more freely soluble in water than the sulphate, but is nearly insoluble therein in the presence of free phenol.

Quininæ phosphas, $(C_{20}H_{24}N_2O_2)_2H_3PO_4.8H_2O$. Phosphate of quinine may be prepared by dissolving quinine in warm dilute phosphoric acid or by decomposing quinine hydrochlorate with sodium phosphate. It crystallizes from hot water in long silky needles which require at 10° C. (50° F.) 784 parts of water for solution, and contain 75.85 per cent. of quinine.

Quiniæ quinas, Kinate (quinate) of quinia, may be prepared by decomposing kinate of barium with sulphate of quinine and evaporating. H. Collier, who recommended it (1878) for hypodermic use, describes it as being amorphous, of neutral reaction, and freely soluble in water. A convenient strength of the solution is 1 part of the salt in 4 of the liquid.

Quininæ salicylas, Salicylate of quinine, is obtained as a curdy precipitate by double decomposition between hydrochlorate of quinine and salicylate of ammonium. The salt dissolves in 225 parts of water, in 120 parts of ether, and in 20 parts of alcohol, and crystallizes from the alcoholic solution in anhydrous prisms.

Quininæ sulphovinas. Carles (1878) prepares the neutral salt by dissolving 16.6 parts of sulphovinate of sodium and 42.8 parts of quinine sulphate, the former in 200, the latter in 600, parts of alcohol, mixing the solutions, filtering from the precipitated sulphate of sodium, and evaporating. It crystallizes with difficulty in prisms, dissolves in 3 parts of water at 15° C. (59° F.), in a less amount of alcohol, and dissolves likewise in acetic ether and glycerin, but not in strong ether or benzol.

Quininæ tannas, Chininum tannicum. It is produced by adding a solution of 2 parts of tannin in 30 parts of cold water to a solution of 1 part of quinine sulphate in the same amount of water, with the aid of some sulphuric acid. It is a pale-yellow, amorphous, bitter, and somewhat astringent powder, which is slightly soluble in cold alcohol and water and melts when introduced into boiling water. By modifying the process so as to use water at a temperature not exceeding 70° C. (158° F.), using sulphuric acid barely sufficient to dissolve the quinine salt, washing the precipitate with water, and drying it at the ordinary temperature, tasteless tannate of quinine is obtained, according to A. Bernick (1878). In testing it Jobst (1878) recommends a weighed portion to be mixed with milk of lime, the mixture to be dried and exhausted with chloroform, on the evaporation of which the cinchona alkaloids are left behind.

Medical Action and Uses.—Valerianate of quinine, which is very unstable and often falsified, has no special therapeutic virtues which entitle it to an officinal rank. It has been vaunted in *nervous headache* and other *neuralgiæ* of the nerves of the head, face, and chest, and even in *hysteria* and *epilepsy*. When the joint actions of valerian and of quinine are desired, it is better to associate the sulphate of quinine or some other preparation of cinchona—quinetum, for instance—with the oil or the fluid extract of valerian, or to prescribe these substances separately. The *dose* of valerianate of quinine is 1 or 2 grains (Gm. 0.06–0.12).

Tannate of Quinine. Briquet relates that Barriswill, acting on the notion that in cinchona the union of bitter principles with quinine renders the latter less stimulating, combined tannic acid with it, so as to make a sort of artificial cinchona in a small bulk. But as this tannate contains but 40 per cent. of quinine and is very insoluble, the probability is that its action must be feeble. And so Briquet found it on clinical trial. He estimated its power at about one-eighth or one-sixth of that of the sulphate, and found that it dissolved very slowly in the stomach, is a weak febrifuge, cannot be used when large doses of quinine are needed, and indeed is suitable only for nervous affections and as a substitute for bark itself, and, finally, that its dose must be three times as large as that of the sulphate of quinine (*Traité du Quinquina*, 2ème ed., p. 515). Strangely, it afterward came to be recommended for its very lack of bitterness, although it was well known that this quality depended on its slight solubility (Becker, 1880), and several

German physicians lauded its virtues in *whooping cough*, as already stated (see QUININÆ SULPHAS), but overlooked the fact that even better results have been attributed to sulphate of quinine. Probably the internal use of sulphate of quinine and the application of a solution of tannin to the fauces and larynx would best secure the benefits of both medicines.

RANUNCULUS.—CROWFOOT.

Buttercups, E.; *Renoncule*, Fr.; *Hahnenfuss*, G.

Ranunculus bulbosus, *Linné*.
Nat. Ord.—Ranunculaceæ.

Origin.—The bulbous crowfoot grows in grassy fields and along roadsides throughout Europe, and has been naturalized in North America. It flowers from April or May till July or August.

Description.—The stem of this species is about 12 or 18 inches (30–45 Cm.) high, and at its base enlarged to a depressed globular tuber which has the appearance of a tunicated bulb from the broad sheathing bases of the leaf-stalks. The radical leaves are, like the entire plant, hairy, long-petiolate, ternate, the lateral divisions sessile, the terminal one stalked, and all of a subrhomboid shape, three-cleft, toothed and wedge-shaped at the base. The stem-leaves are similar, but on shorter petioles. The flowers are about an inch (25 Mm.) broad, have a reflexed calyx and roundish, wedge-shaped, glossy yellow petals, and produce globular heads of obovate akenes having a short curved beak. The plant is inodorous, but has a strongly acrid taste, which it loses after drying.

Allied Species.—All species of Ranunculus and some allied genera appear to possess more or less the acridity of the above. The following European North American species have occasionally been used:

RAN. REPENS, *Linné*. It resembles the preceding, but is without the bulbous base, produces long runners, has the divisions of the leaves stalked, a spreading calyx, and the akenes margined and furnished with a rather straight beak.

RAN. ACRIS, *Linné*. It differs from the creeping crowfoot in being taller and without runners, and in having the divisions of the leaves all sessile.

RAN. SCELERATUS, *Linné*. It is very variable in size, smooth, with a hollow stem, roundish-reniform, three-cleft, and lobed or toothed leaves, small pale-yellow flowers, and oblong heads of ovate and short pointed akenes.

Constituents.—On distilling fresh crowfoot with water Braconnot (1818) obtained an acrid distillate having a radish-like odor and separating on standing thin glossy scales; the distillate of Ran. repens was not acrid. The acrid principle of Ran. sceleratus was found by O. L. Erdmann (1859) to be a golden-yellow volatile oil, which is readily changed into *anemonin* and *anemonic acid*. (See PULSATILLA.) Basiner (1881) observed that petroleum benzin does not extract this yellow oil from the distillate, but that this is dissolved by benzol and by ether; it may be extracted from the fresh plant by glacial acetic acid, and removed from this solution by agitation with the liquids named; caustic alkalies decompose the oil and destroy its acrid-narcotic action.

Medical Action and Uses.—Several of the numerous species of Ranunculus possess the same qualities as R. bulbosus. In its fresh state every part of the plant contains an acrid juice, and the bruised leaves, stems, and flowers applied to the skin occasion redness and vesication, and, if the action is prolonged, ulceration and even gangrene. It is stated that in Europe this plant was used by beggars to produce sores for the purpose of exciting pity and procuring alms. They cured their sores by means of mullein-leaves (Verbascum thapsus). The oil of R. sceleratus acts as an acrid narcotic, producing, in small doses, stupor and slow respiration, in larger doses also paralysis of the posterior and anterior extremities, and before death general convulsions. After death are found gastritis and cortical hyperæmia of the kidneys (Basiner, *Amer. Jour. of Phar.*, March, 1882, p. 130.) The bruised fresh plant (R. bulbosus) has been applied as a counter-irritant for the relief of chronic affections of the *larynx* and *bronchia*, but more particularly of chronic *rheumatism* and *sciatica*. It may still be so employed where other irritants are not at hand. It is not used internally.

RESEDA.—RESEDA.

Nat. Ord.—Resedaceæ.

Origin and Description.—The well-known *mignonette*, Reseda odorata, *Linné*, is indigenous to Northern Africa, and everywhere cultivated for its sweet-scented flowers, which are employed in perfumery.

Reseda luteola, *Linné.*—Dyer's weed, Weld, *E.;* Herbe jaune, Gaude, *Fr.;* Wau, Gelbkraut, Harnkraut, *G.*—It grows in open places throughout Europe, and has been naturalized to some extent in the eastern part of the United States. It has a conical root of a radish-like odor and taste, and a furrowed, smooth, erect, and branching stem about 3 feet (90 Cm.) high. The leaves are alternate, crowded, oblong-lanceolate, near the base on each side with one tooth, narrowed into a short petiole, or the upper ones sessile, mostly undulate on the margin, light-green and shining. The flowers are in dense, finally erect, and elongated racemes, and have a four-parted calyx and four pale-yellowish petals, of which the lower one is linear and entire and the others larger and cleft. The capsule is depressed ovate, and terminates with four short erect horns. The herb is without odor and has a persistently bitter taste.

Constituents.—According to A. Vollrath (1871), the root of the mignonette contains *sulphocyanide of allyl* (oil of mustard), and it is probable that the same constituent exists in the root of weld. The herb contains *luteolin*, $C_{20}H_{14}O_8$, which was discovered by Chevreul (1830). It is obtained by concentrating the tincture, redissolving the crystalline precipitate in 150 parts of alcohol, diluting the solution with 20 parts of water, boiling, filtering, and crystallizing. It is in yellow, silky, inodorous, volatile needles of a faintly bitter and slightly astringent taste, sparingly soluble in water, slightly soluble in ether, soluble in 37 parts of alcohol, and freely soluble in warm glacial acetic acid, from which it crystallizes on cooling. Sulphuric acid dissolves it with a deep-orange color, acetate of lead precipitates it yellow, and ferric chloride is colored by it green, and afterward red-brown. By fused potassium hydrate it is decomposed into phloroglucin and protocatechuic acid. The seeds contain a green drying oil.

Medical Action and Uses.—R. luteola was formerly considered diaphoretic and alexipharmic; it was employed as an antidote to snake-bites and as a vermifuge.

RESINA, *U. S., Br.*—Resin.

Colophonium, P. G.—*Rosin*, *Colophony*, E.; *Colophane*, Fr.; *Kolophonium*, *Geigenharz*, G.

The residue after the distillation of volatile oil from the turpentine of Pinus palustris and of other species of Pinus.

Preparation.—The manner in which rosin is obtained is briefly described on page 1090. The color depends in a great measure on the degree of heat used in its manufacture. From a communication of I. Zacharias (1877), however, it appears that the amount of resin in turpentine increases with the age of the tree, and that the residuary product of the distillation becomes darker in color, probably in consequence of the greater heat employed in distilling off the oil.

Properties.—Rosin is a very brittle, pulverizable, transparent, or translucent resin, having about the density 1.070–1.080, breaking with a glossy and shallow conchoidal fracture, nearly tasteless and of a faint terebinthinate odor. It varies in color from a pale-amber to a dark red-brown, and is distinguished in commerce by the shade of its color, the darkest being called *black rosin.* For pharmaceutical purposes the amber-colored variety is used. *White rosin* is a light-colored variety which is rendered opaque by containing water, on the gradual evaporation of which it becomes translucent. It dissolves readily in ether, chloroform, alkalies, and in the volatile and fixed oils; at 60° C. (140° F.) it is slowly soluble in its own weight of alcohol or of glacial acetic acid. It softens at the heat of a water-bath, melts completely above 100° C.—some varieties at about 135° C. (275° F.)—and at a higher heat burns with a dense yellow and sooty flame. When heated to above 200° C. (392° F.) it may be distilled, apparently unchanged, with a current of superheated steam, but on dry distillation it yields *rosin oil*, which contains *colophene* (see page 1091), various hydrocarbons, and other products holding rosin in solution. Among the lower-boiling fractions of this rosin oil Kelbe and Warth (1882) have recognized caproic, isobutyric, œnanthylic, and other acids of the formula $C_nH_{2n}O_2$, and Renard isolated *amylene*, C_5H_{10}, boiling near 40° C., *hexylene*, C_6H_{10}, boiling near 70° C., and several other hydrocarbons. When rosin is mixed with lime and subjected to distillation volatile oils are obtained, from which, by fractional distillation, Fremy isolated *resinone*, $C_{10}H_{18}O$, which is limpid, readily inflammable, and boils at 78° C. (172.4° F.), and *resineone*, which is thicker, boils at 148° C. (298.4° F.), and seems to have the composition $C_{30}H_{48}O$.

Composition.—According to Maly (1861, 1864), rosin is the anhydride of *abietic acid*, $C_{44}H_{64}O_5$, and is converted into the acid by agitation with warm diluted alcohol.

Flückiger (1867) obtained in this way from 80 to 90 per cent. of the weight of the rosin. By treatment with strong ammonia-water, passing through muslin, and decomposing the jelly-like mass with hydrochloric acid, Emmerling (1879) obtained it as a snow-white powder, and Kelbe (1880) in rather long triclinic prisms by crystallizing it from glacial acetic acid. Abietic acid melts, without losing weight, at 165° C. (329° F.) (Maly, Kelbe); other chemists observed lower melting-points. The acid is often in irregular, glassy, crystalline points or white scales, has in alcoholic solution an acid reaction, dissolves in ether, benzol, wood-spirit, chloroform, and carbon bisulphite, and yields with bases amorphous compounds. The *pinic* and *sylvic acid* of Unverdorben (1825, etc.), Siewert (1859), and others are regarded by Maly as impure abietic acid, but it is not unlikely that, in addition to this one, other acids may be obtained from colophony of different origin.

Off. Prep.—Ceratum (Emplastrum) cantharidis, *U. S., Br.;* Cerat. extr. cantharidis, *U. S.;* Cerat. (Unguent.) resinæ, *U. S., Br.;* Charta epispastica, Empl. calefaciens, *Br.;* Empl. hydrargyri, *U. S.;* Empl. picis, *Br.;* Empl. resinæ, *U. S., Br.;* Empl. saponis, Unguentum terebinthinæ, *Br.*

Medical Action and Uses.—Resin is not prescribed internally. Sometimes, however, the fumes of boiling resin have been used to impregnate the air breathed by persons suffering from chronic *bronchial catarrh* unattended with fever. It is chiefly employed with essential oils to render plasters adhesive and stimulating.

RESINA COPAIBÆ, *U. S.*—Resin of Copaiba.

Acidum copaibicum.—*Copaivic acid*, E.; *Résine de copahu*, *Acide copahuvique*, Fr.; *Copaivaharz*, *Copaivasäure*, G.

Preparation.—The resin remains behind on evaporating copaiba or on distilling from it the volatile oil. (See Oleum Copaibæ. For other processes of preparing the resin see page 505.)

Properties.—The resin is amorphous, of a yellowish or brownish-yellow color, brittle, of a slight odor of copaiba, and is soluble in alcohol, amylic alcohol, ether, benzol, volatile oils, and carbon disulphide. The alcoholic solution has an acid reaction and a somewhat bitter and acrid taste. The resin is a mixture, and consists, according to the variety of copaiba used, of copaivic or metacopaivic acid, mixed with more or less of neutral resin. The crystallized copaivic acid of commerce is usually prepared from gurjun balsam (see page 505.)

Medical Action and Uses.—These have been sufficiently indicated under Copaiba. Resin of copaiba has been administered in the *dose* of from 5 to 15 grains (Gm. 0.30–1.00), but more frequently in emulsion. One mode of preparing the latter is to take 3 ounces of the resin, softened by the addition of half its bulk of rectified spirit, and rub it down with 4 ounces of compound tragacanth powder (Br. Ph.) mixed with 4 pints of water. 1 ounce of this mixture contains 12 or 13 grains of the resin, and is given three times daily. Another formula is the following: Resin of copaiba 15 grains; compound powder of almonds 30 grains; water to f℥j.

RESINA DRACONIS.—Dragon's Blood.

Sang-dragon, Fr.; *Drachenblut*, G.

The resin obtained from the fruit of Dæmonorops (Calamus, *Willdenow*) Draco, *Blume.* *Nat. Ord.*—Palmæ.

Origin and Production.—This palm has a thin stem, which is sometimes 300 feet (90 M.) long, and climbs upon trees by means of strong spines situated on the petioles. Its small, globular-ovate, scaly fruits grow in dense panicles, and are covered with a resin which exudes and hardens upon their surface. By beating and shaking the fruit in a bag the resin breaks off, is mechanically separated from the fruit, softened in the sun or by boiling water, and formed into sticks or cakes. Subsequently the fruit is bruised, boiled with water, and an inferior resin collected in cakes. The palm is indigenous to Borneo and Sumatra, and grows in other of the East Indian islands.

Properties.—Dragon's blood is seen in commerce occasionally in the form of irregular grains, or more frequently in cakes or irregular masses, and in cylindrical sticks which are about 12 inches (30 Cm.) long and ½ inch (12 Mm.) or more thick, and are wrapped in palm-leaves. It is of a dark red-brown color on the surface, of a brighter red, glossy, and somewhat porous internally, transparent in very thin splinters, and breaks with a resinous but irregular fracture, caused by the fruit-scales and other impurities which are always present—in largest proportion usually in cake dragon's blood. Alcohol, amylic alcohol, benzol, and chloroform dissolve the resin readily, leaving the impurities behind; ether and oil of turpentine dissolve it less freely, and it is insoluble in petroleum benzin. It is inodorous, but when heated has a slight agreeable odor resembling that of benzoin; it is faintly sweetish, otherwise nearly tasteless, and when masticated becomes pulverulent.

Composition.—Dragon's blood contains a little fat, and is free from benzoic and cinnamic acid, as was shown by Hempel (1846). It consists of a peculiar resin, for which Johnston (1839) determined the formula $C_{20}H_{20}O_2$. By dry distillation Glénard and Boudault (1844) obtained a dark-red oil containing *dracyl* = toluol, C_7H_8, and *draconyl* = styrol, C_8H_8. Hlasiwetz and Barth (1865) obtained the following decomposition-products by fusing the resin with potassa: phloroglucin, a body giving a red reaction with iron salts, and paraoxybenzoic, protocatechuic, and benzoic acids—products which are likewise obtained by treating benzoin in the same manner.

Other Varieties.—On wounding the stem of Pterocarpus Draco, *Linné*, a papilionaceous tree of the West Indies, or the stem of Dracæna Draco, *Linné*, a liliaceous tree of the Canary Islands, exudations are obtained which resemble the dragon's blood described above. The dragon's blood of Socotra is the product of Dracæna Ombet, *Kotschy*, and is sent to Arabia under the name of *katir*. These varieties are rarely seen in our market.

Uses.—Dragon's blood is occasionally used as an addition to dentifrices, and was formerly an ingredient of several plasters. At present it is chiefly used for imparting a red color to spirit varnishes and for staining horn or wood; a *mahogany stain* is obtained by dissolving 1 part each of dragon's blood and aloes in 15 or 16 parts of alcohol.

Medical Action and Uses.—Dragon's blood, or sang-dragon, has little or no virtue besides its striking name. A certain degree of astringency probably led to its use in former times in diarrhœa, slight hæmorrhage, etc. It is occasionally used as an addition to dentifrices.

RESINA ELASTICA.—Caoutchouc.

Gummi elasticum.—India-rubber, E.; *Caoutchouc*, Fr.; *Kautschuk*, *Federharz*, G.

Origin.—Caoutchouc exists in the milk-juice of a very large number of plants in the form of minute or larger granules, frequently associated with starch-granules, and kept in suspension by mucilage. Plants capable of yielding caoutchouc are found in all parts of the world, and belong mostly to the natural orders of Urticaceæ, Euphorbiaceæ, Apocynaceæ, and Asclepiadaceæ, but only species growing in the tropics yield the product in large quantity.

Siphonia (Jatropha, *Linné filius*) elastica, *Persoon*, s. Hevea guianensis, *Aublet* (Euphorbiaceæ). This is a handsome tree about 60 feet (18 M.) high, with alternate trifoliate leaves, the leaflets being obovate, about 4 inches (10 Cm.) long, dark-green and glossy above and whitish-green beneath. It is a native of Guiana and Northern Brazil, and yields the Para rubber, which is regarded as one of the best varieties. Manihot Glaziovii, *Müller*, is the source of Ceara rubber; Hancornia speciosa, *Gomez* (Apocynaceæ), yields Mangabeira rubber. Similar products are obtained from Hevea (Siphonia, *Kunth*) brasiliensis, *Müller*, Hevea discolor, *Müller*, and other euphorbiaceous trees of Brazil, and in Central America from Castilloa elastica, *Cervantes*, Cast. Markhamiana, *Collins* (Artocarpeæ), and others.

Ficus (Urostigma, *Miquel*) elastica, *Roxburgh* (Urticaceæ, Artocarpeæ). It is a handsome East Indian tree, and is not unfrequently seen here in hot-houses. It has large, leathery, oval, and entire leaves, which are dark-green and glossy above. Ficus indica, *Linné*, F. religiosa, *Linné*, and several other species also furnish caoutchouc which is considered inferior to that of the preceding and following species:

Urceola elastica, *Roxburgh* (Apocynaceæ). It is a large climbing shrub indigenous to the Malayan Archipelago, and has opposite, ovate-oblong, and pointed leaves. Together with Urceola (Chavanesia, *De Candolle*) esculenta, *Bentham*, and other species, it yields Penang and Borneo caoutchouc, while Chittagong caoutchouc is prepared from Willughbeia edulis, *Roxburgh*, and allied Apocynaceæ.

Landolphia gummifera, *Lamarck* (Apocynaceæ), of South-eastern Africa, Landolphia florida, *Bentham*, Urostigma Vogelii, *Miquel* (Artocarpeæ), and other plants of Western Africa, yield also caoutchouc.

Preparation.—In South America the white milk-juice, obtained from incisions made through the bark, is dried upon clay moulds which are dipped into the liquid and suspended over a fire; the dipping is repeated until the layer of caoutchouc has the desired thickness, when it is removed from the mould. In India the juice is allowed to dry in masses or is formed into balls.

Description.—Occasionally the natural exudation is seen as a white or yellowish milk-like liquid, having a cream-like consistence and an unpleasant odor; it contains about 32 per cent. of caoutchouc. This is more generally met with either in the form of hollow clavate or bottle-shaped pieces, or in layers 2 or 3 inches (5 or 8 Cm.) thick, externally of a blackish or dark-brown color, and internally pale-brownish or whitish, and somewhat porous. In this condition it is tough and very elastic, the elasticity being increased at a somewhat elevated temperature, and considerably lessened near the freezing-point, though caoutchouc does not thereby become brittle. Its density varies between .92 and .96. When heated to 125° C. (257° F.) or a little higher caoutchouc melts, but on cooling remains soft and tar-like, and ultimately congeals to a brittle mass; heated to a still higher temperature, it is decomposed, and in the open air burns with a luminous sooty flame.

Caoutchouc is insoluble in water and in dilute acids and alkalies; it softens and swells when treated with hot alcohol or with amylic alcohol, and dissolves to a soft jelly-like mass in carbon bisulphide, stronger ether, oil of turpentine, and other hydrocarbons, notably in petroleum benzin and in the empyreumatic oils obtained on the destructive distillation of caoutchouc; it dissolves more readily and completely in chloroform, and may be melted together with fats and fixed oils. Rubber-tubing is apt to become brittle by use and on exposure—a change which Mareck (1881) found can be prevented by keeping the tubing under water, which is to be occasionally renewed; the outer layer of the rubber thereby assumes a fatty appearance, becomes lighter, then darker, and is improved for practical purposes. A strong solution of caoutchouc or an ammoniacal solution of shellac may be employed as a *cement* for fastening rubber upon other material.

When finely divided, mixed with sulphur, and afterward heated *vulcanized caoutchouc* is obtained; this, however, is more generally prepared by softening or dissolving caoutchouc and combining it with sulphur. Vulcanized rubber is insoluble in the ordinary solvents of caoutchouc, and its elasticity is not materially affected by a low temperature. Compounds of caoutchouc and sulphur, with which tar, white lead, chalk, or other substances have been incorporated, form *hard rubber* and *ebonite*, which at an elevated temperature may be moulded or rolled into sheets.

Composition.—Caoutchouc is a hydrocarbon, $C_{20}H_{32}$, and on destructive distillation yields *caoutchoucin*, which consists of two or more polymeric volatile oils, C_9H_8.

Pharmaceutical Uses.—As an addition to plasters (see page 564).

Medical and Surgical Uses.—The utility of this substance in medicine depends chiefly upon its elasticity and impermeability to air and liquids, and, in the vulcanized condition, upon the numerous mechanical purposes which it subserves. Its elasticity, especially when woven into textile fabrics, adapts it to exert a modified pressure upon various parts of the body, limiting their enlargement and their movements, as in cases of *varicose veins*, *pendulous abdomen*, *hydrocele*, *varicocele*, *prolapsus ani*, *umbilical hernia*, etc. The same fabric and thin sheets of caoutchouc are very commonly used to protect bedding and clothing from the discharges of the sick, and, when worn next the skin, to prevent the exhalation of the perspiration, and thus keep the skin constantly moist or to restrain the evaporation of liquids applied to it. In this manner caoutchouc has been extensively used in treating *eczema* and *psoriasis* and various cutaneous diseases, as well as *burns*, *ulcers*, and other analogous lesions, and in protecting parts liable to *neuralgia* or *rheumatism* from the influence of vicissitudes of weather. It is unnecessary to enumerate the various surgical instruments constructed with this material in its more or less flexible and elastic and its hard or vulcanized condition—the bougies, catheters, pessaries, nipple-shields, specula, syringes, stomach, rectal, drainage, and other tubes, and countless instruments which combine lightness, firmness, durability, insusceptibility to corrosion, and at the same time cheapness, in a degree unequalled by any metal. A similar statement might be made of numerous articles of surgical apparatus, orthopædic and others, including artificial ears, noses, hands, etc. Caoutchouc can scarcely be used for any strictly medicinal purpose; even the application of it dissolved in chloroform to prevent the development of small-pox pustules is really mechanical in its action, and, moreover, is less efficient than it was claimed to be.

RESINA JALAPÆ, *U. S., P. G.*—Resin of Jalap.

Jalapæ resina, Br.—*Résine de jalap*, Fr.: *Jalapenharz*, G.

Preparation.—Jalap, in No. 60 powder, 100 parts (20 oz. av.); Alcohol, Water, each a sufficient quantity. Moisten the powder with 25 parts (5 oz. av. or 5$\frac{7}{8}$ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 200 parts (40 oz. av. or about 2$\frac{3}{4}$ pints) of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the tincture is reduced to 40 parts (8 oz. av.), and add the latter, with constant stirring, to 900 parts (180 oz. av. or 10$\frac{3}{4}$ pints) of water. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of water. Place it upon a strainer, and, having pressed out the liquid, dry the resin with a gentle heat.—*U. S.*

With slight modifications these directions are the same as in the former Pharmacopœia. The alcoholic tincture of the jalap containing the resin in solution is concentrated by distillation, and this liquid while still warm poured into water, stirring continually, so as to bring nearly all particles of the resinous matter in direct contact with water, whereby the solutions of those constituents which are soluble in water is facilitated. After repeated washings with fresh portions of water the resin is collected and dried. By this treatment water removes sugar and some other principles of jalap, which are also soluble in water, and which possess some medicinal activity (see p. 643).

The British Pharmacopœia directs 1 part of water for 2 parts of jalap to be added to to the percolate, from which nearly the whole of the alcohol may be recovered by distillation. The residue while hot is poured into an open dish and allowed to cool, when the liquid portion is decanted, the resin washed several times with hot water, and dried.

The German Pharmacopœia directs the jalap to be exhausted by digestion with alcohol, the tincture to be concentrated, and the resinous residue to be repeatedly washed with warm water as long as this takes up coloring matter. The resin may also be obtained by depriving jalap of its principles soluble in hot water, drying and powdering the residue, and exhausting it with alcohol. Good jalap yields about 15 per cent. of resin (not less than 12 per cent. *U. S.*).

Properties.—Resin of jalap is in yellowish-brown or brown masses or fragments, which break with a glossy resinous fracture and are translucent on the edges. By repeated solution in a little alcohol and precipitation with water it may be obtained nearly white. It is very brittle, and readily reduced to powder, varying in color between yellowish- and light-brown; it has a slight sweetish odor and a somewhat acrid taste, and is entirely soluble in alcohol, and insoluble in carbon disulphide and oil of turpentine. Ether dissolves only a small portion of it, amounting to between 5 and 10 or sometimes 12 per cent., as ascertained by C. D. Farwell (1878); on the evaporation of the ethereal solution a soft resinous mass is left, which may be dissolved in potassa solution, forming a reddish-brown liquid, and is precipitated again on the addition of an acid. The resin, which is insoluble in ether, is the *convolvulin* of W. Mayer, and is soluble in potassa solution, but not precipitated on the addition of an acid. (The chemical nature of this resin and its relation to allied resins have been explained on pp. 846, 847.)

Tests.—Resin of jalap should diminish but little or not at all in weight on being exposed for some time to the heat of a water-bath (absence of water). On being triturated with water it should lose nothing in weight, and the liquid should not become colored, showing that it has been well washed with water. To ether and to potassa solution it should have the behavior described above. Adulterations with other resins are proved by the amount soluble in ether, which should not exceed 10 per cent., or, if they are insoluble in ether, by the precipitate occasioned with acids in the potassa solution. The presence of guaiacum resin is indicated by a green or blue color produced with strong nitric acid or with tincture of chloride of iron. An adulteration with rosin may be detected by the solubility in oil of turpentine, and the presence of aloes manifests itself by its bitter taste and the production of picric acid when treated with nitric acid. "1 part of resin of jalap should dissolve in 5 parts (50 parts, *U. S.*) of warm ammonia-water; on cooling, the solution should not gelatinize (absence of colophony), and should remain clear after being supersaturated with an acid."—*U. S., P. G.* The last part of this test is correct only for that portion of jalap resin which is insoluble in ether; but the pharmacopœial resin, though completely soluble in about 8 parts of ammonia-water, yields with acids a precipitate which is again soluble in ammonia. The ammoniacal solution of the resin, when carefully evaporated to dryness at a moderate heat, leaves a residue which is soluble in water.

Pharmaceutical Preparations.—Sapo jalapinus, *P. G.* 4 parts each of resin of jalap and medicinal (white Castile) soap are dissolved in 8 parts of alcohol spec. grav. 0.894, and the solution evaporated with constant stirring to the consistence of a pill mass weighing 9 parts. This preparation is of a brown-yellow color, is soluble in alcohol, and yields with about 10 parts of water a nearly clear solution, which becomes somewhat cloudy, but does not separate any resin.

Pilulæ jalapæ, *P. G.* Mix jalap soap 3 parts and powdered jalap-root 1 part. Each pill is to weigh 0.10 Gm. and to be dusted with lycopodium.

Tinctura resinæ jalapæ. Jalap resin 1 part, alcohol 10 parts.—*P. G.* 1872.

Off. Prep.—Pilula scammonii comp., *Br.*

Medical Action and Uses.—This preparation contains all or nearly all the purgative elements of jalap, and may be prescribed for the same purposes in doses of from 3 to 6 grains (Gm. 0.15–0.30), or, combined with other purgatives, in even smaller doses. A valuable formula is the following: ℞. Resinæ jalapæ gr. xxx; Pulv. lycopodii gr. x; Saponis medicinal. gr. xc; Amygd. dulc. excort. gr. cxx.—M. S. A. Divide into 120 pills. Two of these pills produce one copious stool, and seven or eight pills as many liquid evacuations.

RESINA PODOPHYLLI, *U. S.*—Resin of Podophyllum.

Podophylli resina, Br.; *Podophyllinum*, P. G.—*Resin of May-apple*, E.; *Résine de podophylle*, Fr.; *Podophyllumharz*, G.

Preparation.—Podophyllum, in No. 60 powder, 100 parts (20 oz. av.); Hydrochloric Acid 1 part (88 grains or 78 minims); Alcohol, Water, each a sufficient quantity. Moisten the powder with 40 parts (8 oz. av. or 9¾ fluidounces) of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for 48 hours. Then allow the percolation to proceed, gradually adding alcohol, until 150 parts (30 oz. av. or about 2 pints) of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the tincture is reduced to the consistence of honey, and pour it slowly, with constant stirring, into 100 parts (20 oz. av. or 19¼ fluidounces) of water, previously cooled to a temperature below 10° C. (50° F.), and mixed with the hydrochloric acid. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold water. Spread it in a thin layer upon a strainer, and dry the resin by exposure to the air in a cool place.—*U. S.*

This process differs from that of the U. S. P. 1870 mainly in this, that the tincture is more concentrated by distilling off nearly the whole of the alcohol, that this residue is precipitated by cold water, and that the precipitate is dried in a cool place. The low temperature directed in the precipitation and drying is also the chief distinction from the process of the British Pharmacopœia, which permits the resin to be dried on a stove.

On pouring the concentrated tincture of podophyllum into acidulated water the extractive matters remain in solution while the resin is precipitated. The addition of hydrochloric acid appears to exert no action on the product, and to be useful merely in hastening the deposition of the resin from the aqueous liquid. Both the British and French Pharmacopœias omit the hydrochloric acid. The yield is between 4 and 5 per cent. of the weight of podophyllum used; by exhausting the rhizome with alcohol of specific gravity .930, G. H. C. Klie (1877) claimed to have obtained as much as 7¼ per cent.

Properties.—The color of resin of podophyllum, when pure, is grayish-white, with a slight tinge of yellow. To obtain it of this shade it is necessary that the resin be precipitated in the cold and dried at a temperature not exceeding 35° C. (95° F.). If a higher heat is used it turns darker, and finally deep-brown. If precipitated in the presence of alum or other earth salt, the resin is of a more decided yellow color. It dissolves to a limited extent in carbon disulphide; from 15 to 20 per cent. of it is soluble in ether, and about 80 per cent. is dissolved by boiling water and reprecipitated on cooling; a small portion of the resin, however, remains in solution in the water, and this solution has a bitter taste, acquires a brown color on the addition of ferric chloride, and becomes opalescent and yellow with basic lead acetate, the mixtures gradually separating orange-red floccules. Alkaline liquids dissolve the resin readily, yielding deep-yellow, afterward brown-yellow, solutions, and deposit nearly the whole of it on being supersaturated with an acid. According to Power, podophyllum resin becomes soft at 120° C. (248° F.), and is completely melted at 124° C. (255° F.). Sulphuric acid colors it intensely yellow, the color changing to purplish and to brown on the addition of a trace of nitric acid. Among the oxidation-products by nitric acid are oxalic acid and an amorphous yellow substance.

Composition.—F. B. Power (1877) observed that the largest portion of the resin yields yellow and orange-yellow precipitates with acetate and subacetate of lead from an alcoholic solution, and after removing the lead an acid resin, which may be called *podophyllinic acid*, is obtained, to which the color reactions described above are due. Its alcoholic solution is colored dull-green by ferric chloride, and its aqueous solution reduces cupric oxide in alkaline solution. Fused with potassa, it yields *protocatechuic acid*, but no resorcin. As it is only partly soluble in ether, it consists probably of two acids. The *neutral resin*, which is not precipitated by lead, shows none of the above characteristics, but is likewise separable into one portion soluble and one portion insoluble in ether. The officinal resin contains also a little fatty matter, and yields a small proportion of ash, consisting chiefly of sodium and potassium salts. Podwissotzki (1880) obtained from podophyllum resin yellow needles resembling quercetin, a green oil, a crystalline fat acid, podophyllic acid (without activity, soluble in hot water), and two poisonous principles: one of these, *podophyllotoxin*, is white, crystallizable, very bitter, faintly acid, sparingly soluble in water, freely soluble in alcohol, and by treatment with ammonia yields podophyllic acid and *picropodophyllin*. The latter is intensely bitter, crystallizable, nearly insoluble in water, soluble in alcohol, and freely soluble in chloroform, ether, and acetic ether.

Medical Action and Uses.—The medicinal properties of this preparation have been sufficiently set forth elsewhere. (See PODOPHYLLUM.) Its action and uses closely resemble those of the resin of jalap. The following formula is convenient for the relief of habitual *constipation:* ℞. Resin. podophyll., Ext. belladon. āā gr. iv ad gr. vj; Ext. nucis vomicæ alcoholic gr. viij. M. et in pil. No. xij divid. S. One after dinner.

RESINA SCAMMONII, *U. S.*—RESIN OF SCAMMONY.

Scammoniæ resina, Br.—*Résine de scammonée*, Fr.; *Scammoniaharz*, G.

Preparation.—Take of Scammony, in No. 60 powder, 100 parts (4 oz. av.); Alcohol, Water, each a sufficient quantity. Digest the scammony with successive portions of boiling alcohol until exhausted. Mix the tinctures, and reduce the mixture to a syrupy consistence by distilling off the alcohol. Then add the residue to 250 parts (10 oz. av. or 9⅝ fluidounces) of water, separate the precipitate formed, wash it thoroughly with water, and dry it with a gentle heat.—*U. S.*

Take of scammony-root, in coarse powder, 8 ounces; rectified spirit a sufficiency; distilled water a sufficiency. Digest the scammony-root with 16 fluidounces of the spirit in a covered vessel at a gentle heat for 24 hours; then transfer to a percolator, and when the tincture ceases to pass add more spirit, and let it percolate slowly until the root is exhausted. Add to the tincture 4 fluidounces of the water, and distil off the spirit by a water-bath. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash this several times with hot water, and dry it on a porcelain plate with the heat of a stove or water-bath.—*Br.*

Prof. Markoe (1877) showed that the alcoholic extract of scammony yields to water only 2 per cent. of soluble matter, which is removed by washing, as directed in the first formula. The French Codex directs the alcoholic solution to be treated with animal charcoal for the purpose of removing most of the coloring matter. The yield of resin varies with the quality of scammony employed. The British Pharmacopœia permits the resin to be prepared from scammony or from scammony-root by washing the alcoholic extract with hot water; the root yields 5 to 5½ per cent. of resin.

Properties.—Scammony resin is of a brownish color, or yellowish after treatment with animal charcoal. It is brittle, of a resinous, glossy fracture, translucent on the edges, and nearly tasteless, but has a slight sweetish odor, which is stronger and peculiar, somewhat like leather, when prepared from the root. It differs from scammony in not forming an emulsion with water, and in being completely soluble in oil of turpentine and in ether. It dissolves in alcohol, ammonia-water, and warm potassa solution, and when this alkaline liquid is supersaturated with an acid it remains transparent and does not produce a precipitate. The resin softens at about 120° C. (248° F.) and fuses near 150° C. (302° F.).

Tests.—The behavior to solvents, as described, distinguishes scammony resin from most other resins. If adulterated with guaiacum, its alcoholic solution would render the fresh-cut surface of a potato blue, and it would acquire a green or blue color on the addition of chlorine-water or ferric chloride.

Constituents.—Except the coloring principle, scammony resin consists wholly of *scammonin*, which in its pure state is white, inodorous, and tasteless. F. Keller (1857) ascertained it to be the anhydride of *scammonic acid*, which is soluble in water, and on being boiled with dilute acids is converted into sugar and *scammonolic acid*. According to Spirgatis (1860), these compounds have the same composition, and are identical with jalapin, jalapic acid, and jalapinolic acid (see page 847).

Off. Prep.—Extr. colocynth. comp., *U. S.*, *Br.;* Mistura scammonii. Pil. scammonii comp., *Br.*

Medical Action and Uses.—The action of resin of scammony does not differ in kind, but only in degree, from that of scammony itself, but the resin is about twice as strong as scammony. In the dose of about 8 grains (Gm. 0.50) it occasions colic and watery stools, very much as jalap does, but is more apt than the latter to excite rectal irritation. Being nearly insipid, it may conveniently be given to children. It is seldom used alone, but is frequently associated with calomel, jalap, etc. in cases of *constipation* and abdominal *dropsy*, and also as a vermifuge for *lumbricoid ascarides*.

It may be prescribed in doses of from 5 to 15 grains (Gm. 0.30–1), and should be made into an emulsion with milk, almonds, mucilage, or other demulcent, and sweetened. The following formula is convenient: ℞. Resin. scammon. gr. viij; rub with Sacch. alb. gr. xlv; mix gradually with Lact. vaccin. f℥iv; Aq. laurocerasi f℥j. M. S. One or two tablespoonfuls every hour.

RESORCINUM.—Resorcin.

Resorcinol, E.; *Résorcine*, Fr.; *Resorcin*, G.

Formula $C_6H_4(HO)_2$. Molecular weight 110.

Origin.—Resorcin was discovered by Hlasiwetz and Barth (1864) on melting galbanum, ammoniac, or guaiacum resin with potassa. It is produced in a similar manner from asafetida, sagapenum, acaroid resin, and from phenol-sulphonic acid and other derivatives of phenol; likewise on the dry distillation of extract of Brazil-wood.

Preparation.—The alcoholic extract of ammoniac or galbanum is carefully fused with three times its weight of potassa until the mass has become homogeneous, when it is dissolved in water, the solution slightly acidulated with sulphuric acid, filtered, and agitated with ether. On evaporating the ether, impure resorcin is left; the volatile fatty acids present are combined with baryta, and the resorcin is dissolved by ether and further purified by distillation and recrystallization.

A cheaper process starts with benzol, which by strong sulphuric acid is first converted into benzol-disulphonic acid; on melting the potassium salt of this acid with potassa it is decomposed into potassium sulphite and resorcin.

Properties.—Resorcin crystallizes in colorless, short, rhombic prisms or plates, which are neutral to test-paper, inodorous, and have a unpleasantly sweet and somewhat acrid taste. It melts at 118° C. (244.4° F.) and boils at 276.5° C. (530° F.). On exposure to air it becomes reddish. It is freely soluble in water (in 1½ parts), in alcohol and ether, less freely soluble in chloroform, carbon disulphide, and benzol, and requires about 20 parts of fixed oil for solution. It burns with a bright flame, without leaving any residue. Its solution is transiently colored violet by chlorinated lime; with ferric chloride it becomes purplish-black, the color disappearing by ammonia; with copper sulphate and ammonia the solution turns black. Resorcin precipitates metallic silver from ammoniacal solution of silver nitrate. Its solution in ammonia when exposed to the air turns rose-red and brown, and, when heated, green and blue, this color being changed to red by acids. The aqueous solution of resorcin yields with bromine-water needles of tribromresorcin, $C_6Br_3H_3O_2$.

Tests.—When carefully heated in a test-tube, resorcin should melt to a clear colorless liquid; on increasing the heat it should volatilize, producing white vapors, and leaving no residue or merely a minute amount of charcoal. Heated in a porcelain or platinum dish, it should volatilize without residue.

Physiological Action.—In 1880, Andeer described the severe toxical phenomena occasioned by resorcin in animals, and concluded that it acts primarily upon the spinal and then upon the cerebral nervous centres. It stimulates and then paralyzes these organs, and occasions somnolence and collapse (*Einleitende Studien über das Resorcin*). Afterward the experiments of Dujardin-Beaumetz and Callias (*Bull. de thérap.*, ci. 13) showed that when given to animals resorcin occasions tremor, and then epileptiform convulsions, which come on and also subside rapidly; that it does not seem at first to impair consciousness or general sensibility; and that recovery from its effects is rapid. Fatal doses excite violent and prolonged convulsions; the eyes are fixed and insensible to light and the pupils dilated; general sensibility is obtunded and afterward destroyed; spasm of the diaphragm occurs; the chest is rigidly contracted, the breathing hurried and shallow; the heart beats rapidly and feebly, and the capillaries become distended; respiration is suspended before the heart's pulsation in the act of death. Among the symptoms is neither vomiting, purging, nor urination. According to Dujardin-Beaumetz and Callais, during the spasms the temperature of the animal is raised to 104° or 105° F., but Andeer states that at the point of death it may fall to 86° F. After the animal's death, according to Andeer, no characteristic lesions are found in the nervous system; but other experimenters state that the cerebro-spinal centres are intensely congested, especially at their upper portion. It is agreed by all that the lungs and the right side of the heart are distended with blood; the coagula are described as dark, with light stripes, and containing uric acid. No definite change is met with in the corpuscles. Resorcin is excreted with the urine, rendering it dark or almost black.

In the course of 2 hours Andeer took about 150 grains (Gm. 10) of resorcin dissolved in a quart of water. He was found fast asleep, but had no recollection of how he fell asleep. Subsequently, he took the same quantity of the drug dissolved in a pint of water in the space of a quarter of an hour. He perceived flashes before his eyes, his sight grew dim, his eyelids heavy; his hearing and smell were completely obtunded; his mouth was pasty, and his tongue thick. He fell to the floor bathed in a cold sweat, and his feet also were cold. Then convulsions came on, respiration grew panting and sighing, and later spasmodic flexion of the limbs occurred, with opisthotonos. After five hours of treatment consciousness returned, but no memory of the attack remained. On the following day restoration to health was complete. Dr. Murrell relates (*Times and Gaz.*, Oct. 1881, p. 486) the case of a woman who took 120 grains of resorcin, and almost immediately became giddy, and then insensible. She was pale and cold, drenched in sweat; the pupils were equal, and the pulse and chest movements almost imperceptible; the limbs were relaxed; there was no reflex action and no spasm; the axillary temperature was 95° F. Recovery took place within 24 hours. The first urine she passed presented an olive-green color. The occurrence of convulsions in the one case and their absence in the other case deserve notice.

Resorcin has the power of retarding or preventing fermentation and putrefaction. A solution of 1 per cent., it is said, will maintain the acidity of normal urine for a month (Andeer). But, according to Platt, the antiseptic power of resorcin is greatly inferior to that of carbolic acid (*Amer. Jour. of Med. Sci.*, Jan. 1883, p. 89). Nevertheless, it is certain that a solution of the strength just mentioned has preserved from decomposition such substances as pancreas, blood, and urine, and arrested commencing putrefaction in them. Andeer claims not only that it is equal to carbolic and pyrogallic acids in antiseptic virtues, but that it has over them the great advantage of not acting poisonously when locally applied, and also of not attacking metallic instruments. It promotes healing by the first intention of punctured or incised wounds, and when applied to artificially-infected wounds of the cornea, conjunctiva, gums, etc. it destroys micro-organisms and promotes the healing of such wounds. A 1 or 2 per cent. solution does not irritate the integuments nor cause any eruption. It is as well tolerated as any other antiseptic by the respiratory tract.

Medical Uses.—According to Lichtheim (*Monthly Abst.*, Dec. 1880, p. 120; *Bull. de thérap.*, ci. 139), if from 30 to 45 grains of this substance are given to a patient in high *fever*, almost immediately a sort of intoxicated excitement takes place, either wild or muttering, with tremor of the hands. It, however, is transient, and is followed by profuse diaphoresis, with subsidence of the pulse and temperature. It is said to produce such effects more quickly than salicylic acid or quinine, but that their duration is brief. It is not claimed that this medicine shortens the duration of idiopathic fever or of serious inflammations; and one is therefore at a loss to conjecture why the sick should be made the subjects of physiological experiments with it. In typhoid fever it has been used without advantage (Dujardin-Beaumetz, *loc. cit.*), and Brieger judged it similarly in this as well as in inflammatory diseases (*Zeitschrift f. klin. Med.*, v. 146). The former of these tested it in acute articular rheumatism, and found that it was not comparable with salicylic preparations. The statements made of its efficacy in puerperal and periodical fevers and erysipelas have not been confirmed. Some laud it in all the various forms of functional gastric disease, which seem to be more common in Germany than elsewhere (catarrh, dilatation, etc.), while Andeer does not so much depend upon it to check gastric fermentation as to promote the healing of abrasions and ulcers of the mucous membrane of the stomach, and to moderate the destructive process in cancer of that organ (*Zeitschrift f. klin. Med.*, ii. 297). It has been used with more or less advantage to deodorize and disinfect fetid stools.

Topically, however, resorcin is more distinctly useful. A solution of the strength of from 1 to 3 per cent. has been found efficient in moderating mucous *profluvia* from the nostrils, ears, vagina, urethra, etc., and in removing their fetor. It has been found efficient in chronic purulent *otitis* of the middle ear when applied pure or mixed with 7 parts of boric acid. In gonorrhœa Brieger used a 5 per cent. solution. It was very painful, and did not cure the complaint, probably because the solution was needlessly strong. A 1 per cent. solution has been applied to the interior of the larynx with alleged advantage in *whooping cough*. Andeer highly commends the caustic treatment of *chancres* by means of crystals of resorcin or a saturated ethereal solution of them. Favorable reports are also furnished by Lebland, Fissiaux, and Bombin (*Med. News*, xlii. 384; xliii. 266). *Papilloma* and other outgrowths of the mucous membrane have been destroyed by this caustic, which Andeer declares to be sure and painless. In a case of *carbunculous boils* occupying a large part of the arm a rapid cure followed the application of a thick layer of "resorcin ointment and vaseline in equal parts" (*Bull. de thérap.*, civ. 325). *Myomas* of the eye and larynx are said to have been cured by resorcin. It is even claimed that in crystals or in powder it displays its greatest virtue in the *diphtheria* of wounds, and especially of the mouth and pharynx. "In one week, at the latest," says Andeer, "the severest form of this disease is wholly cured, and without any evil consequences." This statement has received no confirmation, nor probably will it be found correct, for diphtheria is not a local disease.

Administration.—Resorcin may be given internally in *doses* of from 1 to 4 grains (Gm. 0.06–0.25), and gradually increased to five or even ten times that quantity. It is best administered in syrup or emulsion. For atomized inhalation and for injecting cavities a solution of ½ to 1 per cent. may be used; but in phagedena, syphilis, etc. a saturated solution or the crystals may be employed. In erythematous and erysipelatous complications a resorcin-vaseline ointment may be applied.

RHAMNI SUCCUS.—Buckthorn-Juice.

Suc de nerprun, Fr.; *Kreuzdornbeerensaft*, G.

The recently-expressed juice of the ripe berries of common buckthorn, Rhamnus catharticus, *Linné*, s. Cervispina cathartica, *Moench*. Bentley and Trimen, *Med. Plants*, 64. *Nat. Ord.*—Rhamnaceæ.

Origin and Description.—The buckthorn is a branching shrub about 9 feet (2.7 M.) high; it grows in thickets throughout the greater part of Europe and in Siberia, and is naturalized to some extent and cultivated for hedges in North America. It has ovate, minutely serrate, and frequently fasciculate leaves, small, yellowish-green, diœcious flowers in umbellate clusters, and black, glossy, globular four-celled drupes about ⅓ inch (8 Mm.) in diameter, surrounded at the base by a portion of the persistent calyx, and containing four hard, dark-brown, deeply-grooved seeds enclosed in a parchment-like shell. The dried fruit is deeply and somewhat reticulately wrinkled from the shrinking of the sarcocarp. It is recognized by European pharmacopœias as *Fructus rhamni catharticæ*, s. *Baccæ spinæ cervinæ*, P. G. In the fresh state it contains a greenish or purplish-green sarcocarp, and yields by expression a greenish-colored juice having an unpleasant odor, and a disagreeable, bitter, and rather acrid taste. The color changes on keeping to reddish- or purplish-brown, becomes red on the addition of an acid, and greenish-yellow when rendered alkaline.

Composition.—The various analyses of buckthorn-berries have furnished the cathartic principle *rhamnocathartin* in the form of an amorphous, translucent, yellowish, brittle mass, which Binswanger (1849) and Winckler did not succeed in crystallizing. This has the taste of the berries, is fusible, dissolves in water and alcohol, is insoluble in ether, is not destroyed during the fermentation of the juice, and yields picric acid when oxidized with nitric acid. The juice contains also a peculiar variety of tannin, sugar, gum, and *rhamnin*, which crystallizes in yellowish neutral and inodorous granules or needles, has little taste, dissolves in cold water and alcohol, and is insoluble or nearly so in ether, chloroform, benzol, and carbon disulphide. Its composition is still unknown, the analyses of different chemists having given conflicting results. Its solution is rendered olive-green by ferric chloride, and deep-green, or with an excess red-brown, by chlorinated lime. Dilute acids split it readily into a non-fermentible sweetish sugar, a gummy substance, and *rhamnetin*. This crystallizes readily from phenol in golden-yellow scales, is sparingly soluble in water, somewhat more soluble in alcohol and ether, and is colored green-brown or black by iron salt.

Allied Drugs.—Rhamnus infectoria, *Linné*.—French berries, *E.;* Graines d'Avignon, *Fr.;* Gelbbeeren, *G.*—The shrub grows in Southern Europe, and the berries resemble buckthorn-berries in size and appearance, but are of a brownish or greenish-brown color, and are usually two- or three-furrowed.

Rhamnus amygdalina, *Desfontaines*, Rh. saxatilis, *Linné*, and probably other species growing in Western Asia, South-eastern Europe, and Northern Africa, yield the so-called *Persian berries*. They resemble the preceding, but are of a more greenish and internally yellowish color, and contain pale-brown seeds having a broad furrow. These and French berries contain one or more yellow coloring principles, the principal one being probably *xanthorhammin*, $C_{48}H_{66}O_{29}$, which, according to Liebermann (1878), is split by acids into isodulcit (see QUERCUS TINCTORIA) and rhamnetin, $C_{12}H_{10}O_5$. (See also FRANGULA, p. 711.)

SAP-GREEN is prepared from unripe buckthorn-berries by bruising and fermenting them, expressing the juice, adding alum and potash, and evaporating.

Off. Prep.—Syrupus rhamni, *Br.*, 1867.

Medical Uses.—This preparation is employed in making the syrup of buckthorn.

RHEUM, *U. S.*—RHUBARB.

Rhei radix, Br.; *Radix rhei*, P. G.—*Rhubarb-root*, E.; *Rhubarbe*, Fr.; *Rhabarber*, G.

The root of Rheum officinale, *Baillon*, and of other species of Rheum, from China, Chinese Tartary, and Thibet. Bentley and Trimen, *Med. Plants*, 213, 214, 215.

Nat. Ord.—Polygonaceæ.

Origin.—That rhubarb-root is obtained from the western and north-western provinces of China and from other parts of the highlands of Central Asia has been known for a long time. The efforts made by the Russian government since the first half of the eighteenth century to obtain the rhubarb-plant have been unsuccessful; at least the plants Rheum palmatum and Rh. undulatum, *Linné*, raised in Europe from the seeds thus procured, had roots which were not identical with true rhubarb. More recently, however, several species have become known in Europe which appear to be the source of most, if not all, rhubarb.

RHEUM OFFICINALE, *Baillon*. In 1867, Dabry, French consul at Shanghai, procured from South-eastern Thibet a number of fresh root-stocks, which were sent to Paris, where they arrived in a completely decayed condition, a few buds excepted. From these plants were successfully raised, of which one flowered in 1872 and was described by Baillon under the above name. It has a stout rhizome with few roots, and produces a tall stem, from near the thick base of which numerous orbicular-ovate, five- or seven-lobed leaves grow, attaining sometimes a length of blade equal to 4 feet (1.2 M.). The inflorescence is large, much branched, racemose, with numerous clustered and drooping, small greenish-white flowers, and with pendulous, triangular, yellow fruits, nearly ½ inch (12 Mm.) long, and with a bright crimson wing on each angle.

RHEUM PALMATUM, *Linné*. From the observations made by Lieutenant-Colonel Przewalsky during his travels (1872–73) in Central Asia, it appears that a variety of this species, which he collected near Lake Kokonor, in North-western China, was really the source of the formerly highly esteemed Russian rhubarb. Maximowicz (1874) described this variety as *Tanguticum*, and contended that its cultivation in Europe was unsuccessful on account of the principal roots decaying. Dragendorff (1877), however, compared the roots to English rhubarb in appearance. The plant grows to the height of 8 or 10 feet (2.4 to 3 M.), has large orbicular-ovate, deeply five-lobed and cut radical leaves, numerous small pale pinkish flowers, and drooping, triangular fruits, with a dull red wing on each angle. Przewalsky (1881) observed another very tall rhubarb, the root of which weighed 26 pounds.

Rheum hybridum, *Murray*, is chiefly characterized by the nearly flat and wrinkled leaves, which are heart-shaped at the base, pointed above, and undulately lobed on the margin. A variety of this species, named Colinianum, was received by Prof. Baillon (1878) from M. Colin of Verdun, who had procured it from Central Asia; its root has the characters of rhubarb.

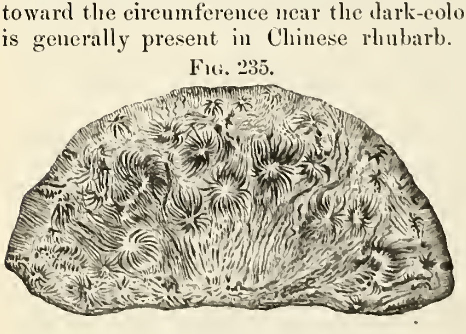
Production.—From the meagre accounts concerning the collection of the root and its preparation for the market, it appears that the root is dug up in autumn, deprived of its corky layer, cut into sections to facilitate the drying, and afterward exposed to the air, frequently strung on a cord, and, if necessary, dried by the aid of artificial heat. In the Chinese ports it is assorted according to its shape.

Rhubarb enters commerce now chiefly from Shanghai and other ports of Northern China, and is hence known as *Chinese rhubarb;* much of it was and is still first shipped to India before it is sent to Europe; the so-called *East India rhubarb* is therefore not distinct from the Chinese. Formerly an excellent quality of rhubarb was received through Siberia under treaty stipulations between the governments of Russia and China. This was almost exclusively received at Kiachta, and there subjected to a very stringent examination, carefully trimmed and dried, and afterward packed in waterproof chests and sent overland to Moscow and St. Petersburg. This variety was known as *Russian* or *crown rhubarb.* However, since about the year 1850 various causes have operated against the rhubarb trade through Siberia; from 1860 very little rhubarb was received at Kiachta, and the office for the inspection of this drug was finally abolished in 1863.

For the eight years ending June, 1883, the average annual importation of rhubarb into the United States was 92,716 pounds; in 1880–81 it was 163,519 pounds.

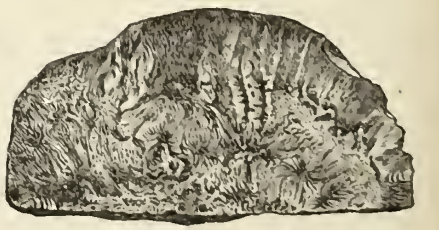
Description.—Rhubarb, as met with in commerce, consists of segments of the rhizome, which are usually assorted into *round* and *flat*, the one kind being either subcylindrical or conical, while the other is irregularly trapezoidal in outline and flattish or convex on one side. They are often perforated with a hole, in which remnants of the cord are found by which the root was suspended in drying. The outer surface is always trimmed, but patches of the corky layer, or at least of the inner portion thereof, are usually present to a small extent, and are of a dark blackish-brown color. Otherwise, the outer surface is nearly smooth or somewhat wrinkled, and after the removal of the adhering yellowish dust shows numerous brown-yellow or red-brown short striæ imbedded in a white tissue, in which an arrangement into elongated meshes is observable. The transverse surface has a marbled appearance, and consists of white parenchyma traversed by innumerable fine reddish medullary rays; these, in the centre of the pieces, are very irregular, curved, and interrupted, and show a more regular radiating arrangement only toward the circumference near the dark-colored cambium-line and in the inner bark, which is generally present in Chinese rhubarb. In Russian rhubarb the cambial zone was entirely trimmed off, leaving only a narrow zone of regularly radiating nearly parallel medullary rays. Near this zone a dense circle of stellate spots was seen, consisting of small groups of medullary rays, each group radiating usually in curved lines from a common centre. These stellate spots are likewise observed in Chinese rhubarb, though not in all pieces, and are in most cases less numerous; they indicate the origin of the radical leaves, and must therefore be necessarily most numerous in old rhizomes. Rhubarb is hard, compact, and breaks with an uneven granular, not at all fibrous, fracture; it has a peculiar aromatic odor, a bitter and somewhat astringent taste, and when masticated is gritty between the teeth and imparts a yellow color to the saliva. The grittiness of rhubarb is due to the parenchyma containing aggregated tufts of microscopic crystals

Fig. 235.



Russian Rhubarb: transverse section.

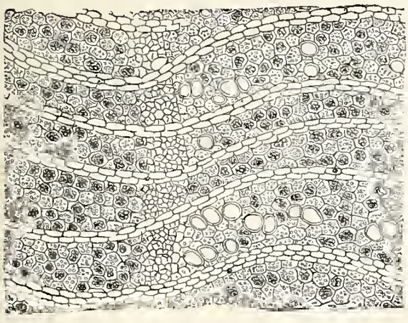
Fig. 236.



Chinese Rhubarb: transverse section.

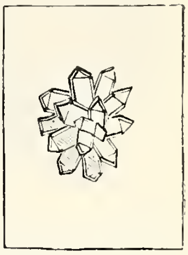
of calcium oxalate, the composition of which was already ascertained by Scheele (1784). Pieces which are spongy, decayed, worm-eaten, or mouldy should be rejected. Unsightly pieces are sometimes artificially improved in appearance by means of powdered turmeric, in which case the surface turns red-brown with a solution of boric acid.

Fig. 237.



Rhubarb: section through and near cambium, magnified 40 diameters.

Fig. 238.



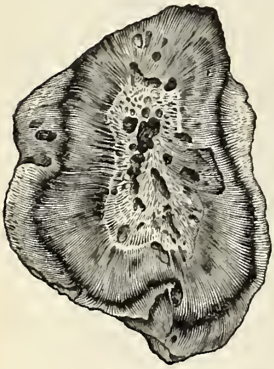
Oxalate of Calcium Crystals in Rhubarb.

Constituents.—Rhubarb has been frequently subjected to analysis, and various more or less active substances were separated from it, and by the different investigators named *rhein*, *rhabarbarin*, *rheumin*, and *rhabarbaric acid*. In 1835, Peretti isolated from it a crystalline, yellow, sublimable principle which dissolves in potassa with a red color. This was subsequently proven by Schlossberger and Döpping (1844) to be identical with *chrysophanic acid*, $C_{15}H_{10}O_4$ (Liebermann, 1875). It was first obtained in a resinous condition by Schrader (1819) from a common lichen, Parmelia parietina, *Linné*, was obtained pure by Rochleder and Heldt (1843), and afterward found in the roots of Rumex and of cultivated rhubarb. The precipitate occurring in tincture of rhubarb yields chrysophanic acid on treating it with benzol. Or rhubarb may be exhausted with cold water, and the residue, after drying, with benzol; on concentrating the benzol solution chrysophanic acid crystallizes on cooling (Schlossberger). It crystallizes in bright-yellow needles or plates, is inodorous and nearly tasteless, fuses at 162° C. (323.6° F.), and sublimes on carefully regulating the heat. It is almost insoluble in cold water, but imparts a bright-yellow color to boiling water, and requires 224 parts of boiling 86 per cent. alcohol for solution. It crystallizes from its concentrated solutions in hot alcohol, amylic alcohol, glacial acetic acid, and ether, and is freely soluble in benzol, chloroform, fixed and volatile oils, and the hydrocarbons of coal-tar. Strong sulphuric acid dissolves it with a bright-red color, and separates it again in yellow floccules on adding the solution to water. Alkalies dissolve it with a deep-red color; the solutions produce with alum a rose-colored lake, and with lead salts precipitates which may vary in color from yellowish to pinkish or bright-red. (See also CHRYSAROBINUM, p. 449.)

After washing the alcoholic extract of rhubarb with water, dissolving the residue in a small quantity of alcohol, and mixing the solution with ether, a precipitate is obtained consisting of *phæoretin*, *aporetin*, and resinous matter. The liquid yields chrysophanic acid on concentration, while the mother-liquor contains *erythroretin*, $C_{38}H_{36}O_{14}$, which is a yellow tasteless powder readily soluble in alcohol, less freely soluble in ether and glacial acetic acid, and dissolves in alkalies with a purple color. By treating crude chrysophanic acid with cold benzol, *emodin*, $C_{15}H_{10}O_5$, is left behind; this crystallizes from hot benzol in orange-colored prisms which dissolve in alkalies with a deep-red color; it was discovered by Warren de la Rue and Müller (1857). The precipitate by ether obtained as above contains aporetin, and yields to cold alcohol *phæoretin*, $C_{32}H_{32}O_{14}$, which is yellowish-brown and soluble in alkalies with a dark red-brown color. *Aporetin* is a blackish resinous mass, sparingly soluble in alcohol, ether, benzol, and chloroform, and yields with alkalies a brown solution.

Kubly (1867) isolated from rhubarb, besides phæoretin, *chrysophan*, $C_{27}H_{30}O_{14}$ (Liebermann), which is orange-colored, bitter, insoluble in ether, soluble in alcohol, and more freely so in water, and by acids is split into sugar and chrysophanic acid; a colorless, crystallizable, neutral and tasteless body, having the composition $C_{10}H_{12}O_4$; and *rheotannic acid*, $C_{52}H_{52}O_{28}$, which is insoluble in ether, soluble in water and alcohol, precipitates gelatin and albumen, yields with ferric salts a black-green precipitate, and when boiled with dilute acids is resolved into sugar and *rheumic acid*, $C_{40}H_{32}O_{18}$. This acid closely resembles rheotannic acid, but is sparingly soluble in cold water and yields dark-blue precipitates with ferric salts. Rhubarb contains also sugar, fat, pectinaceous matter, and starch. The ash left on incineration varies in amount; good rhubarb yields about 12 or 14 per cent., but sometimes as high as 43 per cent. has been obtained (*Pharmacographia*).

FIG. 239.



European Rhubarb: transverse section.

Other Rhubarbs.—Rheum rhaponticum, *Linné*, is indigenous to Asia Minor, Southern Siberia, and South-eastern Russia. It has a large conical fleshy root and cordate-ovate rather obtuse leaves on long fleshy, pleasantly acidulous petioles, the upper part of which has a shallow channel. This species is extensively cultivated as *pie-plant* for the sake of the leaf-stalks, and the root is occasionally employed in domestic practice. The same species is also cultivated in Moravia, Hungary, and near Banbury, England, and yields the Austrian or Moravian and the English rhubarb. In some parts of Russia, Germany, and France, Rheum palmatum, *Linné*, is likewise cultivated; and experiments have also been made with Rh. undulatum, *Linné*, Rh. compactum, *Linné*, and Rh. Emodi, *Wallich*, s. Rh. australe, *Don*. The various kinds of rhubarb grown in Europe are often very handsome in appearance, though usually of a lighter color than good Chinese rhubarb, and generally of smaller dimensions. The medullary rays usually radiate pretty regularly from the centre, but in interrupted lines; the cambium-zone is more distinct, the stellate spots are entirely wanting or present only in small numbers, and the outer surface shows, after trimming, the short striæ of the brownish-red medullary rays, but white meshes are rarely seen.

Tests.—It has been stated above that unsightly pieces of rhubarb are occasionally rendered more attractive in appearance by turmeric; the same is the case with *powdered* rhubarb. For the detection of this sophistication W. L. Howie (1873) recommended the following test: About 5 grains of rhubarb are placed upon white blotting-paper; a few drops of chloroform are percolated through the powder, when the paper surrounding the powder will become very slightly stained from good Chinese rhubarb, while European or dark-colored Chinese rhubarb will produce a deep-yellow stain similar to turmeric. A pinch of powdered borax is now placed on the stain, and a single drop of hydrochloric acid placed upon it; if the stain was produced by rhubarb its color will not be affected, but if the rhubarb contained turmeric the color will change to a distinct red in a few seconds.

Off. Prep.—Extractum rhei, *U. S., Br.;* Extr. rhei fluid., *U. S.;* Infus. rhei, *Br.;* Pilulæ rhei, *U. S.;* Pil. rhei comp., Pulv. rhei comp., Syrup. rhei, *U. S., Br.;* Syrup. rhei arom., *U. S.;* Tinct. rhei, *U. S., Br.;* Tinct. rhei aromat., Tinct. rhei dulcis, *U. S.;* Vinum rhei, *U. S., Br.*

Allied Drugs.—PEREZIA ADNATA, *Gray* (Trixis Pipitzahoac, *Schaffner*, Dumerilia Alami, *De Candolle*), nat. ord. Compositæ, Labiatifloræ. This is a plant of Central Mexico, the root of which is used as a laxative. It is described by Th. Greenish (1884) as 3 to 4 inches (8–10 Cm.) long, $\frac{1}{12}$ inch (2 Mm.) thick, longitudinally wrinkled, brown, bitter, and rather persistently pungent; it has a thick central pith surrounded by about eight short fibro-vascular bundles, on the outside of which, in the thickish bark, are contained a number of cells forming a circle and containing a yellow crystalline substance; stone-cells of a somewhat stellate appearance are scattered in the parenchyma. The yellow principle, *pipitzahoic acid*, $C_{15}H_{10}O_3$, was examined by C. M. Weld (1855); it crystallizes in golden-colored glossy scales or plates: hence it has been called *vegetable gold;* it is nearly insoluble in cold water, dissolves readily in alcohol and ether, melts near 100° C., sublimes when heated with care, and acquires an intense purple color with alkalies and alkaline earths. The same compound was obtained by Charles Mohr (1884) from the root of Perezia Wrightii and P. nana, *Gray*, of South-western Texas—from the latter in smaller quantity; it separates from the decoction in needles. The acid acts as a drastic purgative in doses of 4 to 8 grains (0.25–0.50 Gm.).

RHINACANTHUS COMMUNIS, *Nees* (nat. ord. Acanthaceæ). This shrub is indigenous to India and China. The woody root and leaves have been used in ringworm and other cutaneous diseases. The leaves are 2 to 4 inches (5–10 Cm.) long, ovate-oblong, entire, obtuse, and finely pubescent. The root contains in intercellular spaces of the bark a quinone-like body, which Liborius (1881) called *rhinacanthin*, $C_{14}H_{18}O_4$, which forms with alkalies intensely red compounds, and these are decomposed by benzin, dissolving the rhinacanthin with a yellow color.

Medical History.—The terms *rhabarbarum* and *rheum* are derived from the name of the river Rhâ (Volga) which empties into the Caspian Sea, because from that direction rhubarb was anciently, as at present, brought to the countries bordering on the Levant. Two names were used to designate it, Rha-ponticum, and Rha-barbarum, of which the former revealed its source near the Pontic or Euxine Sea, and the other that it was brought from the barbarous regions of the North. Rhapontic rhubarb is said, however, to have been astringent and not purgative. Certain it is that the earliest account of the cathartic rhubarb comes to us through the Arabian writers, who insist upon its combined tonic and purgative qualities, and its astringency when roasted. Rhubarb was, however, well known in China from time immemorial as a purgative.

Physiological Action.—Rhubarb acts a purgative on horses and dogs as well as on man, and in all cases its coloring and purgative principles are absorbed into the blood, since it tinges the urine and milk, and renders the latter purgative. It also sometimes stains the perspiration yellow. The color which it gives the feces probably led to its being regarded as a cholagogue, but the experiments of Rutherford led him to conclude that it is really so independently of its purgative action. Its purgative and astringent properties have been ascribed to cathartinic (?) and rheo-tannic (?) acids respectively. After large doses a moderate purgative action is followed by quiescence of the bowels; but a very small quantity taken daily in mass and allowed to dissolve in the mouth will maintain them in a free condition for some time, and that without at all impairing the digestion. The purgative action of rhubarb has been manifested when it was applied to ulcers or moistened and rubbed upon the skin.

Medical Uses.—The gentle action of rhubarb renders it one of the best remedies for *hæmorrhoids* connected with constipation. Its tonic or astringent influence superadded to its laxative operation constitutes it one of the best remedies for *diarrhœa* due to cold or to the presence of irritating ingesta in the bowels; and for this purpose roasted rhubarb is thought to be peculiarly efficient. It is prepared by roasting fragments of rhubarb like coffee. The diarrhœa to which children are liable in summer is often cured by this medicine, especially when associated with magnesia. At one time rhubarb was believed to be a valuable remedy for *dysentery*, but in this disease, which presents so many types and varieties, it is difficult to determine in what particular form of it the medicine is most efficient. We believe that it is so in the first stages of simple dysentery when associated with mild salines, in the decline of the bilious form with a tendency to protracted diarrhœa, and as an occasional purgative in chronic dysentery prolonged by scybala in the bowels.

Externally, powdered rhubarb has been recommended as a stimulant and astringent application to old, indolent, and irritable *ulcers*. Opium, calomel, and other substances may be mixed with it.

The *dose* of rhubarb as a purgative is about 20 grains (Gm. 1.30); as a gentle aperient and tonic, 5 grains (Gm. 0.30). Associated with calomel, its action is prompt and efficient. With magnesia it is very appropriate when the secretions of the stomach and bowels are unduly acid. The simple rhubarb pill, which contains soap, is very eligible as a mild laxative for habitual or occasional use. The numerous officinal preparations of this drug are commented upon in their proper places.

RHODODENDRON.—ROSEBAY.

Snow rose, E.; *Rosage*, Fr.; *Alpenrose*, *Schneerose*, *Gichtrose*, G.

Nat. Ord.—Ericaceæ, Ericineæ.

Description.—This genus is composed of evergreen shrubs and low trees inhabiting mountainous localities of the northern hemisphere. They have leathery, entire, somewhat revolute and petiolate leaves, often crowded near the end of the branches, and showy flowers in compact terminal clusters or corymbs, with the corolla five-lobed, funnelform, and somewhat campanulate or with a wheel-shaped border. The leaves of the following species have been used:

RHOD. CHRYSANTHUM, *Linné.* It is indigenous to Siberia, and has yellow flowers. The leaves are about 2 inches (5 Cm.) long, oblong or obovate-oblong, rather obtuse, reticulate, smooth, pale rust-colored beneath. When fresh they have a slight rhubarb-like odor, which is nearly lost in drying; their taste is astringent, unpleasantly bitter, and somewhat pungent.

RHOD. MAXIMUM, *Linné.* It grows in North America, and has rose-colored or whitish flowers. Its leaves are about 7 inches (18 Cm.) long, elliptic-oblong, or obovate-oblong, acute, smooth, dark-green, shining, paler beneath. Their taste is astringent and somewhat pungent.

RHOD. FERRUGINEUM, *Linné.* It is found in Europe and Asia and has purple glandular-dotted flowers. The leaves are about 1½ inches (4 Cm.) long, lanceolate or lance-oblong, rust-colored and scaly beneath, and have an astringent and bitter taste.

Constituents.—These leaves contain tannin, a little volatile oil, resin, etc. The bitter principle of the last-named species was found by R. Schwarz to be *ericolin* (see page 879).

Medical Action and Uses.—The Siberian or snow rose is said to be a very active medicine. It is related that a goat after eating its leaves became excited, then tottered and fell upon its knees, and did not recover for 2 hours. In man small doses appear to increase the secretions, and especially to act as a diaphoretic. Larger doses render the mouth and throat dry and constringe them, promote the alvine and cutaneous secretions, and excite a sense of formication and prickling in the skin, which also exhales an aromatic smell. In still larger doses it causes giddiness, confusion of the senses and ideas, dimness of vision, constriction of the throat, dyspnœa, hebetude, paralysis of sensibility and motility, and even convulsions. Sometimes it acts principally as an evacuant upon the stomach and bowels, and in other cases excites profuse diuresis or sweating, itching or eruptions of the skin, pain and twitching of the limbs, etc. It is said to reduce the pulse and render it intermittent.

Rosebay has been almost exclusively employed in the treatment of *rheumatism* and *gout*, a hot infusion being used at the commencement of the attack when acute; but in the chronic forms of these diseases a moderate but steady action of medicine is maintained for weeks, and even months, the evidence of its utility being furnished by painful sensations in the affected parts. It has also been used in *sciatica*, in chronic *diseases of the skin*, and chronic *diarrhœa* and *dysentery*. It is given in powder in doses of 10 grains (Gm. 0.60) several times a day, or in a decoction made with from 2 to 4 drachms of the leaves in 10 fluidounces (Gm. 8–16 in Gm. 320) of water.

RHŒADOS PETALA, *Br.*—RED-POPPY PETALS.

Flores rhœados.—*Corn poppy*, *Corn rose*, E.; *Coquelicot*, *Pavot rouge*, Fr.; *Klatschrose*, *Klapperrose*, G.

The fresh petals of Papaver Rhœas, *Linné.* Bentley and Trimen, *Med. Plants*, 19.

Nat. Ord.—Papaveraceæ.

Origin.—The red poppy is an herbaceous annual growing in fields among cereals throughout the greater part of Europe, in Northern Africa, and in Asia eastward to India. It is about 2 feet (60 Cm.) high, is covered with spreading hairs, has deeply pinnatifid leaves with the segments lanceolate and cut-toothed; it has showy red flowers, and produces short, smooth, obovate capsules, which are truncate above and contain numerous minute blackish seeds.

Description.—The petals are roundish in outline, 2 inches (5 Cm.) and more in width, one pair always broader than the other pair, deep scarlet-red, after drying of a dull purple, very thin, with a short claw and a black spot near the base. Their odor in the fresh state is heavy and somewhat narcotic, and is dissipated in drying; their taste is mucilaginous and slightly bitter.

PAPAVER DUBIUM, *Linné*, which is sometimes met with spontaneously in the United States, is appressed-hairy and has a club-shaped capsule and roundish-oblong, red petals, which agree in sensible properties with the preceding, but are generally smaller.

Constituents.—Red-poppy petals have been frequently examined, and it has been asserted by some that they contain small quantities of morphine, paramorphine, and narcotine, which alkaloids, however, could not be detected by other investigators. According to Hesse (1865), they contain *rhœadine* (see p. 1106). Leo Meier (1846) found in the petals gum, starch, albumen, fat, and wax, and two deliquescent coloring principles—*rhœadic acid*, which is dark-red, soluble in alcohol and water, but insoluble in ether, and yields brown compounds with alkalies; and *papaveric acid*, which is bright-red, soluble in dilute alcohol and water, and forms violet compounds with the alkalies. Hesse found the milk-juice of the plant to become deep-red with ferric chloride; it probably contains meconic acid.

Off. Prep.—Syrupus rhœados, *Br.*

Medical Action and Uses.—The dried petals of the red or corn poppy are used in the preparation of syrup of red poppy.

RHUS GLABRA, *U. S.*—SUMACH.

Smooth sumach, *Pennsylvania or upland sumach*, E.; *Sumac*, Fr.; *Sumach*, G.

The fruit of Rhus glabra, *Linné.*

Nat. Ord.—Terebinthaceæ, Anacardieæ.

Origin.—The smooth sumach is a shrub or suffruticose plant growing in rocky and barren soil in North America. It attains a height of about 12 feet (3.6 M.). The stem has a large pith and a thin circular layer of white wood, which is covered with a thin brown-gray *bark* having small scattered warts on the outer surface, the inner tangential layers of a green and the inner surface of a brown color. The *leaves* are imparipinnate, with from twenty-one to thirty-one lance-oblong, pointed, and serrate, on the under side whitish, leaflets. The small greenish *flowers* grow in dense ovoid terminal panicles, and appear in June; the fruit ripens in September.

Description.—The fruit is drupaceous, subglobular, less than ⅛ inch (3 Mm.) in diameter; is densely covered with bright purplish-red hairs, and encloses a roundish oblong smooth putamen. It is inodorous and has a strong and pleasant acidulous taste. The leaves and bark, which have also been employed medicinally, have an astringent and bitter taste.

Constituents.—Trommsdorff (1834) found in the fruit of the European sumach tannin, coloring matter, malate of potassium, and much malate of calcium. Similar results were obtained by W. B. Rogers (1835) with the fruit of Rhus glabra and copallina. The seeds contain fixed oil. The astringent taste of European sumach-leaves was ascertained by Chevreul to be due to tannic and gallic acids, and Stenhouse (1862) corroborated this result by converting the tannin into gallic acid. He attributes the variation in the amount of tannin to the fact that the European sumach-leaves are collected also from Rhus Cotinus, *Linné*. Bowman (1869) estimated the tannin in Rhus glabra by means of gelatin, and found in the bark 8.75 and 14.55 per cent., and in the fruit 1.9 per cent.

Allied Species.—Rhus copallina, *Linné*, *Dwarf sumach*. It is from 3 to 7 feet (.9–2.1 M.) high, and has downy branches and the petioles wing-margined between the lanceolate entire leaflets.

Rhus typhina, *Linné*, *Staghorn sumach*. It is 20 to 30 feet (6–9 M.) high, velvety-hairy, and has leaves with from seventeen to thirty-one oblong-lanceolate, pointed, and sharply serrate or cut-toothed leaflets.

Rhus aromatica, *Aiton*, Sweet sumach. It is about 5 feet (1.5 M.) high, has petiolate aromatic leaves, with three sessile rhombic-ovate cut-toothed leaves, and produces yellowish flowers in ament-like spikes. The root-bark is about $\frac{1}{12}$ inch (2 Mm.) thick, covered with a fissured and warty brown cork (underneath which the bark is orange-red), and is whitish or pale-brownish in color. It is brittle, breaks with a short granular fracture, yields an ochre-colored powder, and has a slight pleasant odor and an astringent, aromatic, and bitterish taste. The bark contains scattered oil-cells, and has a somewhat checkered appearance from the tangential arrangement of the bast-layer and the radiating delicate medullary rays. H. W. Harper (1881) found it to contain volatile oil, several resins, fat, tannin, gum, etc., and to yield 13.8 per cent. of ash. A *tincture* has been used made with alcohol, and representing in the pint 4 troyounces of the bark. The *fluid extract* is prepared with alcohol in the same manner as fluid extract of ginger.

Rhus Coriaria, *Linné*, *European sumach*. It is 8 to 12 feet (2.4–3.6 M.) high, and grows near the Mediterranean; the leaves have eleven to fifteen elliptic, coarsely serrate, woolly leaflets. From fifteen to twenty million pounds of this sumach are annually imported.

All the above species have red, hairy, acidulous fruits and astringent leaves, and, with the exception of the last, are indigenous to North America.

Medical Action and Uses.—Sumach-berries, containing both an acid and an astringent principle, may be used in infusion (℥j to Oj = Gm. 32 to Gm. 250) as a gargle in *catarrhal* and other mild forms of *pharyngitis*, for which it forms a very agreeable and efficient remedy. Even in the decline of graver forms of this affection it is deserving of attention. The same is true of its use in *aphthæ* and other forms of sore mouth, including that produced by mercury. An infusion or decoction of the leaves or of the inner bark of the root is simply astringent, but may be applied to the same purposes, as well as for dressing wounds and ulcers. The glandular excrescences on the leaves are powerfully astringent.

Rhus aromatica, or sweet sumach, is reported to have such an action on the pelvic organs as to be useful in *hæmaturia*, *eneuresis*, and *leucorrhœa*. In a case of so-called hysterical incontinence of urine it almost immediately caused a suspension of the infirmity when given as a fluid extract in doses of from 10 to 30 drops several times a day (*Centralbl. f. Therapie*, i. 207).

RHUS TOXICODENDRON, *U. S.*—Rhus Toxicodendron.

Toxicodendron, U. S. 1870; *Folia toxicodendri.*—*Poison oak*, E.; *Sumach vénéneux*, Fr.; *Giftsumach*, G.

The leaves of Rhus Toxicodendron, *Linné*.
Nat. Ord.—Terebinthaceæ.

Origin.—The poison oak is indigenous to Canada and the greater portion of the United States westward to the Rocky Mountains. It attains a height of about 40 inches (1 M.), and has an erect stem, or, if growing in close proximity to trees or walls, it becomes a climber, supporting itself by adventitious roots, and ascends to the height of 30 or 40 feet (9–12 M.). This climbing shrub, Rhus radicans, *Linné*, is now regarded merely as a variety of the erect form, but is popularly distinguished as *poison ivy*. Both forms, when wounded, emit a milky juice which turns black on exposure; they have the small pale greenish pentamerous flowers in axillary paniculate racemes, and produce small dry drupaceous fruits of a whitish color. The juice may be employed as an indelible ink, but is soluble in ether. The leaves are employed, and should be collected from May to July, while the shrub is in bloom. The plant has been introduced into Europe, and has become naturalized there.

Description.—The leaves are on petioles 4 or 5 inches (10–12 Cm.) long, and are trifoliate, with the terminal leaflet prominently stalked, ovate or oval, acuminate, and with a wedge-shaped base. The lateral leaflets are sessile, 4 or 5 inches (10–13 Cm.) long, pointed, rounded at the base, and obliquely ovate in shape, the lower half being broadest. The leaflets are either entire or variously notched, coarsely toothed or lobed, smooth above, somewhat downy beneath, and after drying thin and papery; they are inodorous, and have a somewhat astringent, saline, and acrid taste. The leaves are said to have been confounded with those of Ptelea trifoliata, *Linné* (see p. 1249), which are thicker, pale-green, and have three sessile leaflets.

Constituents.—Khittel (1858) found in the leaves of poison oak tannin, producing a green-black precipitate with ferric salts, fixed oil, wax, mucilage, and other principles commonly found in plants. He believed the poisonous properties to be due to a volatile alkaloid. But we found (1865) the exhalations of this plant to have an acid reaction, and the leaves to contain notable quantities of ammonia, but no other alkaloid, or only minute traces of such a compound. The poisonous *toxicodendric acid* is volatile, has a strongly acid reaction, neutralizes bases completely, and yields with an excess of oxide of lead a soluble salt having a strong alkaline reaction. The aqueous solution of the acid produces with lead acetates heavy white precipitates, yields with nitrate of silver, on boiling, a black precipitate of oxide of silver, and separates metallic gold from a warm solution of chloride of gold. Its neutral salts produce with mercurous salts a white precipitate, changing to black when heated. Potassium permanganate is readily reduced both by the acid and its salts. Toxicodendric acid resembles both formic and acetic acid in some of its reactions, and, according to the unpublished researches of H. P. Pettigrew (1883), who verified the above observations, the neutral solutions of its salts yield also a red color with ferric salts. Applied to the skin either in solution or in the state of vapor, the acid produces vesicular eruption.

Pharmaceutical Preparations.—The expressed juice of the fresh leaves preserved by alcohol probably possesses all the virtues of the drug.

TINCTURA TOXICODENDRI. The bruised fresh leaves are macerated for 10 days with an equal weight of alcohol, and the liquid expressed and filtered.—*F. Cod.*

Allied Plants.—RHUS DIVERSILOBA, *Torrey et Gray* (Rh. lobata, *Hooker*), is a straggling or climbing shrub of the Pacific coast of North America, and has the leaves with three or five more or less deeply lobed or pinnatifid leaflets.

RHUS VENENATA, *De Candolle* (Rh. Vernix, *Linné*). This species grows in swampy localities in Canada and the United States, and is known as *poison sumach*, *poison dogwood*, and *poison elder*. It is a shrub 12 to 18 feet (3.6 to 5.4 M.) high, and has very glabrous leaves, with about eleven oval or obovate-oblong, abruptly pointed, and entire leaflets. The fruit is yellowish.

RHUS PUMILA, *Michaux*, is a procumbent shrub of Western South Carolina, and has pubescent pinnate leaves, with about eleven oval or oblong, coarsely-toothed, and somewhat acuminate leaflets. The fruit is red and softly hairy.

RHUS METOPIUM, *Linné*. The *coral sumach*, *bum-wood*, or *mountain-machineel*, grows in Southern Florida and the West Indian islands. It is about 30 feet (9 M.) high, and has leaves with five long-stalked ovate entire and smooth leaflets. The wood contains much tannin; the fruit is about $\frac{2}{5}$ inch (1 Cm.) long, red and acrid.

All the species named are poisonous, and their properties are probably due to the same principle.

Physiological Action.—Poison oak was well known to the aborigines, and early described by travellers in North America, both as a poison and as a medicine. The volatile acid emanations of the living plant produce an eczematous eruption upon the skin, and it is alleged that a dog exposed to them died with a general swelling of the body. Herbivorous animals devour its leaves with impunity, but dogs are poisoned by its juice, losing their power of muscular co-ordination and strength, and dying with dilated pupils, without coma or convulsions. On man it acts externally as an irritant, some persons being much more susceptible than others to its influence. Even air impregnated with the exhalations of the leaves is sufficient to produce an eczematous inflammation of the skin. This is characterized by violent itching, redness, and swelling, followed by heat, pain, fever, and vesication, which, upon the face and genitals particularly, may be attended with extreme tumefaction. These symptoms begin between a few hours and several days after the application of the poison, and are usually at their height on the fourth or fifth day, after which desquamation commences. But sometimes they continue active for a longer time. The juice of the plant applied to the skin will, in the course of 48 hours, produce a blister which is soon surrounded with vesicles, and later a similar eruption may take place upon distant parts of the body without the primary blisters having been ruptured. The eruption is attended with severe burning and itching. Usually, however, the more distant irritation is due to the discharge from the primary one being conveyed elsewhere by the hands. But there are some cases of poisoning by this plant, taken internally, which were attended with a vesicular eruption of the skin. A case is reported of a woman who used the leaves of the plant instead of paper after defecation, and who suffered, besides the general affection of the skin, from symptoms of inflammation of the rectum (*Phila. Med. Times*, xii. 636). Internally, it gives rise to a species of intoxication, with vertigo, confusion of the senses, dilatation of the pupils, a sense of constriction of the temples, chilliness, nausea, thirst, a slow, small, and irregular pulse, diaphoresis and diuresis, debility, faintness, trembling, and convulsions. Two children who between them had eaten a pint of the berries became drowsy and stupid, and then delirious and convulsed.

Various remedies have been employed to palliate the inflammation caused by poison oak. One of the best is alum-curd, which is appropriate at all stages of the process. Before the blisters have fully formed or have discharged their contents lead-water is useful, but a weak solution of ammonia or a strong one of carbonate or the sulphite of sodium, or the solution of chlorinated soda, is perhaps still more so. Cosmoline allays the itching and burning. When the blisters are mature or have been ruptured, a solution of perchloride or of persulphate of iron or of sulphate of zinc, or simply lime-water, carefully applied to the vesicated skin, will arrest the progress of the inflammation. Grindelia squarrosa has also been used for this purpose (see p. 749).

Medical Uses.—The inflammation of the skin which poison oak excites led to its being employed substitutively in chronic *cutaneous affections*, but ineffectually. It has been alleged (Trousseau) to be efficacious in the treatment of *paraplegia* from concussion of the spinal marrow, and other affections of this organ without lesion of tissue; it is said to occasion no inconvenience, and to strengthen rather than enfeeble digestion. Sometimes a slight degree of strangury is observed. It has also been used to cure *incontinence of urine* depending upon atony of the bladder. One physician has found it useful in spinal anæmia if associated with nux vomica, and that it reduces the temperature if administered with gelsemium; which may very readily be credited,—much more readily than that it is "a laxative, diaphoretic, diuretic, and particularly a stimulant of the nervous system," which is asserted by the same authority (*Detroit Lancet*, Jan. 1880). The *dose* of the powdered leaves is stated to be 5 grains, which should be gradually increased to 60 grains (Gm. 0.30–4). On the whole, the medicinal virtues of this plant are too uncertain to inspire any confidence.

ROBINIA.—LOCUST TREE.

False acacia, E.; *Robinier*, Fr.; *Falsche Akazie*, G.

Robinia Pseudacacia, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The common locust tree is indigenous to the southern part of the United States, but is commonly cultivated and naturalized farther north and in Europe. It is thorny when young, attains a height of 60 or 80 feet (18 to 24 M.), but is smaller in northern localities, and has a durable white or reddish wood and a brownish or gray, smooth, and internally yellowish bark. Its leaves are imparipinnate, the leaflets in from eight to twelve pairs, oval, obtuse, and smooth, and the fragrant whitish flowers in long slender racemes. The legume is about 3 inches (8 Cm.) long, linear, flat, margined on the inner side, and contains about six blackish-brown small seeds. The root and inner bark have a sweetish taste.

Constituents.—The root was examined by H. Reinsch (1845), who found it to contain much albumen, tannin, sugar, starch, and other common vegetable principles. His *robinic acid* is believed by Hlasiwetz (1852) to be *asparagin*, of which he obtained 2½ ounces from 30 pounds of the root. According to Zwenger and Dronke (1861), the flowers contain a yellow glucoside, *robinin*, which, on being boiled with acids, is resolved into sugar and *quercetin*, and which is also contained in the bark and wood.

Medical Action and Uses.—The bark of the root is said to be tonic, and in large doses purgative and emetic, and a syrup prepared from the flowers is related to have produced acro-narcotic effects in children. Gendron mentions that certain boys who had chewed some of the bark and swallowed the juice were affected not only with vomiting, but with coma and slight convulsions (Griffith, *Med. Botany*). No definite information concerning its medicinal virtues is accessible.

ROSÆ CANINÆ FRUCTUS, *Br.*—Hips.

Cynosbata, *Fructus cynosbati.*—*Fruit of the dog rose*, E.; *Gratte-cul*, *Cynorrhodon*, Fr.; *Hagebutten*, *Hainbutten*, G.

The ripe fruit of the dog rose, Rosa canina, *Linné*, and other indigenous allied species. Bentley and Trimen, *Med. Plants*, 103.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The *dog rose* is a spiny European shrub, from 4 to 8 feet (1.2–2.4 M.) high, and resembles the roses indigenous to this country, but differs from them in the shape of the calyx and in the absence of glandular hairs on the peduncle and calyx.

Description.—Hips are not the fruit, but the enlarged calyx-tubes, of the rose. They are about an inch (25 Mm.) in length, ovate, contracted above, of a bright-red color, shining, internally stiff-haired, and enclose a number of ovate, hairy, brownish, bony akenes. Hips are at first tough and crowned with the five-cleft deciduous calyx-lobes; later in autumn they are naked above, softer, and more fleshy. They are inodorous and have a sweet acidulous and somewhat astringent taste. For medicinal use the hard akenes are removed and the fleshy calyx-tube alone is employed. The corresponding part of Rosa carolina, *Linné*, and R. lucida, *Ehrhart* (Meehan, *Native Flowers*, i. 169; ii. 133), is depressed globular, the former somewhat hairy, and has properties similar to those of the first.

Constituents.—Scheele already noticed malic and citric acid in the pulp. Biltz (1824) obtained 7.78 per cent. of malic and 2.95 per cent. of citric acid; also 30.6 per cent. of sugar, 25 per cent. of gum, and small quantities of tannin, resin, wax, malates, citrates, and other salts.

Off. Prep.—Confectio rosæ caninæ, *Br.*

Medical Action and Uses.—Hips are described as slightly refrigerant and astringent, but they are used in medicine only to prepare the confection of hips.

ROSA CENTIFOLIA, *U. S.*—Pale Rose.

Rosæ centifoliæ petala, Br.; *Flores rosæ*, P. G.; *Flores rosarum incarnatarum.*—*Cabbage-rose petals*, *Hundred-leaved rose*, E.; *Rose à cent feuilles*, *Rose pâle*, Fr.; *Centifolienrose*, *Rosenblätter*, G.

The petals of Rosa centifolia, *Linné*. Bentley and Trimen, *Med. Plants*, 105.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—This well-known shrub, which is by some botanists regarded as a cultivated variety of the red rose, is probably indigenous to Western Asia, and is cultivated in innumerable varieties in all countries. Its branches are covered with numerous nearly straight spines; the petioles and peduncles are nearly unarmed, but more or less clothed with glandular bristles, and the leaves have five, or sometimes seven, ovate or elliptic-oval serrate glandular and beneath soft-hairy leaflets. The flowers are collected and deprived of the calyx and ovaries, the petals alone being employed.

Description.—The petals are roundish-obovate, retuse at the apex or almost obcordate, of a pink color, a delicious rose odor, and of a sweetish, somewhat bitter, and slightly astringent taste. In drying they become brownish and less fragrant.

Constituents.—The odor of rose-petals is due to a minute quantity of volatile oil (see page 1081). Enz (1867) determined the other constituents to be tannin, giving a green reaction with ferric salts, fat, resin, sugar, mucilage, a bitter principle, malates, tannates, and phosphates, and a coloring matter which is easily altered, and, from the investigations of Fremy, Cloëz, Filhol, and others, seems to be identical with that of the red rose and of many other red-colored flowers.

Pharmaceutical Uses.—Rose-petals are employed chiefly in the distillation of rose-water, and are for this purpose often preserved by being packed into suitable vessels with one-half or their own weight of common salt. It is stated that in some laboratories the entire rose-flowers are used in the distillation of rose-water, and furnish a good product. The dried petals are used in preparing Syrupus sarsaparillæ comp., *U. S.*

Medical Action and Uses.—Pale rose-leaves are seldom used medicinally except in the form of the officinal rose-water. The nervous symptoms and occasionally the coryza ascribed to fresh roses are apt to be produced by other odorous flowers.

ROSA GALLICA, *U. S.*—RED ROSE.

Rosæ gallicæ petala, Br.; *Flores rosarum rubrarum.—Red-rose petals*, E.; *Rose rouge, Rose de Provins*, Fr.; *Essigrose, Sammtrose, Zuckerrose*, G.

The petals of Rosa gallica, *Linné*. Bentley and Trimen, *Med. Plants*, 104.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The red rose is a bushy shrub 2 or 3 feet (60–90 Cm.) high, which grows wild in Southern Europe and the Levant and is cultivated in gardens in numerous varieties. It is armed with bristly prickles and with a few curved spines, and has slightly heart-shaped and thicker leaflets than the preceding species. The flowers are collected while still in bud, and the petals cut off near the base and rapidly dried.

Description.—As seen in commerce, red rose is in small cones consisting of the numerous densely-imbricated petals, which, when unfolded, are roundish, retuse at the apex, and at the base narrowed into a short yellow claw, the greater portion of which has been trimmed off; the centre of the cone is hollow or it contains some of the stamens. The color is deep purplish-red, velvety in aspect; the odor is roseate and the taste bitterish, slightly acid, and astringent. Red rose should be preserved in a dry place and excluded from the light.

Constituents.—The chemical constituents of red rose are very similar to, if not identical with, those of pale rose, but the astringent principle is more predominating. Filhol (1863) denied the existence of tannin in red-rose petals; by extracting them with ether two fats and *quercitrin* were obtained, to which the dark-green reaction with ferric salts is due; alcohol afterward took up a little gallic acid, and nearly 20 per cent. (?) of invert-sugar. Rochleder (1867), however, ascribed the reaction with iron to *quercetic* and a little gallic acid. The coloring principle of red rose was isolated by H. Lenier (1877) by exhausting the petals with ether, and afterward with alcohol; the tincture was precipitated by lead acetate, and this precipitate decomposed by an insufficient quantity of sulphuric acid in the presence of alcohol. The coloring matter becomes deep-red, with a bright-green fluorescence, by alkalies; it decomposes carbonates, yields with alkalies crystallizable compounds, and is precipitated by salts of alkaline earths and metals, the lead salt having the composition $Pb_2C_{21}H_{29}O_{30}$.

Off. Prep.—Confectio rosæ (rosæ gall.), *U. S.*, *Br.;* Infus. rosæ acidum, *Br.;* Extr. rosæ fluid., Mel rosæ, Pil. aloes et mastiches, *U. S.;* Syr. rosæ (gallicæ), *U. S.*, *Br.*

Medical Action and Uses.—Red-rose leaves were anciently used in infusion as cooling and astringent for the relief of uterine and other *hæmorrhages*, and as an application to *aphthæ* and other *ulcers* affecting the mouth, ears, anus, etc., and the fresh bruised leaves were applied to inflammation of the *eyes*, etc.

A compound infusion of rose, containing sugar and diluted sulphuric acid (*U. S. P.* 1870), is employed as a coloring and flavoring ingredient of mixtures, and as an excipient and solvent for sulphate of magnesia and for sulphate of quinine, whose taste it partially covers. It forms an agreeable gargle for inflamed and ulcerated states of the *mouth* and *fauces*, and may be used to moderate profuse *sweats*. Its virtues are largely due to the sulphuric acid it contains. *Dose*, from 2 to 4 fluidounces (Gm. 64–128).

ROSMARINUS, *U. S.*—ROSEMARY.

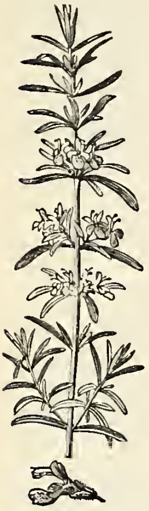
Folia rosmarini, s. roris marini, Folia anthos.—Feuilles de romarin, Fr.; *Rosmarinblätter*, G.

The leaves of Rosmarinus officinalis, *Linné*. Bentley and Trimen, *Med. Plants*, 207.

Nat. Ord.—Labiatæ, Monardeæ.

Origin.—Rosemary is a native of the basin of the Mediterranean, and is often cultivated in gardens. It is shrubby, 3 or 4 feet (.9–1.2 M.) high, much branched, evergreen, and has few-flowered axillary clusters of rather large pale-blue flowers.

Fig 240.



Rosmarinus officinalis, *Linne:* branch and flower.

Description.—Rosemary-leaves are about 1 inch (25 Mm.) long, leathery, linear, entire, sessile, obtuse at both ends, dark-green above, densely woolly and dotted with oil-glands beneath, and revolute on the margin. In drying the margin becomes more strongly revolute, the leaf narrower and rigid, and the midrib prominent on the lower side. Rosemary has a peculiar aromatic somewhat camphoraceous odor and a pungently aromatic taste.

Constituents.—The principal constituent is the volatile oil (see page 1083). A little tannin, resin, and bitter principle are likewise present.

Pharmaceutical Uses.—The leaves are employed in the preparation of fumigating powders and the distillation of the volatile oil.

Medical Action and Uses.—By the ancients rosemary was esteemed for its emmenagogue, galactagogue, and diuretic virtues, and more recently it was regarded as diaphoretic and carminative, and as useful in various functional *nervous disorders.* In Europe it is sometimes still employed for similar purposes. The volatile oil is a powerful stimulant. According to Köhler and Schreiber, its chief action is upon the cerebro-spinal centres. Small doses increase and large doses diminish reflex excitability. When inhaled it greatly reduces the animal temperature, and it gives the urine a violaceous odor (*Edin. Med. Jour.*, xxiv. 1042). An infusion prepared with from 60 to 120 grains of the leaves in a pint of water (Gm. 4–8 in Gm. 500) may be prescribed in tablespoonful doses. Fomentations made with the plant steeped in hot water or alcohol are used for the relief of local pains. The oil may be used for the same purpose, and is a valuable addition to various stimulant and anodyne liniments.

RUBIA.—MADDER.

Dyer's madder, E.; *Garance*, Fr.; *Krapp*, *Färberröthe*, G.

The root of Rubia tinctorum, *Linné.*

Nat. Ord.—Rubiaceæ.

Origin.—This plant is an herbaceous perennial indigenous to the Levant and Southern Europe, and is cultivated in several European countries. It is about 3 feet (90 Cm.) or more high, has elliptic-lanceolate, rough, prickly leaves in whorls of four or six, greenish-yellow flowers, and smooth, black, baccate fruits. 3,138,558 pounds of ground madder were imported into the United States in 1876–77, and 1,145,501 pounds in 1883; the importation of the whole root in the same periods was 43,100 and 398,726 pounds.

Description.—The rhizome is creeping, and has numerous long, light blood-red, cylindrical roots of the thickness of a quill. These are, after drying, deeply wrinkled, have an easily separable gray-red corky layer, a thin dark brown-red inner bark, and a spongy red wood, which in the fresh state is yellowish and contains irregular medullary rays. The rhizome is sometimes present; it resembles the root, and is chiefly distinguished by a central pith. The root breaks with a short and smooth fracture, has a feeble color, and a sweetish, bitterish, somewhat acrid and astringent taste. Madder is usually found in the shops in the form of a coarse powder.

Constituents.—Madder has been very frequently subjected to chemical investigation, and a large number of principles have been isolated, which are most likely oxidation- and decomposition-products of a yellow coloring matter found by Decaisne in the fresh root. Many of these are glucosides, and yield *alizarin*, besides other principles, under the influence of dilute acids. *Rubian* is an amorphous, dark-yellow, bitter mass. *Rubihydran* and *rubidehydran* are gum-like masses. These principles were isolated by Schunck (1847–56). Rochleder's *ruberythrinic acid*, $C_{20}H_{22}O_{11}$ (1855, etc.), crystallizes in silky yellow prisms. The most important constituent is *alizarin*, $C_{14}H_8O_4$, which crystallizes in orange-red sublimable needles, is soluble in boiling water, alcohol, and ether, and yields purple or red-colored compounds with bases. Other compounds obtained from madder are *rubitannic acid*, *rubichloric acid* (blue and green by warm hydrochloric acid), *purpurin*, *rubiretin*, verantin, etc. It contains also pectin, sugar, citric acid, etc. The artificial production of alizarin was discovered by Graebe and Liebermann, and it is now manufactured from *anthracene*, $C_{14}H_{10}$, a crystalline constituent of coal-tar, which is oxidized to *anthraquinone*, $C_{14}H_8O_2$; this is then converted into a sulphonic acid or a bromo-compound, which by the action of alkalies yields alizarin.

Medical Action and Uses.—Madder is an obsolete medicine, but was formerly in high repute as an *emmenagogue*. It was administered in *doses* of ½ drachm, gradually increased to a drachm (Gm. 2–4), four times a day.

RUBUS, *U. S.*—BLACKBERRY.

Écorce de ronce noir, Fr.; *Brombeerrinde*, G.

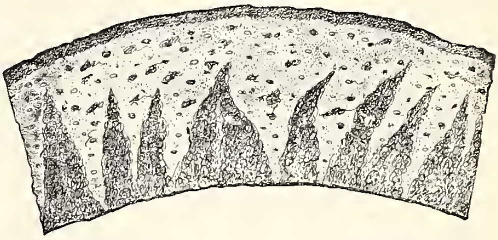
The bark of the root of Rubus villosus, *Aiton*, Rubus canadensis, *Linné*, and of Rubus trivialis, *Michaux*. Bentley and Trimen, *Med. Plants*, 100.

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—These species are common shrubby North American plants with trifoliate or quinate leaves. R. canadensis is the *dewberry*, and has a trailing slightly prickly stem and nearly smooth ovate-lanceolate, sharply serrate leaflets. R. villosus is the common *American blackberry*, has an upright or reclining stem armed with stout recurved prickles, and is glandular and hairy on the branchlets and the lower surface of the leaflets, and ripens its fruit later than the first species. R. trivialis is the dewberry or bush-blackberry of the Southern United States, growing as far north as Maryland; it is armed with bristles and recurved prickles, and has coriaceous, evergreen, nearly smooth leaflets.

Description.—The roots of these species are considerably branched, vary in size from the thickness of a goosequill or less to the diameter of an inch (25 Mm.) or more, and contain a large whitish, tough, ligneous meditullium. The bark is quite thin, blackish or in the dewberry blackish-gray externally, internally dark-brown, and the inner surface pale-brownish and smooth, tough, breaks with some difficulty, shows in the bast-wedges a tangential arrangement of the tissue, is nearly inodorous, and has a strongly astringent and somewhat bitter taste. The thinnest roots are frequently not deprived of the white, tasteless, and inert wood. The bark and leaves of most species of this genus have an astringent and somewhat bitter taste and the fruits are acidulous.

FIG. 241.



Rubus villosus: transverse section through bark, magnified 15 diameters.

Constituents.—Blackberry-bark contains tannin, of which C. F. Kramer (1882) obtained 10.2 per cent; its other constituents have not been investigated.

Off. Prep—Extractum rubi fluid., Syrupus rubi, *U. S.*

Medical Action and Uses.—Blackberry-root and dewberry-root possess astringent and probably tonic virtues, and are much used in *summer complaint* and *infantile diarrhœa*. They are best administered in a decoction made with water or with milk, an ounce in 1½ pints of liquid being boiled down to a pint (Gm. 32 in Gm. 750, reduced to Gm. 500).

RUBUS IDÆUS, *U. S.*—RASPBERRY.

Fructus rubi idæi.—*Framboises*, Fr.; *Himbeeren*, G.

The fresh root of Rubus Idæus, *Linné*.

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—This shrub attains a height of about 6 feet (1.8 M.), is indigenous to the greater portion of Europe and to Northern Asia as far east as Japan, and is frequently cultivated. Areschong (1872) regards it as being derived from Rubus strigosus, *Michaux*, which is common in North America and Japan. The young shoots are glaucous, more or less bristly-spinous, and have imparipinnate leaves with one to three pairs of sessile, ovate, serrate, and whitish-downy leaflets. The flowers have five white petals, about as long as the calyx-lobes.

Description.—The fruit is hemispherical or subconical, and consists of about twenty or thirty small red velvety-hairy drupes, which are laterally coalesced and separate in a collective mass from the dry conical receptacle. Raspberries, which are used in the fresh state only, contain a bright-red juice and have an agreeable fruity odor and a pleasant acidulous taste.

The fruit of the North American Rubus occidentalis, *Linné*, or *thimbleberry*, closely resembles the preceding, but is of a purplish-black color and has a dark-red juice.

Constituents.—Raspberries contain 4.5 to 8.7 per cent. of insoluble matter, .4 to .8 of ash, and 7 to 8.5 per cent. of organic constituents, about one-half of which is sugar, one-fourth is malic and citric acid, and the remainder consists of proteids, pectin, etc. The odor is due to a volatile oil consisting of compound ethers, and when distilled with water the distillate separates a white flocculent stearopten.

Off. Prep.—Syrupus rubi idæi, *U. S.*

Allied Fruits.—Blackberries.—Dewberries, *E.*: Mûres des haies, Baies de ronce, *Fr.*: Brombeeren, *G.*—The fruit of Rubus villosus, *Aiton*, of North America, R. fruticosus, *Linné*, of Europe, and allied species, has a fleshy receptacle, which remains united with the coalesced drupes, is of a black or blackish color, and contains a blackish-purple juice resembling in composition the juice of raspberries, but of a less delicate odor.

Medical Action and Uses.—The sole use of this fruit in medicine is to prepare an agreeable syrup.

RUMEX, *U. S.*—Rumex.

Radix rumicis s. lapathi.—*Yellow dock*, E.; *Patience frisée*, Fr.; *Grindwurz*, *Mengelwurz*, G.

The root of Rumex crispus, *Linné*, and of other species of Rumex.

Nat. Ord.—Polygonaceæ.

Origin.—The *curled dock* is a European perennial, and has been extensively naturalized in North America and in other countries. It grows in waste places and in cultivated ground, and is distinguished from allied species by the wavy curled margins of its lanceolate leaves, and by the roundish-cordate, slightly denticulate, and grain-bearing valves of the fruit. The root is collected in autumn.

Description.—The root is 8 to 12 inches (20–30 Cm.) long, ¼ to ¾ inch (6–18 Mm.) or more thick, many-headed, fusiform, annulate above, somewhat branched and sparsely beset with fibres; after drying deeply wrinkled longitudinally, externally of a brown or reddish-brown color, inodorous, and of a bitter and astringent taste. The root breaks with a short irregular fracture, and upon transverse section shows a rather thick bark nearly one-sixth the diameter of the root, a dark-colored cambium-line, and a fleshy meditullium, containing porous wood-wedges, separated by narrow medullary rays. The color of the inner tissue is white or whitish, after drying dingy brown-yellow, with yellowish or brownish-red striæ. The roots of Rumex obtusifolius, *Linné*, and R. sanguineus, *Linné*, both indigenous to Europe and naturalized in North America, are indiscriminately collected with the preceding, and resemble it.

Constituents.—The chemical composition of yellow dock is nearly identical with that of rhubarb, except in the relative proportion of the constituents, the astringency predominating. The *rumicin* and *lapathin* of earlier investigators were proven by Tamn (1858) to be identical with chrysophanic acid.

Off. Prep.—Extractum rumicis fluidum, *U. S.*

Medical Action and Uses.—Yellow dock is astringent, slightly tonic, and also laxative, and its operation has been compared to that of rhubarb, and also sarsaparilla. It has been chiefly used in chronic *cutaneous diseases*, particularly of a scrofulous nature. Some species of Rumex have been famous for the cure of *intermittent fevers*, for which purpose they were given in a hot decoction, to the production of sweating. Others have been regarded as eminently depurative, and used in chronic *hepatic congestion* and *dyspepsia* with lateritious urinary deposits and a tendency to *gout*. Externally, yellow dock has been applied to the treatment of various *skin diseases*, *glandular swellings*, and *scabies*. For the last an ointment is employed, made by boiling the root in vinegar until the fibre is softened; the latter is then reduced to a pulp and mixed with sulphur and lard. It is pretty certain that the sulphur is the efficient ingredient of this ointment. The root, softened by boiling, may be used as a stimulant and resolvent cataplasm. The decoction is made by boiling 2 ounces of the fresh root or 1 ounce of the dry root, bruised, in a pint of water (Gm. 64 or 32 in Gm. 500). Of this 2 fluidounces may be taken at a dose.

RUTA.—Rue.

Folia (Herba) rutæ.—Rue, Rue des jardins, Fr.; *Raute, Gartenraute,* G.

The leaves of Ruta graveolens, *Linné.* Bentley and Trimen, *Med. Plants,* 44.
Nat. Ord.—Rutaceæ.

Description.—Rue is an herbaceous or suffruticose perennial 2 or 3 feet (60–90 Cm.) high, which grows wild throughout Southern Europe and is frequently cultivated in gardens. The leaves are alternate, on long petioles, thrice or twice pinnate, or the upper ones pinnatifid, the lower ones 3 to 4 inches (7–10 Cm.) long, triangular-ovate in outline, subcoriaceous, grayish-green, finely pellucid-punctate and smooth; the final divisions obovate-oblong or spatulate, sparingly crenate, obtuse or rounded above, the terminal division larger and spatulate wedge-shaped. The plant has yellowish flowers in terminal corymbs and four-or five-lobed capsules containing numerous ovoid-angular blackish seeds. The leaves have a peculiar, strongly balsamic odor and possess an aromatic, bitter, and acrid taste.

Constituents.—The most important constituent of rue is its volatile oil (see page 1083). Maehl found free malic acid. Weiss (1842) isolated the yellow coloring matter, *rutin,* $C_{25}H_{28}O_{15}$, and obtained it in needle-shaped crystals. Bornträger (1844) ascertained it to possess acid properties, and named it *rutinic acid.* Hlasiwetz (1855) observed that it splits into sugar and quercetin, and regarded it as identical with *quercitrin*; but Zwenger and Dronke found the unfermentable *rutin-sugar* to differ from isodulcit and to have the composition $C_{12}H_{18}O_9$. P. Foerster (1882) obtained between 44.5 and 46.5 per cent. of quercetin. In preparing rutin it is with difficulty purified from resinous matter and a compound resembling coumarin.

Allied Drugs.—Evodia rutæcarpa, *Bentham* (Rutaceæ), is a handsome Japanese shrub about 8 feet (2.4 M.) high. The thin, cylindrical, downy stalks and the unripe fruit are used; the latter are of the size of a small pea, five-grooved in the upper half, red-brown, glandular-pitted, and of a rutaceous odor and pungent taste. The drug is employed as a purgative and emmenagogue.

Capparis spinosa, *Linné* (Capparidaceæ). The shrub is indigenous to the countries bordering the Mediterranean, and is sometimes cultivated. The flower-buds, preserved with vinegar and salt, constitute the commercial *capers* (Câpres, *Fr.*; Kapern, *G.*); they contain a volatile oil of an alliaceous odor, and a yellow coloring matter identical with *rutin.*

Sophora japonica, *Linné* (Leguminosæ, Papilionaceæ). This tree, of Eastern Asia, is occasionally cultivated for ornament. It produces a large number of white or yellowish flowers, the buds of which are used as a substitute for hop and as a yellow dye under the name of *waifa* or *Chinese berries.* The coloring matter was regarded by Stein as being identical with rutin, but P. Foerster (1882) obtained from it—his *sophorin*—57.6 per cent. of isodulcit and 46.8 of *sophoretin,* which resembles quercetin, but is not identical with it. The *sophorine* of Prof. H. C. Wood (1877–78) is a poisonous volatile alkaloid which gives a deep-red color with ferric chloride, and was obtained from the seeds of Sophora speciosa, *Bentham,* of Texas; and probably the same alkaloid has been found by Parsons (1879) in the seeds of S. sericea, *Pursh,* of Colorado and New Mexico.

Physiological Action.—Rue is an active irritant, as numerous cases of poisoning by it attest. In one example a man who had been gathering rue suffered from an inflammation of the skin of the forearms with abundant vesicles, which healed very slowly. Three cases are reported by one physician in which rue was used to produce abortion. In the first a decoction of the sliced root, in the second a decoction of the leaves, and in the third the expressed juice of the leaves, were taken. In one of the cases the effects were violent gastric pain, vomiting, or efforts to vomit, with the rejection of a little blood. In all there were great prostration, confusion of mind, cloudy vision, feebleness and slowness of pulse, coldness of the extremities, and twitching of the limbs. All of the patients, who were in the fourth or fifth month of pregnancy, aborted and recovered. In another case a woman had several times caused herself to abort by using an infusion of rue. The symptoms produced were pain in the back, bearing down, frequent micturition, continuing for several days and often attended with headache, when a "show" took place, followed by pains and abortion about 10 days from the beginning of the administration. Three doses of the oil of rue taken within an hour by a healthy adult produced uneasiness in the stomach, oppression and confusion of the brain, aching in the loins, an urgent desire to urinate, a strong smell of rue in the urine, flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency and diminished tension of the pulse. On the other hand, when an infusion of the dried leaves was employed, the pulse fell from 80 to 69 in 3 hours (Van de Warker, *Criminal Abortion,* 1872).

Medical Uses.—Rue was held in high esteem from the time of Hippocrates. It was employed to cure amenorrhœa, promote the lochia, and cause abortion. It was believed that in women it stimulated sexual desire, but that in men it diminished the seminal secretion and the tendency to venery; that it was carminative and tonic, and useful internally and externally to relieve colic; and that it destroyed intestinal worms and cured intermittent fever. It was thought, in due proportion, to strengthen, but in excess to weaken, the sight, and was prescribed as an antidote to poisoning by aconite, mushrooms, etc. Externally, it was known to cause a pustular eruption upon the hands of persons employed to gather it, and was used to destroy fleas.

Rue is a powerful anti-spasmodic, and was formerly administered in enemata for preventing or shortening *hysterical* attacks. Its stimulant action upon the uterus is shown in the unimpregnated as well as the pregnant state of the organ, but especially in the cure of *amenorrhœa* due to non-inflammatory causes. In cases arising from congestion of the uterus, rue has sometimes occasioned profuse hæmorrhage and severe pain. It should, therefore, be cautiously used in *dysmenorrhœa*. In Chili it is said to be applied to the umbilicus and to the soles of the feet to produce an emmenagogue effect. The essential oil is the most convenient form for its administration. Rue has been used instead of savin in uterine *hæmorrhage* after abortion and when it depends upon general debility. A decoction of the fresh leaves of rue has been employed as an injection to destroy *ascarides* of the rectum, and internally to remove *lumbricoid worms*. Externally, compresses saturated with a strong decoction of the plant, and applied to the chest, have been used with advantage in *chronic bronchitis*. A similar decoction has been found very efficient in destroying body *lice*, in various *scaly eruptions*, and in *glandular* engorgements.

The decoction and infusion of rue should be made from the fresh plant, but as this is not always to be procured, the oil may be substituted for it in the dose of from 1 to 5 drops. An infusion may be prepared with about $\frac{1}{2}$ ounce of the leaves to a pint of water (Gm. 16 in Gm. 500).

SABADILLA, *Br.*—CEVADILLA.

Fructus (*Semen*) *sabadillæ.*—*Cévadille*, Fr.; *Sabadillsamen*, *Läusekörner*, G.

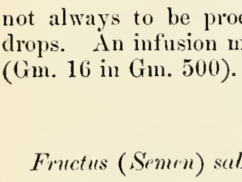
The seeds of Veratrum Sabadilla, *Schlechtendal*, s. Asagræa (Helonias, *Don*) officinalis, *Lindley*, Sabadilla officinarum, *Brandt*, Schœnocaulon officinale, *Gray*. Bentley and Trimen, *Med. Plants*, 287.

Nat. Ord.—Melanthaceæ.

Origin.—The cevadilla is a bulbous plant with long, linear, grass-like radical leaves and a slender scape, bearing a narrow spike-like raceme about 12 or 18 inches (30–45 Cm.) long of greenish-yellow flowers, of which the lower ones only are fertile. It is indigenous to the eastern section of Mexico, also to Guatemala and Venezuela. The plant growing in the latter country differs in some respects from the Mexican cevadilla, but no difference is observed in the seeds. The seeds alone are usually exported from Venezuela, and the ripe capsules from Mexico.

Description.—The fruit consists of three slightly-spreading, brownish, papery follicles which are about $\frac{1}{2}$ inch (12 Mm.) long, and are either empty or contain from two to six seeds each. These are from $\frac{1}{5}$ to $\frac{1}{3}$ inch (5–8 Mm.) long, narrow oblong or lance-linear, one side usually flattened and angular, the lower end rounded and the apex attenuate and rather beaked; the testa is rugosely wrinkled, somewhat shining, of a brownish-black color, and encloses a whitish oily albumen and at the base a small linear embryo. The seeds are inodorous and have a bitter and persistently acrid taste; the powder is sternutatory.

FIG. 242.



Asagræa officinalis, *Lindley*: fruit, nat. size; seed and longitudinal section magnified.

Constituents.—Pelletier and Caventou's analysis (1820) proved the presence of fat, wax, mucilage, and *veratrine*, combined with an acid which was at first supposed to be gallic acid, but was shown by Pfaff to be a different compound; the fat is a mixture of liquid and solid fat, and contains a volatile fatty acid, *sabadillic* or *cevadic acid*, which has an odor similar to that of butyric acid, melts at 20° C. (68° F.), and at a higher heat sublimes in white pearly needles. *Veratrine* was discovered by Meissner (1819). (For recent investigations on the alkaloids of sabadilla see VERATRINA.)

Veratric acid, $C_9H_{10}O_4$, was discovered by Merck (1839); it crystallizes in needles or prisms which are soluble in alcohol and hot water, but insoluble in ether, is fusible and sublimable, and yields with the alkalies crystallizable salts which are soluble in alcohol and water.

Cevadilla yields about $\frac{1}{3}$ per cent. of veratrine and about $\frac{1}{60}$ per cent. of veratric acid. The composition of the capsular integuments has not been ascertained. The seeds are used in pharmacy only for preparing veratrine.

Medical Action and Uses.—The medicinal virtues of cevadilla are due to the veratrine it contains, and will be found more particularly described in connection with that alkaloid. The seeds are poisonous to dogs and cats, causing vomiting and convulsions. Two children drank of a decoction of cevadilla (?), and presented the following symptoms: vomiting, insensibility, pallor, a small sharp pulse, heat of head and cool extremities, and spasms of the face and limbs; deglutition was impossible, the pupils were dilated, and the eyes projecting and oscillating. Both patients recovered.

It was formerly employed to destroy body *lice* and other *vermin*, but sometimes, when applied to the sore head, it has occasioned alarming symptoms. The tincture has been found a very efficient remedy for *scabies*. The powder has been used for the same purpose. mixed with oil and brandy, and applied after the patient had taken a prolonged warm bath. Cevadilla has also been prescribed as a *vermifuge* for tænia and rectal ascarides, and for various nervous affections. It is seldom given internally, but the dose of the seeds is stated to be from 2 to 4 grains (Gm. 0.10–0.20).

SABBATIA.—SABBATIA.

American centaury, E.; *Centaurée américaine*, Fr.; *Sabbatie*, G.

The herb of Sabbatia (Chironia, *Linné*) angularis, *Pursh*.

Nat. Ord.—Gentianaceæ.

Description.—The American centaury is a smooth biennial herb growing in dry fields and on hillsides throughout the Middle and Southern United States. Its stem is about 2 feet (60 Cm.) high, quadrangular, winged, and much branched above; the leaves are about an inch (25 Mm.) long, oblong-ovate, five-nerved, entire, acute, and at the base clasping; the flowers are in terminal corymbose panicles, have a five- or six-parted calyx with lance-linear lobes, a wheel-shaped pale or purplish-red corolla, about 1½ inches (38 Mm.) wide, five or six finally recurved stamens, and produce an oblong-ovate, mucronate, many-seeded capsule. It blooms in July, and should then be collected. The herb is without odor, but has a persistent and purely bitter taste.

Constituents.—The plant contains the principles commonly found in herbs, but appears to be free from tannin, or nearly so; the bitter principle has not been obtained in a pure state. Méhu (1868) isolated *erythrocentaurin*, $C_{27}H_{24}O_8$, by agitating the syrupy alcoholic extract of European centaury with ether; it crystallizes readily, is inodorous, tasteless, neutral, readily soluble in carbon disulphide, benzol, and oils, and dissolves in 1600 parts of cold water, 48 parts of alcohol, 13 of chloroform, and 245 parts of ether; light colors it red, but on recrystallization it is again obtained colorless. The yield is only $\frac{1}{30}$ per cent. Méhu obtained (1870) the same principle also from Erythræa chilensis, *Persoon*, and J. F. Huneker (1871) from American centaury.

Pharmaceutical Preparation.—EXTRACTUM CENTAURII, Extract of centaury. It is made by digesting European centaury with hot water and evaporating the infusion.

Allied Herbs.—SABBATIA ELLIOTTII, *Steudel*, is known in Florida as *quinine-flower*. The stem is 10 to 20 inches (25–50 Cm.) high, terete and diffusely branched; the leaves are sessile, ¼ to ½ inch (6–12 Mm.) long, obovate or oblanceolate, and the upper ones linear; the calyx-lobes are almost filiform and about one-fourth the length of the rose-colored corolla. The plant is inodorous and has a persistent, purely bitter taste. The solution of the alcoholic extract in acidulated water gives with potassio-mercuric iodide a slight precipitate (T. F. Beckert, 1877).

Several other species of Sabbatia, having white, rose-colored, or purplish flowers, are indigenous to the United States, particularly in the Southern States, and appear to possess similar properties.

ERYTHRÆA (GENTIANA, *Linné*) CENTAURIUM, *Persoon*; Herba centaurii, *P. G.*—European centaury, *E.*; Centaurée, *Fr.*; Tausendguldenkraut, *G.*—This species closely resembles American centaury, but has oval or obovate-oblong, obtuse, three or five-nerved, nearly sessile leaves, and the parts of the flowers in fives. It is only 10 or 12 inches (25–30 Cm.) high, and grows spontaneously in a few places in this country.

PLEUROGYNE ROTATA, *Grisebach*, is a very bitter Japanese plant, with narrow linear-lanceolate leaves about 1 inch (25 Mm.) long, and pale-pinkish striped flowers, having the throat of the corolla bearded and the sessile stigmas prolonged on the valves of the ovary.

Medical Action and Uses.—American centaury is a simple bitter, without special virtues. Its cold infusion is useful in debilitated states of the stomach, and its hot infusion as a diaphoretic in muscular *rheumatism*, *sore throat*, and febrile attacks generally. The infusion may be made with an ounce of the plant to a pint (Gm. 32 to Gm. 500) of boiling water, and given hot in the *dose* of from 4 to 6 fluidounces (Gm. 124–190), or cold in the *dose* of 2 fluidounces (Gm. 64).

SABINA, *U. S.*—SAVIN (SAVINE).

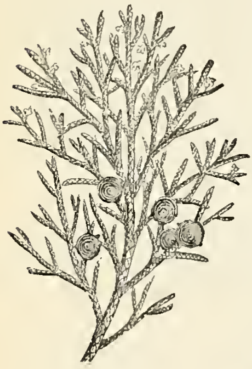
Sabinæ cacumina, Br.; *Summitates (Herba) sabinæ*, P. G.—*Savin-tops*, E.; *Sabine*, Fr.; *Sadebaumspitzen*, *Sevenkraut*, G.

The tops of Juniperus Sabina, *Linné*, s. Sabina officinalis, *Garcke.* Bentley and Trimen, *Med. Plants*, 254.

Nat. Ord.—Coniferæ.

Origin.—Savin is a small evergreen procumbent or erect shrub which grows on rocky banks from Maine to Wisconsin, near the Great Lakes and farther northward. It is distributed throughout a great portion of Europe and eastward to the Caspian Sea and Southern Siberia. Besides in size, it is distinguished from red cedar (see page 851), which it closely resembles, by the larger fruit, which is nodding on the recurved peduncle-like branchlet. The young branchlets are collected for medicinal use.

FIG. 243.



Branch of Savin.

Description.—As met with in commerce, savin is in small and thin subquadrangular pieces, consisting of slender twigs, which are densely covered with minute, scale-like, imbricate leaves, arranged alternately in opposite pairs. The leaves are rhomboid-lanceolate, rather obtuse, and closely appressed, and on the back have a shallow groove containing a gland, which is mostly oblong in shape. Older leaves are more pointed and more or less spreading. Savin has a persistent somewhat terebinthinate odor, which is stronger after bruising the branchlets; the taste is nauseous, resinous, and bitter. The drug is frequently mixed with some fruits which are about $\frac{1}{5}$ inch (5 Mm.) in diameter, globular, but more or less shrivelled, blackish-blue or brownish, contain usually two seeds, and have a similar but stronger odor and taste then the branchlets.

Constituents.—Gardes (1837) found savin to contain tannin, resin, volatile oil (page 1084), extractive, chlorophyll, etc. The fresh fruit yields 10 per cent. of volatile oil.

Off. Prep.—Ceratum (Unguentum) sabinæ, *U. S.*, *Br.*; Extract. sabinæ fluid., *U. S.*; Tinctura sabinæ, *Br.*

Medical History.—In ancient times the virtues of savin were clearly recognized. Its stimulant action caused it to be employed for the treatment of ulcers and carbuncles and as a remedy for alopecia; it was also used with honey for the removal of freckles; and it was well known that, internally, it was apt to cause bloody urine, and, when taken by pregnant females, miscarriage.

Physiological Action.—Given to dogs in powder, it occasions severe pain, vomiting, bloody stools and urine, paralysis, spasms, and death; after which evidences are found of gastro-intestinal inflammation and the brain is congested. The oil of savin produces similar but more intense effects. (See OLEUM SABINÆ.) On man the action of savin itself is chiefly illustrated by cases in which it was taken for the purpose of producing abortion. Thus, an infusion caused incessant vomiting, abortion, excruciating pain, rupture of the gall-bladder, and death. Many cases are recorded of the fatal consequences of its use in large doses.

Medical Uses.—Savin has been used with unquestionable advantage in cases of *amenorrhœa* and *dysmenorrhœa* depending on a want of vigor in the uterine apparatus, and also for the cure of *menorrhagia* depending upon a like condition. Several trustworthy physicians declare that in such cases of uterine hæmorrhage 1 grain of powdered savin, repeated three times a day and continued for weeks together, will overcome the tendency to the uterine loss. Under like conditions *sterility* and *chlorosis* have been cured by this medicine. For amenorrhœa it has been recommended to administer a pill composed of rue, savin, and ergot, of each 1 grain, and aloes $\frac{1}{2}$ grain, three times a day at first, and gradually increasing the dose (Courty). It had once a repute, not entirely undeserved, for its virtues in *chronic gout* and *rheumatism*, for which it was employed in infusion or in decoction, both internally and in a lotion for the affected joints. Savin has no doubt been found efficient as a *vermifuge*, but other anthelmintics are to be preferred as being less dangerous. In pregnancy, and whenever there is a tendency to congestion of any important organ, savin is contraindicated. Savin, in cerate, is used to excite or to prolong the secretion produced by blisters. Its powder, slightly moistened, is one of the most efficient remedies for *venereal warts*. It may be applied alone or mixed with burnt alum or with subacetate of copper. It is also used, either in powder or in solution, to wither *polypi*, and may be applied with advantage to *condylomata*, and, as in ancient times, to stimulate indolent and unhealthy *ulcers*.

Fresh is much more active than dried savin. It may be administered in powder in the *dose* of 5 to 6 grains (Gm. 0.30–0.40), repeated several times a day. It is most conveniently given in syrup or honey.

SACCHARUM, *U. S., P. G.*—SUGAR.

Saccharum purificatum, Br.—*Refined sugar*, *Cane-sugar*, E.; *Sucre*, *Sucre de canne*, Fr.; *Zucker*, *Rohrzucker*, G.

The refined sugar of Saccharum officinarum, *Linné*. Bentley and Trimen, *Med. Plants*, 298 (nat. ord. Graminaceæ). Formula $C_{12}H_{22}O_{11}$. Molecular weight 342.

Origin.—The sugar-cane appears to have been indigenous to India and other parts of Southern and Eastern Asia, and has been cultivated from time immemorial. At present it is not known in the wild state, but it is raised in most tropical and subtropical countries, and in many of them for the production of sugar. It is a perennial, and produces a stem which is from 8 to 12 feet (2.4–3.6 M.) high, 1 to 2 inches (2–5 Cm.) thick, cylindrical, jointed, and, with the exception of the flowering tops, which are hollow, filled with a juicy pith. The leaves are 4 to 5 feet (1.2–1.5 M.) long, 2 inches (5 Cm.) wide, and linear; and the flowering panicles large, pyramidal, and with spreading branches. Several varieties are known, differing chiefly in the color and hairiness of the stem. Saccharum chinense, *Roxburgh*, having a slender, erect panicle, is probably a distinct species, and the one principally cultivated in China.

Cane-sugar is present in a large number of grasses, particularly in those having a rather thick stem, such as Sorghum saccharatum, *Persoon*, s. Holcus saccharatus, *Linné*, Zea Mays, *Linné*, and others. From the thorough researches of H. Leplay, published in 1882, it appears that in maize the sugar is produced in the leaves and transferred to the stem, where it gradually accumulates, and when the fruit begins to develop it is conveyed to the grain, where it is converted into starch, the sugar at the same time disappearing from the leaves and diminishing very materially in the stem. It is also present in the juice of different species of maple, birch, palm, and other trees, and in many fleshy roots, prominent among which is a cultivated variety of Beta vulgaris, *Linné*, or *sugar-beet*, which is largely employed in Europe in preparing sugar.

Preparation.—Recently-collected sugar-cane yields by crushing and expressing about 80 per cent. of juice, which contains from 78 to 84 per cent. of water, 16 to 21 per cent. of sugar, 0.3 to 0.4 per cent. of mucilaginous, resinous, fatty, and albuminous matters, and nearly the same amount of salts. The juice is a grayish, turbid, sweet liquid, which is clarified by heating, a little lime being at the same added for the purpose of neutralizing free acid; it is then concentrated by rapid evaporation in open pans, transferred to coolers, where it is frequently stirred, and afterward into casks perforated at the bottom and arranged in such a manner that the liquid portion may drain off and be collected in suitable tanks. The granular solid product thus obtained constitutes the *raw* or *muscovado sugar* of commerce; the liquid portion is known as *treacle* or *molasses*. Raw sugar is refined by dissolving it in water, the solution is heated with blood, the impurities are skimmed off, and the liquid is filtered through recently-burned granular animal charcoal. The clear and colorless filtrate is concentrated in a vacuum-pan, and when of sufficient density run off into conical moulds, the narrow orifice of which is closed by a plug. It solidifies as a dense crystalline mass, which is drained by the removal of the plug, and freed from the remaining colored mother-liquor by percolating through it a concentrated solution of pure sugar, after which it is dried and sent into commerce as *refined* or *loaf sugar*. By concentrating the mother-liquors they are made to yield more sugar of an inferior grade, until finally a thick syrupy liquid is obtained, which refuses to crystallize, and is known as *sugar-house molasses*, and in England as treacle.

The method of obtaining sugar from the sugar-beet is very similar to that described, but is attended with greater difficulties, owing to the presence of larger quantities of proteids and other foreign constituents. Sugar-beets contain about 12 per cent. and yield about 9 per cent. of cane-sugar.

Properties.—Refined sugar is seen in commerce broken into small pieces or lumps, which are hard and have a granular crystalline texture and a pure white color. Somewhat inferior kinds of sugar are softer, and those having a yellowish tint are often artificially improved in appearance by adding, while crystallizing, a minute quantity of blue pigment, like ultramarine, with the view of neutralizing the objectionable tint and making the sugar appear whiter; such sugar will yield a yellowish solution with water, and on standing will gradually separate the pigment. Perfectly white sugar, known in commerce as *double refined*, is the only kind that should be used in pharmaceutical preparations. Sugar may be obtained in large transparent rhombic prisms, known as *rock candy*, *saccharum candidum*, which does not differ from lump sugar except that this is in crystalline masses from disturbed crystallization. Sugar has the specific gravity 1.58 (Kopp), is permanent in the air, neutral, without odor, has a very sweet taste, and dissolves at ordinary temperatures in one-half its weight of water, yielding a dense, sweet, and colorless liquid known as syrup; saturated at 15° C. (59° F.), such a solution contains 66 per cent. of sugar, and this has the density 1.345082 (Michel and Kraft). At the boiling-point sugar dissolves in water almost in all proportions (in 0.2 parts, *U. S.;* 0.212 parts, Flourens). It requires for solution about 80 parts of boiling absolute alcohol, 28 parts of boiling officinal alcohol, and about 4 parts of boiling alcohol spec. grav. .830, these solutions depositing most of the sugar on cooling. The solubility is greater in weak alcohol, both cold and hot. At 15° C. (59° F.) 1 part of sugar dissolves in 2 parts of 50 per cent. alcohol, in 7.7 parts of 75 per cent. alcohol, in 14.7 parts of 80 per cent. alcohol, in 31.6 parts of 85 per cent. alcohol, in 175 parts of 92 per cent. alcohol, and in 228 parts of methylic alcohol of the same strength (Casamajor). Sugar dissolves also in glycerin, the solubility being increased on dilution with water, but it is insoluble in ether, chloroform, carbon disulphide, and in hydrocarbons. It combines with chloride of sodium, yielding deliquescent crystals which contain 14.9 per cent. of that salt. Definite compounds have likewise been obtained with several other salts and with alkalies and alkaline earths. (See Syrupus Calcis.) When triturated in the dark it becomes luminous. Its solution deviates polarized light to the right—a behavior which is of great practical importance for the estimation of sugar in aqueous liquids and for distinguishing different kinds of sugar, which have a different rotary power.

When sugar is heated to 160° C. (320° F.) it melts without losing in weight, and congeals on cooling to a transparent amorphous yellowish mass known as *barley sugar*, *saccharum hordeatum*, which becomes gradually opaque on the surface from the formation of minute crystals. If sugar is kept in the melted state between 160° and 170° C. (320° and 338° F.) for a short time, it is converted into a deliquescent mixture of *glucose* and *levulosan;* $C_{12}H_{22}O_{11}$ yields $C_6H_{12}O_6 + C_6H_{10}O_5$; the latter is not fermentable until after it has been boiled with water or dilute acids. When heated to between 180° and 200° C. (356° and 392° F.) sugar turns brown, evolves a peculiar odor, and is converted into *caramel*, $C_{12}H_{18}O_9$, parting at the same time with $2H_2O$; the pure product of this composition, *caramelan*, was obtained colorless by Gélis (1862). Caramel may be prepared in the same manner from inferior qualities of sugar, from molasses, and from glucose, and the conversion is hastened in the presence of small quantities of alkalies; the addition of a little carbonate of ammonium, which is again volatilized by the heat, is of service, for the reason stated. Subjected to dry distillation, sugar yields aldehyd, acetone, acetic acid, tarry products, and carbonic acid, carbonic oxide, and marsh gas. According to Lassaigne, iodine heated with solution of sugar is converted into hydriodic acid. Under the influence of ferments, as well as of dilute acids, cane-sugar is converted into *invert-sugar*, which is a mixture of *dextrose* or grape-sugar and *levulose* or fruit-sugar, and is directly fermentable. This inversion of sugar takes place slowly on boiling with water, but cold aqueous solutions keep unaltered for a long time, provided the access of ferments suspended in the air be prevented. Under the same condition, according to the investigations of Kreusler, Lemoine, and others, light does not exert the inverting effect reported by Raoul (1871). Nitric acid inverts cane-sugar readily, and when heated with it produces saccharic, racemic, tartaric, and oxalic acids.

Tests.—The purity of cane-sugar is ascertained by the physical properties described above, and by its complete solubility in water and alcohol. The absence of glucose or of a similar sugar is ascertained by some of the reactions given below. "Aqueous and alcoholic solutions of sugar should have no effect on litmus-paper. The solution in 20 parts of distilled water should be scarcely rendered turbid by silver nitrate or barium nitrate (chloride and sulphate)."—*P. G.* "Neither an aqueous nor an alcoholic solution of sugar kept in large, well-closed, and completely-filled bottles should deposit a sediment on prolonged standing (absence of insoluble salts, foreign matters, ultramarine, Prussian blue, etc.). If a portion of about 1 Gm. of sugar be dissolved in 10 Ccm. of boiling water, then mixed with 4 or 5 drops of test solution of nitrate of silver and about 2 Ccm. of water of ammonia, and quickly heated until the liquid begins to boil, not more than a slight coloration, but no black precipitate, should appear in the liquid after standing at rest for 5 minutes (absence of grape-sugar and of more than a slight amount of inverted sugar)."—*U. S.*

Off. Prep.—Confectiones, Ferri carbonas sacchar., Massa (Pilula) ferri carb., Mistura ferri comp., *U. S., Br.;* Mist. guaiaci, *Br.;* Pil. ferri iodidi, Pulvis cretæ comp., Pulv. glycyrrh. comp., *U. S., Br..;* Pulv. amygdalæ comp., Pulv. tragacanthæ comp., *Br.;* Syrupi, Trochisci, *U. S., Br.*.

ELÆOSACHHARA, Oil sugars. Volatile oil 1 drop, sugar 2 Gm.; mix.—*P. G.*

Other Sugars.—GLUCOSE, GRAPE-SUGAR, DEXTROSE, or STARCH-SUGAR, $C_6H_{12}O_6$; molecular weight 180. Hydrated, $C_6H_{12}O_6.H_2O$; mol. weight 198. Carbohydrates having a sweet taste are frequently met with in plants and among the products of decomposition of those organic compounds forming the large class of *glucosides*. The sugar yielded by the latter is frequently, though not always, identical with the sugar met with in grapes and other fruits and with that produced from starch. This is now very largely made for uses in the arts by boiling 100 parts of starch, 400 parts of water, and 4 or 5 parts of sulphuric acid until starch can no longer be detected in the liquid, the transformation being hastened by heating under pressure; the free acid is then neutralized with chalk, the filtrate clarified and decolorized, if necessary, by treating it with clay and animal charcoal, and, finally, concentrated, preferably in a vacuum-pan. The grape-sugar or glucose of commerce is prepared in this manner. Liquid glucose contains from 34 to 43 per cent. of dextrose, from 0 to 19 per cent. of maltose, from 30 to 45 per cent. of dextrin, and from 14 to 23 per cent. of water. Solid grape-sugar is usually in a white or whitish, irregularly granular powder or mass; from alcohol it may be obtained in compact, nodular groups of needles. A. Behr (1882) has shown that the cooling concentrated solution of glucose, on the addition of crystals or powdered crystals of that compound, will give a large crop of prisms of anhydrous glucose. It rotates polarized light to the right, though less than cane-sugar, reduces the so-called noble metals, and acquires a dark color when heated with solutions of alkalies. It is less sweet than cane-sugar, is directly fermentable, undergoes by heat alterations analogous to those of cane-sugar, is insoluble in ether, dissolves in about 50 parts of alcohol, and requires little more than 1 part of cold water for solution; but after it has been rendered amorphous by heat it dissolves in water in nearly all proportions. Nitric acid oxidizes it to saccharic, tartaric, racemic, and oxalic acids. *Saccharic acid*, $H_2C_6H_8O_8$, is amorphous, deliquescent, freely soluble in water and alcohol, and yields mostly crystallizable salts.

LEVULOSE, CHYLARIOSE, or FRUIT-SUGAR, $C_6H_{12}O_6$; mol. weight 180. It frequently accompanies grape-sugar in fruits, also in honey; in some plants it is associated with cane-sugar. It is usually a colorless, uncrystallizable syrup, has nearly the same sweetness as cane-sugar, and turns the plane of polarized light to the left. It may be obtained in fine silky needles which are insoluble in absolute alcohol and ether, but dissolve readily in aqueous liquids. Levulose is produced from inulin by treatment with dilute acids; with nascent hydrogen it yields mannit. Among the products of oxidation by nitric acid are succinic, acetic, and oxalic acids.

INOSIT, PHASEO-MANNIT, $C_6H_{12}O_6.2H_2O$; mol. weight 216. It is present in the juice of some meats, in the green fruit of many Leguminosæ, in asparagus, and in other plants. It is very sweet, crystallizes readily from water and alcohol, is insoluble in ether, does not undergo alcoholic fermentation, and yields with nitric acid explosive compounds and oxalic acid.

Sugar Tests.—*Moore's Test.* A solution of cane-sugar, heated with 3 or 4 per cent. of potassa for a minute or two, remains colorless; glucose and milk-sugar are colored brown.

Trommer's Test. A solution of cane-sugar, mixed with a little sulphate of copper and an excess of potassa or soda, retains its blue color on boiling, but turns bright-red in the presence of glucose or milk-sugar, red cuprous oxide being deposited. Glucose and most allied sugars effect the same reduction, though more slowly, in the cold.

Fehling's test is a modification of the preceding, and may be used for the quantitative determination of glucose. The test liquid is prepared by dissolving 34.64 Gm. of crystallized sulphate of copper in water, adding 200 Gm. of Rochelle salt, and 600 or 700 Gm. of soda solution spec. grav. 1.20, and diluting the whole to 1 liter (Schorlemmer). 10 Ccm. of this solution are reduced by 0.5 Gm. of grape-sugar. Boedecker introduced Rochelle salt in place of potassium tartrate, which was used by Fehling. The test is usually made with a solution containing about 1 per cent. of glucose; weaker solutions reduce a somewhat smaller amount of the test liquid.

Pettenkofer's Test. Bile in the presence of sugar (of other carbohydrates and of proteids) acquires a blood-red color with concentrated sulphuric or phosphoric acid.

Boettger's Test. A little subnitrate of bismuth, boiled with solution of glucose, rendered alkaline by sodium carbonate, acquires a gray or black color; pure cane-sugar produces no alteration.

O. Schmidt's Test. Acetate of lead, added to a saccharine liquid, is precipitated white by excess of ammonia; on heating the mixture it remains unchanged if cane-sugar or milk-sugar is present, but turns orange-red with glucose.

Sachsse's Test. 18 Gm. mercuric iodide, 25 Gm. potassium iodide, and 80 Gm. caustic potassa are dissolved in distilled water sufficient to make 1 liter. 40 Ccm. of this solution heated to boiling are decomposed by 1.1342 Gm. of glucose, so that a drop of the liquid is not rendered black by sulphydrate of ammonium.

Maumené's Test. On heating a solution of glucose with a few drops of solution of silver nitrate the liquid acquires a brown color.

Tollen's Test. An ammoniacal solution of silver nitrate containing caustic soda is reduced by glucose, with the production of a metallic mirror.

Gawalowski's Test. A solution of sugar heated with neutral ammonium molybdate to 100° C. (212° F.) becomes blue in the presence of glucose.

Many other tests have been proposed; the above are quite available and give good results. Tannin and similar compounds which are likely to interfere are previously removed, either by solvents or precipitants.

History.—Cane-sugar has been manufactured in Asia from the most remote antiquity. "Thou hast bought me no sweet cane with money" (Isa. xliii. 24), in the eighth century before Christ, seems to be an allusion to the sugar-cane. In the fourth century before our era Theophrastus wrote of a sort of "honey" procured from canes or reeds. In the first century several writers allude to it, and describe its origin as Oriental; but for more than a thousand years it remained unknown in Europe, when it was introduced by the Arabians, along with the arts and sciences of which they were the surviving depositaries. From the Mediterranean countries it was transplanted to the New World, which was destined to return the gift with interest, but it is only within the last two or three hundred years that its use became general as an article of food.

The medicinal virtues of sugar were alleged by the ancients to be that it is laxative, and cleansing to inflamed and ulcerated surfaces, and is less apt than honey to excite thirst. When, in course of time, it came into general use, it was accused of impairing the digestion, producing biliousness, promoting the generation of intestinal worms, and causing caries of the teeth—opinions every one of which is popular at the present day. Sugar is generally regarded as nutritious food, contributing directly to the growth of the tissues, and especially to the formation of fat. But a more thorough experimental investigation of the subject has shown that sugar cannot be regarded as nutritious. On the contrary, an excessive consumption of it leads to wasting of the tissues and a scorbutic condition. Its real value as an article of food appears to be that it diminishes tissue-waste, and that in so far, therefore, it resembles alcohol and oil in its mode of action.

Medical Uses.—Sugar is of comparatively little value for its independent effects, but few substances are more useful as an associate of other medicines, whether to preserve them from oxidation and decomposition, to conceal or improve their taste, or to give them special pharmaceutical forms.

In solution sugar is almost exclusively lenitive, but in powder it is stimulant. It is universally employed to diminish dryness of the mouth and fauces, to allay irritation, and to mitigate *cough* and *hoarseness.* Sugar dissolved in water is said to have a diuretic effect. When injected into the veins of animals it is said to be powerfully diuretic (Richet and M. Martin, *Med. Record*, xxi. 394.) It certainly, when moderately used, promotes digestion and allays nervous excitement. For these purposes sweetened water (*eau sucrée*) is universally employed in France and Southern Europe. Formerly a strong solution of sugar was much used as an antidote to *corrosive poisons.* It enters into all the drinks, mucilaginous, farinaceous, and gelatinous, employed in febrile diseases. Finely-powdered sugar will sometimes relieve the *hiccough* which in nursing infants is apt to arise from over-feeding. Loaf-sugar, eaten freely, is said to arrest the development of *alcoholic intoxication*, perhaps by retarding gastric absorption. A strong solution of sugar injected into the rectum has been used successfully to destroy *ascarides* of that part. In powder it is very efficient as a remedy for *aphthæ* of the mouth, in repressing the exuberant and stimulating the indolent granulations of *ulcers*, in removing opacities of the *cornea*, and in curing granular *eyelids.* Sugar has been claimed by Fischer to be an efficient antiseptic dressing for *wounds.* He associated it, however, with other antiseptics; but Windelschmidt states that for small wounds sugar is equal to iodoform as a dressing (*Med. News*, xliii. 462). In *chronic laryngitis*, when inhaled by a sudden aspiration from a tube extending to the root of the tongue, it may be used with advantage alone or mixed with other powders. In the same manner it may be employed as a snuff in chronic *ozæna.* The fumes from burnt sugar destroy *offensive effluvia*, and are conveniently disengaged by sprinkling sugar upon burning coals or on a hot shovel.

The culinary and medicinal uses of beet-sugar are the same as those of cane-sugar, but in sweetness it is inferior.

SACCHARUM LACTIS, *U. S., Br., P. G.*—Sugar of Milk.

Lactose, Milk-sugar, E.; *Sucre de lait, Lactine,* Fr.; *Milchzucker,* G.

A crystalline sugar prepared from the whey of cow's milk.

Formula $C_{12}H_{22}O_{11}.H_2O$. Molecular weight 360.

Preparation.—Milk-sugar is one of the constituents of the milk of mammals, and appears to be present in larger proportion in the milk of herbivorous animals than in that of the Carnivoræ. To obtain it, the butter and casein are first removed, the whey (see p. 861) is concentrated, and the liquid permitted to crystallize in large tanks, the crystallization being facilitated by the introduction of thin sticks or cords; the impure crystals are once or twice recrystallized from water. It is chiefly prepared in Switzerland. About 100,000 pounds of milk-sugar are annually imported by the United States. Milk-sugar was prepared by Bertoletti in 1619, and was introduced into medicine by Testi in 1698.

Properties.—Sugar of milk is usually met with in commerce in cylindrical pieces composed of numerous crystals aggregated around an axis of stick or cord. It crystallizes in hard white or translucent four-sided prisms, is permanent in the air, yields a white sandy powder, is neutral, inodorous, and has a slightly sweet taste. It dissolves in 6 parts (7 parts, *U. S., P. G.*) of water at 15° C. (59° F.), and in 1 part (Guérin-Varry), or, according to other observers, in 2½ parts, of boiling water, and is insoluble in ether, chloroform, and hydrocarbons. Its aqueous solution rotates the plane of polarized light to the right, is rendered yellow or brown on being heated with solutions of alkalies or alkali carbonates, reduces in the cold, or more rapidly on heating, alkaline liquids containing salts of copper, bismuth, mercury, or silver, and produces a bright metallic mirror with ammoniacal solution of silver. When heated to 130° C. (266° F.) milk-sugar parts with its water of crystallization without fusion, and leaves a white mass which again absorbs water, at a higher heat becomes yellow, and melts at 203.5° C. (398° F.) (Lieben); but above 170° C. (338° F.) it is converted into *lacto-caramel,* $C_6H_{10}O_5$, and afterward into products similar to those obtained on the dry distillation of cane-sugar and glucose. Milk-sugar does not readily undergo vinous fermentation until after it has been boiled with diluted sulphuric acid, which converts it into *galactose,* $C_6H_{12}O_6$, and glucose. In the presence of casein it is converted into *lactic acid* (see page 71), alcohol being formed at the same time, but in small quantity only if the free acid is neutralized as fast as it is produced. By boiling with dilute nitric acid it is converted into mucic, saccharic, tartaric, racemic, and finally into oxalic, acid. Its hardness renders it serviceable for reducing other substances to a fine powder.

Tests.—If 1 part of sugar of milk be sprinkled upon 5 parts of sulphuric acid contained in a flat-bottomed capsule, the acid should acquire at most a greenish or reddish, but no brown or brownish-black, color within 1 hour (absence of cane-sugar)."—*U. S., P. G.* It is important that in applying this test heat be avoided, since milk-sugar is rendered dark-brown by concentrated sulphuric acid at the heat of the water-bath. "On adding 0.2 Gm. of milk-sugar to a boiling mixture of 4 Gm. of solution of basic lead acetate and 2 Gm. of ammonia-water, a white precipitate free from a red tint should be produced (absence of glucose)."—*P. G.*

Off. Prep.—Triturationes, *U. S.*

Medical Action and Uses.—Sugar of milk is far less sweet than cane- or beet-sugar, and is thought to be less apt to ferment in the stomach and bowels. It is chiefly used as a vehicle for small doses of pulverulent medicines. It is said that added largely to warm skimmed milk it may be used as a laxative (*Bull. de thérap.*, cii. 182).

SALEP.—Salep.

Tubera (*Radix*) *salep,* P. G.—*Salep,* Fr., G.

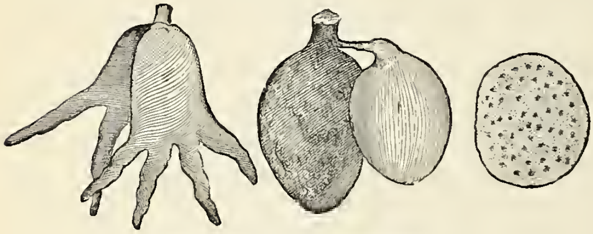
The tubers of different species of Orchis and allied genera.

Nat. Ord.—Orchidaceæ, Ophrydeæ.

Origin and Preparation.—The plants belonging to the genus Orchis are small herbs, usually with a stem between 6 and 18 inches (15–45 Cm.) high, with showy, mostly pink, red, or purple-colored ringent flowers, having the lip turned downward and bearing a nectariferous spur underneath, and with parallel-veined sheathing leaves, those of the stem often reduced to bracts. The subterraneous portion usually consists of two fleshy tubers, the smaller of which originates from the axil of a radical leaf and produces the flowering stem during the following year. These tubers furnish the salep. They are collected, scalded in water, and rapidly dried, and thereby lose their white opaque appearance, as well as their unpleasant odor and bitter taste. Salep was formerly procured in Persia and other Oriental countries from the tubers of Eulophia campestris, E. herbacea, *Lindley*, and several allied species. At the present time it is prepared in various parts of Southern and Central Europe. The German Pharmacopœia admits only unbranched tubers, such as are furnished by Orchis mascula, *Linné*, O. Morio, *Linné*, O. ustulata, *Linné*, Anacamptis pyramidalis, *Richard*, Platanthera (Habenaria, *R. Brown*) bifolia, *Reichenbach*, and other species.

Description.—Oriental salep is 1–1⅗ inches (25–40 Mm.) long, and usually dark-colored; European salep is always smaller. Salep is globular, pyriform, ovate, or oblong in shape, somewhat flattened or wrinkled, with a scar of the terminal bud at the apex, of a pale brownish-yellow color, somewhat translucent, of a horny texture, hard, inodorous, and of an insipid, very mucilaginous taste. It is generally kept in the form of powder, which has a yellowish color. The tissue consists of thin-walled parenchyma filled with starch, the granules of which are more or less ruptured from scalding, and of large, nearly globular cells containing mucilage. The scattered fibro-vascular bundles are small and thin, and few cells contain raphides.

Fig. 244.



Salep: tubers and transverse section.

The tissue of palmately-divided tubers is similar, but the mucilage-cells are generally much smaller and more or less elongated. Such tubers are derived from Orchis latifolia, *Linné*, O. maculata, *Linné*, O. sambucina, *Linné*, Gymnadænia conopsea, *R. Brown*, and other species, and were formerly known in European pharmacy as *radix palmæ Christi*. They are rather flat, below divided into two to five branches, and less mucilaginous, but otherwise resemble the former kind.

Constituents.—Raspail found the old tuber collected in autumn to be free from starch, while the young tuber contained then large quantities of it. Dragendorff (1865) obtained from 100 parts of salep starch 27.3, mucilaginous constituents 48.1, sugar 1.2, proteids 4.9, and cellulose 2.4, parts; the mucilage is not extracted by cold water. Salep yields 2.1 per cent. of ash.

Adulterations and Substitutions.—The scalded tuber of colchicum resembles salep in appearance, but has a broad groove on one side and a sweetish afterward bitter and acrid taste. An adulteration of powdered salep with starch is best detected by the microscope, which reveals the shape of the foreign starch-granules; owing to the manner of its preparation, salep has its starch converted into a pasty mass. 1 part of powdered salep should yield, with 50 parts of boiling water, a jelly which after cooling is rather stiff, and with 100 parts a thick turbid mucilage; this has an insipid taste and is rendered blue by iodine.

MUCILAGO SALEP, *P. G.*, is prepared by shaking in a vial 1 part of powdered salep with 10 parts of cold water until it is uniformly diffused, when 90 parts of boiling water are added and the whole well agitated.

Medical Action and Uses.—Salep was, even in ancient times, regarded as very nutritious, and as a demulcent it was used in medicine. It tends to confine rather than relax the bowels, and hence is a very useful article of diet for infants and children affected with *diarrhœa* or *summer complaint*, and for adults suffering from tuberculous and other forms of chronic diarrhœa. The mucilage is prepared by first macerating powdered salep in cold water, and gradually adding boiling water, with stirring, in the proportion of 5 grains of salep to the ounce. Instead of water, milk or some animal broth may be used. Salep jelly may be made as follows: Rub 60 grains of powdered salep with water in a mortar until it has swollen to four times its original bulk; then add gradually, and with constant stirring, 16 ounces of boiling water, and boil down to 8 ounces.

SALICINUM, *U. S., Br.*—SALICIN.

Salicine, Fr.; *Salicin*, G.
Formula $C_{13}H_{18}O_7$. Molecular weight 286.

Origin.—Salicin exists in the bark of most species of Salix and Populus, and to a small extent also in the leaves and pistillate flowers. According to Herberger, it is best prepared from the bark of young wood, which contains it in relatively larger proportion than the trunk-bark, and associated with smaller quantities of other compounds, which interfere with its isolation. It may also be prepared from populin by boiling it with lime-water or with solution of barium hydrate. Salicin was discovered by Leroux (1830); in the same year Braconnot obtained from it saligenin and saliretin, without, however, recognizing their relations to salicin; these and the glucoside nature of the latter were first established by Piria (1838, 1845). Herberger obtained 3 to 4 per cent. of salicin from the bark of Salix pentandra and S. Helix; but the results of different investigators with various species are very variable, which may in part be due to the kind of bark examined. This principle was prepared synthetically by A. Michael in 1879.

Preparation.—A decoction of willow-bark is deprived of tannin and coloring matter by digesting it with levigated litharge (Duflos) or by precipitating with basic lead acetate (Peschier); in the latter case the free acid is afterward neutralized with calcium carbonate. The filtrate on concentration yields crystals which require purification by recrystallization. The tannin may also be removed by milk of lime, and the salicin taken up by alcohol from the filtrate concentrated to a soft extract.

Properties.—Salicin crystallizes in colorless plates or flat rhombic prisms, but is usually seen in white glossy scales or needles. It remains unaltered in the air, has a neutral reaction to test-paper, is inodorous, and possesses a persistently bitter taste. Piria found it to be soluble in 30 parts of water at 11.5° C. (52.7° F.), and somewhat less freely in alcohol (30 parts, Hager). It dissolves in 0.7 part of boiling water and in 2 parts of boiling alcohol (*U. S.*), is soluble in amylic alcohol, creasote, and without alteration in acetic acid, dissolves more freely in alkaline liquids than in water, but is insoluble in ether, chloroform, benzol, and petroleum benzin. Its ammoniacal solution is not colored on exposure (difference from phlorizin), and its aqueous solution is not precipitated by tannin or the various reagents for alkaloids. Salicin melts at 198° C. (388.4° F.) to a colorless liquid, which on cooling congeals crystalline; at a higher heat it becomes brown, at about 260° C. (500° F.) gives off acid vapors having the odor of salicylous acid and of caramel, and at a red heat is completely decomposed, without leaving any residue.

Cold sulphuric acid dissolves salicin with a bright-red color; after the absorption of water from the air—but not after the addition of water or after being neutralized by an alkali—deposits a red powder (*rutilin*) which after washing is yellowish-red, after drying blackish-brown, insoluble in water, alcohol, and glacial acetic acid, and is colored violet-red by alkalies (Braconnot). On warming salicin with somewhat diluted sulphuric acid and potassium bichromate, *salicylous acid* or *salicyl-aldehyd*, $C_7H_6O_2$, is given off, recognizable by its peculiar fragrance. Salicin is a glucoside, and when digested with emulsin or saliva, or heated to 80° C. (128° F.) with dilute sulphuric acid, assimilates 1 molecule of water and is split into glucose and *salicylic alcohol* or *saligenin*, $C_7H_8O_2$, which crystallizes in pearly tables, is easily soluble in hot water, alcohol, and ether, melts at 82° C. (179.6° F.), and sublimes at 100° C. (212° F.). Saligenin is characterized by yielding in solution a deep-blue color with ferric chloride, and when boiled with dilute acids by being converted into a resinous body, *saliretin*, $C_{14}H_{14}O_3$, while oxidizing agents convert it into salicylous and salicylic acids. Cold nitric acid of specific gravity 1.16 oxidizes salicin, with the production of *helicin*, $C_{13}H_{16}O_7$, which crystallizes in white needles, and is by ferments and dilute acids resolved into sugar and salicylic aldehyd. If nitric acid of spec. grav. 1.09 is employed, salicin yields *helicoidin*, $C_{26}H_{34}O_{14}$, which may be regarded as a compound of salicin and helicin. These interesting reactions have been chiefly investigated by Piria (1837, etc.).

Tests.—The behavior of salicin to ammonia distinguishes it readily from phlorizin, and its solubility in cold nitric acid from those alkaloids which acquire with this reagent a characteristic color. To test for poisonous alkaloids, which may possibly be present, Hager recommends agitating 0.2 Gm. of salicin with 4 Ccm. of water and 1 Ccm. of potassa solution, when a clear solution should be obtained. "The aqueous solution of salicin should not be precipitated by tannic or picric acid, nor by iodide of mercury and potassium (absence of, and difference from, alkaloids)."—*U. S.*

Physiological Action.—Salicin does not, like quinine, exert any marked influence in preventing or retarding putrefaction or fermentation; but when taken internally it has the same effect as salicylic acid in preventing the fermentation of urine in the bladder, because in the system it is converted into that acid. Injected under the skin of rabbits to the extent of 30 grains, it caused no toxical phenomena. Although it is related that some very sensitive persons after repeated doses of 3 or 4 grains complained of dimness of sight and flashes before the eyes, yet in others, when several ounces were taken in the course of three weeks, no disorders were occasioned except ocular scintillations and ringing in the ears. In one instance about 250 grains were administered within two days without any sensible effects. Very marked and singular phenomena were produced by four doses of 40 grains each, taken at intervals of two hours by a physician affected with rheumatism. They consisted of a succession of phantasmal illusions and musical delusions that lasted for 48 hours (*Boston Med. and Surg. Jour.*, Jan. 1884, p. 118).

The experiments of Ringer and Bury with salicin upon healthy children appear to show that it has no influence upon the temperature, and that under full medicinal doses a dusky flush suffuses the face on slight excitement, while the expression becomes dull and heavy. Less constant symptoms are deafness, noises in the ears, frontal headache, trembling of the hands, and quickened breathing. Very large doses occasion severe headache, marked muscular weakness, tremor, and irritability. Tingling may be felt in the extremities, and the voice becomes husky; the breathing is hurried, but there is no dyspnœa; large doses often repeated raise the pulse-rate to 140 and render the beats feeble. Other observers have noted an intermittent or a slower pulse among the physiological effects of this medicine, while the greater number declare that in healthy persons and in medicinal doses it does not affect the pulse at all. Such has certainly been the case after doses of 40, and even 75, grains, which produced buzzing in the ears and a state of semi-intoxication. In some cases it has caused vomiting and purging, and its continued use has occasioned gastric catarrh. A similar dissidence exists in regard to its influence upon the temperature in health. The singular opinion has been expressed that it is only sedative to the calorific function when it acts as a diuretic. On the whole, we repeat, there is no reason to believe that in healthy persons it reduces the temperature. Salicin appears to render the sweat alkaline or neutral even in rheumatic patients with acid urine, but the evidence of this operation is not conclusive. To its promotion of urinary elimination must be attributed its alleged action in removing yellowness of the skin in jaundice.

Medical Uses.—Salicin has been used, and indeed was first used, in the inflammatory affections in which it has since been customary to employ salicylic acid and its compounds. In the report of one physician (Riess), who vaunted the antiphlogistic virtues of this substance, the mortality from *pneumonia* is stated to have been 11 out of 35 cases —a result which is the reverse of encouraging. The experience of Dr. Greenhow in treating *rheumatic* fever with salicin was, on the whole, not so satisfactory as to encourage him in continuing to employ it (*Trans. Clin. Soc.*, xiii. 261). Conway vaunted its topical application in severe cases of *diphtheria*, but his success has not been matched (*Practitioner*, xxviii. 61). Many have reported salicin to be a valuable substitute for quinine, but these reports are counterbalanced by others, which appear to show that it was quite powerless in periodical fevers. In neither case was the natural tendency to cure of these affections sufficiently considered. In the absence of quinine, salicin may be employed in mild cases of *intermittent fever*. Salicin has been found efficient in preventing the development of acute *coryza* when given in doses of from 20 to 40 grains, and also in mitigating the symptoms of *hay fever*. It has been thought to moderate the pain of *lumbago*. In *neuralgia* of a periodical type, and not amenable to quinine, it is said to have been very efficient in doses of from 20 to 40 grains, given every hour for three or four hours. Even *diabetes* is alleged to have got well under the influence of this medicine!

Administration.—Salicin, although not very soluble, may be given in water in the *dose* of from 10 to 40 grains (Gm. 0.60–2.60). It is better to give the smaller dose and repeat it frequently than to administer a full dose at once. It may be administered in powdered liquorice extract.

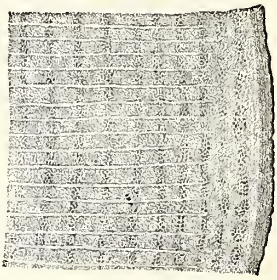
SALIX, *U. S.*—SALIX.

Willow-bark, E.; *Écorce de saule*, Fr.; *Weidenrinde*, G.

The bark of Salix alba, *Linné*. Bentley and Trimen, *Med. Plants*, 234.
Nat. Ord.—Salicaceæ.

Origin.—The willows form a large genus, which is mostly confined to the northern temperate zone, and with some species extends into the Arctic regions. They are either trees or shrubs with flexible branches, and have alternate, short-petioled, and mostly more or less lanceolate, entire, or finely serrate leaves, with small or conspicuous stipules. The flowers are diœcious, in cylindrical catkins, each bract being one-flowered, and have at the base one or two glands, but no other floral envelopes. The fruit is a one-celled and two-valved capsule, and contains numerous minute seeds which are furnished with a silky down. Most of the species are exceedingly variable in some of their characters, and all grow in moist localities, along streams, etc. The species recognized by the Pharmacopœia is common in Europe, and is frequently cultivated, and has been to some extent naturalized, in North America. It grows to the height of 60 or 80 feet (18–24 M.), and belongs to the group of *crack willows*, which are characterized by having their branches brittle at the base. Salix fragilis, *Linné*, resembles this species. Salix purpurea, *Linné*, is mostly shrubby, with olive-green, brownish, or purplish bark, and has the branches not brittle at the base. A large number of hybrids have been observed between the different species. The bark is collected from the branches in spring, when it is easily removed from the wood.

FIG. 245.



Willow-Bark: transverse section, magnified 15 diameters.

Description.—Willow-bark is met with in fragments or quills. It varies in thickness between $\frac{1}{25}$ and $\frac{1}{12}$ inch (1–2 Mm.), is externally smooth or little wrinkled, varies in color between gray, brownish, and brown-yellow, is shining, when young has a somewhat metallic lustre, and is furnished with some roundish, small, suberous warts. The inner surface is smooth, pale-brownish, or cinnamon-colored. The bark may be readily torn in a longitudinal direction, but breaks transversely with some difficulty. Under the thin corky layer it has a green color, and the inner bast-layer is striate by very fine medullary rays, is arranged in tangential rows, and may be separated in thin shreds. The dry bark is nearly inodorous and has a bitter and astringent taste. Willow-bark collected from old wood is usually deprived of the more or less fissured corky layer, and consists of the pale-brownish liber, which breaks with a tough, splintery fracture and is less bitter than the branch-bark. The parenchyma of the primary bark contains scattered groups of crystals; the bast-layer is formed of tangentially-arranged bast-fibres, which are accompanied by crystal-cells and alternate with thin layers of parenchyma; the numerous narrow mostly one-rowed medullary rays impart to the bast a finely-checkered appearance.

Constituents.—Salicin, the important medicinal constituent of willow-bark, has been described above. The other constituents are wax, fat, gum, and tannin. The crack willows appear to contain more tannin, and the purple willows more salicin. According to Johanson (1875), the tannin of willow-bark is a glucoside, and gives with ferric salts a blue-black precipitate, the liquid becoming purplish-red on the addition of soda. Johanson also showed the presence of a kind of sugar having a slightly sweet taste and reducing alkaline copper solution with difficulty, and of the glucoside *benzohelicin*, $C_{20}H_{20}O_8$, which was prepared by Piria (1851) by dissolving populin in cold nitric acid; it yields with sulphuric acid a yellow solution which, on the addition of water, becomes colorless and gives off the odor of salicylous acid.

The bark and leaves of different species of Populus contain, in addition to salicin, *populin* or *benzoyl-salicin*, $C_{20}H_{22}O_8$, which crystallizes in white needles of a sweet and somewhat acrid taste, and yields, under the influence of dilute acids, benzoic acid and decomposition-products of salicin.

Physiological Action and Medical Uses.—Willow-bark was anciently employed in medicine as an astringent. Like simple bitters, it appears to increase the appetite and improve the digestion, but if its use is long continued it confines the bowels. It has been used in cases of *dyspepsia* and of general *debility* and to lessen excessive discharges from mucous membranes. It has had some repute as a *vermifuge*, and its powder has been applied as a dressing for unhealthy and gangrenous *ulcers*. Before being introduced into medicine willow-bark had been a popular domestic febrifuge. It was first recommended for the treatment of *intermittent fever* by Stone of London in 1763, and was reported to be efficient by many others down to the discovery of salicin in 1825.

Powdered willow-bark may be given in *doses* of from 20 to 60 grains (Gm. 1.30–4) three times a day as a tonic; as an anti-periodic at least an ounce (Gm. 32) must be taken during an intermission. A decoction or infusion may be made with an ounce of the bruised bark to a pint (Gm. 32 to Gm. 500) of water.

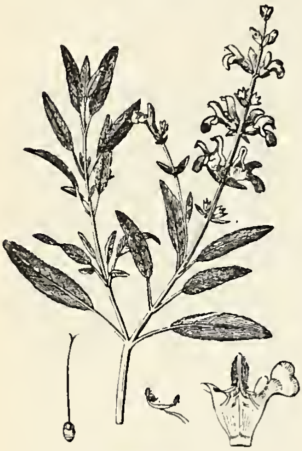
SALVIA, *U. S.*—Salvia.

Folia (Herba) salviæ, P. G.; *Sage, Garden sage*, E.; *Sauge officinale*, Fr.; *Salbei*, G.

The leaves of Salvia officinalis, *Linné.* Bentley and Trimen, *Med. Plants*, 206.
Nat. Ord.—Labiatæ, Monardeæ.

Origin and Description.—Sage is a suffruticose perennial indigenous to Southern Europe and extensively cultivated in England, France, and Germany and in gardens in the United States. The stem is about 2 feet (60 Cm.) high, woody at the base, much branched, quadrangular, and whitish pubescent above. The leaves are opposite, petiolate, 2 or 3 inches (5–8 Cm.) long, thickish, ovate- or lance-oblong, obtuse or subacute, finely crenulate on the margin, wrinkled, grayish-green, and beneath soft hairy. The lower leaves are sometimes auriculate or rounded, more frequently narrowed, at the base, the upper ones smaller and nearly sessile. The flowers are in three-flowered cymes in the axils of the upper leaves or bracts, have a tubular, bell-shaped, bilabiate, brownish, pubescent calyx, with mucronate divisions, and a violet-blue, bilabiate corolla, with a short tube, a depressed, helmet-shaped upper lip, three-lobed, spreading lower lip, and two stamens. All parts of the plant are more or less glandular and have a peculiar, strong, aromatic odor, and a warm, bitterish, and somewhat astringent taste.

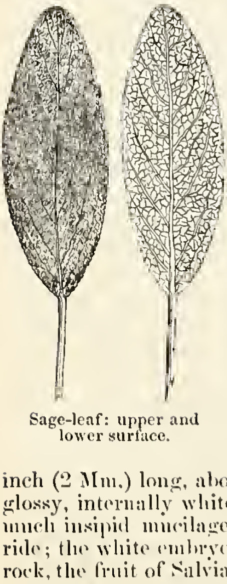
Fig. 246.



Salvia officinalis, *Linné.*

Constituents.—The most important constituent is volatile oil, of which the fresh herb yields $\frac{1}{6}$ to $\frac{1}{4}$ per cent., and, when recently dried, about three times this quantity. *Oil of sage* is of a greenish or yellowish color, has the density 0.86 to 0.93, commences to boil at 130° C. (266° F.), and is very freely soluble in 80 per cent. alcohol. P. Muir (1876) found the portion boiling between 156° and 158° C. (312.8° and 316.4° F.) to be a terpene, $C_{10}H_{16}$, which yielded cymene under the influence of sulphuric acid and terephtalic acid when treated with sulphuric acid and acid chromate of potassium. The portion having the boiling-point 10° C. (18° F.) higher yielded identical products, and in the neighborhood of 200° C. (392° F.) an oxygenated portion was obtained, which Muir designated *salviol*, $C_{10}H_{18}O$, and at 260° C. (500° F.) a hydrocarbon of the formula $C_{18}H_{24}$. The stearopten of the oil melts at 187° C. (368.6° F.), and closely resembles ordinary camphor. The other constituents of sage are of no medicinal importance, and are those commonly found in plants; Hirsch did not succeed in obtaining tannin.

Fig. 247.



Sage-leaf: upper and lower surface.

Pharmaceutical Preparations.—Aqua salviæ, Sage-water. Distil 10 parts of water from 1 part of sage-leaves.—*P. G.* 1872.

Infusum salviæ. Sage $\frac{1}{2}$ troyounce, boiling water a pint.—*U. S.* 1870.

Off. Prep.—Vinum aromaticum, *U. S.*

Allied Species.—Most species of Salvia are aromatic and bitter. Salvia pratensis, *Linné*, and S. Sclarea, *Linné*, are used in Southern Europe; S. lyrata, *Linné*, is common in North America, but only slightly aromatic.

Salvia polystachya, *Ortega* (Salvia Chian, *La Llave*). The fruit of this Mexican species is used under the name of *chia-seed.* It is about $\frac{1}{12}$ inch (2 Mm.) long, about $\frac{1}{20}$ inch (1.2 Mm.) broad, flattish-globular, gray marbled with brown, glossy, internally white and oily. The testa is covered with a transparent epithelium containing much insipid mucilage, which, according to Hiland Flowers (1882), is coagulated by ferric chloride; the white embryo contains a pale-yellow drying oil. According to Profs. Gray and Rothrock, the fruit of Salvia Columbariæ, *Bentham*, which is indigenous to New Mexico and westward, is likewise known as chia-seed. The fruit of Salvia verticillata, S. verbenaca, S. Horminum, *Linné*, and other species, is also mucilaginous.

Pogostemon Patchouly, *Pelletier* (Pog. suave, *Tenore*), is an East Indian hairy, suffruticose plant, with petiolate ovate or rhombic-ovate, doubly crenate-serrate leaves of a strong aromatic odor. The volatile *oil of patchouly* is brownish-yellow, and begins to boil at about 257° C. (495° F.), but the greater part distils near 285° C. (545° F.). It contains a hydrocarbon (Gladstone) and a liquid oil, having the same composition as the stearopten present, $C_{15}H_{26}O$ (Montgolfier, 1877), which after purification melts at 55° C. (131° F.).

Medical Action and Uses.—Sage is an ancient medicine. From the time of Hippocrates, when it was reputed to be desiccant and astringent, it was used in chronic pulmonary complaints and uterine derangements and as a dressing for wounds and sores. Later on, it was regarded as emmenagogue, and used to arrest hæmoptysis and as a gargle for sore throat.

Sage is stimulant, tonic, and astringent. Pidoux states that, having caught cold during the month of July, an infusion of half an ounce of sage caused him to sweat copiously for several hours. Such effects are likely to be produced by a hot infusion of any stimulant herb. It is certain that a cold infusion of sage has in all ages been employed to moderate excessive sweats depending upon debility alone. A vinous infusion is to be preferred for this purpose. It is less serviceable in the colliquative *sweats* of phthisis accompanied by hectic fever, yet even in them it adds to the power of aromatic sulphuric acid when used as a vehicle for the latter. A strong infusion of sage has been employed successfully to hasten the drying up of the *milk* at weaning-time. Sage tea or an infusion of sage in red wine is a popular and efficient remedy for aphthous and other *ulcers* of the mouth and for all forms of *sore throat;* it is best used as a wash or gargle when sweetened with honey. Its power is increased by the addition of vinegar, alum, borax, or chlorate of potassium. Externally, similar applications are of great use in healing *ulcers* and the raw surfaces occurring in *intertrigo*, etc. The aromatic wine of the French Codex, and which is so largely used for such purposes, contains sage. Sage is much used as a seasoning for gross and fat meats, such as pork and goose. It is seldom prescribed internally, unless in an infusion, which is no longer officinal.

SAMBUCUS, *U. S.*—SAMBUCUS.

Sambuci flores, Br., P. G.; *Elder-flowers*, E.; *Fleurs de sureau*, Fr.; *Fliederblumen*, *Hollunderblüthen*, G.

The flowers of Sambucus canadensis, *Linné* (S. nigra, *Linné*, *Br.*, *P. G.*). Bentley and Trimen, *Med. Plants*, 137, 138.

Nat. Ord.—Caprifoliaceæ.

Origin.—The American elder is suffruticose, attaining a height of 8 or 10 feet (2.4–3 M.) and grows in moist thickets and on the banks of streams throughout a great portion of North America. It has opposite mostly smooth *leaves*, with from seven to eleven short-stalked, oblong, pointed, serrate leaflets, the lower pair of which is frequently three-parted, and juicy, purplish-black, drupaceous *fruits*, containing three one-seeded hard nutlets and having an acidulous and sweetish taste. The bark, leaves, flowers, and fruit are sometimes medicinally employed, but only the flowers are recognized as officinal.

Description.—The flowers are in large, level-topped cymes, which terminate the small branches and are five-branched below and forked above. The marginal flowers are occasionally radiate; all have a superior calyx, with five minute teeth, a wheel-shaped, cream-colored, or whitish corolla, with a short tube and a spreading five-lobed limb, and five stamens which are inserted between the obtuse corolla-lobes. The flowers appear in June, and have in their fresh state a peculiar rather disagreeable odor, which becomes more pleasant and sweetish on drying. They are collected when in full bloom, and rapidly dried to prevent them from turning black; the corollas fall off very readily, and are separated from the stalks by shaking. Well-dried elder-flowers are of a pale brownish-yellow color, and have a slight peculiar odor and a sweetish, mucilaginous, and bitterish taste. The constituents of this drug appear to be closely allied to those of the European elder.

SAMBUCUS NIGRA, *Linné*, extends throughout the greater portion of Europe, Southern Siberia, and Northern Africa. It is a shrub or small tree, has the leaflets ovate-oblong and acute, and the flowers in smaller compound cymes than the preceding; otherwise the two species resemble each other very closely.

Constituents.—European elder-flowers contain as their most important principle a volatile oil which, according to the investigations of Eliason, Pagenstecher, and others. is yellowish and limpid, but mostly of a butyraceous consistence, of a strong odor and of a warm, bitterish, afterward cooling taste. The recently-dried flowers yield only $\frac{1}{3}$ to $\frac{1}{2}$ per cent. of it if the distilled water is extracted with ether. The remaining constituents of the flowers are acrid resin, a little tannin, mucilage, albumen, and other common vegetable principles; among the salts are malates of potassium and calcium. Scheele found in the berries mucilage, sugar, and malic acid, and Kraemer (1846) obtained from the bark *viburnic acid*, which is identical with *valerianic acid.* C. G. Traub (1881) ascertained that the bark of American elder contains likewise valerianic acid, and in addition resin, tannin, sugar, etc. J. B. Metzger (1881) found in the berries sugar, gum, tannin, fat, etc.

Allied Species.—Sambucus Ebulus, *Linné.* All parts of this European species have a strong, disagreeable odor and a bitterish, somewhat acrid taste. At present the four-seeded fruit, which resembles elder-berries, but has a more agreeable taste, is occasionally employed. The plant is known as dwarf-elder, *E.;* yèble or hièble, *Fr.;* and Attich, *G.*

Pharmaceutical Preparations.—Succus sambuci inspissatus.—Extract of elder-berries, *E.;* Rob de sureau, *Fr.;* Fliedermus, *G.*—Bruise fresh elder-berries, after 24 hours express the juice, allow to settle, decant, strain, and evaporate the clear liquid to the consistence of a soft extract.—*F. Cod.* It has a sweet acidulous taste and dissolves in water with a brown-red color.

Off. Prep.—Aqua sambuci, *Br.*

Medical Action and Uses.—Elder-berries (S. nigra) are cooling, aperient, and diuretic, and when their juice is fermented it forms a wine which is much used in England as a domestic cordial. The flowers are said to be poisonous to peacocks and the berries to hens (Strumpf). According to Cazin, cattle refuse to eat the leaves, caterpillars avoid them, and hence the shrubs are planted around the beds of kitchen-gardens; the flowers are used to preserve clothing from moths.

The ancients considered elder-bark and leaves as purgative and diuretic, and several centuries ago the leaves, bark, and seeds were much used in dropsy, and the flowers for fomentations, as they continue to be at the present time. From the flowers a water is distilled which is employed as a perfume, and an ointment is prepared with them for the treatment of *burns* and *excoriations.* An ointment made with the inner bark has been used in *tinea capitis,* as a dressing for *blisters* and various excoriations and sores, and in *erysipelas,* as well as for moderating the pain of *hæmorrhoids,* and in poultices as an application to *gangrenous* tissues, glandular engorgements, etc. For most of these purposes an infusion of the flowers is employed. Porcher states (*Resources of the Southern Fields, etc.,* p. 448) that "a decoction made by pouring boiling water over the leaves, flowers, or berries of the elder is recommended as a wash for wounds to prevent injury from flies. An ointment is used for the same purpose." In the same work elder is said to have been employed in an ointment—which, however, contained sulphur—in the treatment of *scabies.* Dr. T. A. Smith of Crêve Cœur, Mo., informs us that a strong decoction of sambucus is employed in his neighborhood to expel *maggots* from parts not readily accessible, particularly the nostrils; and adds that a decoction made with the green leaves and shoots of the elder succeeded perfectly in driving away these creatures from the wounds made in cutting off lambs' tails when every other application had failed. It acted very promptly and was entirely unirritating. The young leaf-buds are said to be a drastic cathartic, but the fresh inner bark is more efficacious. The juice of the root of S. nigra has been found to act as a hydragogue cathartic in the dose of 1 or 2 ounces (Gm. 32–64), taken fasting. This dose excites copious salivation, followed by vomiting without excessive straining; later, watery stools occur, and continue for eight or ten hours. In this country similar effects have followed the use of the native elder-bark (S. canadensis) infused in hard cider. The expressed juice of the root of the officinal plant may be given in the *dose* of 2 fluidounces (Gm. 64) every 2 hours until its specific operation begins. A decoction is made by boiling an ounce of the inner bark in 2 pints of water until reduced to a pint (Gm. 32 in Gm. 1000 to Gm. 500); of this 4 fluidounces (Gm. 128) may be given at a dose.

SANGUINARIA, *U. S.*—Sanguinaria.

Bloodroot, Puccoon, Tetterwort, Indian paint, E.; *Sanguinaire,* Fr.; *Blutwurzel,* G.

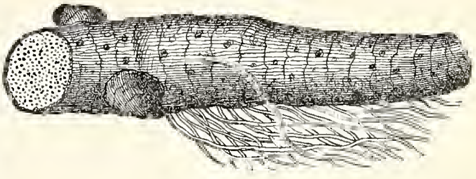
The rhizome of Sanguinaria canadensis, *Linné.* Bentley and Trimen, *Med. Plants,* 20. *Nat. Ord.*—Papaveraceæ.

Origin.—Bloodroot is a native of Canada and the United States, where it grows in open woods on a rich soil. In early spring the rhizome sends up one or two leaves and a slender scape about 4 or 6 inches (10–15 Cm.) high, bearing a single large white flower.

The leaves do not attain their full size until after the petals have been shed in April or May, and are then about 3 inches (75 Mm.) long and 4 or 5 inches (10–12 Cm.) wide, heart-shaped at the base, reniform in outline, palmately seven- or nine-veined, and divided into the same number of obtuse lobes; the upper surface is of a light green, the lower surface glaucous, whitish, and the veins often reddish. The calyx consists of two fugacious sepals, and the corolla of about eight oblong and obtuse petals; the stamens are in several rows, and the fruit, which ripens in June, is an oblong two-valved capsule tapering at each end and containing numerous roundish seeds with a strongly crested raphe. All parts of the plant contain a bright orange-red juice, but only the rhizome is employed.

Description.—The rhizome is 2 to 4 inches (5–10 Cm.) long and about $\frac{2}{5}$ inch (1 Cm.) thick, horizontal, slightly branched, cylindrical, and faintly annulate by leaf-scars. In the fresh state it is fleshy, and emits, when wounded, a dark-red juice; after drying it is reddish-brown externally, longitudinally wrinkled, and breaks with a short fracture of a slight waxy appearance. Transverse section shows a thin bark, which is in width about one-twelfth the diameter of the rhizome, a very fine cambium-line, and a white mealy inner portion, in which the circle of about eighteen small fibro-vascular bundles is not readily distinguished, and which contains a large number of small red resin-cells; the interior tissue is not unfrequently of a nearly uniform brownish-red color, due probably to the manner in which the drug was dried. The thin rootlets are mainly on the lower side, and in commercial bloodroot are mostly broken off, short remnants or scars only remaining; they have a bark about equal in thickness to the ligneous cord and contain scattered red resin-cells. Bloodroot yields a pale grayish-red, irritating powder, and has a slight heavy odor and a persistently bitter and acrid taste.

Fig. 248.



Bloodroot.

Constituents.—Dr. Dana (1828) obtained from bloodroot the alkaloid *sanguinarine*, which Probst considered identical with the alkaloid chelerythrine discovered by him (1838) in celandine (see page 423). The identity of the two was conclusively proven by Shiel (1855). Riegel (1845), and afterward Gibb (1860), isolated a second alkaloid, which they named *porphyroxine*, from its supposed identity with a constituent of opium formerly known by that name. It was obtained by exhausting the rhizome with dilute acetic acid, precipitating the sanguinarine with ammonia, neutralizing the filtrate with acetic acid, and precipitating with tannin; on decomposing the precipitate with either lime or potassa and exhausting with ether white, tasteless crystals are stated to be obtained, which yield with acids bitter and neutral salts. In 1856, E. S. Wayne announced the discovery of a third alkaloid, named *puccine* by Gibb. It was said to remain dissolved in ether after precipitating the ethereal solution of crude sanguinarine with sulphuric acid. L. C. Hopp (1875) proved it to be sanguinarine held in solution as sulphate by a trace of resin; he also found *sanguinarinic acid* of Newbold (1866) to be a mixture of impure citric and malic acids.

Sanguinarine, $C_{19}H_{17}NO_4$, is obtained from the syrupy alcoholic extract of sanguinaria by digesting it with dilute hydrochloric acid, filtering from the resin, precipitating by ammonia, dissolving the crude alkaloid in ether, and passing hydrochloric acid gas into the solution, when hydrochlorate of sanguinarine is precipitated. The pure alkaloid is in white verrucose or needle-shaped crystals, which are sternutatory, freely soluble in ether and alcohol, and yield with acids bright-red salts having a bitter and persistently acrid taste, like the alcoholic solution of the alkaloid. The second alkaloid observed by Riegel was obtained by F. W. Carpenter (1879) as a yellow mass which acquired with strong sulphuric acid a deep-purple color, intensified on the addition of potassium bichromate, the reaction resembling that produced by these two reagents with strychnine. F. L. Slocum crystallized the same alkaloid from ether in colorless, slightly bitter needles of an alkaline reaction, and in this pure state yielding with sulphuric acid a deep-purple color, which, however, was not permanent, and changed with chromate to yellow. It exists in minute quantity only, and is not precipitated by ammonia. Slocum examined also the red resinous matter which is separated by alcohol into two portions, both of which, when fused with potassa, yielded protocatechuic acid. C. W. Dodd (1882) found in 100 parts of air-dry bloodroot 10.9 moisture, 7.9 ash, 2.7 benzol extract, 19.9 alcohol extract, 16.2 water extract, 7.2 starch, and 1.11 sanguinarine.

Off. Prep.—Acetum sanguinariæ, Extract. sanguinariæ fluid., Tinct. sanguinariæ, *U. S.*

Physiological Action.—In non-nauseating doses it increases the appetite and improves digestion. Rutherford and Vignal found that in dogs sanguinarine, when mixed with a small quantity of bile and water and placed in the duodenum, powerfully stimulated the liver, rendering, however, the bile more watery. In larger doses it nauseates and slows the pulse, and in excessive quantities sometimes excites vomiting, but more usually causes burning in the stomach, faintness, vertigo, impaired vision, general insensibility, coldness, extreme reduction of the force and frequency of the pulse, with irregularity and palpitation of the heart, great prostration of muscular strength, and sometimes a convulsive rigidity of the limbs. Fatal poisoning has resulted from an overdose of this medicine. The foregoing effects have been essentially reproduced in experiments upon animals by Dr. Robert Meade Smith (*Inaugural Thesis*, University of Pennsylvania, 1876), who concludes that sanguinarine, with which he experimented. affects and directly depresses the functions of the spinal cord, of the cardiac nerves, and of the heart itself. In man, sanguinarine, in doses of from $\frac{1}{6}$ to $\frac{1}{4}$ grain continued for several days. occasions nausea and sometimes vomiting, and a manifest reduction of the pulse-rate. 1 grain in solution, repeated at intervals of 10 minutes, may excite vomiting after the third dose.

Medical Uses.—The physiological action of sanguinaria bears no relation to its medicinal uses. In all cases in which the former is developed the depressing operation of the medicine is distressing and unsafe. Its only value is demonstrated, if at all, by its long-continued use in moderate doses, so as to produce its so-called deobstruent or alterative effects. These are supposed to be exhibited when it is used in the treatment of *atonic dyspepsia*, with "torpor of the liver," but in such cases the cure is probably due, in some degree, to the simultaneous regulation of the diet, etc. and abstinence from active medication. Possibly in protracted muscular rheumatism the medicine may deserve a trial. It has been used in *bronchitis*, *croup*, and *asthma*.

Powdered bloodroot has been employed as a *sternutatory* and as a stimulant to indolent and unhealthy *ulcers*. The latter effect probably led to its being used by quacks in the treatment of *cancer*. The fresh juice of the root is said to cure *warts*, and an infusion or decoction of the root has been applied to chronic *scaly* and *pustular eruptions*.

The *dose* of sanguinaria as an emetic is from 10 to 60 grains (Gm. 0.60–4). An infusion made with an ounce of the bruised root in half a pint (Gm. 32 in Gm. 250) of boiling water may be given in tablespoonful doses at short intervals. The officinal preparations represent the medicine fully.

SANGUIS.—Blood.

Sang, Fr.; *Blut*, G.

Description and Composition.—Blood is an animal fluid which passes to all organs through the circulation. In the inferior animals it is of a white color, while in the vertebrated animals it is red, and the red color is brighter in blood taken from the arteries than in that contained in the veins. Blood is not a simple solution of different compounds, but it is a kind of emulsion containing chiefly blood-corpuscles in suspension. According to Lehmann, 1000 parts of corpuscles contain 688 water, 16.75 hæmatin, 282.22 globulin, 2.31 fat, 2.60 extractive matter, and 8.12 mineral constituents, among which potassium salts predominate. The red color of blood-corpuscles is due to *hæmoglobin*, which under some conditions may be obtained in well-defined crystals, as was shown by B. Reichardt (1847); acids and alkalies decompose it into the red coloring matter hæmatin, which contains iron and may likewise be crystallized, and into the albuminoid compound globulin. 1000 parts of the liquid portion of blood contain 902.90 parts of water, 4.05 fibrin, 78.84 albumen, 1.72 fat, 3.92 extractive matter, and 8.55 mineral constituents, among which chloride of sodium predominates. The saline constituents both of the corpuscles and liquid are, besides iron, phosphates of calcium and magnesium, and chlorides, phosphates, and sulphates of potassium and sodium. The composition of blood varies, however, in different animals, and in the same animal if taken from different vessels. When left to itself, blood coagulates, forming a *clot*, *cruor*, which separates from the liquid portion, called *serum*. The clot consists of the fibrin, which has become insoluble, and of the corpuscles, while the serum is chiefly a solution of albumen and salts. According to Boussingault, the red color of the blood of the higher animals is not due to iron, since the white blood of mollusks contains about the same amount of iron, varying in different animals between about 0.04 and 0.06 part in 1000.

Bullock's blood has been used in the fresh state, and, according to W. C. Bakes (1872), also evaporated to an extract (*extractum sanguinis*), and, if subsequently powdered, under the name of *pulvis sanguinis*.

Medical Action and Uses.—We shall not in this place discuss the nutritive qualities of blood, but only recall the fact that, in spite of the wise Mosaic law against eating blood, it is more or less used as food in several countries. We remember to have observed many years ago in the Roman market cakes of coagulated blood sold openly as food, and which disagreeably recalled the basins of human blood we had then but recently seen shed in hospital practice.

In 1873, Mr. Vacher, an English health officer, having learned that the serum of the blood of sheep and oxen was regarded by the journeymen in certain slaughter-houses as "a remedy of great value for the treatment of scrofulous children, and as little less than a specific in cases of seat- and tape-worms," undertook some experiments with it which confirmed him in his impression of its efficacy. When employed in the Birkenhead Borough Hospital it was found "most successful in cases of thread-worms, and less so in those of Ascaris lumbricoides; it failed almost entirely in tænia." It would seem unnecessary to introduce a new remedy for these entozoa when so many efficient anthelmintics are already available, especially when the proposed medicine is difficult to obtain in a fresh and sound condition and is of doubtful value. It has been proposed to render it more permanently available by drying it, but there is as yet no evidence of its virtues in that condition. There is, moreover, in our opinion, a serious objection to converting food into medicine, which is at present so much practised in the case of "charcoal biscuit," "beef biscuit," wines and elixirs of "beef and iron," etc. These preparations are far more apt to inspire an aversion to wholesome food than to quicken the appetite or improve the digestion. We submit that in the treatment of disease the laboratory and the kitchen should not be associated in the same prescription. The same objection does not exist against the administration of defibrinated blood by enema. It is claimed by Dr. Andrew H. Smith (*Amer. Jour. of Med. Sci.*, July, 1879, p. 242) that it is almost wholly absorbed; confines rather than irritates the bowels, as a rule; and that "in favorable cases" it quickens nutrition more than other remedies. Sansom (*Lancet*, Feb. 16, 1881) reports favorably of the method, stating that in urgent cases 2 or 3 ounces of the liquid should be injected into the rectum every two or three hours, and that in chronic cases, in which it supplements gastric alimentation, from 2 to 6 ounces should be administered twice a day. Moller has confirmed this experience by his own in several cases of extreme debility and anæmia. In one instance the weight of the patient and the proportion of red elements in the blood largely increased under this treatment (*Archives gén.*, Dec. 1882, p. 731). Before each enema is given the intestine should be washed out with tepid water slightly salted, and it is recommended that 10 or 15 grains of hydrate of chloral should be added to every enema. It may be mentioned that defibrinated blood has been injected into the peritoneal cavity, and also hypodermically, in cases of extreme exhaustion (Bareggi, *Medical Record*, xxiv. 239).

SANICULA.—Sanicle.

Sanicle, Fr.; *Sanikel*, G.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—The genus Sanicula is composed of perennial herbs with palmately divided and coarsely serrate radical leaves and irregular or compound umbels, having polygamous, rather capitate flowers, and few-leaved involucres and involucels. The fruit is nearly globular, and has the mericarps closely united, without prominent ribs, covered with hooked prickles, and containing five oil-tubes.

San. marilandica, *Linné*, has the radical and stem-leaves five- or seven-parted and the divisions rather narrow; the staminate flowers are numerous and on slender pedicels, and the perfect flowers have elongated and recurved styles. The blackish root and the leaves are nearly inodorous, and have a somewhat bitter and persistent acrid taste. The American species are in some localities known as *black snakeroot* and *pool-root*.

Constituents.—C. J. Houck (1884) obtained from the air-dry root 8 per cent. of ash, volatile oil, resinous matter, tannin, and other common constituents. The ethereal extract is very aromatic and has a burning, acrid taste.

Allied Plants.—Sanicula europæa, *Linné*, is a common European plant. The root is several-headed, branched, and dark-brown. The radical leaves are palmately five-parted, and the obovate wedge-shaped segments again three-lobed. The stem-leaves are few in number and small. The perfect flowers are sessile and the staminate flowers on very short stalks.

San. canadensis, *Linné*, resembles the European species, but has three-parted stem-leaves, and is distinguished from the first species by the nearly sessile staminate flowers, the shorter styles, and the smaller number of fruits in each umbellet.

Astrantia major, *Linné*, is a European plant, the root of which is known as *black sanicle*, and is occasionally used as *radix imperatoriæ nigræ*. It consists of an oblique annulated rhizome about 4 inches (10 Cm.) long and ¼ inch (6 Mm.) thick, externally brown-black, internally whitish, and of fragile, shrivelled rootlets having a similar color; it resembles the roots of the preceding plants.

Medical Action and Uses.—Nothing appears to have been recently added to the often-repeated statements respecting the American species, that the aborigines of this country use sanicle in syphilis and diseases of the lungs, and that some physicians affirmed its virtues in chorea and intermittent fever. S. europæa has an acrid, astringent, and somewhat bitter taste, and is popularly employed in Germany and France as a remedy for profuse *hæmorrhages* from the lungs, bowels, uterus, or urinary organs, and for the cure of *diarrhœa*, *dysentery*, and *leucorrhœa*, and externally as an application to *wounds*, *bruises*, etc. The fresh juice of the plant is prescribed in doses of ½ ounce (Gm. 16) or more, and a vinous infusion of it is also given internally.

SANTALUM RUBRUM, *U. S.*—Red Saunders.

Pterocarpi lignum, Br.; *Lignum santalinum rubrum.*—*Red sandal-wood*, E.; *Santal rouge*, Fr.; *Rothes Sandelholz*, G.

The wood of Pterocarpus santalinus, *Linné filius.* Bentley and Trimen, *Med. Plants*, 82.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This species is a small or medium-sized tree, with a trunk of a foot (30 Cm.) or more in diameter. The leaves are pinnately trifoliate, with orbicular ovate emarginate leaflets. The flowers are small, yellow, and in lax racemes. The pod is roundish, sickle-shaped, winged, and contains one or two seeds. It grows wild only in the Madras Presidency, but is cultivated in Southern India.

Description.—Red sandal-wood is met with in commerce in hard and heavy billets, which are deprived of the light-colored sap-wood, are externally of a dark-brown or reddish-brown color, and split irregularly and coarsely splintery in a longitudinal direction. If cut transversely, it is of a somewhat variegated appearance, the circles being alternately rather broad and dark brown-red and narrow and lighter colored. The medullary rays appear as delicate red radiating lines. In the shops the wood is usually found in chips or in a coarse and irregular powder of a brown-red color, nearly inodorous and having a scarcely perceptible astringent taste. A red resinous mass exudes from the wood on heating it. Red saunders is distinguished from other red-colored woods by the characters given, and by means of water, which is not colored by it; it imparts a deep-red color to alcohol, and this tincture acquires a dark-violet color on the addition of ferric chloride.

Constituents.—The coloring principle of red saunders is *santalic acid* or *santalin*, $C_{15}H_{14}O_5$, which may be obtained, according to Leo Meier (1849), by precipitating the tincture with acetate of lead, washing the precipitate with hot alcohol, and decomposing it with sulphuretted hydrogen in the presence of alcohol. Santalic acid forms microscopic needles of a beautiful red color, is inodorous and tasteless, melts at 104° C. (219.2° F.), is insoluble in water, but dissolves in concentrated sulphuric acid with a deep-red, in alkalies with a violet, in alcohol with a blood-red, and in ether with a yellow, color; it is soluble in the volatile oils of cinnamon, cloves, bergamot, and bitter almond, but is insoluble in most other volatile and fixed oils. The coloring matter, as obtained by Franchimont (1879), was amorphous, had the composition $C_{17}H_{16}O_6$, and yielded resorcin and acetic acid when fused with potassa. L. Meier (1849) obtained several other compounds, which appear to be decomposition-products. Weidel (1870) obtained 0.5 per cent. of colorless and inodorous scaly crystals of *santal*, $C_8H_6O_3$, which resemble benzoic acid in appearance, but are tasteless; they are insoluble in water, carbon disulphide, chloroform, and benzol, sparingly soluble in alcohol, ether, ammonia, and alkali carbonates, but freely soluble in potassa and soda, these solutions turning yellow, red, and green. The alcoholic solution becomes red with ferric chloride. Cazeneuve's *pterocarpin*, $C_{17}H_{16}O_5$ (1875), is likewise colorless and crystalline, but is soluble in ether, chloroform, and carbon disulphide. Red saunders is free from gallic acid, but appears to contain a minute quantity of tannic acid, which has not been further examined.

Off. Prep.—Tinctura lavandulæ comp., *U. S.*, *Br.*

Medical Uses.—Red sandal-wood has no medicinal virtues, and is used only as a coloring agent.

SANTONICA, *U. S., Br.*—Santonica.

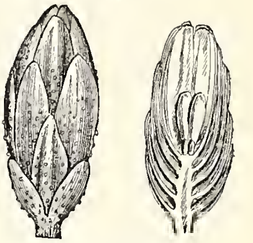
Flores cinæ, P. G.; *Semen cinæ, s. contra, s. sanctum, s. santonici.—Levant wormseed*, E.; *Semen-contra, Barbotine, Semencine*, Fr.; *Wurmsamen, Zittwersamen*, G.

The unexpanded flowers of Artemisia maritima, *Linné*, var. Stechmanniana, *Besser.* Bentley and Trimen, *Med. Plants*, 157.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Levant wormseed is obtained from Asia, and appears to be mainly if not exclusively collected in the northern part of Turkestan, and to be sent to the great fair at Nishnei-Novgorod, and thence to St. Petersburg and Western Europe. Berg characterized the plant botanically from the commercial drug as Artemisia Cina, *Berg*, and Willkomm (1872) described under the same name a plant brought from Turkestan; but the flower-heads of this plant do not entirely resemble the wormseed of trade, in that they have fewer scales (*Pharmacographia*). Flückiger and Hanbury consider the drug to be obtained from the plant mentioned above, which is identical with A. Lercheana, *Karel et Kiril*, A. maritima, var. pauciflora, *Ledebour*, and A. pauciflora, *Weber*. The typical form of A maritima, *Linné*, grows in salt marshes in Western Europe, extends under various forms eastward to Western Asia, and has tomentose flower-heads with about eighteen scales.

Fig. 249.



Santonica: head and longitudinal section, magnified 10 diameters.

Description.—Levant wormseed consists of unexpanded flowheads, which are about $\frac{1}{12}$ to $\frac{1}{8}$ inch (2–3 Mm.) long and $\frac{1}{25}$ inch (1 Mm.) wide, oblong-ovoid in shape, obtuse at both ends, smooth, somewhat shining, and of a grayish-green color, changing to brownish-green on exposure to light. The involucre is densely imbricate, and consists of twelve to eighteen keeled scales, of which the lower ones are smallest and ovate in shape, and the oblong upper ones have a scarious margin and are dotted with numerous minute yellowish glands. The florets are four or five in number, but undeveloped and minute. The drug has a strong peculiar odor and a bitter camphoraceous and disagreeable taste, and frequently contains fragments of the thin peduncles and of linear leaves.

Constituents.—Levant wormseed has been frequently examined, and found to contain as active principles about $1\frac{1}{2}$ or 2 per cent. of a crystalline body, *santonin* (see below), and 1 or 2 per cent. of volatile oil; also resin and various other less important constituents. *Oil of Levant wormseed* is pale-yellow, limpid, has the density 0.92, commences to boil at about 170° C. (338° F.), is readily soluble in ether and alcohol, and, according to Völkel, is a mixture of various oxygenated compounds, of which Hirzel (1854) distinguished *cinæbene, cinæbene camphor*, and others.

Pharmaceutical Uses.—Levant wormseed is the source of santonin.

Extractum cinæ. Exhaust the powdered drug with ether or with a mixture of equal parts of ether and alcohol (*P. G.* 1872) and evaporate the tincture until the ether has been completely dissipated, *F. Cod.* (or to the consistence of a soft extract, *P. G.*). The yield is about 20 or 25 per cent. The extract is of a green or green-brown color, and on keeping becomes granular, depositing crystals of santonin. It should be well agitated before dispensing it.

Allied Drugs.—The unexpanded flower-heads of a species of Artemisia, supposed by some to be derived from A. ramosa, *Smith*, have sometimes entered commerce from North-western Africa, and are known as *Barbary wormseed.* This consists of roundish-ovate flower-heads having a grayish-brown color, covered with a whitish down, and mixed with numerous fragments of peduncles and of leaves; the outer scales are roundish and the inner ones ovate. Another variety has occasionally been observed in Europe and described as *Indian wormseed*. It is only about one-half the size of the officinal drug, and is hairy and of a more yellowish color. We have repeatedly observed American wormseed to be sold in place of santonica, to which it bears no resemblance (see page 424).

Action and Medical Uses.—This medicine was introduced into Europe by the Crusaders, and has ever since been employed as an anthelmintic. After the discovery and isolation of santonin, the proximate principle upon which the "seeds" depend for their virtues, it became less used than formerly. The seeds were then held to be stomachic in small doses, general stimulants of the circulatory and nervous systems in larger doses, and in still larger quantities were found to produce gastric oppression, nausea, vomiting, and diarrhœa. Sometimes they gave rise to symptoms of cerebral congestion.

Santonica is used almost exclusively as a vermicide for lumbricoid *worms* and *ascarides* of the rectum, but occasionally for *tapeworm* also. For the last it is of little efficacy; for the other parasites it is one of the best remedies. It is administered in coarse powder with honey, molasses, or some analogous liquid, to which jalap may be added for its purgative effect. The *dose* is from 10 to 60 grains (0.60–4) three times a day.

SANTONINUM, *U. S.*, *Br.*, *P. G.*—Santonin.

Santonine, Fr.; *Santonin*, G.
Formula $C_{15}H_{18}O_3$. Molecular weight 246.

Preparation.—Santonin was discovered in 1830 simultaneously by Kahler and by Alms, and since that time has been frequently examined by chemists. The process given by the British Pharmacopœia has been elaborated by the researches of Calloud, Cerntti, Mialhe, and others. The santonin is extracted by boiling 16 parts of bruised santonica with 5 parts of lime and sufficient water, and, after straining, repeating the operation with 2 parts of lime. In the process of Trommsdorff (1834) diluted alcohol is used in the place of water, and digesting instead of boiling. The lime and santonin form a compound soluble in water and alcohol, and on concentrating the liquors an aqueous solution of calcium santonin remains, contaminated with coloring and extractive matter and with resin held in solution by lime. The calcium compounds are decomposed by either acetic or hydrochloric acid, which form freely-soluble calcium salts and liberate the santonin, together with resin and other compounds. The impure santonin thus obtained may be freed from some of its impurities by washing it with dilute ammonia, or, without being thus treated, may be purified by recrystallization from hot alcohol, a little charcoal being used to remove coloring matter; the resin will remain dissolved in the alcohol. The yield is 1½ to nearly 2 per cent. In 1876, 427 pounds of santonin were imported into the United States, 63 pounds in the following year, and 1508 pounds in 1883.

Properties.—Santonin crystallizes in flat, rhombic prisms, which are colorless, of a pearly lustre, and of a slightly bitter taste, which is gradually developed, but the solutions of santonin are persistently bitter. When heated to about 170° C. (338° F.) it melts to a colorless liquid, which, on being slowly cooled, becomes again crystalline, but when rapidly cooled usually remains amorphous and gum-like until after it has been moistened with alcohol, ether, or acetic acid, or has been heated again to a little over 40° C. (104° F.). When carefully heated in small quantities to a little above its melting-point, it sublimes without decomposition in white needles; but if larger quantities of it are heated, dense yellowish, irritating vapors are formed, condensing to a resinous mass; decomposition takes place, and at a higher heat santonin burns in the air with a sooty flame and without leaving any fixed residue. Santonin dissolves in about 5000 parts of, and is therefore nearly insoluble in, cold water, and requires 250 parts of boiling water and 40 parts, *U. S.* (44 parts, *P. G.*), of cold alcohol for solution. Trommsdorff found santonin to be dissolved at 17.5° C. (63.5° F.) in 43 parts, and at 80° C. (176° F.) in 2.7 parts, of alcohol spec. grav. .848, while at the same temperatures 280 and 10 parts of an alcohol having the density .928 were necessary. Santonin dissolves in 72 parts (160 parts, *U. S.*) of cold and 42 parts of boiling ether (Trommsdorff), and in 4.35 parts (4 parts, *U. S.*, *P. G.*) of chloroform (Schlimpert); these solutions have a neutral reaction. It is likewise soluble in strong acetic acid, in volatile oils, and in warm olive oil. Santonin should be kept excluded from the light or in amber-colored bottles. Air has no effect upon it, but in the sunlight it acquires a yellow color, and, according to Sestini (1864, 1865), is converted into *photo-santonic acid*, $C_{23}H_{34}O_6$, which is more freely soluble in simple solvents, has a bitter taste, when pure is colorless and inodorous, and melts near 65° C. (149° F.). The coloring matter produced at the same time is of a resinous nature. Santonin yields with sulphuric acid a colorless solution, and is precipitated without alteration by water; but the color of the solution changes to yellow, red, and dark-brown, and then gives with water red or brown resinous precipitates (Trommsdorff). Santonin is transiently colored red by hot alkalies and alkaline earths. "With alcoholic solution of potassa it yields a scarlet-red liquid, which gradually becomes colorless."—*U. S.* "On boiling 5 parts of santonin and 4 parts of sodium carbonate with 60 parts of alcohol and 20 parts of water the liquid has alternately a red and yellow color."—

P. G. After the solutions in alkalies or alkaline earths have become colorless, they yield insoluble precipitates with the salts of most heavy metals. According to Hesse (1874), these compounds are true salts, and on liberating from them the *santonic acid* it may be obtained from the hot aqueous solution in white rhombic crystals, which do not turn yellow in the light, are sparingly soluble in cold water, but are readily soluble in alcohol, ether, chloroform, and glacial acetic acid, and have the composition $C_{15}H_{20}O_4$. The officinal santonin is therefore *santonic anhydride.*

Impurities.—Santonin has been sometimes adulterated with *boric acid*, which imparts to the flame of alcohol a green color, and on being heated upon platinum-foil is left behind as a glass-like mass, the solution of which turns turmeric-paper brown. *Strychnine* has been mistaken for santonin; it is readily detected by the bluish-purple color produced by sulphuric acid and a little potassium bichromate. *Picric acid*, which has been mistaken for santonin colored yellow by light, is very bitter, and may be recognized by the behavior described on page 86.

Tests.—"If the colorless solution of santonin in sulphuric acid be precipitated by water, the supernatant liquor should not be altered upon the addition of test solution of bichromate of potassium or of iodide of mercury and potassium (absence of alkaloids)."—*U. S.* "After boiling for some time 1 part of santonin with 100 parts of water and 5 parts of diluted sulphuric acid, the filtered liquid should not have a bitter taste, and on the addition of a few drops of solution of potassium chromate should not give a precipitate (of yellow crystalline strychnine chromate)."—*P. G.*

Pharmaceutical Preparation.—TROCHISCI SANTONINI, *Br.*, *P. G.* The santonin lozenges (*U. S.* 1870) weighed about 20 grains and contained ½ grain of santonin and 18 grains of sugar; those of the French Codex are colored by carmine, and contain 0.01 Gm. ($\frac{1}{6}$ grain); while those of the P. G. (which does not give a formula) are to contain 0.025 Gm. ($\frac{2}{5}$ grain), and those of the Br. P. 1 grain (total weight 17 grains).

Physiological Action.—*On Animals:* Given to rabbits in 30-grain doses, the animals appear to be much depressed, they pass purplish or yellow urine freely, and gradually die of exhaustion. In larger doses it occasions trembling of the limbs, insensibility, rigidity, and opisthotonos, alternating with convulsions, salivation, and dilatation of the pupils. It is thought by some experimenters that death by santonin is due to spasm of the respiratory muscles. Manometric observations appear to show that it is not caused by failure of the heart. After death the heart, lungs, brain, and spinal marrow are found engorged with blood.

On Man: The most remarkable effect of medicinal doses of this substance is that the whole field of vision appears yellow or yellowish-green; if the dose is large, it may be purplish or even red. The effect seems to be due to changed conditions of the retina or of the brain, and not, as was formerly supposed, to a staining of the humors of the eye. When given in large doses, as 5 grains or more, santonin imparts to the urine a deep-saffron color and stains the linen as bilious urine does. (For the distinction between urine colored by santonin and that stained by rhubarb see Munk, *Virchow's Archiv*, lxxii. 136.) At the same time it operates strongly as a diuretic. When the urine grows alkaline by putrefaction, or is made so by the addition of an alkali, the saffron tint is replaced by a violet or purplish color. In doses of 3 grains santonin may occasion nausea and vomiting, with abdominal pain, thirst, giddiness, and diarrhœa. (Compare Labbé, *Practitioner*, xxii. 284.) Decidedly poisonous effects sometimes arise from doses which are quite insignificant in comparison with those which some experimenters have taken without serious inconvenience. For example, a child six months old was rendered amaurotic for two months by a dose of 5 grains of santonin. In another case 2 grains, given to a child two years old, occasioned convulsions, injection and heat of the face and head, twitching of the eyeballs, dilatation of the pupils, foaming of the mouth, clenching of the teeth, stertorous breathing, and jerking of the arms. On the morrow recovery was complete. In a third case a healthy child of two years swallowed two santonin troches at 6 o'clock in the morning. No result appeared until 4 in the afternoon, when suddenly the muscles of the left side of the face began to twitch and the pupils to dilate. Then clonic convulsions affected the left side, beginning at the fingers, and these were followed by muscular rigidity of the same side. After a quarter of an hour the spasms subsided, but in the course of an hour were renewed, the voice meanwhile becoming quite extinct. The spasms were at intervals repeated for several days, during which the respiratory act grew very feeble, and artificial respiration was resorted to (Becker). A child of five years took 5 grains of santonin. She immediately complained of pain in the stomach; in a minute or two convulsions came on, with insensibility. There was neither vomiting nor purging. Death took place in 35 minutes. Post-mortem, the stomach was inflamed in patches, and the duodenum throughout. The right heart was contracted and contained no blood; the left contained about 1 ounce of black fluid blood (Kilner. *St. Thomas's Hospital Reports*, N. S., x. 247, where the tests for santonin are discussed). In other cases it is not the nervous but the digestive apparatus that is chiefly affected, and violent vomiting and purging, followed by collapse, produce an attack like one of cholera morbus. In all cases the urine has the characteristic color. Although recovery generally takes place after such grave symptoms, they occasionally terminate in death. These illustrations suffice to prove the necessity of caution in the administration of santonin.

Medical Uses.—The chief practical value of santonin consists in its power of destroying *lumbricoid worms*, and in a less degree rectal *ascarides*. A single dose of about 2 grains has sufficed to cause the expulsion of one hundred and sixty-six of the former species. It should be prescribed in doses not larger at first than 1 grain (Gm. 0.06) for adults and ¼ grain (Gm. 0.016) for children, and ought to be taken at night, both because its action upon the parasites is less interfered with by food at that time, and because the yellow vision which it may occasion will not then be a source of so much annoyance. Early on the following day a dose of castor oil or of some other purgative should be given. As santonin in substance is almost devoid of taste and smell, it may be prescribed with powdered sugar or in jelly. Pastilles or troches of santonin, made with chocolate, are much used and are very efficient. Lewin recommends that it be administered in oil, which prevents its absorption by the patient, but increases its action upon the worms (*Practitioner*, xxxi. 65). (For the mode of action of santonin as a vermifuge see Guermonprez, *Bull. de thérap.*, cii. 89.) Santonin has also been employed with alleged advantage in the treatment of *whooping cough*, as a diuretic in cases of *renal colic*, and for subacute and chronic inflammation of the *choroid* and *retina*, especially of an atrophic character. But in none of these affections has its utility been demonstrated. Internal and external stimulants, heat, cold, and artificial respiration, have all been employed in *poisoning by santonin*, but of these the last is the only one of positive value. Evacuants should be used to remove any of the drug remaining in the alimentary canal, and inhalations of ether to control the spasms.

SAORIA.—Saoria.

The fruit of Mæsa lanceolata, *Forskal*, s. M. picta, *Hochstetter*.
Nat. Ord.—Myrsinaceæ.

Origin and Description.—Saoria is a shrub growing throughout Abyssinia at the height of about 7000 feet (2150 M.). The fruit, which is the part employed, is drupaceous, globular-ovate, united with and about two-thirds of its length covered by the calyx, about ⅛ or ⅙ of an inch (3–4 Mm.) in diameter, often crowned by the short style and capitate stigma, yellowish- or brownish-green, and containing numerous small turbinate, angular seeds, which are flattened above and imbedded in a resinous mass adhering to the central placenta. Saoria has a bitterish, pungent, and acrid taste.

Constituents.—According to the analysis of Apoiger (1857), saoria contains a little volatile oil, various organic acids, tannin, reacting green with iron salts, an acrid principle, fixed oil, pectin, and other common vegetable principles. The ash of the dried fruit amounted to 7.76 per cent., and contained 0.30 per cent. of boric acid.

Allied Drug.—MYRSINE AFRICANA, *Schimper*, belonging to the same natural order, grows throughout the greater portion of Africa. The fruit, *tatzé* or *satzé*, has been used like the preceding, from which it differs in being more globular, not united with the calyx, of a reddish-brown color, and in containing only one nearly globular seed, which is grooved at the base. The taste of the fruit is more disagreeable than that of saoria.

Medical Action and Uses.—Saoria gives a violet tint to the urine and occasions slight nausea and liquid stools. According to some authorities, it is a more certain remedy for *tænia* than the indigenous tænifuges of France, but others regard its action as uncertain. It may be given in powder, mixed with porridge, in the *dose* of 1 ounce or 1½ ounces (Gm. 32–48).

TATZÉ has a persistently acrid and disagreeable taste, and is apt to produce vomiting and purging. Dr. Strohl found it partially successful in six cases of *tænia*. He administered from 4 to 6 drachms (Gm. 128–192) of the powder in a liquid vehicle.

SAPO, *U. S., Br., P. G.*—Soap.

Savon, Fr.; *Seife*, G.

Preparation.—Soaps may be obtained by combining fatty acids (see page 1032) with alkalies, but they are generally prepared by boiling fats with a solution of caustic soda or potassa, when the fatty acids unite with the alkali, the soap remaining dissolved in the water, together with the glycerin which is liberated from the fat. The lye used in this operation is employed in a rather diluted state, is gradually added, and an excess of it is mostly used, since the saponification is thereby much facilitated, and the free alkali may be readily removed from the soap. The decomposition of the fats being effected by the gradual conversion of tripalmitin, etc. into di- and mono-palmitin before saponification is completed, the boiling must be continued until the mixture becomes transparent and rather tenacious. The soap is separated from the lye by adding common salt to the liquid, soap being insoluble in the solutions of most salts of potassium and sodium. If potassa has been used for saponification, the sodium chloride serves also the purpose of converting the potassa soap into soda soap. When the soap has separated from the liquor and sufficiently solidified it is transferred into wooden frames until it is stiff enough to be cut into bars, which are exposed to the air in a warm place until they become hard and dry.

Properties and Composition.—Soaps are salts of the fat acids, and if soluble have an alkaline reaction and taste. Commonly, the term "soap" is restricted to such of these salts as contain potassa or soda as the base and are soluble in water. The compounds with earthy and metallic bases are chemically analogous to these *soluble soaps*, but, being insoluble in water, are often distinguished as *insoluble soaps*. Of this latter kind two are recognized by the pharmacopœias—namely, lead plaster (p. 570) and liniment of lime (p. 883). Other insoluble soaps are extensively employed for rendering fabrics *waterproof*, and are produced by impregnating such fabric first with aluminium acetate or soluble salt of calcium or barium, and afterward steeping it in a solution of soap. The consistence of soap depends in part on the nature of the fat and in part on the alkali. Drying oils yield softer soaps than non-drying oils, and of the latter those containing much olein furnish soaps which are less hard, but more freely soluble in water and alcohol, than those rich in palmitic or stearic acid. Soda soaps are invariably harder than potassa soaps, which are mostly deliquescent, and therefore remain soft; dry potassium palmitate readily absorbs from the air about 50 per cent., and the oleate about 160 per cent. of moisture, while the corresponding sodium compounds absorb only 8 and 12 per cent. Soaps have mostly a white color when pure; the color and the marbled appearance of many soaps are due either to accidental impurities or to coloring matter contained in the oil, or they are produced by the intentional addition of coloring matters or of metallic salts, like sulphate of iron, in which case the result is due to the presence of an iron soap. Good soluble soaps have a slight fatty but not a rancid odor, or they have the fragrance of the fat (palm oil, etc.) from which they have been made.

The well-known detergent properties of soap depend upon its decomposition by a large quantity of water into acid and basic salts, of which the latter contain about 50 per cent. more alkali than the former, and act as solvents of fats and other matters; in this respect their action is similar to, but milder than, that of caustic alkali. So-called *hard water* is unsuited for washing on account of calcium or magnesium salts which are contained in solution, and which form insoluble soaps by double decomposition.

Examination and Valuation.—Soaps frequently contain a large amount of water—in some kinds 40 or even 50 per cent. From 12 to 15 per cent. of water is usually regarded as admissible for good air-dry Castile soap. The water is determined from a weighed quantity of the soap reduced to thin shavings, which are exsiccated at a temperature between 100° and 110° C. (212° and 230° F.). On treating the powdered soap with benzin or benzol or with ether, any unsaponified fat present will be dissolved, and on the evaporation of the solvent may be weighed; rosin oils and tar oils sometimes incorporated with soap are extracted by the same solvents. By incinerating another portion of the soap the soda may be determined from the residue, and should be about 10 or 11 per cent. for the exsiccated soap; if this quantity is exceeded, free alkali is most likely present. The dry soap is then dissolved in strong alcohol, in which sodium and potassium carbonate are insoluble, and, after separation from the alcoholic solution, may be estimated by titration with normal oxalic acid. On passing carbonic acid gas into the alcoholic liquid the caustic alkali will be precipitated as carbonate, and may be estimated as before. The solution may now be mixed with water, and again titrated with an acid for estimating the combined alkali. By decomposing a solution of soap with hydrochloric acid, washing, and collecting the fat acid, its weight may be ascertained, and should be near 90 per cent. of the dried soap. The melting- and congealing-points of these mixtures will usually give some indication of the nature of the fat used for preparing the soap. The acid liquid may be employed for the determination of glycerin if present; it is concentrated by evaporation and dried, care being taken to prevent charring; on exhausting the saline residue with absolute alcohol the glycerin will be dissolved, and on evaporating this solution at about 60° C. (140° F.) it will be left behind. Adulterations with starch, chalk, clay, and similar compounds are ascertained by their insolubility in hot water or alcohol. Common soaps are sometimes mixed with resin soap (an alkaline solution of rosin being incorporated) or with alkali silicate. There is usually no difficulty in recognizing the presence of rosin, but we know of no method for accurately determining its amount. F. S. Gladding (1882) recommends decomposing the solution of soap in alcoholic ether by powdered silver nitrate; the silver resin compound remains in solution, is decomposed by hydrochloric acid, the solution evaporated, and the resin weighed. Sodium silicate is insoluble in alcohol, and the amount of silica present may be determined in the usual way by dissolving this residue in water, acidulating with hydrochloric acid, evaporating to dryness, and dissolving the salts in acidulated water. Free alkali cannot be recognized by litmus-paper, since soap solutions possess an alkaline reaction; but if powdered soap is mixed with calomel, and the mixture is moistened with distilled water, it will acquire a gray or blackish color in proportion to the amount of free alkali present; its solution in distilled water gives with corrosive sublimate a white precipitate, which is yellowish or brown-red in the presence of alkali or alkali carbonate.

Medicinal Soaps.—Sapo, *U. S.;* Sapo durus, *Br.;* Sapo oleaceus, s. hispanicus, s. venetus.—Soap, Hard soap, Castile soap, *E.;* Savon blanc de Marseille, Savon d'Espagne, *Fr.;* Oelseife, Spanische Seife, *G.*—It is prepared from olive oil and soda, and should be white or grayish-white, free from rancid odor, hard, and should not become moist on exposure; it should be completely soluble in alcohol and in water, should not impart an oily stain to paper, and on incineration should yield an ash which is not deliquescent. *Mottled Castile soap* is a similar soap, which is more or less colored by the addition of an iron salt; internally it is white, mottled with black, changing to red-brown on exposure. The U. S. Pharmacopœia requires fresh soap to contain not over 34 per cent of water, but omits to state the limit of water allowable in soap used for preparing soap liniment; it gives no test to prove the absence of caustic alkali, and permits the presence of 3 per cent. (equal to 4.55 per cent. for dried soap) of matter insoluble in alcohol, of which at least 2 per cent. (3 per cent. for dried soap) should be soluble in water. "The aqueous (and alcoholic, *P. G.*) solution of soap should remain unaffected on the addition of solution of hydrosulphuric acid."—*U. S.* Some of the compounds of metals with fat acids are somewhat soluble in alcohol, but they are insoluble in water; the test given, therefore, has reference to the mixture or turbid solution in water, which should not be colored brown or black by sulphuretted hydrogen. Stearate and palmitate of sodium being sparingly soluble in cold alcohol, an adulteration of olive-oil soap with such prepared from animal fat is detected by the latter separating in the form of a jelly on the cooling of the alcoholic liquid. "A 4 per cent. alcoholic solution should not gelatinize on cooling (absence of animal fats)."—*U. S.*

Sapo medicatus, *F. Cod.*, is a soda soap prepared from expressed almond oil, and agrees in its principal characters with the preceding. The soap recognized under the same name by the P. G. is a soda soap made with equal weights of olive oil and lard; it is required to be free from alkali, and may be used in the preparation of opodeldoc (see page 886).

Sapo animalis, *Br.;* Sapo domesticus.—Curd soap, *E.;* Savon animal, *Fr.;* Hausseife, *G.*—It is made with soda and a purified animal fat consisting principally of stearin. It resembles the preceding; its solution in boiling alcohol, after cooling, forms a translucent jelly-like mass, which constitutes the basis of opodeldoc.

Sapo viridis, *U. S.;* Sapo mollis, *Br.;* Sapo kalinus, *P. G.*—Green soap, Soft soap, *E.;* Savon vert, *Fr.;* Kaliseife, Grüne Seife, *G.*—Heat solution of potassa (spec. gr. 1.144) 135 parts; add gradually linseed oil 100 parts; continue the heat for 30 minutes, then add alcohol 25 parts, and as soon as the mixture has become uniform add gradually water 200 parts, and heat until the mass becomes translucent and will be soluble in hot water without separating any oil; evaporate to 150 parts.—*P. G.* According to Hirsch, the saponification is rapidly completed after the addition of the alcohol, rendering the further addition of water unnecessary.

Soft soap is directed to be made from olive oil (*Br.*) or other fixed oils (*U. S.*). Commercial soft soap (Sapo kalinus venalis, *P. G.*) is frequently made of fish oil, rancid fats, etc., has generally a nauseous odor, and varies in color from yellow or green to black, pigments being sometimes incorporated. Prepared by the above formula, it is a brownish-yellow, transparent, soft, unctuous mass, of a slight but not repulsive odor, free from granular admixtures, and completely soluble in water and alcohol. It is stated to be greenish-yellow (*U. S.*) or yellowish-green (*Br.*), to yield nothing to warm benzol (*U. S.*), and to not impart an oily stain to paper (*Br.*); it has an alkaline reaction, and when incinerated leaves a very deliquescent ash of potassium carbonate. It should contain not over 40 per cent. of moisture (*U. S.*), but, being very hygroscopic, generally contains more. The granules frequently seen in the commercial article are sodium stearate, which separates from the jelly-like mass; sometimes starch, earthy carbonates, or similar compounds are added to produce this appearance. The adoption by the U. S. P. of the antiquated term Sapo viridis is unfortunate, since soft soap, even if made from green hempseed oil, will become brown-yellow unless artificially colored.

Off. Prep.—1. *Of hard soap:* Empl. cerati saponis, Empl. resinæ, *Br.;* Empl. saponis, Extr. colocynthidis comp., *U. S.*, *Br.;* Linim. potassii iodidi cum sapone, *Br.;* Linim. saponis, Pil. aloes, Pil. aloes et asafœtidæ, *U. S.*, *Br.;* Pil. asafœtidæ, *U. S.;* Pil. cambogiæ comp., *Br.;* Pil. opii, Pil. rhei, *U. S.;* Pil. rhei comp., Pil. saponis comp., Pil. scillæ comp., *Br.*

2. *Of curd soap:* Pil. scammonii comp., Suppos. acidi carbolici cum sapone, Suppos. acidi tannici c. sapone, Suppos. morphiæ c. sapone; it may also be substituted for the hard soap in preparing Linim. potass. iodidi c. sapone, *Br.*

3. *Of soft soap:* Linimentum terebinthinæ, *Br.*

History.—Pliny, after speaking of several ammoniacal preparations as resolvents of scrofulous tumors, says: "Soap, invented by the Gauls to make the hair yellow, may also be employed. It is prepared with tallow and ashes, the best with goats' fat and beech-ashes. It is of two kinds, the solid and the liquid. Both are employed by the Germans, but by the men more than by the women." In Arabian medicine soap was used to hasten the suppuration of boils, and, especially when mixed with honey, as a stimulant for ulcers; as a suppository to promote defecation; for washing leprous skins, and, with salt in a warm bath, to cure prurigo and ulcerated scabies; with oil to heal the salt rheum (eczema) of children's heads; with warm water to cleanse the scalp of dandruff and destroy nits and lice; and with "sandix" and slaked lime to dye the hair (Ebn Baithar).

Medical Action and Uses.—Soap acts upon quadrupeds (horses and dogs) internally very much as it does upon man—*i. e.* as mildly laxative and as weakly antacid through its alkaline constituent. But it is hardly ever used alone for these purposes, but rather to dissolve resinous medicines, along with which it is given, and thereby to quicken and strengthen their action. Pereira states that he knew of an idiot who had frequently eaten large lumps of soap without any ill effects, and that he had heard of a pound of it being swallowed for a wager.

Besides the use of soap as a *laxative*, it has been given internally as a solvent for uric acid. Along with calcined egg-shells (lime) and aromatic bitters it formed a once-famous cure for *gravel;* probably in this case it acted by giving up its acid to the lime and liberating the soda, which then tended to neutralize the free uric acid in the system. Soap is one of the best antidotes for *acid poisons*, because it is always to be promptly obtained, and because it does not itself act as an irritant. It should be given freely in the form of soapsuds. As a local remedy for external injuries by acids or by phosphorus soapsuds are efficient if promptly used.

As an external remedy soap acts by modifying the condition of the skin; it combines with the fat of the excretions, and removes them when they have grown acid or fetid, and, with them, the dirt accumulated from without; it softens the epidermis and removes its outer layers, and thus exposes the integument to the vivifying influence of the air; by all of which agencies a healthier condition of it is secured. If the soap be too strongly alkaline, or too little diluted with water, or applied with too active friction, it may induce painful irritation of the skin. This is particularly the case when there is added to the soap proper some article intended to exert a specific action, as sulphur, tar, etc. But in general the curative agent is used separately after the skin has been brought to a proper condition by warm water and soap. These remarks are particularly applicable to the treatment of *scabies*, *prurigo*, *psoriasis*, *acne*, and *eczema*. For this purpose soft soap is greatly to be preferred. In Germany, where the treatment of itch with soft soap originated, it is now nearly abandoned, not only on account of the offensive smell and irritant properties of the preparation (green soap), but because the speedier and more agreeable cure by balsam of Peru and storax has superseded it. The stimulant action of soft soap is also resorted to in the treatment of *ichthyosis* and of *lupus*. The semi-liquid or liquid soaps have been much used as discutients of acute and chronic *glandular* swellings, whether of a simple or specific nature, and in serous effusions into *joints* (Senator, *Med. Record*, xxii. 711). A soft soap made with olive oil and pure solution of potassa is devoid of the offensive smell of ordinary soft soap, and is to be preferred when patients are delicate or fastidious, as in the case of ladies and children. It can be scented with an essential oil or dissolved in cologne-water. The ancient treatment of *boils* by soap continues to be used. In general, yellow soap, mixed with sugar and spread on leather or muslin, is applied to the part. So far from irritating it and causing greater pain, this remedy, when promptly resorted to, lessens the pain materially and hastens suppuration.

SAPONARIA.—Soaproot.

Radix saponariæ.—Soapwort, E.; *Saponaire*, *Savonnière*, Fr.; *Seifenwurzel*, G.

The root of Saponaria officinalis. *Linné.*
Nat. Ord.—Caryophyllaceæ.

Origin.—Soapwort is a perennial herb growing throughout the greater part of Europe on the banks of streams and roadsides. It is sometimes met with in cultivation in gardens, and has been naturalized in North America. The stem is about 20 inches (50 Cm.) high; the leaves are opposite, mostly sessile, ovate, oblong or nearly lanceolate, three-nerved, entire, and nearly smooth. The large, pale rose-colored flowers are in corymbed clusters, have a cylindrical five-toothed calyx and five petals, with a two-cleft appendage at the top of the long claw. The herb flowers from June to August.

Description.—The root is collected in the spring or autumn without the creeping runners, is 10 to 15 inches (25–38 Cm.) long, cylindrical, about ⅛ or ¼ inch (3–6 Mm.) thick, gradually tapering below, somewhat branched, longitudinally wrinkled, and of a red-brown color externally. It breaks with a short fracture, and is internally white, with a rather thick bark and a soft yellowish, and in the centre whitish, wood, which has no medullary rays and is surrounded by a fine dark-colored cambium-line. The root is inodorous, and has a sweetish and bitter afterward persistently acrid taste.

Constituents.—Soaproot contains *saponin*, and is free from starch. Bucholz (1811) found also resin, mucilage, and other common principles. Osborne (1827) obtained from the root collected before flowering white, fusible, very bitter needles soluble in water, alcohol, and ether; but the nature of these has not been ascertained. Schiaparelli (1883) obtained saponin as a white, amorphous, inodorous powder, sternutatory and of a disagreeable taste, insoluble in ether, benzol, and chloroform, of the composition $C_{32}H_{54}O_{18}$, and by dilute acids split into glucose and *saponetin*, $C_{40}H_{66}O_{15}$. Saponin from quillaia-bark was found by Stütz to have the composition $C_{19}H_{30}O_{10}$. (See also QUILLAIA.)

Allied Drugs.—LEVANT SOAPROOT is obtained from Gypsophila Struthium, *Linné*, a caryophyllaceous perennial of Northern Africa and Southern Europe. It is 8 to 16 inches (20–40 Cm.) long, 1 to 4 inches (2–10 Cm.) thick, transversely and longitudinally wrinkled, brownish-yellow externally, internally white, with a rather hard wood and numerous medullary rays. In sensible properties and in composition it resembles the preceding.

SOAP-BERRIES are the fruit of Sapindus Saponaria, *Linné* (nat. ord. Sapindaceæ), a medium-sized tree of tropical America. They are the size of a cherry, globular or somewhat ovate, orange-colored, and contain a parchment-like endocarp enclosing two or three black seeds; the fleshy sarcocarp contains saponin and formic and tartaric acids. The fruit of the East Indian Sap. laurifolius, *Vahl*, is red-brown or blackish, and has similar constituents and properties. The seeds yield about 30 per cent. of a butyraceous fat.

Medical Action and Uses.—Saponaria has long enjoyed the reputation of being diaphoretic and diuretic, and alterative in that it cured chronic *diseases of the skin* and *bronchia*, *rheumatism*, *gout*, *syphilis*, and *periodical fevers*, or the *visceral engorgements* following them. It has been compared with sarsaparilla and with senega. It is administered in a decoction made with an ounce of the root to a pint (Gm. 32 in Gm. 500) of water. That this plant possesses active powers is evident from the large proportion it contains of saponin, whose peculiar virtues are treated of elsewhere. (See SENEGA.)

SARCOCOLLA.—SARCOCOLLA.

Sarcocolle, Fr.; *Fleischleimgummi*, *Fischleimgummi*, G.

An exudation of Penæa Sarcocolla, *Linné*, and P. mucronata, *Linné*.
Nat. Ord.—Penæaceæ.

Origin and Description.—The plants named are small branching shrubs, with small, opposite, entire, coriaceous leaves, and clusters of yellow flowers surrounded by a purplish-red leafy involucre. The shrubs are indigenous to Central and Southern Africa, and exude a juice which after hardening constitutes sarcocolla. Dymock (1879), however, noticed that the sarcocolla which comes in considerable quantities to Bombay from the Persian port of Bushire is always mixed with fragments of a thorny stem and with short, slender, and cottony pods containing a single gray-brown vetch-like seed; he believes that the gum is obtained from one of the desert Leguminosæ, probably a species of Astragalus. It is in small, roundish, somewhat spongy, and friable grains, which are sometimes agglutimated to larger masses, often mixed with fine hairs, and have a yellowish, reddish, or brownish color. Sarcocolla is inodorous, has an insipid, sweetish, afterward somewhat acrid and bitter taste, resembling that of liquorice-root; is soluble in water, almost completely soluble in alcohol, except the impurities, and when heated burns and gives off the odor of burning sugar.

Constituents.—On treating sarcocolla with ether, Pelletier (1834) separated a resin; the undissolved residue yielded to alcohol *sarcocollin*, and left gummy matter behind. Sarcocollin is uncrystallizable, soluble in alcohol and water, possesses a bitter-sweet taste, and when oxidized with nitric acid yields oxalic acid. Its composition is stated to be $C_{13}H_{23}O_6$.

Medical Action and Uses.—The name of this substance, which means a healer of the flesh, it has borne since an early period in the history of medicine. It was held in great repute for agglutinating *wounds* and curing *defluxions of the eyes*, and was also applied to *joints* affected with chronic inflammation. It was reputed to be a *depilatory*, was used with honey to check *otorrhœa*, and was applied with nitre as a discutient of *scrofulous glands*.

SARRACENIA.—PITCHER-PLANT.

Side-saddle plant, *Huntsman's cup*, *Water cup*, E.; *Sarracenie*, Fr., G.

Sarracenia purpurea, *Linné*.
Nat. Ord.—Sarraceniaceæ.

Description.—This plant grows in boggy places from Canada southward. The *rhizome* is oblique, conical, about an inch (25 Mm.) or more long, of a reddish-brown color externally and brownish-white internally, has numerous, thin, nearly simple, toughish rootlets attached, breaks with a short fracture, and does not acquire a blue color with solution of iodine. It is inodorous, and has a bitter and somewhat astringent taste. The *leaves* are radical, 6 or 8 inches (15–20 Cm.) long, pitcher-shaped, most inflated near the middle, curved, broadly winged, with an erect, roundish, heart-shaped hood, and have a bitterish taste. The *flower* is nodding, globose, and deep-purple, and has fiddle-shaped petals.

Constituents.—The plant was analyzed by Björklund and Dragendorff (1863), who found, besides the usual constituents of herbs, *acrylic acid*, which is volatile, and about $\frac{1}{6}$ per cent. of a *volatile base* having an odor resembling that of conine. Stan. Martin (1865) announced the presence of a bitter alkaloid, *sarracenine*, the sulphate of which is crystallizable; and Hêtet found two alkaloids, one of which had the properties of veratrine. E. Schmidt (1872) isolated a yellow coloring matter, *sarracenic acid*, which yields with alumina a yellow lake.

Allied Plants.—SAR. FLAVA, *Linné*, Trumpet-leaf. The *rhizome* is similar to the preceding, but larger. The *leaves* are about 2 feet (60 Cm.) long, tubular, gradually enlarged to the open throat, and have a very narrow wing and a roundish mucronate hood, which is narrowed toward the base. The flower is yellow. The plant grows in the Southern United States.

SAR. VARIOLARIS, *Michaux*, grows from South Carolina to Florida, and has elongated leaves mottled with white on the back, with a linear wing, and with the lamina inflected over the throat of the tube. The flower is yellow.

Medical Action and Uses.—S. flava and S. variolaris possess stimulant and tonic virtues, for which they enjoy a high reputation in South Carolina, where they are used in the treatment of *dyspepsia* and its associated ailments. Sarracenia is said to have been employed in gout and rheumatism, and Hêtet has claimed that it contains an alkali identical with veratria (*Bull. de thérap.*, xcvi. 178). A hasty and immature observation at one time ascribed to S. purpurea the virtues of a specific remedy for small-pox—a notion which, it is almost superfluous to say, was not confirmed by experience, but which, like other errors, it required some time and labor to destroy.

SARSAPARILLA, *U. S.*—Sarsaparilla.

Sarsæ radix, Br.; *Radix sarsaparillæ*, P. G.—*Salsepareille*, Fr.; *Sassaparilla*, G.

The root of Smilax officinalis, *Kunth*, Sm. medica, *Schlechtendal et Chamisso*, and of other species of Smilax. Bentley and Trimen, *Med. Plants*, 289, 290.

Nat. Ord.—Smilaceæ.

Origin.—Sarsaparilla is obtained from different species of Smilax growing in swampy forests of Mexico and as far south as the northern portion of Brazil. These are woody climbers, and often attain a great height. Smilax Sarsaparilla, *Linné*, is indigenous to the United States, and grows chiefly in the Southern States; it is in part at least Smilax glauca, *Walter*, but does not afford any sarsaparilla; its subterraneous portion is a long, cylindrical, creeping rhizome with prominent nodes and a few small rootlets, and bears no resemblance to the commercial drug. The only sarsaparilla-yielding species which are tolerably well known are the following:

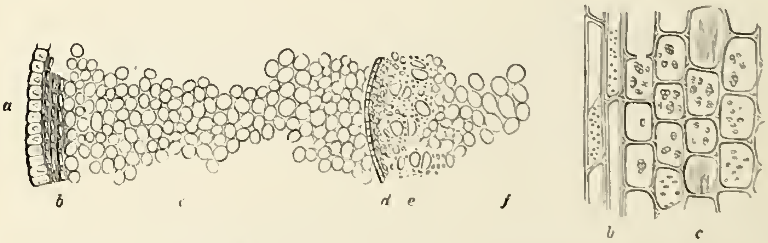
Smilax officinalis. It is indigenous to New Granada and other parts of Northern South America, and has a quadrangular stem and large cordately-ovate or oblong, five- or seven-nerved leaves; it furnishes Jamaica sarsaparilla.

Smilax medica. It has a zigzag stem and much smaller leaves, which are frequently auriculate, with broad and obtuse basal lobes. It is indigenous to Mexico, and affords the Mexican sarsaparilla.

Smilax syphilitica, *Kunth*, S. scabriuscula, *Kunth*, S. cordato-ovata, *Richard*, S. papyracea, *Poiret*, S. Purhampuy, *Ruiz*, and others, seem to be imperfectly known, or, at all events, it is uncertain whether they are sources of some variety of the drug.

Collection.—No satisfactory account has been given of the manner in which the different varieties are collected and prepared for the market. According to Rich. Spruce, in the valley of the Amazon the roots are about 9 feet (2.7 M.) long, spread horizontally, and are collected after several stems have been produced, younger plants having so few roots as not to be worth grubbing up. The earth is scraped away from the roots by hand, aided by a pointed stick, and the roots of other plants interfering are cut through with a knife. When at length laid bare, the sarsaparilla-roots are cut off near the crown, a few slender ones being allowed to remain to aid the plant in renewing its growth, and the stems are cut down to near the ground. The yield of a plant of four years' growth is about 16 pounds, and of older plants from two to four times that quantity (*Pharmacographia*). During the year 1876, 883,590 pounds of sarsaparilla were imported into the United States, but the average importation during eight years, including 1883, was only 484,010 pounds.

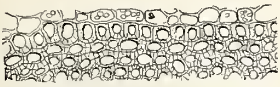
Fig. 250.



Transverse and longitudinal section of Sarsaparilla: *a*, epidermis: *b*, subcuticular tissue; *c*, parenchyma; *d*, nucleus-sheath; *e*, woody zone: *f*, central parenchyma.

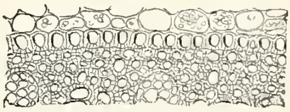
Description.—As met with in commerce, sarsaparilla consists either of the horizontal roots alone or in part also of the short knotty rhizome, to which, in some sorts, portions of the overground stems are sometimes attached. The roots are long, cylindrical, tapering toward both extremities, and beset with thin branching fibres called the *beard*, or nearly free from fibres. They are more or less deeply furrowed in a longitudinal direction, and have mostly a gray or blackish-gray color externally from adhering earth, and after this has been washed off are of a bright brownish- or reddish-yellow color, and partic-

Fig. 251.



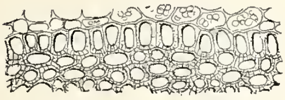
Honduras Sarsaparilla.

Fig. 252.



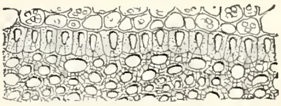
Mexican Sarsaparilla.

Fig. 253.



Rio Negro Sarsaparilla.

Fig. 254.

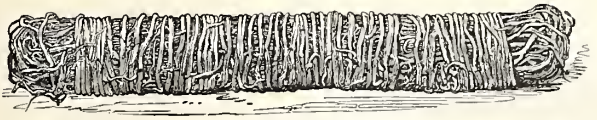


Jamaica Sarsaparilla.

Sections through nucleus-sheath, showing above one row of cells of bark-parenchyma, and beneath it several rows of cells of the woody zone; magnified 80 diameters.

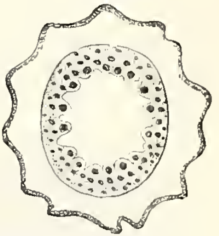
ularly in the folds are often clothed with short simple hairs. When cut transversely several distinct zones are observed, which, under the microscope, have the following appearance: The epidermis is formed of one layer of cells, some of which are prolonged into hairs; then follows the outer endoderm, a subcuticular layer composed of two or three or more rows of axially-elongated cells with their walls thickened from secondary deposits, and a layer of parenchyma, called the *bark*, and containing starch or an amorphous mass, and some cells filled with bundles of needle-shaped crystals consisting of oxalate of calcium. Underneath the bark is the nucleus-sheath, also called bundle-sheath and inner endoderm, consisting of a single row of cells with thickened walls, resembling those of the subcuticular tissue, and varying in shape and in the secondary deposits in the different varieties; to this adheres the *woody zone*, varying in width in the different kinds, and chiefly composed of fibro-vascular bundles. The central layer, usually called the *pith*, consists of parenchyma-cells similar to those outside the nucleus-sheath, and occasionally contains a few scattered wood-bundles. Schleiden, and afterward Berg, proposed a classification of the sarsaparillas mainly from the character of the nucleus-sheath, and more recently a similar view was taken by Ferd. Otten (1876). The cells of the nucleus-sheath are nearly uniformly thickened on all sides, and have an almost quadrangular appearance in Honduras sarsaparilla; they are somewhat elongated in a radial direction in Brazilian sarsaparilla, and toward the outside are rather less thickened than on the inner and lateral cell-walls. Mexican sarsaparilla has the cells of the nucleus-sheath of a somewhat wedge-shaped appearance, the layers of the cells-walls being thickest in the inner half. Jamaica sarsaparilla has the incrustation of the sheath-cells thickest upon the inner and lateral walls—frequently so as to assume a wedge-shaped appearance; another kind has the cells radially elongated, but not wedge-shaped, and the cell-walls nearly uniformly thickened on all sides. There are, however, frequently modifications or intermediate forms of these characters observed. The cells of the subcuticular layer have their cell-walls considerably thickened, particularly the outer ones.

Fig. 255.



Honduras Sarsaparilla.

Fig. 256.

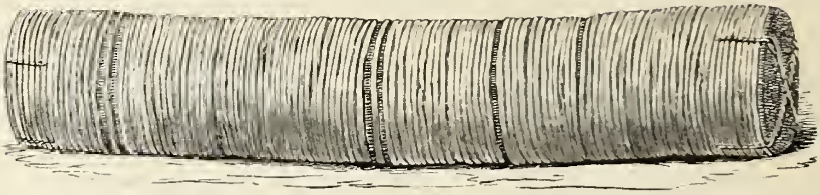


Honduras Sarsaparilla, 3 diameters.

Sarsaparilla is nearly inodorous, except in infusion and decoction; it has at first a slight taste, but leaves an acrid impression in the fauces, by the intensity of which the quality of the root may be approximately judged.

Commercial Varieties.—The sarsaparillas may be conveniently distinguished as *mealy* and *non-mealy;* the former are amylaceous in the interior, but usually contain in some portions of the parenchyma-tissue amorphous masses of altered starch, and they are usually marked externally by rather uniform and shallow wrinkles. The non-mealy varieties are rather horny, and not farinaceous when broken transversely, contain but little granular starch, and are usually characterized by deep longitudinal and irregular folds. The sarsaparillas from Honduras and Mexico, which are mostly met with in the United States, are representatives of the two classes.

Fig. 257.

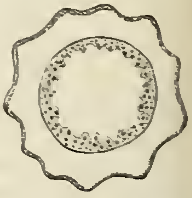


Rio Negro or Para Sarsaparilla.

Mealy Sarsaparillas.—Honduras Sarsaparilla. This is exported from Belize and other ports on the Bay of Honduras, and comes in bundles 2 or 3 feet (60 to 90 Cm.) long, consisting of the folded roots, in the interior containing some hard woody rhizomes and often short fragments of the stem, and tied with roots of the same kind. The roots have some fibres attached, and have the cortical layer somewhat thicker than the woody zone, and of about the same width or thinner than the pith. It is the kind recognized by the German Pharmacopœia.

Rio Negro Sarsaparilla, also called *Para*, *Brazilian*, and *Lisbon Sarsaparilla*. This is exported from Para, and comes in long cylindrical rolls tied together by a smooth stem, and with both ends cut off evenly. It is free from rhizomes and stems, and contains but few root-fibres, but the interior of the bundle is frequently packed with roots of inferior quality. The bark and pith are nearly of the same width, but the ligneous zone is only one-third or one-fourth that thickness.

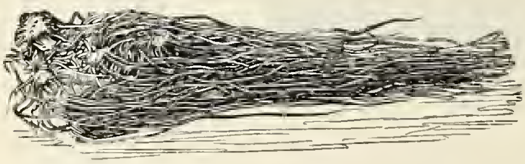
Fig. 258.



Rio Negro Sarsaparilla, 3 diameters.

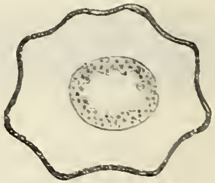
Non-mealy Sarsaparillas.—Mexican Sarsaparilla, also called *Vera Cruz* and *Tampico Sarsaparilla*. The roots are folded back, so as to cover the knotty rhizomes and portions of the stem, which are often 6 inches (15 Cm.) in length. The roots have but few rootlets attached, and are deeply and irregularly wrinkled. The pith is of about the same width as the woody zone or a little thicker, but the bark is sometimes twice this thickness, at least in the projecting ridges or after soaking in water. It is probably obtained from Smilax medica.

Fig. 259.



Mexican Sarsaparilla.

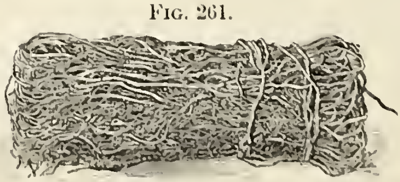
Fig. 260.



Mexican Sarsaparilla, 3 diameters.

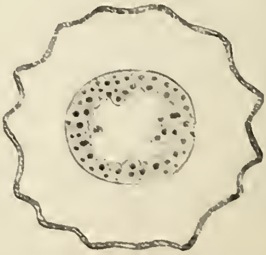
Jamaica Sarsaparilla. This is also known as *bearded sarsaparilla*, from the numerous root-fibres attached to it. It comes in bundles similar to, but usually shorter than, those of Honduras sarsaparilla, and less neatly tied. The rhizomes are generally absent. The layers of pith and bark are nearly of the same width, but the woody zone is narrower, being about one-half the width of the pith. It varies in mealiness, often in different parts of the same root, and is also distinguished from the other varieties by its reddish-brown color. It does not grow wild in Jamaica, but is obtained from Costa Rica, and a similar drug, agreeing in all essential qualities with

Fig. 261.



Jamaica Sarsaparilla.

Fig. 262.



Jamaica Sarsaparilla, 4 diam.

this, is sometimes exported from Venezuela and known as *Caracas sarsaparilla.* It is supposed to be derived from Smilax officinalis, which is cultivated to a limited extent in Jamaica, but there furnishes a more mealy root. Jamaica sarsaparilla is the only kind recognized by the British Pharmacopœia.

Other varieties of sarsaparilla have been described by European writers, but are rarely, if ever, met with in commerce in this country.

Constituents.—Sarsaparilla was analyzed by Pallotta (1824), Folchi, Thubeuf (1831), Batka (1834), Poggiale (1835), and others, and the acrid principle has at different times received the designations *smilacin*, *pariglin*, *parillin*, *salseparin*, etc. Pallotta precipitated the decoction with milk of lime, decomposed the precipitate with carbonic acid, and, after drying, exhausted it with alcohol. Thubeuf exhausted the root with boiling alcohol, concentrated the tincture, treated the residue with charcoal, and recrystallized from hot alcohol; 10 pounds of the root yielded 3 ounces of smilacin. Lamatsch (1857) precipitated the concentrated alcoholic decoction with water, washed the precipitate with ether, and purified it by treating its alcoholic solution with animal charcoal; Flückiger (1877) recrystallized this precipitate from alcohol; the yield was 0.19 per cent. In its purest state parillin has been obtained as colorless needles, which are sparingly soluble in cold water and diluted alcohol, but more freely soluble in hot water (20 parts, Flückiger) and hot alcohol; it is also soluble in alkalies and dilute acids, and nearly insoluble in ether and chloroform. Its aqueous solution foams in a manner similar to that of a solution of saponin, and on boiling reduces in a slight degree an alkaline solution of copper, but more abundantly after it has been boiled with dilute sulphuric acid, when sugar and *parigenin*, which is insoluble in water, are formed. Parillin is precipitated by lead acetate and subacetate and by tannin, dissolves in sulphuric acid with a yellow afterward cherry-red color, and with warm diluted sulphuric acid turns greenish, red, and brown; it appears to be closely related to sapogenin, but its exact composition has not been determined. The other constituents of sarsaparilla are a trace of essential oil, resin, pectin, albumen, and other common principles. Otten obtained also between 2 and 3 per cent. of *saponin*, and determined the starch in the non-mealy varieties to vary between 3 and 13.8 per cent., while the mealy varieties contained sometimes as high as 15 per cent., and in rare cases as low as 10, or even 6.25, per cent. of starch.

Valuation.—Marquis (1875) estimated the amount of (impure) parillin by digesting the root with 30 per cent. alcohol, evaporating to an extract, washing this with cold water, and exhausting with boiling alcohol, on the evaporation of which a yellowish mass was left, which was weighed as parillin. After modifying the process, Otten obtained similar results, tending to show that Honduras and Para sarsaparilla yield less parillin than the Vera Cruz and Jamaica varieties.

Allied Drugs.—Smilax China, *Linné.* This is a climbing shrub of Eastern and South-eastern Asia. Its irregular, tuberous rhizomes, together with those of several other species, are used in Europe as Rhizoma (Radix) Chinæ.—China-root, *E.;* Squine, Racine de Chine, *Fr.;* Chinawurzel, *G.*—They vary in length from 4 to about 10 inches (10–25 Cm.), and in thickness from 1 to 2 inches (2–5 Cm.), are more or less covered with short obtuse branches, are reddish-brown and somewhat wrinkled externally, and internally brownish-white, with numerous brown resin-spots, somewhat horny or mealy, hard, and dense. China-root is inodorous and has an insipid, faintly bitter, and somewhat acrid taste. Smilax Pseudo-china, *Linné*, and Sm. tamnoides, *Linné*, which are natives of the United States, yield similar tuberous rhizomes, which are usually lighter in color and weight. The root of Sm. aspera, *Linné*, of Southern Europe, has been employed there in place of sarsaparilla.

The Mexican Pharmacopœia recognizes as *raiz de China de Mexico* a large conical or somewhat spindle-shaped root, which is 18 inches (45 Cm.) long, 6 or 7 inches (15–18 Cm.) in diameter, reddish-brown, internally lighter, fleshy, with numerous irregular wood-bundles, inodorous when dry, and of an astringent and somewhat bitter taste. It is erroneously referred to Smilax rotundifolia, *Linné*, which is indigenous to the United States and has a creeping rhizome with prominent nodes.

Carex arenaria, *Linné.*—Sand sedge, German sarsaparilla, *E.;* Laiche, *Fr.;* Sandriedgras, Rothe Quecke, *G.* (nat. ord. Cyperaceæ).—It is indigenous to Europe, and grows frequently in sandy soil and near the coast of Germany. The rhizome (Rhizoma caricis) is creeping, several feet long, about $\frac{1}{10}$ inch (2.5 Mm.) thick, subcylindrical, gray-brown, wrinkled, and on the nodes beset with rootlets and with fringed sheaths. Internally, it shows a woody zone composed of three irregular circles of fibro-vascular bundles enclosing soft white cellular tissue, and surrounded by a cortical layer having a circle of large prominent air-passages. The dried rhizome has little odor and a mealy, sweetish, afterward bitter and acrid taste. It is employed like sarsaparilla.

Off. Prep.—Decoct. sarsæ, *Br.;* Decoct. sarsaparillæ (sarsæ) comp., Extract. sarsaparillæ fluid. (sarsæ liquidum), *U. S.*, *Br.;* Ext. sarsaparillæ fluid. comp., Syrup. sarsaparillæ comp., *U. S.*

History.—The Spaniards first brought sarsaparilla to Europe about the middle of the sixteenth century from Peru, St. Domingo, and Brazil. It was then believed to be a specific for constitutional syphilis, and especially for the rheumatoid and ulcerative symptoms of that disease. It had, however, quite fallen into neglect when a belief in its virtues was for a time revived at the end of the eighteenth century; but it again gradually lost confidence as a remedy for syphilis, and was more largely used by nostrum-venders than by physicians.

Physiological Action.—The operation of the active principle of this root (smilacin, parillin) is by no means a negative one. According to Pallotta, in doses of 6 grains it occasions malaise and slowness of the pulse; 8 grains produce nausea and constriction of the throat; 10 grains, general debility and diaphoresis; 13 grains, moderate vomiting of a bitter liquid, with irritation and constriction of the throat, faintness, and general exhaustion. These effects have been ascribed to a different principle from either of the above, but which has not been isolated. It is certain, however, that they may be caused by some derivative of sarsaparilla, however named, and that they have also been produced by large doses of the drug itself. In medicinal doses neither sarsaparilla nor its usual preparations occasion any such phenomena. Their effects are manifested during a state of disease, rather than in health, and consist of an improved condition of the digestive and nutritive functions and the gradual subsidence of the morbid derangement.

Medical Uses.—Although sarsaparilla has been recommended in chronic *gout*, *rheumatism*, and *skin diseases*, yet the only disease for the cure of which special virtues have been claimed for it is constitutional *syphilis*, and the most eminent authorities upon this subject have generally agreed that its efficacy depends upon the patient having been previously subjected to a mercurial treatment. It is certain that with the disuse of mercury to produce salivation, and the dire consequences of the saturation of the system with that mineral, the use of sarsaparilla grew less and less frequent, so that it at last came to be prescribed, not so much from a belief in its utility as to gratify the popular faith in its virtues. Some have gone so far as to declare that the various decoctions of sarsaparilla are curative solely by means of the water which they contain—a judgment which, in view of the powers manifested by its active principles, seems to be exaggerated, if not erroneous. It is the more difficult to determine the value of sarsaparilla in the treatment of syphilis because it is nearly always associated with other active medicines, as with guaiacum and mezereon in the compound decoction, and with the former of these drugs in the compound syrup of sarsaparilla. Of the officinal preparations, the first is the only one that is worthy of being used. It is customary to associate with it iodide of potassium, which is commonly curative without the sarsaparilla. Nevertheless, there are cases of constitutional syphilis which make no progress or grow worse under treatment by mercury or by iodine, and which are restored to health by the decoction of sarsaparilla (*e. g.* two cases by Carter, *Practitioner*, xxvi. 357).

Zittmann's decoction for the cure of syphilis is one of the most celebrated and efficient preparations of sarsaparilla. It is composed of two decoctions, a stronger and a weaker. The former is prepared as follows: Take 12 ounces of clipped sarsaparilla and 72 pints of water, and allow them to digest for 24 hours; then add ℥vj each of powdered sugar and alum, and in a covered vessel expose to a steam-bath until the liquid is reduced to 24 pints. Toward the close of the operation add anise and fennel, of each ℥ss, of senna ℥iij, and of sliced liquorice-root ℥iss. Press and strain, and when the decoction is cool decant the clear liquid and bottle 24 pints. In the original formula, besides the sugar and alum, there were added ℥ss of calomel and ʒj of sulphuret of mercury enclosed in a linen bag, and allowed to remain in the liquid during the boiling, which furnished to it a very minute proportion of corrosive sublimate. The weaker decoction is prepared by adding to the dregs of the stronger decoction of fresh sarsaparilla ℥vj and 72 pints of water, and boiling as before, but toward the end of the ebullition are introduced ℥iij each of lemon-peel, cinnamon, and liquorice-root. In using this mode of treatment, which lasted from two to four weeks, the patient was required to live on a mild diet and drink of the stronger and weaker decoctions alternately; *e. g.* every morning from 10 to 16 fl℥ (Gm. 300–500) of the former, and every evening the same quantity of the latter, or morning and evening a like quantity of the stronger decoction, but warm at the one time and cold at the other, and between the two an equal quantity (Oij) of the weak decoction. Of the virtues of this preparation we have the authority of Erasmus Wilson for saying that in extreme and very obstinate cases of the ulcerating forms of syphilis which have resisted both mercury and iodine, and particularly in those most difficult of all cases where the disease has got possession of the tongue and the mucous membrane of the mouth, it may often be had recourse to with great success.

Carex arenaria was at one time regarded as possessing all the virtues of sarsaparilla, and particularly as promoting the cutaneous and renal secretions. It was used in the treatment of *rheumatism*, *gout*, *pulmonary* and *cutaneous diseases*, and *syphilis*. The root was used in the decoction, and in its stead C. intermedia and C. hirta were often employed.

Arenaria rubra is a popular remedy in Algiers for *gravel* and various affections of the urino-genital organs and in some forms of dropsy. It is said to be entirely innocuous. It probably owes its diuretic qualities to the large proportion it contains of sodium and potassium salts. It is best given in a decoction prepared with an ounce of the plant in a pint of water, reduced one-fifth, and sweetened. *Dose*, a tablespoonful six or seven times a day (*Bull. de thérap.*, xcv. 287; xcvii. 69, 94).

SASSAFRAS, *U. S.*—Sassafras.

SASSAFRAS MEDULLA, *U. S.*—Sassafras-Pith.

The bark of the root (the root, *Br.*, *P. G.*) and the pith of Sassafras officinalis, *Nees*, s. Laurus (Persea, *Sprengel*) Sassafras, *Linné*. Bentley and Trimen, *Med. Plants*, 220.

Nat. Ord.—Lauraceæ.

Origin.—Sassafras became known in Europe toward the close of the sixteenth century. The plant is indigenous to North America from Canada southward to the Gulf of Mexico and westward to Texas; remains shrubby in the north, but attains a height of 40 or 50 feet (12–15 M.) in the Southern States. The trunk has a rough furrowed gray bark, but the young branches are of a brown color. The wood is white or reddish, light, but very strong and durable. The leaves are alternate, petiolate, 3 or 6 inches (7–15 Cm.) long, bright-green and smooth above, downy beneath, especially when young; broadly ovate in shape and entire, or some of them two- or three-lobed—all, however, with a wedge-shaped base. The greenish-yellow flowers appear before the leaves in March and April or May, are diœcious, grow in downy racemes, and have linear bracts at the base and a deeply six-lobed perianth. The male flowers have nine stamens in three rows, and the female flowers six short imperfect stamens. The fruit is a dark-blue, oval or ovoid, one-seeded drupe, supported in the permanent base of the perianth and on the thickened clavate reddish peduncle. The flowers have an agreeable though not a strong odor; the bark of the branches is aromatic, but differs in flavor from that of the root; the leaves contain a considerable quantity of mucilage.

Description.—The following parts are recognized by the pharmacopœias:

1. Sassafras, *U. S.*; Cortex sassafras.—Sassafras-bark, *E.*; Écorce de sassafras, *Fr.*; Sassafrasrinde, *G.*—Only the root-bark is employed. It is deprived of the dark-gray, inert, corky layer, is whitish in the fresh state, and is seen in commerce in irregular flattish or curved pieces, usually 2 to 4 inches (5–10 Cm.) in length and width. It is of a bright rust-brown color, on the inner surface finely striate and glistening, rather soft and fragile, breaks with a short corky fracture, and on transverse section is radially striate. It has a strong fragrant odor and a sweetish, aromatic, somewhat astringent taste.

2. Sassafras radix, *Br.*; Lignum sassafras, *P. G.*—Sassafras-root, *E.*; Bois de sassafras, *Fr.*; Sassafrasholz, Fenchelholz, *G.*—The root is medicinally employed in Europe, but not in the United States. It comes in crooked and branching pieces with or without the bark attached, varying in size, and in color between yellowish-white and pale-brownish or reddish. The wood is rather spongy, porous, light, composed of numerous annual layers and marked by numerous medullary rays; it has the odor and taste of the bark, but in a milder degree. The German name *Fenchelholz* (fennel-wood) has reference to the fancied resemblance of its odor to that of fennel.

3. Sassafras medulla, *U. S.*, Sassafras-pith. It is obtained from the branches, and is met with in slender, cylindrical, very light pieces, frequently curved or coiled, white, inodorous, and of an insipid, mucilaginous taste. When macerated in water it forms a ropy but non-tenacious mucilaginous liquid, which is not precipitated by alcohol.

Constituents.—Sassafras-bark was examined by Reinsch (1845), who obtained from it volatile oil (page 1086), tannin, sassafrid, starch, resin, waxy matter, mucilage, and coloring matter. On treating the bark, previously exhausted by ether, with alcohol, evaporating the alcohol, and macerating the extract with water, *tannin* is dissolved, yielding with ferric salts bluish-green precipitates, and *sassafrid* remains behind as a light reddish-brown, inodorous, and nearly tasteless powder, which is nearly insoluble in ether, and separates from its hot concentrated alcoholic solution in yellowish-brown crystalline granules. Its solutions are colored red by alkalies, and precipitated carmine-red by alkaline earths, dark greenish-brown by ferric salts, and whitish by acetate of lead. It is doubtless an oxidation-product of tannin. Pectin could not be found. The bark contains about 6 per cent. of tannin and over 9 per cent. of sassafrid. According to Procter (1866), fresh sassafras-bark contains no sassafrid, but this is formed from the tannin on exposure to air. The woody portion of the root contains the same constituents, but in smaller proportion. The principal constituent of sassafras-pith is *mucilage*.

Off. Prep.—1. *Of the bark and root:* Decoct. sarsaparillæ (sarsæ) comp., *U. S.*, *Br.*; Extract. sarsaparillæ fluidum comp., *U. S.*; Species lignorum, *P. G.* 2. *Of the pith:* Mucilago sassafras, *U. S.*

Allied Plant.—Umbellularia (Oreodaphne, *Nees*, Tetranthera, *Wight et Arnott*) californica, *Nuttall*, California bay-laurel or spice tree. This evergreen tree is indigenous near the Pacific coast of North America, and in Oregon attains a height of 80 feet (24 M.) or more, but in California is of smaller size. The brownish close-grained wood is much esteemed for cabinet-work. The leaves are alternate, lanceolate, entire, pinnately veined, reticulate, and pellucid punctate. They yield about 4 per cent. of a yellowish volatile oil having the spec. grav. .936, an odor resembling nutmeg and cardamom, and a warm camphoraceous taste. The oil was examined by J. P. Heamy (1875) and J. M. Stillman (1880), and appears to contain a hydrocarbon and a terpene-hydrate, $C_{20}H_{32}.H_2O$, boiling below 190° C. (374° F.), and *oreodaphnol* (umbellol, Stillman), $C_8H_{12}O$, boiling above 210° C. (410° F.). The seeds contain a fat which melts near 32° C. (89° F.), and, according to Stillman (1882), contains crystalline *umbellulic acid*, $C_{11}H_{22}O_2$, distilling near 272° C. (522° F.) without decomposition.

Medical Action and Uses.—Sassafras-bark is believed to be somewhat stimulant, quickening the pulse slightly, promoting digestion, and increasing the secretions of the skin and kidneys. It was formerly used in the treatment of chronic *syphilis* and diseases of the *skin*, and is one of the medicines which are popularly supposed to purify the blood. Its real virtues, if any, are undetermined. It may be given *ad libitum* in an infusion made with from ½ ounce to an ounce of the bark and ½ pint (Gm. 16–32 in Gm. 250) of hot water. It is said that an infusion of sassafras-bark is "almost a specific for the rash produced by poison oak." It should be taken internally and applied topically (Hinton).

Sassafras-pith is used to form a mucilage with cold water. It is demulcent, and at the same time a very mild local stimulant. An infusion of it may be used internally as a drink in *dysentery*, in inflammations of the *throat*, *air-passages*, and *stomach*, and in febrile affections generally. It forms an agreeable and efficient collyrium in cases of acute *conjunctivitis*, and serves as a vehicle for more active remedies.

SAURURUS.—Lizard's Tail.

Saururus cernuus, *Linné*.

Nat. Ord.—Saururaceæ.

Description.—This is a common North American perennial, inhabiting swampy localities. Its stem is about 2 feet (60 Cm.) high and rather weak. The leaves are alternate, petiolate, about 4 inches (10 Cm.) long, heart-shaped, entire, pointed, convergingly ribbed, slightly hairy, and underneath pale-green. The flowers are in a slender, crowded, terminal, spike-like raceme which is about 4 inches (10 Cm.) long, are destitute of any floral envelope, contain six hypogynous stamens and three or four ovaries united at the base, and produce a somewhat fleshy berry-like fruit. The entire plant has an aromatic but rather unpleasant odor and a somewhat acrid taste.

Constituents.—The plant has not been analyzed.

Allied Plant.—Anemopsis californica, *Hooker*. It is a small perennial, indigenous to California and Mexico, where it is known as *yerba mansa*. The leaves are mostly radical, smooth, and have sheathing petioles; the root is whitish and fleshy; all parts of the plant, when broken, have a pungent peppery taste. Prof. Lloyd (1880) obtained from a pound of the root 6 drachms of a yellowish volatile oil, which becomes red and thick with sulphuric acid, is slowly colored blue, violet, purple, and brown by hydrochloric acid, and acquires a blue color with nitro-muriatic acid. Alcohol deprives the root of its sensible properties, and when evaporated leaves an oil which is heavier than water, and from which carbon disulphide precipitates a brown granular substance having an astringent and peppery taste and being soluble in dilute alcohol and in glycerin.

Medical Action and Uses.—The root is used in poultices as an application to *abscesses* and other painful swellings, and a decoction of it is sometimes employed in *strangury* and other irritations of the urinary passages and bowels. It is also directed in a strong infusion, of which several ounces should be continuously given at short intervals when the symptoms are urgent.

SCAMMONIÆ RADIX, *Br.*—Scammony-Root.

Racine de scammonée, Fr.; *Scammoniawurzel*, G.

SCAMMONIUM, *U. S., Br.*—Scammony.

Scammonée, Fr.; *Scammonium*, G.

The root and the resinous exudation from the root of Convolvulus Scammonia, *Linné.* Bentley and Trimen, *Med. Plants*, 187.

Nat. Ord.—Convolvulaceæ.

Origin.—The scammony-plant is an herbaceous twining perennial growing in Syria, Asia Minor, and Greece; it has alternate, triangular-cordate, very acute leaves, large, funnel-shaped, pale-yellowish flowers, and ovate-globose capsules containing four angular seeds.

Description.—1. Scammony-Root. It is 20 to 40 inches (.5–1 M.) in length, after drying about 2 inches (5 Cm.) thick in the upper part, cylindrical, somewhat tapering below, more or less twisted, with several short stem-fragments at the crown, longitudinally wrinkled, of a grayish- or yellowish-brown color externally and grayish or brownish-white within. The root is hard, has but a slight odor, and a sweetish afterward acrid taste, and upon transverse section shows a thin bark about one-eighth or one-sixth the diameter of the root, and, like the parenchyma of the meditullium, containing numerous resin-dots, the concrete latex of the milk-vessels; the wood consists of a number of separate groups of wood-bundles varying in thickness, irregularly arranged, and separated from one another by parenchyma of variable thickness.

2. Scammonium. This is collected by laying the upper portion of the root bare, cutting the top off in an oblique direction, and collecting the milk-juice in shells, the contents of which are mixed together with the juice scraped from the root and dried. Scammony is met with in commerce in irregular angular pieces or circular cakes of a greenish dark ash-gray or dark-brown nearly black color, of a peculiar sour and somewhat cheese-like odor, and of a slight but distinctly acrid taste; it breaks readily with an angular or splintery fracture, and exhibits in the interior small fissures and cavities and a resinous lustre. When triturated with water it yields a greenish emulsion; its powder has a gray or greenish-gray color. It yields to alcohol or ether not less than 75 (*U. S.*), and sometimes as much as 95, per cent. of its weight, and when the solvent has been evaporated and the resinous residue dissolved in warm solution of potassa, no precipitate is produced on the addition of an acid. The portion left undissolved by alcohol or ether is of a gray color, and is not colored blue by iodine.

The best quality of scammony is known in commerce as *virgin scammony.* Of late years scammony is usually sold in the market, at least at wholesale, by the amount of resin it contains—a commendable custom which we believe has been introduced in this country through the efforts of Dr. E. R. Squibb. 766 pounds of scammony were imported in the year 1876–77, and 2942 pounds in 1883.

Adulterations.—A distinction has been sometimes made between *Aleppo* and *Smyrna* scammony, the former being regarded as the pure article, but we have seen in commerce scammony sold as one or the other kind which was very impure. The adulterations usually consist of farinaceous substances, chalk, and earthy material, which can easily be recognized by their insolubility in ether. Scammony thus adulterated is frequently smooth externally, dense, heavy, and effervesces when thrown into dilute hydrochloric acid, or its decoction with water yields a blue color on the addition of iodine. M. Conroy (1883) reported an adulteration consisting of the resin prepared from scammony-root, which is recognized by its distinctive persistent leathery odor.

A factitious scammony has been described by European writers as *Montpellier scammony*, and is said to be the milk-juice of Cynanchum monspelliacum, *Linné*, mixed with other substances. It is said to have been occasionally imported into this country. Though it may be made to resemble true scammony in appearance, it does not show the behavior to solvents described above.

In place of scammony-root, we have seen a thin farinaceous root offered, which resembled turpeth-root (page 847), but was not identical with it.

Constituents.—Scammony-root is stated to be richest in resin immediately before the flowering period. Good roots will yield about 5 per cent. of resin. Hager found 10 per cent. of resin, 3 per cent. of tannin, and 15 per cent. of sugar and extractive; starch is likewise present. According to the British Pharmacopœia, scammony should contain between 80 and 90 per cent. of resin. The pure resin has been named *scammonin;* its composition, derivatives, and relation to allied resins have been described on pages 847 and 1300.

Off. Prep.—1. *Of the root:* Resina scammonii, *Br.* 2. *Of scammony:* Confectio scammonii, Pil. colocynthidis comp., Pil. colocynth. et hyoscyami, Pulv. scammonii comp., *Br.;* Resina scammonii, *U. S.*, *Br.*

History.—Scammony, or at least the concrete juice of a Convolvulus, was well known to the Greek, Latin, and Arabian medical writers, who agree in ascribing to it active irritant and purgative qualities. It was used externally in the treatment of cutaneous diseases and in a tampon to provoke abortion. As a purgative they describe its harsh, painful, and exhausting action and its cholagogue qualities, and mention that it may produce cold sweats, syncope, and even death. To guard against its violent operation they advised that it be associated with certain gums, oils, mucilage, etc.

Physiological Action.—No other purgative is so uncertain as scammony, partly in consequence of its adulteration with inert substances, and in part from its slight solubility in the gastro-intestinal contents when these are acid. According to Rutherford and Vignal, it is a cholagogue of feeble power. It is singular that while in some experiments upon animals it occasioned active, exhausting, and even fatal purgation, yet in others it inflamed the bowels and killed the animals without purging at all. The actions of jalapin and convolvulin or scammonin are said to be identical. Careful experiments show that scammonin is a less active cathartic than scammony itself, unless finely divided by trituration. It appears also that in the case of both very slightly greater effects are obtained by a large increase of the dose—a result doubtless due to the imperfect solubility of the medicine. This is said to be increased by the presence of bile. That its active principle is absorbed appears from the following case: A healthy woman, nursing a healthy child two months old, took a dose of scammony to relieve herself of constipation; she suffered no purgation or any other symptoms attributable to the medicine, but her child was presently seized with violent cholera morbus, which rapidly ended in collapse and death (*Bull. de thérap.*, lxxv. 554).

Medical Uses.—Scammony is hardly ever used alone at the present day, although, on account of its tastelessness, it has been recommended as a purgative for children. Even in the cases to which it has been thought to be peculiarly applicable as a hydragogue, colocynth, jalap, and even gamboge, are to be preferred, and the same may be said in regard to its association with calomel as a cholagogue purgative. The compound powder of scammony is possibly preferable to scammony or to jalap alone when a powerful derivative action from the brain is desired.

The *dose* of ordinary scammony is from 10 to 20 grains (Gm. 0.60–1.30), and of pure scammony or of its resin from 5 to 15 grains (Gm. 0.30–1). It may be given powdered in a wafer, but is inactive in the pilular form. It is also administered in emulsion with milk, almond milk, mucilage, or other demulcent sweetened.

SCILLA, *U. S.*, *Br.*—Squill.

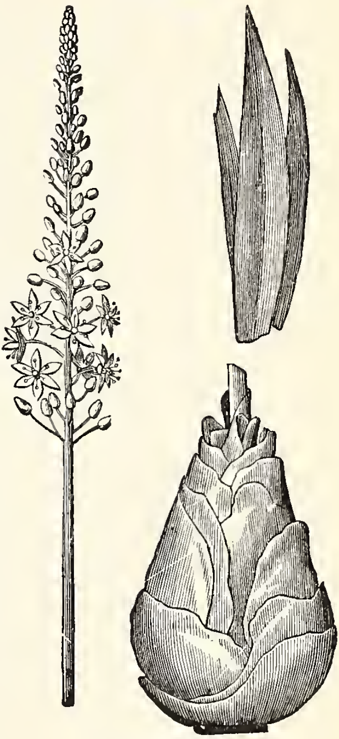
Bulbus scillæ, P. G.—*Squills*, E.; *Scille*, *Squille*, Fr.; *Meerzwiebel*, G.

The bulb of Urginea Scilla, *Steinheil*, s. Scilla (Urginea, *Baker*) maritima, *Linné*. *Nat. Ord.*—Liliaceæ.

Origin.—The squill is indigenous to the basin of the Mediterranean from Syria westward to the coast of the Atlantic. It grows in sandy and sunny places near the seashore, but is likewise found inland to some extent and in hilly localities. Two varieties are known, which differ only in the color of their bulb-scales, being of a reddish tint in the one and whitish in the other variety. The leaves make their appearance during the flowering period, and are broad-lanceolate, 12 to 20 inches (30–50 Cm.) long, channelled, finally recurved and spreading. The scape attains a height of 3 or 4 feet (.9–1.2 M.), and is terminated by a long raceme of whitish green-nerved flowers with six stamens inserted on the base of the sepals. Along the Mediterranean the bulb is frequently employed in the fresh state, but in the United States it is now usually seen in dry segments. 12,213 pounds of squill were imported in 1878, and 54,365 pounds in 1883.

Description.—The bulb of squill is broadly ovate or somewhat pear-shaped, and is from 3 to 6 inches (7–15 Cm.) long, and of the same thickness at its lower portion, weighing sometimes over 4 pounds. It consists of a large number of fleshy scales, which are either whitish or reddish, and are covered by dry reddish-brown and scarious scales. The bulb is collected while leafless, about the month of August, freed from the inert outer and small, insipid central scales and from the dense stem portion and rootlets, and then cut transversely into segments, which are dried in the sun. Thus prepared, it is found in the market, and consists of narrow slices ⅛ to ¼ inch (3–6 Mm.) wide and 1 or 2 inches (2–5 Cm.) long, somewhat translucent, yellowish-white or reddish, brittle and pulverizable when dry, but very hygroscopic, and therefore often flexible. Squill is scentless, and even in the fresh state is but slightly odorous; it has a mucilaginous afterward bitter and acrid taste. When dried and powdered it is easily converted into a solid hard mass from the absorption of moisture. In damp weather squill loses on drying from 10 to 14 per cent. of its weight. On handling squill it is apt to cause irritation of the skin, due to the sharp-pointed raphides of calcium oxalate.

Fig. 263.



Scilla maritima, *Linné.*

Constituents.—Squill has been frequently the subject of chemical investigation, but even at the present time the medicinally important principles of this drug are not satisfactorily known. Two such principles are usually distinguished: one, having a bitter taste, is called *scillitin;* the other, being acrid, has received the name *skulein.* Wittstein (1850) observed that the expressed juice of fresh squill yields with alcohol a precipitate consisting mainly of gum and amounting to 28 per cent. of the dry drug; the filtrate was freed from alcohol by evaporation, fermented with yeast, and, after the sugar had been thus destroyed, yielded with acetate of lead a slight precipitate. After removing the lead from the filtrate by sulphuretted hydrogen the resulting extract had a bitter and acrid taste, the latter of which was removed by agitation with hydrate of lead, but not by baryta. The earlier investigations were less successful. Vogel's and Tilloy's *scillitin* was amorphous and neutral; both regarded the acrid principle as being volatile. Landerer and Marais (1857) obtained compounds which they regarded as alkaloids. But Tilloy (1854) proved the non-existence of such a body in squill, and announced then that squill does not contain any volatile acrid principle; the compound producing irritation of the skin was by him believed to be crystallized citrate of calcium. Labourdais (1849) obtained the bitter principle, after precipitating the infusion of squill with acetate of lead, by treating it with animal charcoal, and exhausting this with hot alcohol; and Bley obtained it once by this process in flexible needles. The presence of crystals in squill was recognized long ago, but these were generally considered to be either tartrate, carbonate, or citrate of calcium, until Schroff (1864) proved them to be very fine and sharp-pointed needles of *oxalate of calcium.* Schroff is likewise convinced of the existence of a non-volatile acrid besides the bitter principle, and of the greater efficacy of the red-colored variety of the drug. The bitter principle forms a compound with tannic acid (*Pharmacographia*). Jarmersted (1879) isolated from this precipitate the glucoside *scillein,* which is white or yellowish, dissolves in strong hydrochloric acid with a red color, and is decomposed by dilute acids into glucose and a resin. E. Merck (1879) obtained three not quite pure principles, the two last of which are poisonous—namely, *scillin* (crystalline, pale-yellow, sparingly soluble in water, more freely soluble in alcohol and hot ether, colored by sulphuric acid red-brown, by nitric acid yellow, and on heating green); *scillipicrin* (amorphous, whitish, hygroscopic, and bitter); and *scillitoxin* (amorphous, cinnamon-brown, insoluble in water and ether, soluble in alcohol, colored red and brown by sulphuric acid and orange-red and green by nitric acid). Schmiedeberg (1879) isolated the gummy matter by precipitating the infusion with basic lead acetate, and afterward with lime; on decomposing the last precipitate with carbonic and oxalic acids *sinistrin*, $C_6H_{10}O_5$, is obtained; this is colorless, amorphous, levogyrate, and is readily converted into levulose and another fermentable but inactive sugar. *Scillin* of Riche and Rémont (1880) is probably identical with sinistrin.

Off. Prep.—Acetum scillæ, *U. S., Br.;* Extract. scillæ fluid., *U. S.;* Oxymel scillæ, Pil. ipecacuanhæ cum scilla, Pil. scillæ comp., *Br.;* Syr. scillæ, *U. S., Br.;* Syr. scillæ comp., *U. S.;* Tinct. scillæ, *U. S., Br.*

History.—Squill was used by the Greeks and their medical followers in Rome, Arabia, and Europe. Its preparations with honey and vinegar were anciently employed in dropsical affections, and the latter were extolled in the treatment of spongy and ulcerated gums, ulcerated throat, and debility of the digestive organs.

Physiological Action.—*On Animals:* Squill acts poisonously upon various animals. The camel is said to reject it from among the plants on which he browses. It is fatal to mice, rabbits, cats, dogs, swine, fowls, etc. In most of these animals it appears to occasion pain with vomiting, great distress and purging, and loss of muscular power or convulsions. When administered to dogs the animals grow dull, slaver, and seem nauseated; vomiting and liquid stools follow. If the dose be large, trembling succeeds, and paralysis of the hind and then of the anterior limbs. Convulsions ensue with general muscular resolution immediately before death. 4 grains of scillitin have destroyed a dog of medium size within 24 hours. In rabbits the alcoholic extract of squill, and also scillitin, occasion contraction of the pupils, great debility, sinking of the pulse, diuresis, dyspnœa, and death. After death by scillitin inflammation and erosion of the stomach and hæmorrhagic transudations about the heart and lungs and in the kidneys and brain are found. Later experiments appear to show that in animals (cats, rabbits, pigeons, frogs) the extract of squill renders the pulse less frequent, and causes death by arresting the heart in systole before respiration is suspended; to this action, which, at least in its primary stage, implies an augmented arterial blood-pressure, the diuretic operation of the medicine is attributed. In these experiments the extract of squill (contrary to earlier observations) does not appear to have produced any lesion of the stomach nor any inflammation of the kidneys or bladder, but the lungs, and sometimes the pleuræ, were congested as an effect of the impeded circulation through the heart. No depression of the animal temperature was observed (Husemann and König). Still more recently, the experiments of Jarmersted (*Archiv f. Pathol. u. Pharm.*, xi. 22), Drouot (*Amer. Jour. Med. Sci.*, July, 1879, p. 243), Merck (*Med. Record*, xvi. 325), Lipinskii (*Bull. de thérap.*, ci. 465), and others have rendered it evident that there is in squill a constituent whose action closely resembles that of digitalin, and which has been variously called scillain, scillipicrin, and scillitoxin. Jarmersted found that in cats and dogs it caused vomiting and purging, became fatal through a tonic contraction of the heart; first increased, and then lowered, the blood-pressure, with the former slowing, and with the latter accelerating, the pulse.

On Man: The juice of the fresh plant acts upon the skin as a rubefacient, and has also occasioned diuresis. Even the powder of the dried corm applied to the denuded cutis has had the same effect in dropsy. Its local action is irritating, which is ascribed to the large proportion it contains of oxalate of lime. Internally, the effects of a very large dose of squill are violent vomiting, purging, and colic, dysury or bloody urine, rapid breathing, a cold skin, coma, and general convulsions. It has even destroyed life. In small or medicinal doses it usually exerts a diuretic action, tends to relax the bowels, and reduces the frequency and increases the tension of the pulse. The characteristic effects are most distinctly produced by the powder or the wine of squill. The syrups of squill in medicinal doses and in disease appear to act rather upon the bronchial mucous membrane. The continued use of squill impairs the appetite and digestion.

Medical Uses.—Although there is nothing in the results of scientific investigation even to suggest that squill acts upon the bronchial mucous membrane, the much more direct and conclusive evidence of clinical experience leaves no doubt of its great value in *bronchitis*, whether of an acute form, when the sputa are tenacious and scanty, or of a chronic type occurring without complication or associated with obstructive disease of the heart and pulmonary emphysema. It is of daily use as an expectorant in the treatment of *spasmodic croup*, but in the form of compound syrup of squill, which owes its efficacy chiefly to the antimony it contains.

As a diuretic squill is universally employed in *dropsy*. Even when the effusion is owing to some organic and incurable lesion, it may often be temporarily evacuated by squill. The experimental researches into its mode of action in dropsy have tended to confirm what was long ago established by clinical experience, that it is most useful in the passive forms of the disease, when the pulse is weak and the heart feeble or obstructed, and when there is neither fever nor an irritable condition of the kidneys present. Undoubtedly, it is oftener useful in cardiac than in renal, splenic, or hepatic dropsy. As already mentioned, it seems probable that its action is very analogous to that of digitalis. Within certain limits this is true, but is not the whole truth. The diuretic action of neither medicine is due exclusively to its sensible sedative action on the heart. Squill is not so apt as digitalis to cause sudden and alarming depression. The best mode of using these medicines in dropsy is to combine them in the same prescription in pilular form, or as tinctures with compound spirit of juniper, or with a solution of acetate of potassium in water. When the stomach is intolerant of the medicine, it may be administered by rubbing its tincture with that of digitalis into the skin, or applying compresses saturated with these liquids to the abdomen and covering them with impermeable cloth. Scillipicrin dissolved in water may be administered hypodermically. It is apt, however, to cause some local irritation. In one case 4 tablespoonfuls a day of a 2 per cent. solution of scillipicrin were given without effect. For subcutaneous injection a 10 per cent. solution has been preferred (Fronmüller). Powdered squill, with or without digitalis, may also be applied endermically. In the *hydrocele* of young subjects a cure has been effected by applications of vinegar of squill. Powdered squill has been used to remove *warts.*

The *dose* of squill in substance is from 1 to 3 grains (Gm. 0.06–0.20), three times a day in pilular form. It may gradually be increased to 10 grains a day. As a general rule, if it disturbs the stomach the dose should be reduced. An infusion is sometimes employed, which is made with from half a drachm to a drachm of squill in half a pint (Gm. 2–4 in Gm. 250) of hot water, of which from 2 to 4 fluidrachms (Gm. 8–16) may be given at a dose.

SCOPARIUS, *U. S.*—Scoparius.

Scoparii cacumina, Br.; *Herba scoparii.*—*Broom*, *Irish broom*, E.; *Genêt à balais*, Fr.; *Besenginster*, *Pfriemenkraut*, G.

The tops of Sarothamnus (Cytisus, *Link*) scoparius, *Koch*, Sar. vulgaris, *Wimmer*, Genista scoparia, *Lamarck*, Spartium scoparium, *Linné*. Bentley and Trimen, *Med. Plants*, 70.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Broom is a shrub about 3 to 6 feet (.9–1.8 M.) high, and grows in Western Siberia and throughout the greater portion of Europe, but is more abundant in the western part of that continent and in Great Britain. It is sometimes cultivated in our gardens, and is occasionally met with wild in some of the Middle and Southern States. It prefers a sandy soil, and flowers in May and June. The shrub has long, wand-like branches, small trifoliate leaves with obovate or elliptic-lanceolate sessile leaflets and produces an abundance of large golden-yellow papilionaceous flowers, and a flat dark-brown legume, which is white-hairy on the edges, and contains about twelve olive-colored, oblong, and, below, truncate seeds. The flower-buds are in some places used like capers, and the branches as a substitute for hops.

Description.—The green twigs constitute the portion generally employed. They are long, thin, and flexible, pentangular, winged, but not spiny, smooth, except the extremities, which are pubescent, and are usually free from leaves and flowers. In the fresh state they have a peculiar odor, but are nearly inodorous after drying; their taste is bitter and disagreeable. The *flowers* have been occasionally employed; on drying they usually become brown and their honey-like odor is almost entirely lost; their taste is nauseous and bitter.

Constituents.—The analyses by Cadet de Gassicourt (1824) and Reinsch (1846) failed to isolate any important principle. Stenhouse (1851) obtained two interesting principles, scoparin and sparteine. *Scoparin*, $C_{21}H_{22}O_{10}$, is prepared from the concentrated decoction of broom-tops, which gelatinizes on standing; the jelly-like mass is expressed and purified by repeated solution in hot water, and finally in hot alcohol. Scoparin is amorphous and brittle or in small crystals, has a pale-yellow color, yields with lead acetates green-yellow precipitates, and furnishes picric acid when treated with nitric acid; it is inodorous and tasteless. On fusing it with potassa, phloroglucin and protocatechuic acid are produced (Hlasiwetz). *Sparteine*, $C_{15}H_{26}N_2$, is best obtained, according to Mills (1861), by exhausting broom with acidulated water and distilling the concentrated liquid with soda. In its pure state it is a colorless, transparent, oily liquid, which becomes brown on exposure, has a slight aniline-like odor, a very bitter taste, a strongly alkaline reaction, boils at 288° C. (550° F.), and yields amorphous and crystallizable salts. The alkaloid is but slightly soluble in water and alcohol. 150 pounds of the plant yielded 22 Ccm. of sparteine. The air-dry plant yields about 5.6 per cent. of ash.

Off. Prep.—Decoct. scoparii, Succus scoparii, *Br.*

Allied Species.—Spartium junceum, *Linné* (Spartianthus, *Link*, Genista, *Lamarck*). Spanish broom. This evergreen European shrub resembles the preceding, but has obtuse-lanceolate, at the base wedge-shaped, and on the lower side soft-hairy leaves, and nearly reniform seeds. The branches, leaves, and seeds have a bitter taste, and are stated to possess diuretic, purgative, and emetic properties.

History.—Broom had long been known and used by the people as a remedy for dropsy, and its virtues had been celebrated by Floyer and by Culpepper in the seventeenth century, before Mead and Cullen introduced it into medical practice. Even the shepherds were accustomed to cure their dropsical sheep by feeding them with the fresh plant. A German clergyman first published an account of its virtues in eczema and other cutaneous diseases.

Medical Action and Uses.—No other medicine is entitled to more credit than broom for removing *dropsical effusions*. Its diuretic virtues depend in part upon the potassium salts that exist in it, and in part also upon its proximate principle, sparteine. The latter is a sedative of the spinal reflex centres, and in a less degree of the circulatory system, and it even acts upon some of the lower animals in a slight degree as a narcotic (Fick). A drop of sparteine introduced by Schroff into a rabbit's mouth occasioned spasms of the muscles of the spine and limbs and paralysis of the latter, slowing of the respiration and heart, and death in 6 minutes. On dissection the intestine responded but feebly to stimulation, the heart, except the auricles, not at all, and the venous system was gorged with blood. The phenomena noted by Fick were somnolence, a staggering gait, at first extreme frequency of the pulse and respiration, and subsequently great dyspnœa and slowing and feebleness of the heart, and finally death in convulsion, with dilated pupils. Its effects have caused it to be compared with conine, but they do not in the least degree explain the value of broom as a diuretic medicine.

Broom is applicable to all forms of *chronic dropsy* as one of the most efficient of hydragogues, acting both by the bowels and the kidneys. It is best given in a decoction prepared by boiling half an ounce (Gm. 16) of the tops in half a pint (Gm. 250) of water in a covered vessel for 10 minutes. This quantity may be taken in divided doses in 24 hours, or the officinal decoction (British Pharmacopœia) may be used instead. A compound decoction, which is still more efficient, may be prepared by boiling broom tops and dandelion, of each ½ ounce (Gm. 16), in 1½ pints of water to a pint (Gm. 750 to Gm. 500), and near the close of the process adding ½ ounce (Gm. 16) of juniper-berries. When cold, the decoction should be strained. 1 or 2 fluidounces (Gm. 30–64) may be given at a dose. *Scoparin* and *sparteine*, dissolved in water with the aid of glycerin, have been successfully used subcutaneously to produce diuresis.

SCROPHULARIA.—Figwort.

Scrofula-plant, E.; *Scrofulaire*, Fr.; *Kropfwurz*, *Knotenwurz*, G.

Scrophularia nodosa, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Origin and Description.—Figwort is a perennial herb growing in damp places in Europe and North America. The American plant is usually taller, growing to the height of 4 or 5 feet (1.2–1.5 M.), and has an obtusely angled stem, but otherwise agrees closely with the European plant; it was formerly regarded as a distinct species, Scrophularia marilandica, *Linné*. The plant has a horizontal branching fleshy *rhizome*, to which numerous oblong or oval tubers of the thickness of a thumb are attached. The *leaves* are opposite, petiolate, ovate-oblong, rounded or heart-shaped at the base, and cut-serrate on the margin. The flowers are in a terminal loose panicle, have a greenish-brown, tubular-globose, five-lobed corolla with four stamens, and produce a two-celled many-seeded capsule. The fresh plant, bruised, has an unpleasant odor and a nauseous, bitter, and acrid taste; on drying it loses about 75 per cent. in weight and becomes nearly inodorous.

Constituents.—The fresh flowering plant was analyzed by Walz (1853), who found in the aqueous distillate *acetic* and *propionic acids* and a stearopten, *scrophularosmin*. On treating the decoction with acetate and subacetate of lead, tannic, tartaric, citric, and malic acids, pectin, and coloring matter were precipitated, and the filtrate, after freeing it from lead, yielded with tannin a precipitate containing *scrophularin*. This principle crystallizes in scales, has a bitter taste, and is soluble in water and alcohol. Scrophularia aquatica, *Linné*, contains the same principle, and in addition thereto a resinous body, *scrophulacrin*, which is soluble in ether.

Medical Action and Uses.—S. nodosa and S. aquatica appear to possess analogous qualties. The generic name of the plant seems to have been gained through a popular belief that it was useful in *scrofula*. It was employed in the glandular form of the disease, and also in *cutaneous affections* originating in the strumous diathesis. It was an ingredient of an ointment much used in the treatment of *itch*. It was also applied to *hæmorrhoids* and *anal ulcers* and as a dressing for unhealthy *wounds* and *sores* generally. The fresh juice, and also a decoction of the leaves or root, were used, the latter being made with half an ounce to a pint of water (Gm. 16 to Gm. 500).

SCUTELLARIA, *U. S.*—SKULLCAP.

Hoodwort, *Madweed*, E.; *Scutellaire*, Fr.; *Helmkraut*, *Schildkraut*, G.

Scutellaria lateriflora, *Linné*.
Nat. Ord.—Labiatæ, Stachydeæ.

Description.—This species, in some places known as *mad-dog skullcap*, is a common North American perennial herb, growing in swampy and wet places. Its stem is about 2 feet (60 Cm.) high, quadrangular, smooth, and much-branched. The leaves are opposite, petiolate, about 2 inches (5 Cm.) long, oval-lanceolate, pointed, coarsely serrate, rounded at the base, thin, and smooth. The flowers are small, in slender axillary leafy racemes, with a minute filiform bract at the base of each pedicel, and with a pale-blue or purplish bilabiate corolla. The calyx is divided into two entire lips, the upper with a helmet-like appendage on the back. The herb flowers in July, and should then be collected; its loss, on drying, amounts to from 75 to 80 per cent. It has a slight odor and bitterish taste. Its constituents have not been ascertained.

Allied Species.—The following and probably other indigenous species of Scutellaria possess a more decidedly bitter taste, and are occasionally employed:

SCUT. INTEGRIFOLIA, *Linne*. It is 12 to 18 inches (30 to 45 Cm.) high, minutely hairy all over, has lance-oblong or linear-oblong, mostly entire, short petiolate leaves, and terminal racemes of blue flowers, which are about an inch (25 Mm.) long.

SCUT. PILOSA, *Linné*. It is 1 or 2 feet (30 to 60 Cm.) high, covered with spreading hairs, has rhombic- or oblong-ovate, crenate, petiolate leaves in distant pairs, and short terminal racemes of rather large purplish-blue flowers.

SCUT. GALERICULATA, *Linné*. It is somewhat downy, has short-stalked, lance-ovate, crenately serrate leaves, which are rounded or heart-shaped at the base, and bear in the axils of the upper leaves rather large blue flowers, which are turned to one side. This species is indigenous to Europe, Northern Asia, and the northern section of North America.

BRUNELLA (PRUNELLA) VULGARIS, *Linné*.—Heal-all, Self-heal, *E.;* Pâquerette, *Fr.;* Braunelle, Braunheil, *G.*—This is a perennial herb, common in fields, grassy places, and in woods in North America, Asia, and Europe. Its ascending stem is about 12 inches (30 Cm.) long; the leaves are about 1½ inches (38 Mm.) long, petiolate, oblong-ovate, entire or somewhat toothed, and more or less hairy. The flowers are purplish-blue and form a dense leafy-bracted spike. The herb is nearly inodorous, and has a bitterish and somewhat astringent taste.

Constituents.—These plants contain principles similar to those found in other plants of the same order. Cadet de Gassicourt (1824) obtained from the officinal species a little volatile oil, fat, tannin, a trace of bitter principle, sugar, etc.

Medical Action and Uses.—Skullcap has been employed in extract, fluid extract, and infusion, and has had some repute in *intermittent fever* and as a nervine—that is, in diseases presenting a depressed and disordered condition of the nervous functions. It has even been recommended in *epilepsy* when continuously given in a decoction made with 2 ounces of the herb to 8 ounces of water (Gm. 64 to Gm. 250). There is no evidence of its virtues which entitles it to a place among officinal drugs.

SEDUM.—Stonecrop.

Mossy stonecrop, E.; *Joubarbe âcre*, *Poivre des murailles*, Fr.; *Mauerpfeffer*, *Steinkraut*, G.

Sedum acre, *Linné*.

Nat. Ord.—Crassulaceæ.

Description.—This little moss-like spreading plant is indigenous to Europe, where it grows in dry fields and on old walls; it is cultivated in gardens and runs wild in some places in North America. Its leaves are ⅛ to ¼ inch (3–6 Mm.) long, alternate, nearly imbricate, in about six spirally turned rows, ovate, thick, convex on the back, punctate, and smooth. The flowers are on one side of the branched inflorescence, forming scorpoid cymes, and have four or five yellow petals, the same number of pistils, and twice that number of stamens. The plant is inodorous and has a mucilaginous and acrid taste.

Constituents.—Mossy stonecrop contains much mucilage and malates (Vauquelin), also rutin (Mylius); its acrid principle has not been isolated.

Allied Species.—Sedum Telephium, *Linné*.—Live-for-ever, Garden opine, *E.*: Joubarbe des vignes, Grassette, *Fr.*; Grosse Fetthenne, *G.*—It is likewise indigenous to Europe, and in the United States has escaped from cultivation. It has a spindle-shaped root, an ascending stem about 20 inches (50 Cm.) high, and oval or ovate, obtuse and toothed sessile leaves, which are 2 or 3 inches (5–8 Cm.) long, and are either alternate, opposite, or in whorls of three. The purplish or greenish flowers are in dense compound cymes.

Sempervivum tectorum, *Linné*.—Houseleek, *E.*; Grande joubarbe, *Fr.*: Hauswurz, Dachwurz, *G.*—It is indigenous to the Alps, but now grows spontaneously throughout Europe on roofs and old walls, and, with several allied species, is cultivated in North America. It has numerous fleshy rosulate radical leaves, which are 1 to 2 inches (2–5 Cm.) long, obovate in shape, of a green color, and on the margin stiff-hairy, and often of a brownish or reddish color. The flowers are rose-colored and purplish. The leaves have an acidulous taste and contain malates.

Penthorum sedoides, *Linné* (Ditch-stonecrop), is not fleshy, has a stem about 16 inches (40 Cm.) high, lanceolate serrate leaves, and terminal spike-like secund racemes of greenish or yellowish flowers having a five-beaked ovary. The plant is common in wet places in North America, and is used in nasal catarrh.

Medical Action and Uses.—Experiments upon animals appear to show that stonecrop is an active local irritant and also a depressor of the nervous system. In man the expressed juice, in large doses, acts as an acrid emetic and purgative, and is capable of blistering the skin. Sedum was formerly in common use as a remedy for *scrofula*, and was administered internally in decoction and applied to the ulcerated skin, etc. Its emeto-cathartic action was employed in the treatment of *intermittent fever*, and also in *dropsy* and *epilepsy*, with a certain degree of success, but the plant appears to have been found more really useful when it was applied bruised or its expressed juice was used as an application to scrofulous, cancerous, and other *ulcers*, as a resolvent to enlarged lymphatic *glands*, and as a dressing for chronic *diseases of the skin*. The juice has also been used to remove *warts* and *corns*. The dried plant was prescribed internally in powder in the *dose* of 12 or 15 grains (Gm. 0.8–1), or a decoction was made with a handful of it in a pint of beer. The juice was given in doses of 2 or 3 fluidrachms (Gm. 8–12), or, as others state, of from 8 to 30 grains (Gm. 0.5–2), in wine. Externally, the bruised fresh plant was generally preferred.

Houseleek has been described as refrigerant, astringent, anti-spasmodic, and detergent. Its expressed juice was once prized in *dysentery* and in *hysterical* disorders, and externally as a dressing for *ulcers* and chronic *skin diseases*, *hæmorrhoids*, etc. It is still used to soften *corns* and *warts*.

SELINUM.—Marsh-Parsley.

Radix olsnitii.—*Sélin* (*Persil*) *des marais*, Fr.; *Sumpfsilge*, *Elsenich*, G.

The root of Selinum (Thysselinum, *Hoffmann*, Peucedanum, *Moench*) palustre, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This is a perennial plant indigenous to Europe, and growing in swampy and moist localities. It is about 4 feet (1.2 M.) high, has twice or thrice pinnately divided and cleft leaves with linear-lanceolate lobes, large and lax compound umbels of white flowers, and oval-oblong brown fruits.

Description.—The root is about 6 inches (15 Cm.) long, in the upper part nearly 1 inch (25 Mm.) thick, one- or several-headed, annulate above, with deep longitudinal wrinkles, grayish-brown, and with scattered whitish suberous warts. The bark is thick, spongy, and brown, and contains a circle of rather large laticiferous vessels; the meditullium is soft and often radially cleft. The root has a strong, disagreeable, somewhat terebinthinate odor and a pungent and acrid taste.

Constituents.—The chemical constituents are analogous to those of other umbelliferous roots—volatile oil, mucilage, sugar, etc. Peschier's *selinic acid* has not been further investigated.

Allied Plants. See (Heracleum, p. 763), Imperatoria (p. 812), and Levisticum (p. 879).

Medical Action and Uses.—The juice of this plant is said to be irritating, and even caustic, in its action. Many years ago it was found to be a popular remedy for *epilepsy* in the Russian province of Courland. It afterward attracted a good deal of attention in Paris, and received for a time greater credit than it deserved. It was exhibited in powder in the *dose* of from 30 to 40 grains (Gm. 2–4), several times a day. This medicine is no longer employed in epilepsy.

SENECIO.—GROUNDSEL.

Seneçon, Fr.; *Kreuzkraut*, *Jacobskraut*, G.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—Several European species of this genus have been employed, among which may be mentioned Sen. saracenicus, S. Doronicum, S. Jacobæa, and S. vulgaris, *Linné*. The latter, with rayless flower-heads, is a common weed in Europe and sparingly naturalized in North America. It has lanceolate, pinnatifid, and toothed, clasping and rather fleshy leaves, and a cylindrical involucre; it is inodorous and has a bitterish saline and acrid taste. The most common North American species is Senecio aureus, *Linné*, known as *golden rag-weed*, *squaw-weed*, and *life-root*. It is found on the borders of streams, in thickets, and in swamps, and has a thin horizontal rhizome with numerous slender rootlets; long-petioled, round or roundish heart-shaped, and crenately toothed radical leaves; lyrate or pinnatifid, usually lanceolate stem-leaves; and a corymbose inflorescence with many-flowered heads, having bright-yellow pistillate ray-florets. There are many varieties, differing chiefly in the shape of the radical leaves. These plants seem to contain a little tannin and a bitter and an acrid principle.

Medical Action and Uses.—Groundsel appears to be emollient and also slightly acrid. It was employed by the American aborigines as a vulnerary. In Germany its juice is a domestic remedy for *colic*, *intestinal worms*, etc. It is used in France to prepare gargles for *sore throats*, to make poultices for *boils*, *rheumatic swellings*, and local *cutaneous eruptions*, and to prepare emollient and laxative enemas. Dr. N. S. Davis found that in doses of from 45 to 90 minims (Gm. 3–6) the fluid extract of senecio-root relieved the pains of chronic muscular *rheumatism* (*Phila. Med. Times*, ix. 634). A decoction may be prepared with 1 or 2 drachms in 4 ounces of water (Gm. 4–8 in Gm. 120).

SENEGA, *U. S.*—SENEGA.

Senegæ radix, Br.; *Radix senegæ*, P. G.—*Seneka-root*, *Senega snakeroot*, E.; *Polygale de Virginie*, Fr.; *Senegawurzel*, G.

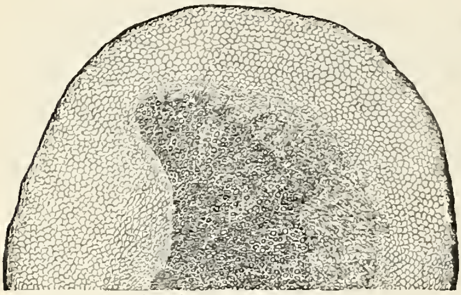
The root of Polygala Senega, *Linné*.

Nat. Ord.—Polygalaceæ.

Origin.—Senega is a native of North America from Canada southward to South Carolina and westward to Wisconsin. It has numerous slender stems about a foot (30 Cm.) high from each root. The leaves are alternate, sessile, lanceolate or oblong-lanceolate, rough on the margin, otherwise smooth, and narrowed to both ends. The flowers are nearly sessile, in slender terminal spikes, and have five sepals, of which the two lateral ones are round, petaloid, and rose-colored; the three petals are whitish. Senega flowers in May and June, and ripens its small two-celled and two-seeded capsule in July. The root is collected in autumn, mainly in the Southern and Western States.

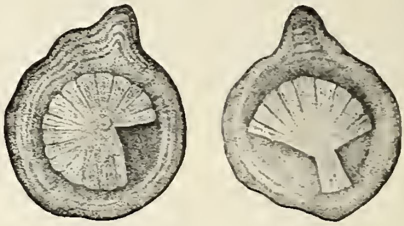
Description.—Senega-root has a head or crown which is ½ or 1 inch (12–25 Mm.) in diameter, very knotty from the numerous thin remnants of stems, and is below contracted into the root, having a diameter of ⅙ or ¼ inch (4–6 Mm.). The root is 4 or 6 inches (10–15 Cm.) long, and divided into several branches nearly uniform in thickness, which are tapering below, usually spreading, more or less tortuous, fleshy and cylindrical when fresh, but after drying twisted and furnished with a projecting ridge or keel, which runs around the root in about one spiral turn from near the base to the tip. Opposite the keel are sometimes seen irregular annulations; otherwise the root is longitudinally wrinkled. Externally, it varies in color between yellowish-gray and brownish-yellow, and is whitish internally. When cut transversely it presents a porous, yellowish radially striate ligneous portion and a thick white bark. The wood is circular near the crown, and surrounded by bark nearly uniform in thickness. At some distance from the head the wood presents a more or less irregular appearance, being rounded on one side and only partially developed on the opposite side. The bark is seen to consist of two layers. the inner one of which is found chiefly on the rounded side of the wood, and projects more or less conically into the keel, which is therefore formed by the one-sided development of the inner bark. On soaking the root in water the outer bark swells to a greater extent than the inner layer, and the root becomes again nearly cylindrical. Senega-root has a slight odor when dry, but the liquid preparations of it have a characteristic, rather nauseous odor; the taste is sweetish, and afterward persistently acrid. The root is brittle and breaks with a short fracture.

FIG. 264.



Senega-root: section showing one-sided growth of wood and inner bark, magnified 18 diameters.

FIG. 265.



Transverse sections of Senega-root.

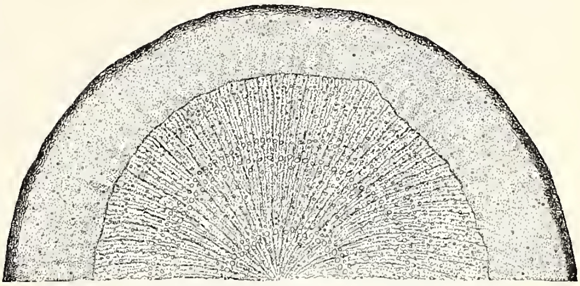
Senega-root of the above description is collected in Virginia and westward to Arkansas and Missouri, and is sometimes designated as "Southern senega." Since about 1870 senega of much larger dimensions has frequently been seen in the market; the head is often 2 or 3 inches (5–8 Cm.), and the top portion of the root sometimes $\frac{4}{5}$ inch (2 Cm.), thick; the root is less contorted, more fleshy, and the branches show the keel often rather indistinctly. Prof. Lloyd (1881) has shown that this "Northern senega" is derived from a variety of Polygala senega growing in Minnesota and Wisconsin; from the latter State we have also roots agreeing in every respect with Southern senega.

Constituents.—The acrid taste of senega-root is due to *senegin* (Gehlen, 1804), *polygalin*, or *polygalic acid* (Peschier, 1821). Quevenne (1836) prepared it in a nearly pure condition, and Procter (1859) obtained 5½ per cent. of it by exhausting the root with 60 per cent. alcohol, concentrating the tincture to about one-half the weight of the root, removing coloring matter by means of ether, and mixing the syrupy liquid with strong alcohol and ether, which precipitates the polygalic acid as a light fawn-colored powder, requiring to be washed with a mixture of ether and alcohol; the mother-liquor, from which Procter obtained a small quantity of crystals, seems to contain the salt of an organic acid. Precipitation with baryta gave to Christophsohn a yield of 2½ per cent. of white amorphous senegin. *Polygalin* of Peschier is volatile, and is contained in the aqueous distillate of the root, therefore identical with the trace of volatile oil observed by Dulong (1827). Bucholz, and afterward Bolley (1854), regarded senegin as identical with *saponin*; and this view seems to be sustained by the observations of Christophsohn (1874) and Schneider (1875). But Quevenne obtained from an aqueous solution of senegin only a slight precipitate with acetate of lead, which disappeared on the addition of more of the reagent; while Rochleder and Schwarz state that saponin yields with the same salt a gelatinous precipitate, which, according to Bucholz, is soluble in acetic acid. According to Braconnot and Bussy, saponin is not precipitated by acetate of lead. On the other hand, polygalic acid, like saponin, is precipitated from its aqueous solution by baryta; the products of decomposition of the two bodies by acids appear to be identical; and the gelatinous mass observed by Quevenne to be produced from his polygalic acid with cold concentrated hydrochloric acid and with boiling dilute mineral acids appears to be *sapogenin*. Evidently further investigations are required to determine the chemical relations of these bodies. According to Trommsdorff (1832) and Schneider, the activity of senega resides chiefly in the cortical portion; however, the wood of the large senega described above is quite acrid, though less so than the bark.

Liquid preparations of senega are apt to become gelatinous, which property is usually ascribed to the presence of pectin compounds, but is very likely, at least in part, due to *sapogenin*, generated under the influence of acids or of other compounds; the jelly is rendered soluble again on the addition of an alkali. Flückiger (*Pharmakognosie*, 2d edit.) obtained from powdered senega by ether 8.68 per cent. of fixed oil containing free acids, and, after saponification and acidulation of the lye, yielding a distillate having the odor of acetic and valerianic acids. The *virgineic acid* of Quevenne and the bitter principle *isolusin* of Peschier have not been investigated. Other less important constituents of senega are a little resin, 7 per cent. of sugar, malic acid, etc.

Off. Prep.—Abstractum senegæ, Extr. senegæ fluid., *U. S.;* Infusum senegæ, *Br.;* Syrup. scillæ comp., Syr. senegæ, *U. S.;* Tinct. senegæ, *Br.*

Fig. 266.



False Senega: transverse section, magnified 10 diameters.

Allied Roots and Substitutions.—Polygala Boykinii, *Nuttall*, a plant growing in the Southern and South-western States of North America, has a root which has been used by Dr. J. H. Gunn (1881) in place of senega, and which has the same appearance as rather small specimens of the latter, but is destitute of the keel, and has a cylindrical wood and a thinner uniform bark. We believe this to be identical with the *white* or *false senega* which was quite common in the market for several years after 1875, but appears to be no longer met with at the present time. It was said to have been collected in South-western Missouri. This root yielded to Geo. Goebel (1881), by Quevenne's process, 3 per cent. of senegin, and all preparations made with it were much lighter in color than the corresponding preparations of true senega.

Another kind of so-called white senega which we have seen was amylaceous internally, and had none of the prominent characteristics of the pharmacopœial drug.

Ginseng-root and the rhizome of Cypripedium are sometimes found among commercial senega as accidental impurities; they do not resemble senega-root, and are easily distinguished from it. The same may also be said of the roots of Ionidium Ipecacuanha (p. 839), Cynanchum Vincetoxicum (p. 537), and of valerian, which have occasionally been mentioned in Europe as adulterations of senega.

Physiological Action.—The following symptoms were caused by taking 20 grains of senega three times within 6 hours: An unpleasant irritation of the fauces and throat, with copious salivation, was succeeded by heat at the epigastrium and violent mucous vomiting; the skin meanwhile grew moister and warmer, and sharp colic with watery diarrhœa followed; the urine was increased, and scalded when voided. In larger doses senega excites severe burning pain in the stomach, violent vomiting, purging, anxiety, and giddiness.

The action of *saponin* has been more closely studied. When a bottle containing it is applied to the nostrils it excites sneezing and a bronchial and post-sternal irritation, which may last for an hour. A strong solution of it applied to the skin of a frog's thigh or a rabbit's shaven skin occasions redness, due to a thorough capillary congestion, with anæsthesia of the part. The red corpuscles thus aggregated appear to wilt and lose their shape and color.

When a strong solution of saponin is injected into a frog's thigh, it impairs the motility and sensibility of the limb and abolishes the reflex excitability of the muscles. The muscular flaccidity may ultimately be succeeded by tonic rigidity. These facts occur even when the limb is partially or wholly severed from the body of the animal, and are therefore independent of the great nervous centres. If the poison is directly applied to the heart through the circulation or otherwise, it reduces the frequency and force of the contractions of the organ, and finally paralyzes it. The local effects of its application elsewhere are the first to appear, but gradually the heart and nervous centres become involved. These phenomena have been described in the current pharmaco-dynamical language of the day as follows: "Saponin, introduced into the blood, paralyzes the muscles and the nerves, and in a peculiar manner the nerves of the heart, since it paralyzes as well the terminations of the vagus and inhibitory centres, and the accelerator nerves derived from the sympathetic, and finally arrests the movements of the heart. . . . . Saponin also acts speedily upon the vaso-motor centre, paralyzing it, slowly or rapidly according as the dose is small or large."

Keppler injected 1½ grains of saponin into the inner side of his thigh. Severe pain and local inflammation ensued, although the part immediately around the puncture was anæsthetic. The temperature rose for 3 hours, but in 24 hours it fell to the normal point, and on the fifth day to 93° F. This prolongation of its action showed the slight diffusibility of the drug. Among the general symptoms were mental depression, somnolence, salivation, pallor, cold sweats, a tendency to syncope, chattering of the teeth, nausea, photophobia, exophthalmos, and strabismus (Husemann, etc., *Die Pflanzenstoffe*, 2te Aufl. p. 536). But neither in these experiments nor in those of Eulenberg was there any indication of that muscular anæsthesia ascribed to saponin by Pelikan and others.

Medical Uses.—Physiological investigation of the action of senega and saponin has shed no light upon their clinical applications. They are practically useless as anæsthetics and cardiac sedatives. Nor does their mode of action help to explain the recognized utility of senega in the different forms of bronchial and pulmonary disorder in which it has been found advantageous. These are, first, *typhoid pneumonia*, in which, *a priori*, a stimulant and not a sedative remedy is indicated, yet it is precisely in that affection, and not in the inflammatory form of pneumonia, that senega has won its reputation, and especially in the decline of the disease, when it would seem that a stimulant expectorant is called for. In like manner senega is useful in *bronchorrhœa* and in chronic *bronchitis* with profuse expectoration. Even in *croup* (spasmodic laryngitis) it is most appropriate after the inflammatory stage with spasm has passed and the affection has become a simple catarrhal laryngitis. In like manner, when it was prescribed in the treatment of *amenorrhœa*, the cases in which it seems to have done good were those of passive and not of active congestion of the uterine system. The diuretic operation of senega is too inconsiderable to constitute it a trustworthy remedy in any form of dropsy.

The *dose* of powdered senega is from 10 to 20 grains (Gm. 0.60–1.30). The abstract and fluid extract are officinal.

SENNA, *U. S.*—SENNA.

Folia sennæ, P. G.; *Senna alexandrina and S. indica*, Br.—*Senna-leaves*, E.; *Feuilles de séné*, Fr.; *Sennesblätter*, G.

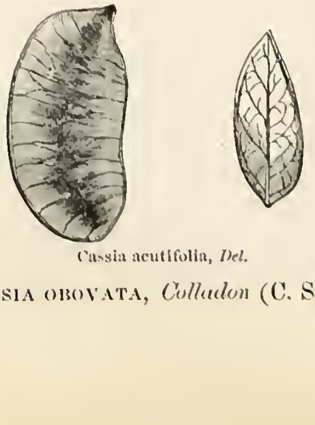
The leaves of Cassia acutifolia, *Delile* (of C. obovata, *Colladon*), and of C. elongata, *Lémaire-Lisancourt*. Bentley and Trimen, *Med. Plants*, 89, 90, 91.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The subgenus Senna of the genus Cassia is regarded by some botanists as a distinct genus, characterized by the absence of glands from the common petiole of the leaves, by the axillary racemose inflorescence, and by the flat, broad, papyraceous legumes, which are indehiscent, cleft on the margin at maturity, and contain near the middle the small triangular or truncately wedge-shaped seeds attached to a long funiculus. The senna-yielding species are small shrubs 2 or 3 feet (60–90 Cm.) high, have small, persistent stipules and axillary racemes of yellow flowers.

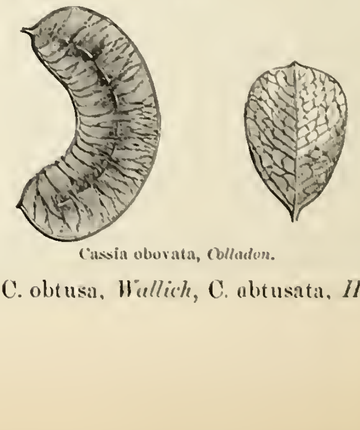
CASSIA ACUTIFOLIA, *Delile* (C. lanceolata, *Nectoux*, C. Senna β, *Linné*, C. orientalis, *Persoon*, C. lenitiva, *Bischoff*, Senna acutifolia, *Batka*). It is found in Upper Egypt and southward to Nubia, Sennaar, and Kordofan, and farther westward in tropical Africa. The leaflets are mostly in four or five pairs, are from ⅘ to 1⅕ inches (2–3 Cm.) long, and about ⅖ inch (1 Cm.) broad, vary in shape between oval, lance-oval, and lanceolate, and are acute or rather pointed, mucronate, on the under side somewhat hairy or nearly smooth, and are rather thick in texture. The stipules are subulate, and the fruit is broadly oblong, slightly bent, about 2 inches (5 Cm.) long, and contains about six seeds.

FIG. 267.



Cassia acutifolia, *Del.*

FIG. 268.

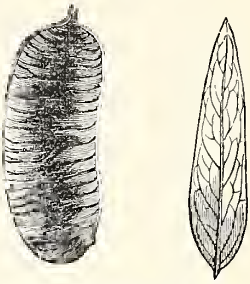


Cassia obovata, *Colladon*.

CASSIA OBOVATA, *Colladon* (C. Senna, *Forskal*, C. obtusa, *Wallich*, C. obtusata, *Hayne*, Senna obovata, *Batka*). It is found in Arabia and in Africa from Egypt southward, in Nubia, Abyssinia, and Southern Africa, and westward to Tripoli and Senegal. The leaflets are in four to seven pairs, obovate or oblong-obovate, mucronulate, clothed with few appressed hairs or nearly smooth. The stipules are linear-lanceolate, acute and rigid, and the legume is curved, rounded at both ends, 1½ inches (38 Mm.) long, and contains about ten seeds. Batka distinguishes three varieties: *α genuina*, with the leaflets rounded or mucronulate at the apex; *β obtusata*, with the leaflets more blunt; and *γ platicarpa*, with shorter racemes and broader and less curved legumes than the preceding. C. obovata is cultivated, and has been naturalized in Jamaica. It is mentioned by the British Pharmacopœia as one of the sources of Alexandria senna, but its leaflets are now rarely met with in the drug.

Cassia elongata, *Lémaire* (C. angustifolia, *Vahl*, C. lanceolata, *Wight et Arnott*, C. acutifolia, *Nees*, C. medica, *Forskal*, C. medicinalis, *Bischoff*, Senna officinalis, *Roxburgh*, S. angustifolia, *Batka*). It is found in South-western Arabia, along the Somali coast of Africa, and eastward in Northern India. The leaflets are in four to eight pairs, are from 1 to 2 inches (25 to 50 Mm.) long, ½ to ¾ inch (12–19 Mm.) broad, vary in shape from narrow-lanceolate to lance-ovate and oblong-ovate; are narrowed above to the mucronate apex, slightly pubescent, and beneath somewhat glaucous. The stipules are narrow, and the legumes oblong or oval, about 2 inches (5 Cm.) long, and contain about eight seeds. Batka distinguishes three varieties—namely, *α dilatata* (*α* genuina, *Bischoff*), the leaflets broadest above the base and in the middle, and gradually tapering to the apex; *β arcuata* (*β* Royleana, *Bischoff*), the leaflets narrowed at the base, broadest below the middle, and more pointed and thinner than in the preceding variety; *γ genuina* (*γ* Ehrenbergii, *Bischoff*), the leaflets narrower than the preceding varieties, linear-lanceolate, and pointed. The variety *β* seems to be a form produced by cultivation at Tinnevelly in Southern India.

Fig. 269.



Cassia elongata, *Lém.*

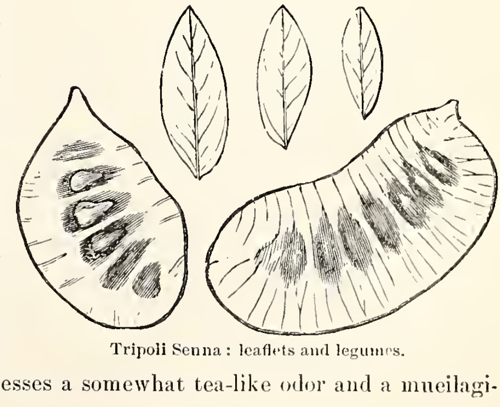
Collection.—In Nubia the collection of senna appears to be carried on in the same manner now as it was at the time when Nectoux visited that country near the close of the last century. In the month of September, after the termination of the rains, the natives cut down the shrubs and dry them on the rocks in the sun, after which they are stripped. The leaves are then packed in bags made of palm-leaves and transported by camels to the Nile, and thence to Cairo and Alexandria, from which port the drug derives its name and finds it way into commerce. A second crop, which is frequently very limited, is obtained about the middle of March, when the fruit ripens.

The United States imported 114,766 pounds of senna in 1875, and 512,124 pounds in 1881.

Description.—The pharmacopœial varieties of senna are—

1. Alexandria Senna. This variety has been very variable in quality, and sometimes much broken up and mixed with leaf-stalks and fragments of the branches. Leaflets of the three species of Cassia described above have at times been observed in the commercial article, but of late years the drug consisted chiefly of the leaflets of C. acutifolia, to the exclusion of the other species. Recently (1878), however, we have seen samples containing again, to a limited extent, the leaflets of C. obovata, which is called by the Arabs *senna baladi* (*wild senna*), and is regarded in Egypt as much less valuable than the *senna jebeli* (*mountain-senna*), the C. acutifolia. Alexandria senna requires to be freed from argel-leaves (not by *P. G.*) and from discolored leaves, and frequently needs sifting and picking in order to separate stalks, foreign leaves, fruits, and earthy impurities (see below). Including finely-broken leaves, such impurities amount sometimes to from 40 to nearly 60 per cent. of the weight of the drug. Alexandria senna is of a pale-green color, of a thickish texture, plainly veined, finely hairy, mainly on the midrib, and possesses a somewhat tea-like odor and a mucilagi-

Fig. 270.

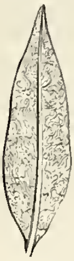


Tripoli Senna: leaflets and legumes.

nous afterward bitterish and nauseous taste. Like the other varieties of senna, the leaflets are oblique and uneven toward the base.

Identical with the preceding in its botanical origin is *Tripoli senna*, which comes by caravans from the interior of Africa to Tripoli, but rarely reaches this country. It is frequently much broken up, and even discolored, but otherwise free from foreign leaves, though not from other impurities, including legumes, stalks, and earthy matters.

FIG. 271.



Solenostemma argel, *Hayne.*

2. INDIA SENNA consists solely of the leaflets of C. angustifolia, but is met with of different qualities, the handsomest being—

Tinnevelly senna. It is the kind recognized by the Br. P. as Senna indica, and consists of the carefully-dried and fully-matured leaflets of the variety arcuata, which are dull-green in color, smooth or slightly pubescent beneath, and are free from stalks, legumes, broken or discolored leaves, and other impurities. Their odor is similar to that of Alexandria senna, but the taste is more mucilaginous and less nauseous.

East India or *Bombay senna* has the same origin, but is less carefully dried, and frequently contains smaller and somewhat discolored leaflets. It is not unfrequently sold here as Tinnevelly senna.

Arabian or *Mecca senna*, also sold as *Bombay senna*, is collected and dried with still less care, and is often mixed with brown leaflets and with legumes.

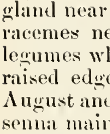
Allied Drugs and Admixtures.—CASSIA (SENNA, *Batka*) PUBESCENS, *R. Brown*, s. C. Schimperi, *Steudel.* The leaflets are about an inch (25 Mm.) long, oval or ovate, obtuse, mucronate, soft-hairy on both sides, and ciliate on the margin. They have occasionally been met with in Mecca senna.

CASSIA BREVIPES, *De Candolle.* The leaflets were sent from Central America to Great Britain in 1875; they resemble India senna, but have three veins running nearly parallel from the base to the blunt apex, and their infusion was found by Holmes to be destitute of purgative properties.

CASSIA MARILANDICA, *Linné* (*U. S.* 1870); Folia sennæ Americanæ.—Séné Américain, *Fr.:* Amerikanische Senna, *G.* Bentley and Trimen, *Med. Plants*, 88.—This perennial plant is found in low grounds and along streams from the New England States and New York south to the Carolinas and west to the Mississippi. It produces erect branching stems 3 to 5 feet (.9–1.5 M.) high, and has pinnate leaves on petioles 1 to 2 inches (25–50 Mm.) long and with a nearly sessile gland near the base on the upper side, six to nine pairs of leaflets, numerous pedunculate erect racemes near the top of the branches, showy yellow or whitish flowers with dark veins, and legumes which are finally smooth, linear, compressed, often curved, and somewhat sinuate on the raised edges; the ovate oblong seeds are separated by transverse dissepiments. It flowers in August and ripens its fruit in October. It belongs to the subgenus Chamæsenna, which differs from senna mainly in the narrow glands upon the petioles and in the dehiscent legumes. The leaflets are 1 and occasionally 2 inches (25 or 50 Mm.) long, about ½ inch (12 Mm.) wide, on short foot-stalks, smooth, ovate oblong to elliptic, obtuse, uneven at the base, green above and paler beneath. Collected in summer, the leaflets have an herbaceous odor, but if collected in September or the beginning of October, after the plant is out of bloom, they acquire a distinct senna odor. They are thinner in texture and larger than Alexandria senna, and lose on drying about 70 per cent. of moisture. The analyses of J. J. Martin (1835) and E. L. Perot (1855) did not throw any light upon the active principle, assuming that the leaves contain such. The usual constituents of leaves, a minute quantity of volatile oil, some fat, resin, mucilage, etc., were found, in addition to a complex body resembling the formerly so-called cathartin of senna.

SOLENOSTEMMA (CYNANCHUM, *Delile*) ARGEL, Hayne, s. Cyn. oleæfolium, *Nectoux* (nat. ord. Asclepiadaceæ). The leaves constitute the principal adulteration of Alexandria senna, aside from stalks and earthy admixtures. They resemble senna-leaves closely in size, shape, and color, but are readily distinguished by the indistinctness of their lateral veins and by their even base; they are also more leathery in texture, have a wrinkled surface, are grayish-green, pubescent, and of a decidedly bitter taste. They are often accompanied by the flower-buds of the same plant, by the whitish flowers, or occasionally by the slender pear-shaped fruit, which is 1½ inches (38 Mm.) long, and contains numerous hairy tufted seeds. The plant inhabits Upper Egypt, but is never collected with senna, the addition being made to supply the demand.

FIG. 272.



Tephrosia apollinea, *D. C.*

The leaflets of Tephrosia (Galega, *Delile*) apollinea, *De Candolle*, a leguminous plant of Southern Europe, are said to have been sometimes noticed as an adulteration of senna; they are somewhat uneven at the base, but their shape is obovate and they are emarginate at the apex.

The leaves of Coriaria are described on page 509, and the leaflets of Colutea on page 491; they are rarely, if ever, met with now as adulterations of senna.

GLOBULARIA ALYPUM, *Linné* (nat. ord. Globulariaceæ). The shrub is indigenous to Southern Europe; the leaves, which are used as a substitute for senna, are nearly sessile, obovate-oblong, entire or slightly toothed, finely granular, and on the lower side bluish-geen. Walz found in the leaves a peculiar tannin and an amorphous bitter principle, *globularin*, which is precipitated by tannin, is soluble in water, alcohol, ether, and chloroform, and is a glucoside. Heckel and Schlagdenhauffen (1882) found its composition to be $C_{15}H_{20}O_8$, and that of its decomposition-product, globularetin, C_9H_6O; the latter, heated with alkalies, yields cinnamic acid, which also exists in the leaves, together with mannit, wax, etc.

Constituents.—Senna-leaves have been frequently subjected to analysis, but the results are even at the present time not entirely satisfactory. Lassaigne and Feneulle's *cathartin* was found by Heerlein (1843) to be destitute of active cathartic properties. Winckler (1840) obtained the bitter principle again in an impure state; but in the same year *chrysoretin* was isolated by Bley and Diesel, and this substance was subsequently (1857) pronounced by C. Martius to be identical with *chrysophanic acid*, and to be mixed with *phæoretin* and fatty acids. Bourgoin (1871) ascertained cathartin to be free from cathartic acid, but to be a mixture of sugar, chrysophanic acid, and *chrysophanin*, which latter is white, soluble in water, insoluble in alcohol, and is not precipitated by lead acetate. Ludwig (1864) obtained an acrid and a bitter principle, both of which are absorbed by charcoal, but *sennacrol* is soluble and *sennapicrin* is insoluble in ether. From the investigations of Dragendorff and Kubly (1866) and Groves (1868) there can be no doubt that the cathartic properties of senna reside mainly, if not exclusively, in the calcium and magnesium salts of *cathartic acid*, which are insoluble in alcohol, but soluble in water, and may be obtained by precipitating a concentrated infusion of senna with an equal bulk of absolute alcohol; the liquid filtered from the precipitated mucilage and salts is mixed with more absolute alcohol as long as a precipitate is produced. This precipitate is washed with alcohol, dissolved in a little water, freed from albumen by a few drops of hydrochloric acid, and the filtrate completely precipitated by the addition of more hydrochloric acid; the impure cathartic acid thus obtained is purified by dissolving in 60 per cent. alcohol and precipitating by ether. T. B. Groves (1868) takes advantage of the colloidal properties of cathartic acid, and purifies it by dissolving the crude cathartate in moderately strong hydrochloric acid and subjecting the solution to dialysis on a diaphragm of parchment-paper. Thus obtained, cathartic acid contains nitrogen and sulphur, and is a brown, and after drying a black, amorphous substance, which is insoluble in water, but dissolves in alkalies. from which solutions it is again precipitated by acids. The cathartates of the alkalies and alkaline earths are soluble in water, but insoluble in alcohol. On boiling the alcoholic solution of cathartic acid with hydrochloric acid it yields 34 per cent. of glucose and 65 of *cathartogenic acid*, which is a yellowish-brown powder insoluble in water and ether. According to Groves, the long-continued action of heat on cathartates exposed to air in watery solution decomposes them, rendering them inert; organic acids, added to the aqueous solutions of cathartates, precipitate cathartic acid, but, unlike the mineral acids, do not decompose it on boiling. Dragendorff and Kubly obtained also a dextrogyrate saccharine substance, *cathartomannit*, in verrucose crystals, and regard the yellow coloring matter as similar to, but distinct from, chrysophanic acid; it is probably the glucoside *chrysophan*. (See Rheum.) Keussler (1878) prepared from senna chrysophanic acid and inactive cathartomannit. L. Siebold (1875) found that senna-leaves treated with strong alcohol are rather less purgative than the unextracted leaves, but he confirmed the earlier observations, that the alcoholic extract is destitute of such action, though it contains the griping principles. Diehl (1875) made similar observations.

Pharmaceutical Uses.—Species laxantes, *P. G.* Senna-leaves 16 parts, elder-flowers 10 parts, fennel and anise each 5 parts, are cut, bruised, and mixed with 4 parts of cream of tartar. A uniform mixture cannot thus be obtained, since the powdered cream of tartar separates readily; it is therefore recommended by Thanisch to moisten the unbruised fennel and anise with simple syrup, and then to mix them with the cream of tartar, which after drying will adhere. Another advantage is that the volatile oils will then not be exposed to the air.

Species laxantes St. Germain. The formula is practically identical with the preceding, except that senna-leaves, previously exhausted by alcohol, are used.

Off. Prep.—Confectio sennæ, *U. S.*, *Br.*; Extract. sennæ fluid., *U. S.*; Infus. sennæ comp., *U. S.*, *Br.*; Mistura sennæ comp., *Br.*; Pulv. glycyrrhizæ comp., *Br.*; Syrup. sarsaparillæ comp., *U. S.*; Syrup. sennæ, *U. S.*, *Br.*; Tinct. sennæ, *Br.*

Physiological Action.—A decoction of senna injected into the veins of a dog produces agitated movements of the abdomen and bilious vomiting. It readily purges swine, dogs, cats, and horses. In man an infusion of senna injected into the veins has occasioned both vomiting and purging. Some persons are so susceptible to its action as to be purged even by the odor of senna or of its infusion. It renders the milk of a nursing woman purgative to her infant. It is very apt to create flatulence, nausea, and colic, unless associated with some lenitive or aromatic substance. It produces yellow stools, and its action is not followed by constipation. It never occasions hypercatharsis. Its operation is said to be promoted by bitter medicines, such as colombo, and hence it is a valuable purgative when constipation is associated with debility of the bowels. Cathartic acid has a sour and somewhat astringent taste. It passes through the system without decomposition, and affects the milk of nursing women like senna itself. In the dose of 1½ to 3 grains (Gm. 0.10–0.20) it occasions griping and liquid yellow stools.

Medical Uses.—The uses of senna were learned from the Arabians, who employed it in various local affections, especially of the skin. Their later authorities refer to its tendency to gripe, to obviate which they recommend its association with violets, prunes, and other lenitives. Even now it is seldom given alone, but generally with some corrective of its griping qualities, as with coriander in the simple infusion, or with tamarinds, or with Epsom or Rochelle salt, manna, and fennel-seed, as in the infusion known as the "black draught." Care should be taken not to let the leaves macerate too long, nor to compress them when the liquid of the infusion is decanted, lest their acrid principle be taken up and produce griping. The *dose* of either of these infusions is from 2 to 4 fluidounces (Gm. 64–128), repeated every two or three hours until its purgative effects begin to be felt. The infusions are better purgatives than the simple tincture, for water extracts from senna a larger proportion of its purgative principle than alcohol. An excellent laxative is the compound powder of liquorice, whose active ingredient is senna, as it also is of "Tamar Indien."

American senna is identical with Alexandria senna in the mode of its operation, but a dose one-third larger of it is required. At best, it is but a poor substitute for the African drug.

SERPENTARIA, *U. S.*—SERPENTARIA.

Serpentariæ rhizoma (*radix*), Br.—*Virginia snakeroot*, *Serpentary-root*, E.; *Serpentaire* (*Couleuvrée*) *de Virginie*, Fr.; *Virginische Schlangenwurzel*, G.

The rhizome and rootlets of Aristolochia (Endodeca, *Klotzsch*) Serpentaria, *Linné*, and of Aristolochia reticulata, *Nuttall*. Bentley and Trimen, *Med. Plants*, 246.

Nat. Ord.—Aristolochiaceæ.

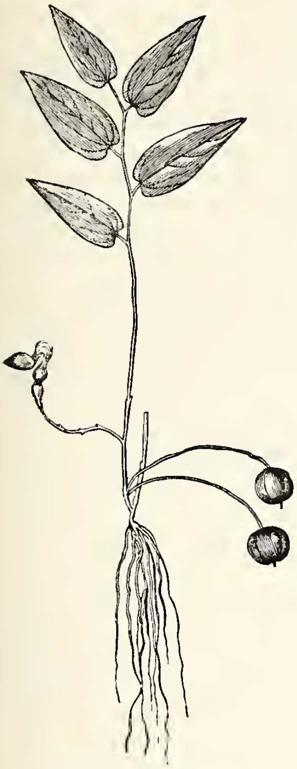
Origin.—The two plants from which Virginia snakeroot is derived are perennial herbs, with slender erect zigzag stems about 12 inches (30 Cm.) high, alternate cordate or cordately-ovate leaves, and with purple flowers, which grow on slender flexuose branches from the lower nodes and have the tube of the perianth inflated at both ends and bent like the letter S. Arist. Serpentaria has the leaves petiolate, pointed, thin, and somewhat pubescent, and is found in rich woodlands from Connecticut westward to the Mississippi, and southward in the middle and southern part of the United States; it is not common except near the Alleghany Mountains. The variety hastata (Arist. sagittata, *Muhlenberg*, Ar. hastata, *Nuttall*) is smaller, more slender, has narrow lance-oblong auriculate leaves, and grows in South Carolina and westward. Arist. reticulata has the leaves subsessile, obtuse, thickish, reticulate, and hirsute, and is indigenous to Louisiana and Texas.

Description.—Virginia snakeroot consists of a rhizome which is about an inch (25 Mm.) long, ⅛ inch (3 Mm.) thick, is bent up and down, and bears on the upper side the short approximate stem-remnants, which are flat or slightly convex above; below and on the sides are numerous thin branching rootlets, 3 to 6 inches (7–15 Cm.) long, and matted together. It is of a dull yellowish-brown color, and has an aromatic camphoraceous odor and a bitterish, aromatic, camphoraceous, and somewhat terebinthinate taste. The drug derived from Ar. reticulata is sometimes distinguished in commerce as *Red River* or *Texas snakeroot*; it closely resembles the preceding, but has a somewhat thicker rhizome and coarser, rather longer, and less interlaced rootlets. On transverse section the rhizome is seen to consist of a thin bark containing some oil-cells, and an eccentric wood with broad, slightly-curved medullary rays, and enclosing a pith which is near the upper side. The rootlets have a thick bark containing scattered oil-cells and a thin angular central ligneous cord.

Constituents.—Bucholz (1807) determined the presence in serpentary of about ½ per cent. of volatile oil and of resinous, extractive, and mucilaginous matters. The *volatile oil* is brownish-yellow, lighter than water, and has an odor and taste resembling those of a mixture of valerian and camphor. The *bitter principle* was obtained by Chevallier (1820) by precipitating the decoction with lead acetate, exhausting the precipitate with hot alcohol, evaporating, and treating the residue with water, which dissolves the bitter principle. Feneulle (1826) found the bitter principle in the filtrate from the precipitate occasioned in the decoction by lead acetate. It is yellow, amorphous, soluble in water and alcohol, yields precipitates with tannin and various metallic salts, and appears to resemble the bitter principle contained in the rhizome of Aristolochia Clematitis, *Linné*. A small quantity of tannin, malic acid, albumen, sugar, and other common constituents are also contained in serpentary. According to T. S. Wiegand (1844), Red River snakeroot has the same constituents, but is more mucilaginous and yields a somewhat larger proportion of volatile oil.

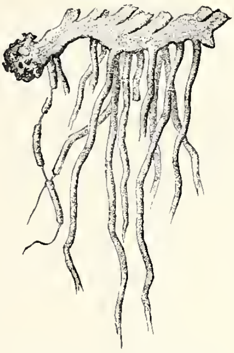
Impurities and Adulterations.—As found in commerce, serpentary frequently has portions of the stem attached, sometimes with leaves and with the six-sided and six-celled capsules. Ginseng-root and the rhizomes of cypripedium and of hydrastis are occasionally met with as accidental impurities, but Milleman (1874) also observed hydrastis as an evident intentional adulteration of serpentary. Spigelia is occasionally used for the same purpose. All these impurities and adulterations may, however, be easily identified from the characters of these drugs, as described elsewhere.

Fig. 273.



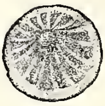
Aristolochia serpentaria, *Linné*.

Fig. 274.



Rhizome with rootlets.

Fig. 275.



Transverse section of rhizome.

Off. Prep.—Extract. serpentariæ fluid., *U. S;* Infusum serpentariæ, *Br.;* Tinct. cinchonæ comp., Tinct. serpentariæ, *U. S.*, *Br.*

History.—Serpentaria was used by the American aborigines as a cure for snake-bites (whence its name) and by the early colonists as a tonic and stimulant. It was introduced into medicine in London in 1633. Sydenham alludes to it as a remedy for intermittent fever when infused in white wine and taken so as to produce sweating before the paroxysm.

Medical Action and Uses.—In large doses it occasions nausea, eructation, vomiting, and flatulence, but not diarrhœa; it gives rise to some fulness of the head and quickens the circulation. In certain states of the system it promotes perspiration, but experiments with it on healthy persons give no indication of its virtues in disease. They are manifested in *typhus* and *typhoid fever*, and in the *typhoid state* generally, whenever the pulse is feeble or irregular, the skin cool and clammy, the mouth fuliginous, the eyes injected and dull, and the mind delirious or stupid. When, in addition, the urine and feces are dark and fetid, the skin covered with ecchymoses, etc., serpentaria is indicated, and with it cinchona and alcohol. Such an association of medicines exists in the compound tincture of cinchona, which from the days of Huxham, who invented it, has been an habitual remedy in these affections. In *typhoid pneumonia* serpentaria is much relied on, and in low forms of *diphtheria*.

The *dose* of serpentaria in powder is from 10 to 30 grains (Gm. 0.60–2). The infusion, which is officinal (*Br.*), is the best simple preparation of the medicine, but the fluid extract, the tincture, and especially the compound tincture, are much more commonly employed.

SEVUM, *U. S.*—Suet.

Sevum præparatum, Br.; *Sebum ovile (ovillum)*, P. G.—*Prepared suet, Mutton suet*, E.; *Suif de mouton*, Fr.; *Talg, Hammeltalg*, G.

The purified internal fat of the abdomen of Ovis Aries, *Linné*, the sheep.

Class Mammalia. *Ord.* Ruminantia.

Origin.—The sheep is domesticated everywhere, and is by zoologists considered to be a variety either of the *argali* of Siberia, Ovis Ammon, *Linné*, or of the South European *muflon*, Ovis Musimon, *Linné*. The part employed is the internal fat of the abdomen, which is cut into small pieces, melted by the aid of a moderate heat, and strained.

Properties.—Mutton suet is a white, smooth, solid, nearly inodorous fat, which on exposure to air gradually becomes rancid. It has a neutral reaction and bland taste, melts between 46° and 50° C. (114° and 122° F.), and congeals between 36° and 40° C. (96.8 and 104° F.), with a rise of temperature of nearly 5° C. (9° F.), fresh suet having the lower melting- and congealing-point. It dissolves in 44 parts of boiling alcohol of specific gravity .821, but is insoluble in cold alcohol; on warming equal parts of suet and alcohol, agitating thoroughly, and afterward cooling, the clear alcoholic liquid does not become turbid on the addition of water (absence of fat acids). According to Lecanu, suet requires over 60 parts of cold ether for solution; it is slowly soluble in 2 parts of benzin, and crystallizes again from this solution on keeping it for some time in a closed vessel.

Composition.—According to Chevreul and Heintz, mutton suet consists of 70 per cent. of *stearin* and *palmitin*, 30 per cent. of *olein*, and a trace of *hircin*; the latter is the glyceryl compound of *hircic acid*, which is a colorless oil, of a peculiar goat-like and acetous odor, has a strong acid reaction, and is freely soluble in alcohol. The olein prepared by expressing the suet is nearly colorless, has a slight odor, and dissolves in about 1½ parts of boiling absolute alcohol.

Off. Prep.—Cerat. resinæ comp., *U. S.*; Emplast. cantharidis, *Br.*; Ungu. hydrargyri, *U. S.*, *Br.*; Ungu. picis liquidæ, *U. S.*

Medical Action and Uses.—Suet, when perfectly fresh, forms a suitable dressing for blistered and other excoriated surfaces, but it is very apt to grow rancid, and is then decidedly irritant. It is used as an ingredient of various ointments, cerates, and plasters, and gives them a firmer consistence than they would derive from lard.

SIMARUBA.—Simaruba.

Simarouba, Fr.; *Ruhrrinde*, G.

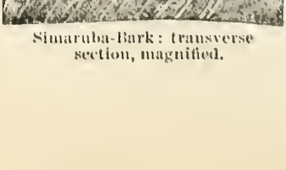
The bark of the root of Simaruba officinalis, *De Candolle* (Sim. amara, *Aublet*, Sim. guianensis, *Richard*, Quassia Simaruba, *Linné filius*), and the bark of Simaruba medicinalis, *Endlicher* (Sim. amara, *Hayne*, Sim. glauca, *De Candolle*, Quassia Simaruba, *Wright*). Bentley and Trimen, *Med. Plants*, 56.

Nat. Ord.—Simarubaceæ.

Origin.—This first species is a native of Guiana, Venezuela, and Northern Brazil. It is 60 to 70 feet (18–21 M.) high, and has some resemblance to the ash. The leaves are alternate, pinnate, and have from eight to twelve or sixteen oval-oblong, obtuse or mucronate, entire, and short-stalked leaflets about 4 inches (10 Cm.) long. The diœcious or monœcious flowers are small, white, and are aggregated in few-flowered clusters on the slender alternate branches of an elongated racemose inflorescence. The second species is indigenous to Southern Florida, the West India Islands, and Central America; it is the *stave-wood* or *mountain-damson* of Jamaica, and differs from the preceding chiefly by the smaller wedge-oblong leaflets and by the larger compressed drupe.

Description.—Simaruba-bark comes in curved or quilled pieces, which are several feet long, 2 to 3 inches (5–8 Cm.) wide, and about ⅛ or sometimes ¼ inch (3–6 Mm.) thick. Its external surface is uneven, rough, and wrinkled, covered with a yellowish or brownish suberous layer, or, if this is removed, of a grayish-brown color. The coarsely fibrous bast-layer is thick and dull-brownish; the inner surface is of a lighter color and striate. The bark is very tough, and breaks with difficulty in a transverse direction, but may be longitudinally torn, the pieces remaining united by some of the long and tough bast-fibres. When cut transversely the outer tissue is seen to contain scattered brown-yellow granules consisting of groups of stone-cells, and the inner

Fig. 276.



Simaruba-Bark: transverse section, magnified.

layer is radially striate in an oblique direction, caused by the long and wavy bast-wedges. Simaruba-bark is without odor and has a strong and persistent bitter taste.

The bark of the second species is very similar to the one described, but is paler, usually thicker, of a light yellowish- or reddish-brown color, has a smoother inner surface, and is equally bitter.

Constituents.—Simaruba-bark was analyzed by Morin (1822), and found to contain a little volatile oil, resin, traces of gallic acid, malate and oxalate of calcium, and other salts. The bitter principle is not precipitated by lead salts; it was obtained as an extract-like mass, and is supposed to be identical with *quassin.*

Allied Drugs.—Most if not all the trees belonging to the order of Simarubaceæ have a very bitter wood and bark. (See Quassia, page 1264.)

Simaba cedron, *Planchon*, and Sim. ferruginea, *St. Hilaire.* These trees are indigenous, the former to Colombia and the latter to Brazil; they resemble the above, but have hermaphrodite flowers. All their parts are very bitter. The fruit is a pear-shaped drupe of the size of a hen's egg, and contains an oblong seed about $1\frac{1}{2}$ inches (38 Mm.) long and about $\frac{4}{5}$ inch (20 Mm.) broad; the cotyledons are plano-convex, grayish or brownish, hard, inodorous, and very bitter. Lewy (1851) exhausted the seeds with ether, and afterward with alcohol, from which very bitter silky needles of *cedrin* crystallized. Tanret (1880) regards it as identical with his *valdivin*, obtained from the fruit of Simaba Valdivia, *Planchon*, by treating the alcoholic extract with chloroform and crystallizing from boiling water. Valdivin, $C_{36}H_{48}O_{20}.5H_2O$, melts at 230° C., is insoluble in ether, easily soluble in alcohol and chloroform, and soluble in 600 parts of cold water; this solution foams on agitation. Alkalies decompose the principle, which is emetic.

Samadera indica, *Gaertner* (Niota pentapetala, *Lamarck*), is a medium-sized East Indian tree, all parts of which are very bitter. The bark is $\frac{1}{6}$ to $\frac{1}{4}$ inch (4–6 Mm.) thick, red-brown, smooth, internally whitish dotted, and has a short and finely fibrous fracture. The fruit is obliquely ovate, compressed, about 2 inches (5 Cm.) long, and contains a brownish curved seed. De Vrij (1872) expressed from the seeds 33 per cent. of a light-yellow bitter oil which contains, according to Oudemans, 84 per cent. of olein and 16 per cent. of palmitin and stearin. The bitter principle *samaderin* was yellowish, and soluble in water and alcohol, and amorphous; Tonningen (1858) had obtained it from the seed and bark in white scales, which became yellow with nitric or hydrochloric acid and violet-red with sulphuric acid.

Cascara amarga, or Honduras Bark. Under this name a bitter bark has been introduced which has been referred to a species of Picramnia. It is about $\frac{1}{6}$ inch (4 Mm.) thick, has a gray-brown, smoothish, thick cork, and is internally deep-brown, with numerous white dots of groups of stone-cells. F. A. Thompson (1884) obtained 4.5 per cent. of ash and 3 per cent. of impure amorphous alkaloid having a sweetish afterward bitter taste.

Medical Action and Uses.—Like quassia, to which it is nearly allied, simaruba is intensely bitter and also slightly aromatic. In moderate doses its action is that of the simple bitters; in large doses, like them also, it operates as an emetic and purges. In South America, its native country, it is said to have been long employed as a specific for dysentery, and it was first introduced into Europe in the beginning of the eighteenth century for a like purpose. Although it has ceased to be used in *acute dysentery*, it is occasionally employed as a bitter tonic in the decline of that disease and in *dyspepsia.* At one time it was regarded chiefly as an emetic, and it was even proposed to use it as a substitute for ipecacuanha. It has also been prescribed in various conditions of debility associated with scrofula, chronic diarrhœa, etc. At present it is hardly ever used.

Simaruba may be given in powder in the *dose* of from 10 to 30 grains (Gm. 0.60–2), but this form is ineligible, owing to the difficulty of reducing the bark to powder. It is best administered in a decoction or infusion made with 2 drachms of the bark in a pint of water (Gm. 8 in Gm. 500).

Simaba cedron is used as a bitter tonic in New Granada, as a fever medicine also, and as an antidote for the bites of poisonous animals (*Amer. Jour. Phar.*, lii. 89). According to some experiments made in Paris, *cedrine* kills a rabbit in the dose of 10 Mgm. ($\frac{1}{6}$ grain), and about half that quantity administered hypodermically to man occasions vertigo. It is denied that it is an antidote to snake-poison, but affirmed that it is a febrifuge, although feebler than quinine (*Bull. de thérap.*, c. 328).

SINAPIS ALBA, *U. S.*—White Mustard.

Semen erucæ.—*Yellow mustard-seed*, E.; *Moutarde blanche*, Fr.; *Weisser Senf*, G.

The seed of Sinapis (Leucosinapis, *Spach*, Brassica, *Hooker filius et Thompson*) alba, *Linné.* Bentley and Trimen, *Med. Plants*, 23.

SINAPIS NIGRA, *U. S.*—Black Mustard.

Sinapis nigræ semina, Br.; *Semen sinapis*, P. G.—*Moutarde noire (grise)*, Fr.; *Schwarzer Senf*, G.

The seed of Sinapis (Brassica, *Koch*) nigra, *Linné*, s. Brassica sinapiodes, *Roth.* Bentley and Trimen, *Med. Plants*, 22.

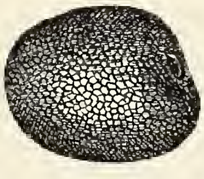
Nat. Ord.—Cruciferæ, Siliquosæ.

Origin.—Both white and black mustard have escaped from cultivation in the United States, and are sometimes found wild here. Both are indigenous to Southern Europe and Western Asia, and now grow as weeds throughout a great portion of Europe and Middle Asia, black mustard extending farther to the north, and white mustard farther eastward to China. The two plants are annuals, and have thin, branching, spindle-shaped roots, lyrate-pinnatifid lower leaves, compact and finally elongated racemes of yellow flowers, and beaked three- to six-seeded pods. *White mustard* is retrorsely hairy, has the upper leaves stalked, three-lobed and toothed, and the pods hairy, ascending, beaded by the seeds, and furnished with a prominent sword-shaped beak, containing a seed at its base. *Black mustard* is larger, 3 or sometimes 4 feet (.9 or 1.2 M.) high, smooth above, has the upper leaves slightly toothed or entire, and produces smooth linear pods which are appressed to the axis and furnished with a short beak. During the preceding eight years the importation into the United States of mustard-seed fluctuated between 823,558 pounds in 1878 and 4,507,975 pounds in 1882, and that of ground mustard between 399,244 pounds in 1878 and 555,535 pounds in 1881.

White and black mustard-seeds, powdered and mixed, are admitted by the British Pharmacopœia together as *sinapis*, but separately by the U. S. and French Pharmacopœias. The German Pharmacopœia recognizes black mustard-seed alone as *Semen sinapis*.

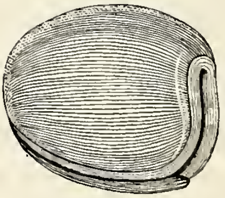
Description.—1. White mustard-seed. The seeds are globular or nearly so, about $\frac{1}{12}$ inch (2 Mm.) in diameter, weigh about .005 Gm., and are on one end marked with a small circular hilum and on the inner side with two shallow grooves. The testa is of a yellowish or pale grayish-brown color, very finely pitted and somewhat rough. The seed is inodorous, but when masticated has a pungent and acrid taste. Its internal structure is identical with that of the next.

Fig. 277.



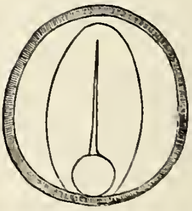
Black Mustard-Seed: entire, magnified.

Fig. 278.



Embryo.

Fig. 279.



Transverse section.

2. Black mustard-seed resembles the preceding in shape, but has only a diameter of $\frac{1}{25}$ inch (1 Mm.) and an average weight of .001 Gm., is blackish-brown or deep reddish-brown, has the testa covered with shallow pits, and when crushed and macerated with water acquires a strong and pungent odor.

Both seeds, after the integuments have been removed, contain an embryo having the shape of the seed, the cotyledons of which are folded along their midribs, one covering the other, while the radicle is turned back and enclosed between the folds of the inner cotyledon. This arrangement is well shown on a transverse section of the seed, which exhibits on one side the round radicle near and between the edges of the plano-convex folds of the inner cotyledon, and these are surrounded by the concavo-convex folds of the outer cotyledon. In both seeds the embryo is yellow and very oily, and imparts to the powder of white mustard a dull pale-yellow, and to that of black mustard a yellowish-green color.

Constituents.—Both seeds are free from starch, and when crushed and subjected to pressure yield from 20 to 25 per cent. of a yellow or brownish-yellow fixed oil, which congeals between − 15° and − 17.5° C. (5° and .5° F.) to a butyraceous mass. This *fixed oil of mustard* does not readily turn rancid, has a bland taste, and consists of olein with some stearin and the glycerides of *erucic acid*, $C_{22}H_{42}O_2$, and of *behenic acid*, $C_{22}H_{44}O_2$ (p. 1088), but when expressed between heated plates from black mustard it has to some extent the pungent odor and taste of these seeds after maceration in water. The oils have the specific gravity .916, and give with sulphuric acid a green or blue-green afterward brown color, and with fuming nitric acid a red color. Erucic or *brassic* acid forms white shining tasteless needles which fuse at about 34° C. (93.2° F.). It was discovered by Darby (1849), who isolated also another fatty acid, *sinapoleic acid*, which, according to Städeler (1853), has the formula $C_{20}H_{38}O_2$. The two kinds of mustard-seed contain a considerable amount of mucilage in the epidermis, and various proteids, the most interesting of which is *myrosin;* and this is obtainable, according to Bussy (1839), from the cold infusion of white mustard by concentrating it below 40° C. (104° F.) and precipitating the syrupy liquid with not too large a quantity of alcohol. Myrosin acts as a ferment upon two distinct principles, one being contained in white and the other in black mustard, and yields among their products of decomposition those compounds to which the acrid and pungent properties of both seeds are due. Myrosin is coagulated by heat and by alcohol; hence black mustard introduced into boiling water does not yield the volatile oil. Both mustard-seeds yield from 4 to 5 per cent. of ash, containing 37.4 per cent. of phosphoric acid.

The principle of white mustard yielding the acrid compound was fully investigated by H. Will (1870), and named by him *sinalbin*, $C_{30}H_{44}N_2S_2O_{16}$. It had been previously obtained in a nearly pure state, and was experimented with by Henry and Garot, Boutron, Robiquet, Winckler, Babo, and others, being described as *sulphocyanide of sinapine*, *sulpho-sinapisin*, *sinapin*, and under various other names. Sinalbin is obtained from white mustard which has been deprived of its fixed oil by exhausting it with boiling alcohol, from which it crystallizes on cooling. When pure it forms small glass-like inodorous bitter prisms which are freely soluble in water, but sparingly soluble in cold alcohol, and insoluble in ether, oil of turpentine, and bisulphide of carbon; it is perfectly neutral, is not colored by ferric chloride, yields white precipitates with corrosive sublimate and nitrate of silver, is colored yellow by traces of alkalies, and by myrosin is decomposed into sugar, acid *sulphate of sinapine*, $C_{16}H_{23}NO_5.H_2SO_4$, and *sulphocyanide of acrinyl*, $C_7H_7O.NCS$. This last compound is obtainable by agitating the aqueous liquid with ether, on the evaporation of which it remains as a nearly colorless, thick, non-volatile oil, which is readily soluble in alcohol and ether, has a sweetish afterward acrid and biting taste, and possesses epispastic properties; it is not colored red by ferric chloride until after its alcoholic solution has been heated with an alkali and again acidulated. *Sinapine* is an alkaloid which has not been isolated, since it is readily decomposed; the solutions of its salts are colored yellow by alkalies, and on boiling the mixtures yield a strong base, *sinkaline* and *sinapic acid*, the barium salt of which is nearly insoluble in cold water; Von Babo and Hirschbrunn (1852) gave these two compounds the formulas $C_5H_{13}NO$ and $C_{11}H_{12}O_5$.

A principle analogous to sinalbin exists in black mustard, and was recognized by Bussy as a peculiar acid, *myronic acid*, combined with potassium. Although he observed also volatile oil of mustard among its products of decomposition by myrosin, the exact composition and behavior of *myronate of potassium*, for which Will (1870) proposed the name *sinigrin*, were not ascertained until investigated by Will and Körner (1863). Sinigrin is obtained from black mustard exhausted with boiling strong alcohol by treating it with cold water, adding a little barium carbonate to the infusion, evaporating to a syrupy consistence, and boiling this residue repeatedly with 85 per cent. alcohol, on the evaporation of which sinigrin is left. The yield is .5 to .6 per cent. When pure it is in white, silky, inodorous needles, or, if crystallized from water, in short glass-like prisms, has a cooling bitter taste, dissolves in water, is insoluble in chloroform, ether, and benzol, and nearly insoluble in absolute alcohol. When treated with myrosin it is decomposed into *sulphocyanide of allyl* or *volatile oil of mustard*, C_4H_5NS (see page 1088), acid sulphate of potassium, $KHSO_4$, and sugar. The analogous decompositions of the peculiar principles of white and black mustard are explained by the following equations:

Sinalbin, $C_{30}H_{44}N_2S_2O_{16} = C_8H_7NSO + C_{16}H_{25}NSO_9 + C_6H_{12}O_6$.
Sinigrin, $C_{10}H_{18}NS_2KO_{10} = C_4H_5NS + HKSO_4 + C_6H_{12}O_6$.

Adulterations.—Mustard-seed is not subject to adulteration, but ground mustard is very often mixed with various farinaceous substances, and the cold decoction will then acquire a blue or greenish tint on the addition of an aqueous solution of iodine. Ground white mustard has a dull gray-yellow color, which is often rendered brighter by the addition of turmeric; it will then respond to the test for starch, and will acquire a red-brown color with solution of boric acid or of borax.

Off. Prep.—Cataplasma sinapis, *Br.;* Charta sinapis, *U. S.*, *Br.;* Oleum sinapis, *Br.*

Allied Plants.—Brassica (Sinapis, *Linné*) juncea, *Hooker filius*, is extensively cultivated in Southern Russia, and constitutes the *Sarepta* or *Russian mustard*. It is likewise cultivated in Africa and India, and is exported from the latter country to Europe. The seeds closely resemble those of black mustard and yield the same products.

Br. sinapistrum, *Boissier*, s. Sinapis arvensis, *Linné*, called *charlock*, is a European annual, and a troublesome weed in some parts of the United States, and has nearly smooth, dark-brown seeds, which are smaller and less pungent than those of black mustard.

Br. campestris, *Linné*, is extensively cultivated in several varieties, the principal ones being Br. Napus, with glaucous foliage, and Br. Rapa, with green foliage; they yield the various kinds of *turnip*, and the seeds, which are respectively $\frac{1}{12}$ and $\frac{1}{16}$ inch (2 and 1.5 Mm.) thick, and less pungent than black mustard-seed, are used for obtaining the bland yellowish *rape-seed* and *colza oil* (Huile de navette, de colza, *Fr.;* Rüböl, Rapsöl, Kohlsaatöl, *G.*). These oils are brownish or greenish-yellow, have a somewhat acrid taste, are more bland after refining, yellow, of about the spec. grav. .913, congeal near — 5° C. (23° F.), and are colored green-brown or brownish-yellow by sulphuric acid.

Raphanus raphanistrum, *Linné*, is a weed known as *wild radish* and *jointed charlock*. According to Pless (1846), the seeds contain also oil of mustard, but the sulphuretted volatile oil obtained from the *garden radish*, Raphanus sativus, *Linné*, appears to be different. The fixed oils expressed from these seeds closely resemble those of mustard-seeds.

History.—Mustard has been used medicinally from the earliest periods. Hippocrates described a variety of its applications, but chiefly as an external or local stimulant to dissipate slight inflammations, diminish coma, allay pain, promote the growth of hair, relieve deafness, etc. Internally, he recommended it as a remedy for intermittent fever. Subsequent ancient writers enlarged its sphere of usefulness, applying it as a counter-irritant in nearly all chronic diseases and painful affections, and using it as an emetic and a vermifuge. They were well acquainted with the fact that a sinapism made with vinegar is weaker than one mixed with water.

Physiological Action.—*On Animals:* Essential oil of mustard is a virulent poison. In rabbits it occasions the following symptoms: great frequency of the heart's action, speedy loss of sensibility and muscular power, feebleness of the heart's pulsations, difficult respiration, repeated convulsions, insensibility, coldness, and death. The odor of the oil is very distinct in the internal organs, the urine has a characteristic smell, and the irritability of the heart and voluntary muscles continues for a long time after death.

On Man: Mustard-seed, taken whole in doses of a teaspoonful three or four times a day, have a laxative action upon the bowels and are discharged without perceptible change. As cases have occurred in which an accumulation of them obstructed the bowel, and as they also may possibly find their way, with fatal effect, into the vermiform appendix, they should be used cautiously and swallowed with a large quantity of water.

Powdered mustard applied to the tongue or throat causes prickling and burning. It promotes the digestion of food, but too much of it or its prolonged use enfeebles the stomach. In large quantities, a teaspoonful or more, diffused through tepid water, it acts as a prompt and efficient emetic. Care should be taken to evacuate all of the mustard swallowed.

Applied as a sinapism to the skin, it produces after several minutes an acute prickling, stinging, and burning pain, the skin grows red, and, if the application is too prolonged, is blistered. The blisters are followed by ulcers which are very difficult to heal. The rapidity and completeness of the effect depend upon the delicacy of the skin to which the sinapism is applied. Hence great caution should be observed in prescribing it for children and females. Gangrene and death have resulted from applying a mustard poultice to the swollen glands of a child's neck.

On the other hand, when the skin is naturally tough or when its vitality is impaired by collapse, chill, or low states of the system generally, sinapisms may fail to exert any influence whatever. In these several cases sinapisms made with water are referred to; those made with vinegar possess very inferior activity, and the mustard is less active in proportion as the vinegar is stronger. This fact, although now generally unknown, the ancients were well acquainted with, as already stated.

The effects of a general mustard bath at 86° F. are singular. At first wandering chills are felt in the loins, back, abdomen, and limbs, followed by a feeling of decided coldness and twitching of the extremities. There is even suffering from a sense of cold. Later, and even after the skin has become red, the sensation of coldness continues until the patient leaves the water, when reaction is speedily established, with stinging and burning of the integument.

Volatile oil of mustard is a powerful irritant. A single drop of it upon the tongue causes a severe burning pain which extends to the throat, nose, and stomach. Upon the skin it acts promptly as a vesicant and caustic.

Medical Uses.—For internal purposes, and particularly where the whole seed is given, white mustard-seed is to be preferred. In *atonic dyspepsia* with *constipation* it has long been employed with advantage in the dose of a teaspoonful and in a draught of water before or after meals. It prevents flatulence, promotes digestion, and keeps the bowels regular. But, like all condiments, it loses its effect by use. An infusion of mustard has sometimes succeeded in arresting obstinate *hiccough*. It is one of the most prompt and efficient emetics which can be used in cases of *narcotic poisoning*. In the early stage of *delirium tremens* a mustard emetic will sometimes cut short the attack. In *atonic dropsy* mustard whey or an infusion of whole mustard-seed in cider is a diuretic of considerable power. That the active principle of mustard is carried into the circulation is shown by the benefits accruing from the use of white mustard-seed in *chronic bronchitis*, *chronic rheumatism*, and some *cutaneous affections*. This use of the medicine has been condemned as being destitute of a rational basis, but the only rational basis for the use of a medicine is its power to cure, and that is sufficiently attested in the present case.

Externally, oil of mustard has been successfully used in the treatment of *scabies*. But one of the most usual and useful applications of mustard is in the form of poultice, plaster, or bath to produce a lively stimulation, and thereby arouse the nervous system, as in the insensibility of *swooning* and *hysteria*, in which it acts by exciting a sense of pain, and in the *convulsions* of children, in which it stimulates the nervous system and perhaps disperses morbid accumulations of blood in the central nervous organs. In foot-baths it relieves *headache* and cerebral and other internal *congestions*, especially uterine congestion accompanied with *dysmenorrhœa*. Dr. Weber claims to have been remarkably successful in the treatment of *pneumonia* in children by means of the hot mustard bath. He placed the child in a bath-tub filled with water at a temperature of from 100° to 105° F., and had the skin rubbed thoroughly until it began to look red. This process required from 7 to 10 minutes, when the child was wiped dry and put into a bed previously warmed. No ill effects were observed from allowing the genitals to remain unprotected. The bath was repeated, if necessary, as often as every three hours. General baths, at a temperature of from 77° to 82° F., containing 2 or 3 ounces of mustard and applied for the space of half an hour, have been used with great advantage in allaying the violence of *insanity*. Large poultices or epithems containing mustard and sinapised hip-baths have been beneficial in analogous conditions. However it may be explained, it is certain that mustard pediluvia, and even mustard plasters employed to relieve pain, frequently induce sleep; indeed, it sometimes happens that the patient falls asleep while the plaster is "drawing," with the result of producing painful and intractable sores.

When the action of a part is morbidly diminished or that of an internal organ is morbidly increased, as in *retrocedent gout* or *rheumatism*, or where a part is too anæmic for the application of *leeches*, or where a muscle or muscles suffer partial *atrophy*, mustard poultices, etc. are sometimes beneficial.

Every form almost of local pain may be relieved in the same manner as that of subacute and chronic *articular rheumatism*, *pleurodynia*, *neuralgia*, *toothache*, *earache*, *flatulent colic*, *muscular rheumatism*, and *dysmenorrhœa*. The same is true of various abnormal discharges, such as *vomiting*, *diarrhœa*, *cholera morbus*, and *dysentery*. In epidemic *cholera* general mustard baths have frequently been found beneficial in the early stages of the disease, and occasionally in the cyanotic stage.

Administration.—Of white mustard-seed 1 or 2 teaspoonfuls in 3 or 4 ounces of water may be taken once a day or oftener. The *infusion* of mustard, for an emetic, is prepared by adding 1, 2, or 3 teaspoonfuls of mustard flour to a pint of warm water. Mustard *whey* is made by adding to a pint of milk mixed with a quart of water 1½ ounces of bruised mustard-seed, boiling the mixture until it is curdled, and straining off the whey. A wine-glassful may be given every hour or two. The *sinapism*, or mustard plaster, is prepared by adding cold or lukewarm water to equal quantities of mustard and wheaten or rye flour, and stirring until a thick paste is formed. This is spread upon linen or other convenient tissue and applied to the skin. It is well to interpose a piece of gauze between the plaster and the body, to prevent the former from adhering. It should remain applied from ten minutes to an hour, according to the degree of its action. The mustard *cataplasm* (*Pharm. Br.*) is an ordinary poultice with which mustard has been mixed; it is intended to maintain a gentler but more prolonged action than the sinapism. "*Mustard-leaves*" should be dipped in water before being applied. Sinapised *pediluvia* are made by adding a sufficient quantity (a tablespoonful or two) of mustard flour to an ordinary foot-bath. When pediluvia are used as general stimulants, they should be as warm as they can be borne; but when employed as derivatives, especially from the head and chest, their temperature should not exceed that of the blood, or from 98° to 100° F. The *essential oil* of mustard has been prescribed internally in an emulsion in the dose of from $\frac{1}{12}$ to $\frac{1}{4}$ of a drop. It may be used externally as a rubefacient in the proportion of 24 drops of the oil to an ounce (Gm. 1.60 to Gm. 32) of alcohol, or 5 or 6 drops to a fluidrachm (Gm. 0.30 to Gm. 4) of almond oil. Care must be taken to proportion the strength of the liniment to the delicacy of the skin. The best application for the sores produced by mustard is lime-water liniment; if the pain be severe, the part may first be covered with stramonium ointment. Later, poultices of grated raw carrots, and finally oxide of zinc ointment, may be employed.

SODA, *U. S., Br.*—Soda.

Soda caustica, Br.; *Natrum causticum*, *Natrium hydricum*.—*Caustic soda*, *Sodium hydrate*, E.; *Soude caustique*, Fr.; *Natron*, *Aetznatron*, G.

Formula NaHO. Molecular weight 40.

Soda should be kept in well-stopped bottles made of hard glass.

Preparation.—Take of solution of soda 2 pints. Boil down rapidly in a silver or clean iron vessel until there remains a fluid of oily consistence, a drop of which, when removed on a warmed glass rod, solidifies on cooling. Pour the fluid on a clean silver or iron plate or into moulds, and as soon as it has solidified break it in pieces and preserve it in stoppered green-glass bottles.—*Br.*

The preparation of solution of soda is described on page 922. On evaporating it, hydrate of sodium is left, and this is either moulded into thin cylinders or congealed on a plate or tile. Vessels of porcelain, glass, etc. are readily corroded; soda must therefore be prepared in clean iron or silver vessels. For uses in the arts caustic soda is extensively prepared from the same raw material from which sodium carbonate and bicarbonate are made; baryta and strontia have been used in the place of lime, and various complicated processes have been applied in the manufacture. Soda was first obtained by Stahl (1702), but its preparation from the sulphate and chloride was first described by Duhamel (1736).

Properties.—Caustic soda is white (or grayish-white, *Br.*), hard, opaque, inodorous, very alkaline in reaction, strongly corrosive, and of an intensely acrid and caustic taste. It is usually seen in irregular fragments having a fibrous appearance, or in cylindrical sticks which are crystalline upon a fresh fracture. On exposure to the atmosphere it absorbs water and is liquefied, and subsequently it solidifies again and becomes efflorescent, in consequence of the absorption of carbonic acid and the crystallization and efflorescence of sodium carbonate. According to Osann, 1 part of water dissolves at 18° C. (64.4° F.) 0.6 parts of soda, while boiling water takes up 1¼ parts; such concentrated solutions, when exposed to a temperature of − 10° C. (14° F.) or less, separate thick tabular crystals of the hydrate, $(NaHO)_2.7H_2O$, which melt again above 6° C. (42.8° F.). Soda is also freely soluble in alcohol. The strong aqueous solution of soda dropped into test solution of tartaric acid, so that the latter remains in excess, deposits acicular crystals of acid sodium tartrate, which are dissolved on the addition of more soda or of water. Anhydrous soda melts at a full red heat, but the hydrate fuses at a lower heat to a colorless oily liquid, and at a strong red heat is slowly volatilized. If held in a non-luminous flame an intense yellow color is imparted to the latter.

Tests.—Alcohol dissolves caustic soda, but leaves most of the salts behind which are likely to be present. "If soda be dissolved in 2 parts of water and the solution dropped into alcohol, not more than a slight precipitate should make its appearance (limit of silica or of carbonate). Dropped into an acid, it should not produce more than a faint effervescence of isolated bubbles (limit of carbonate)."—*U. S.* When dissolved in water, the solution should be colorless (organic matter), and after acidulating with nitric acid merely a slight cloudiness should be produced with nitrate of silver or chloride of barium (limit of chloride and sulphate). 40 grains of soda dissolved in water should leave scarcely any sediment, and require for neutralization about 900 grain-measures of the volumetric solution of oxalic acid (*Br.*), indicating the presence of about 90 per cent. of NaHO. The U. S. P. requires not less than 90 per cent. of this hydrate, so that 2 Gm. of soda are neutralized by at least 45 Ccm. of the volumetric solution of oxalic acid. Commercial soda sometimes contains alumina, which is soluble in water, but insoluble in alcohol; on treating with excess of ammonium chloride, it will separate as a white gelatinous precipitate, which is dissolved again by excess of hydrochloric acid. Sulphide, if present, will cause the precipitate with lead salt to be more or less brown, instead of white, and cyanide will produce Prussian blue on adding to the solution a little ferrous and ferric salt and acidulating with hydrochloric acid.

Composition.—The formula of soda is NaHO. When pure it contains 22.5 per cent. H_2O and 77.5 per cent. Na_2O. Crystallized hydrates of sodium are also known containing 3½ and 1½ molecules of water, and respectively 30.1 and 46.3 per cent. Na_2O.

Off. Prep.—Liquor sodæ, *U. S.*, *Br.*

Metallic Sodium and Salts.—Sodium, s. *Natrium*, was isolated by H. Davy (1807), and is prepared on a large scale by heating in an iron retort an intimate mixture of 30 parts of exsiccated carbonate of sodium, 13 parts of coal, and 5 parts of chalk; the reduction takes place at a lower temperature than is required for the isolation of potassium. Sodium is silver-gray, has a strong metallic lustre, and at ordinary temperatures may be cut like wax. It melts near 90° C. (194° F.), and at a red heat volatilizes. Its density is .97. In contact with air it is oxidized, and therefore requires to be kept under petroleum naphtha, or should be protected by being coated with a layer of paraffin, as proposed by Wagner (1863). It unites with oxygen, forming *monoxide*, Na_2O, and *dioxide*, Na_2O_2. It was admitted in the *Br. P.* for preparing solution of sodium ethylate (page 923).

Salts of Sodium. Soda is nearly as strong a base as potassa, and yields salts which are colorless unless the acid is colored, have a neutral reaction except those with weak acids, and are not volatilized at a low red heat, and somewhat less readily than potassium salts at a higher temperature. They impart to flame an intense yellow color, which is not visible if examined through a blue glass. They are mostly readily soluble in water, and these solutions yield with hydrofluosilicic acid gelatinous precipitates, and, when neutral or alkaline, afford with metantimoniate of potassium white crystalline precipitates. Similar precipitates are obtained with most other metallic salts, which must therefore be removed by the proper reagents, with the exception of those of potassium, before the test for sodium is applied.

Medical Action and Uses.—The chemical and toxical actions of soda are the same as those of potassa. (For a detailed description, see Lesser, *Virchow's Archiv*, lxxxiii. 224.) Caustic soda, although less deliquescent, and therefore more manageable, than caustic potassa, is not so generally employed as an escharotic. It would appear probable also that as it is more assimilable, and therefore less apt than potassa to be immediately secreted with the urine, it should be better adapted than the latter for all cases in which it is desired to render the blood and the secretions more alkaline. But in either case the bicarbonates are preferable to the alkalies themselves. Soda is administered in the officinal solution and in *doses* of from 10 to 20 minims (Gm. 0.60–1.30).

SODÆ CITRO-TARTRAS EFFERVESCENS, *Br.*—Effervescent Citro-Tartrate of Soda.

Sodii citro-tartras effervescens, Br.—*Effervescent citro-tartrate of sodium.*

Preparation.—Mix thoroughly the following powders: Bicarbonate of Sodium, 17 ounces; Tartaric Acid, 9 ounces; Citric Acid, 6 ounces; and Refined Sugar, 5 ounces. Mix the powders thoroughly, place them in a dish or pan of suitable form heated to between 200° and 220° F., and when the particles of the powder begin to aggregate stir them assiduously until they assume a granular form; then by means of suitable sieves separate the granules of uniform and most convenient size, and preserve the preparation in well-closed bottles.—*Br.*

For the preparation of granular powders, see page 1254. If kept dry, this citro-tartrate is preferable to a mixture of the powdered ingredients, which soon undergoes decomposition. Thrown into water, it dissolves with brisk effervescence.

Medical Action and Uses.—This preparation is equivalent in its action to the effervescing draught, and may be prescribed with advantage to moderate fever, promote perspiration, and diminish the acidity of the urine and other secretions. It is conveniently employed in *fevers* and *inflammations*, and especially in acute articular *rheumatism*. *Dose*, from 60 to 120 grains (Gm. 4–8) in several fluidounces of water.

SODII ACETAS, *U. S.*—Acetate of Sodium.

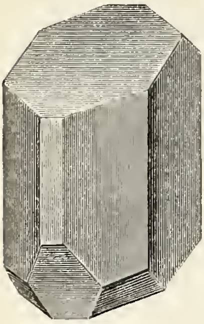
Sodæ acetas, Br. 1867; *Natrium aceticum*, P. G.; *Acetas sodicus (natricus)*; *Terra foliata tartari crystallisata.*—*Acetate of soda*, E.; *Acétate de soude*, Fr.; *Natriumacetat*, *Essigsaures Natron*, G.

Formula $NaC_2H_3O_2.3H_2O$. Molecular weight 136.

Preparation.—Acetate of sodium was first prepared by Duhamel (1736) and by J. F. Meyer (1767), and was made by Doerffurt (1793) from sugar of lead by decomposing it with carbonate and sulphate of sodium. It may be obtained by neutralizing acetic acid or by decomposing acetate of lead with carbonate of sodium, in the latter case filtering from the insoluble carbonate of lead and evaporating the clear liquids to crystallization. The salt is, however, manufactured on a large scale in the United States in the process for purifying acetic acid from wood-vinegar. (See p. 20.)

Properties.—This salt crystallizes in colorless, transparent, monoclinic prisms which are odorless and slightly alkaline, have a bitterish saline taste and are somewhat efflorescent on exposure, falling in dry air to a white powder. The crystals melt at 75° C. (167° F.), and this liquid boils at 123° C. (253.4° F.) (Jeannel, 1866), and parts with the water of crystallization, the loss amounting to 39.7 per cent. The anhydrous salt, when exposed to the air, absorbs again the water of crystallization, and when carefully heated to about 315° C. (599° F.) (Schaffgotsch, 1857) melts to a colorless liquid, and on cooling congeals to a crystalline mass. At a higher heat the salt becomes black, and is decomposed, yielding acetone and volatile empyreumatic products, and leaving black sodium carbonate behind, which on being heated to redness in the air becomes white. The crystallized salt, according to Osann, dissolves at 6° C. (43° F.) in 3.9 parts, at 37° C. (98.6° F.) in 2.4 parts, and at 48° C. (118.4° F.) in 1.7 parts, of water. Solutions made with boiling water contain anhydrous salt, and remain for a time supersaturated. The salt is stated to be soluble in 1.4 parts (*P. G.*), in 3 parts (*U. S.*) of water at 15° C. (59° F.); according to Osann, 3.5 parts are necessary. According to Gerardin (1865), at 18° C. (64.4° F.) the crystallized salt dissolves in 47.6 parts of alcohol sp. gr. .8322, in 25.7 parts of alcohol sp. gr. .8464, and in 6.8 parts of alcohol sp. gr. .9088, and, according to Doebereiner, in 2.1 parts of boiling strong alcohol. The salt is insoluble in ether. Sulphuric acid liberates from it acetic acid, and its aqueous solution becomes deep-red with ferric salts, and on boiling yields a brown-red precipitate.

Fig. 280.



Crystal of Sodium Acetate.

Tests.—Dissolved in 50 parts (20 parts, *P. G.*) of distilled water, the solution should not be rendered turbid or precipitated by sulphuretted hydrogen, sulphide of ammonium, carbonate of sodium, oxalate of ammonium, chloride of barium, or nitrate of silver (absence of metals, calcium, sulphate, and chloride); the U. S. P. permits the presence of traces of sulphate, chloride, and calcium. A concentrated solution of sodium acetate yields with nitrate of silver a crystalline precipitate of acetate of silver. Carbonate, if present, is detected by the effervescence produced by the salt when thrown into a diluted acid or on adding hydrochloric or nitric acid to its aqueous solution; the latter, acidulated as indicated, when evaporated to dryness should leave a residue which is entirely soluble in water (silica). "Fragments of the salt, when sprinkled upon colorless concentrated sulphuric acid, should not impart to it any color (absence of organic impurities). If 3.4 Gm. of acetate of sodium be ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization 25 Ccm. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure acetate of sodium)."—*U. S.*

Pharmaceutical Uses.—Acetate of sodium is employed in preparing acetic acid, acetic ethers, and other compounds.

Medical Action and Uses.—Acetate of sodium resembles acetate of potassium in its action, but is milder, less apt to derange the digestion, and more efficient as a diuretic. Its *dose* is from 15 to 40 grains (Gm. 1–3) in a large quantity of water as a diuretic. In doses of a drachm (Gm. 4) or more it is apt to be laxative.

SODII ARSENIAS, *U. S.*, *Br.*—ARSENIATE OF SODIUM.

Sodæ arsenias, Br.; *Natrium arsenicicum*, *Arsenias natricus* (*sodicus*).—*Arseniate* (*arsenate*) *of soda*, E.; *Arséniate de soude*, Fr.; *Natriumarsenat*, *Arsensaures Natron*, G.

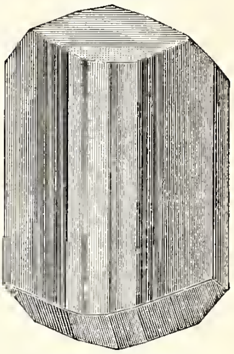
Formula $Na_2HAsO_4.7H_2O$. Molecular weight 311.9.

Preparation.—Take of Arsenious Acid 10 ounces; Nitrate of Sodium 8½ ounces; Dried Carbonate of Sodium 5½ ounces; Boiling Distilled Water 35 ounces. Reduce the dry ingredients separately to fine powder and mix them thoroughly in a porcelain mortar. Put the mixture into a large clay crucible and cover it with the lid. Expose to a full red heat till all effervescence has ceased and complete fusion has taken place. Pour out the fused salt on a clean flagstone, and as soon as it has solidified, and while it is still warm, put it into the boiling water, stirring diligently. When the salt has dissolved filter the solution through paper and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering-paper, enclose them in stoppered bottles.—*Br.*

On fusing arsenious acid in the proper proportions with carbonate and nitrate of sodium, carbonic acid gas, CO_2, and nitrous anhydride, N_2O_3, are given off, and the residue is converted into pyroarseniate of sodium, as will be seen from the equation $As_2O_3 + 2NaNO_3 + Na_2CO_3 = Na_4As_2O_7 + N_2O_3 + CO_2$. The pyroarseniate, on being dissolved in water, is converted into orthoarseniate by combining with water; $Na_4As_2O_7 + H_2O$ yields $2Na_2HAsO_4$, and this salt crystallizes with $7H_2O$. The carbonate may be conveniently replaced by an equivalent quantity of solution of caustic soda, in which the arsenious acid may be dissolved, and the residue left on evaporation to dryness should then be oxidized by fusion with sodium nitrate; all danger of expelling arsenic by injudicious heating will then be avoided. The same salt is also obtained on oxidizing arsenious to arsenic acid by means of hot nitric acid, dissolving the dry residue in hot water, and adding sodium carbonate as long as effervescence is produced.

Properties.—Arseniate of sodium crystallizes in colorless, transparent, inodorous prisms having a faint alkaline taste, and which usually contain $7H_2O$ or 40.4 per cent.; when obtained at a low temperature they contain $12H_2O$ or 53.7 per cent. The officinal salt is slightly deliquescent in a moist atmosphere, but in dry air it effloresces and loses $5H_2O = 28.8$, the white powder which is finally left having the composition $Na_2HAsO_4.2H_2O$ and containing 16.2 per cent. of water of crystallization, which is given off near 148° C. (299.4° F.). The salt is soluble at 15° C. in 4 parts of water, is slightly soluble in cold alcohol, and is freely soluble in boiling water and in 60 parts of boiling alcohol. The aqueous solution has a slight alkaline reaction, and yields white precipitates with the soluble salts of barium, calcium, zinc, iron, and lead, and a brownish-red precipitate with nitrate of silver, all these precipitates being soluble in nitric acid, and that with ferric salt turning red by heat. Sulphuretted hydrogen produces in the cold slowly, but rapidly on being acidulated and heated, a yellow precipitate, which is completely soluble in sulphydrate of ammonium. When heated upon charcoal before the blowpipe the salt gives off an alliaceous odor.

Fig. 281.



Crystal of Sodium Arseniate.

Tests.—The cold aqueous solution of the salt, acidulated with hydrochloric acid, should not at once produce a yellow precipitate or assume a yellow color on the addition of solution of hydrosulphuric acid (absence of arsenite).—*U. S.* An aqueous solution of 12.4 grains of anhydrous arseniate of sodium, acidulated with acetic acid, requires not less than 34 grains of acetate of lead for complete precipitation.—*Br.* This test is intended to show the absence of notable quantities of other salts.

Off. Prep.—Ferri arsenias, *Br.*; Liquor sod. arseniatis, *U. S.*, *Br.*

Other Arseniates of Sodium.—If an excess of carbonate of sodium is used in the formula given above, the aqueous solution will contain *trisodic arseniate*, and yield crystals having a stronger alkaline reaction and the composition $Na_3AsO_4.12H_2O$. With an excess of arsenic acid crystals of *monosodic arseniate*, $NaH_2AsO_4.H_2O$, may be obtained.

Medical Action and Uses.—Arseniate of sodium is said to be less apt than arseniate of potassium to produce the phenomena of arsenical poisoning, whether locally upon the stomach or, through the blood, in the eyelids, conjunctivæ, etc. It might be suspected that the difference, if real, would indicate that it is less efficient. The fact, however, is declared to be otherwise. This preparation is seldom used, and then in the form of the officinal solution. 1 part dissolved in 30 parts of water is made use of to saturate unglazed linen paper, from which the so-called anti-asthmatic cigars are prepared. The *dose* of the arseniate is from $\frac{1}{20}$ to $\frac{1}{8}$ grain (Gm. 0.003—0.008).

SODII BENZOAS, *U. S.*—BENZOATE OF SODIUM.

Natrium benzoicum, P. G.; *Benzoas sodicus.*—*Benzoate de soude*, Fr.; *Natriumbenzoat*, *Benzoesaures Natron*, G.

Formula $NaC_6H_5O_2.H_2O$. Molecular weight 162 (anhydrous $NaC_7H_5O_2 = 144$).

Preparation.—Add to 10 parts of benzoic acid suspended in 20 parts of hot water, gradually, 7 parts of sodium bicarbonate; after the evolution of carbonic acid gas has ceased, neutralize the liquid exactly by the addition of a little benzoic acid, or if necessary with sodium bicarbonate; filter, and evaporate with frequent stirring until the residue weighs between 13½ and 14 parts. As the salt separates it creeps up on the sides of the dish, and should therefore be frequently scraped off and returned to the liquid portion. When sufficiently concentrated the mass is stirred until cold, when the remaining water will evaporate. The yield is 13¼ parts. This salt being very efflorescent, the German Pharmacopœia directs it to be made anhydrous, for which purpose the above solution is evaporated to dryness, when the yield is 11⅘ parts. If prepared with acid sublimed from benzoin, the solution of the salt has a brown color and the dry salt is brownish or gray.

Properties.—Benzoate of sodium is described as being a "white, semi-crystalline, or amorphous powder, efflorescent on exposure to air, odorless or having a faint odor of benzoin, of a sweetly-astringent taste free from bitterness, and having a neutral reaction; soluble in 1.8 parts of water and in 45 parts of alcohol at 15° C. (59° F.), in 1.3 parts of boiling water, and in 20 parts of boiling alcohol. When heated the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a blackened residue of an alkaline reaction which imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On mixing an aqueous solution of the salt with a solution of ferric sulphate previously diluted with water, a flesh-colored precipitate is produced."—*U. S.* "The anhydrous salt is white, amorphous, and soluble in 1.5 parts of water and less soluble in alcohol. A solution of the salt in 10 parts of water has a faint acid reaction, and on the addition of hydrochloric acid yields a magma containing white crystals (of benzoic acid) which are soluble in ether."—*P. G.* According to Hager, the anhydrous salt dissolves in 13.5 parts of 90 per cent. alcohol, in 4.5 parts of 60 per cent. alcohol, in 15 parts of glycerin, and is insoluble in ether, chloroform, and volatile oils; when heated, the salt becomes brown, and afterward melts near 450° C. (842° F.) to a dark-brown mass, which, ignited, burns for a short time only.

Tests.—"If the benzoic acid be separated from the salt by precipitating it with diluted nitric acid and thoroughly washed, it should respond to the tests of purity mentioned under ACIDUM BENZOICUM."—*U. S.* Besides this test of identity, the following tests of purity may be mentioned: "A solution of the salt in 20 parts of water should not be rendered turbid by barium nitrate (sulphate), and, after acidulating with nitric acid and adding alcohol until the crystals of benzoic acid have been redissolved, the addition of silver nitrate should not produce a precipitate (chloride)."—*P. G.* An opalescence with the last test is permitted. The solution of the salt in 40 parts of water rendered alkaline by lime-water should not give a white precipitate (carbonate, tartrate).

Medical Action and Uses.—In 1841, Ure observed that benzoic acid or an alkaline benzoate caused the uric acid to be replaced by hippuric acid in the urine, so that when taken internally they tended to prevent the formation of uric-acid gravel. Practically, these agents have been found useful in gout and rheumatism and the various ailments dependent upon either affection. In 1879, Salkowski showed that sodium benzoate very largely increases the secretion of nitrogenous and sulphurous compounds with the urine, and drew the conclusion that, while it should be useful in all diseases in which the blood is overcharged with effete matters, it must be injurious in all wasting disorders (*Virchow's Archiv*, lxxviii. 530). In 1879 there was published in a Vienna medical journal a statement that the inhalation of benzoate of sodium was capable of curing tubercular phthisis even after cavities had formed, but not long afterward experiments were made by other physicians, who declared that "they failed to yield the slightest favorable result or a trace of even the most trifling diminution of dangerous symptoms" (*Times and Gaz.*, Nov. 1879, pp. 585, 643). Before another year the medicine had been put to the clinical test in Berlin also, and found to be useless in phthisis (*Ibid.*, Jan. 1880, p. 94). One or two physicians stated that the inhalation had an anæsthetic action upon the throat, and was, under certain circumstances, not without utility.

Salkowski, Fleck, and Buchholtz discovered that sodium benzoate prevents the development of bacteria in putrescible liquids, and Graham Brown (*Arch. f. Pathol. und Pharm.*, viii. 151) found that diptheritic fluids lose their contagious quality more speedily in a solution of benzoate of sodium than in one of salicylate of sodium or muriate of quinine. Letzerich declared that in his hands no other remedy had produced such rapid and lasting effects in *diphtheria.* In patients under the age of three years he prescribed 120 grains a day; between the third and seventh year the daily dose was from 120 to 180 grains; for children more than seven years old, 150 to 240 grains; and for adults, 150 to

360 grains. Moreover, the exudation was treated with insufflations of the powdered benzoate every three hours or less frequently, according to circumstances, or in older persons gargles were used containing the salt (*Boston Med. and Surg. Jour.*, July, 1879, p. 88). In opposition to the favorable results just referred to, we find that in Vienna the salt was not successful (*Amer. Jour. of Med. Sci.*, Jan. 1880, p. 254). Various other physicians, including Klebs and Kien, reported favorably of this treatment, while others, even in Germany, were unable to see its advantages, and outside of that country it has not found acceptance. It is needless to refer particularly to the curative virtues attributed to it in acute rheumatism, puerperal fever, pneumonia, whooping cough, etc. Whatever they may have appeared to those who promoted its use, they have not prevented the medicine from quite fading out of view.

SODII BICARBONAS, *U. S., Br.*—BICARBONATE OF SODIUM.

Sodæ bicarbonas, Br.; *Natrium bicarbonicum*, P. G.; *Natrium carbonicum acidulum*, *Bicarbonas sodicus.*—*Bicarbonate of soda*, *Sodium hydrocarbonate*, E.; *Bicarbonate de soude*, *Sel digestif de Vichy*, Fr.; *Natriumbicarbonat*, *Doppeltkohlensaures Natron*, G.

Formula $NaHCO_3$. Molecular weight 84.

Bicarbonate of sodium should be kept in well-dried stoppered bottles.

Preparation.—Take of Carbonate of Soda 2 pounds; Dried Carbonate of Soda 3 pounds; White Marble, in fragments, 4 pounds; Hydrochloric Acid 1 gallon; Water 2 gallons; Distilled Water a sufficiency. Fill with the water a tubulated glass bottle having a few small holes drilled in the bottom; connect the tubulure tightly by a bent tube and corks with an empty two-necked bottle, and connect this with another bottle filled with the carbonates of soda well triturated together, and let the tube be long enough to reach the bottom of the bottle. Before fixing the cork in the bottle containing the carbonate of soda partially immerse the bottle containing the marble in the hydrochloric acid, previously diluted with the water and placed in any convenient vessel. When the whole apparatus is filled with carbonic acid gas fix in tightly the cork of the bottle containing the carbonate of soda, and let the action go on until the gas ceases to be absorbed. Pour upon the damp salt which is formed half its weight of cold distilled water, and shake it occasionally during the course of half an hour; then drain the undissolved portion, and dry it by exposure to the air on filtering-paper placed on porous bricks.—*Br.*, 1867.

This salt is rarely if ever prepared by the pharmacist, but is manufactured on the large scale, one of the processes being described above. Bicarbonate of sodium does not contain any water of crystallization; a portion of the carbonate is therefore used in the exsiccated state, and another portion in crystals, which, if used in the proportion given above, contain more than sufficient water for the conversion of all the carbonate used into bicarbonate. This is produced according to the equation $Na_2CO_3 + CO_2 + H_2O = 2NaHCO_3$, and the excess of water removed by draining and exposure to the air. In the United States the process of Dr. F. R. Smith (1830) is employed by some manufacturers. Crystallized carbonate of sodium is placed in a chamber arranged in such a manner that water may be drained off; carbonic acid gas is then conducted into the chamber, and, combining with the salt, forms bicarbonate, while the water is liberated and is carried off to prevent its action as a solvent. By this arrangement the crystalline structure of the carbonate is usually not disturbed, except that the crystals lose their transparency and become opaque in proportion as the carbonate is converted into bicarbonate, and are porous and friable.

The same salt is also obtained in Solvay's process for soda: a concentrated solution of sodium chloride is mixed with ammonia, and the liquid saturated with carbonic acid gas under a pressure of about two atmospheres, when sodium bicarbonate is deposited and ammonium chloride remains in solution.

It is obviously not essential that the carbonic acid needed in this operation should be generated from marble; the same gas is largely produced in establishments where saccharine substances are undergoing fermentation, and is obtained as a waste product in many chemical operations. In some manufactories the products of combustion of the fuel used for heating steam-boilers are deprived of their impurities by washing, and subsequently utilized for saturating, at least in part, the carbonate of sodium with carbonic acid. Large quantities of this salt are manufactured in the United States, and its importation has decreased from nearly 7,000,000 pounds in 1875 to about 2,000,000 pounds annually; in 1881 it was 1,195,851 pounds.

Bicarbonate of sodium as obtained by the above processes is recognized by the United States Pharmacopœia as *Sodii bicarbonas venalis*, or *commercial bicarbonate of sodium.* It often contains carbonate of sodium, and sometimes other impurities, from which it should be freed before it is used for medicinal purposes. A suitable process is the one given by the U. S. P. 1870, modified so as to yield a product of the purity required by the present Pharmacopœia.

Purification.—Introduce 4 pounds of commercial bicarbonate of sodium gradually into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour 6 pints of water upon it. When the liquid has ceased to drop, or when the washings cease to give a brown-red precipitate with a solution of mercuric chloride, remove the bicarbonate of sodium from the percolator, and dry it on bibulous paper or upon porous tiles in a cool place.

Bicarbonate of sodium is far less readily soluble in cold distilled water than the impurities which are usually present, and in percolating water slowly through it these foreign compounds, consisting mainly of carbonate and of traces of sulphate and chloride of sodium, are dissolved, together with a portion of the bicarbonate. The percolate may be utilized, after boiling for a short time, as a solution of carbonate of sodium. In the presence of water, however, the salt slowly parts with a portion of its carbonic acid, and more rapidly on a strong agitation and at an elevated temperature. While by this process the salt may be obtained of pharmacopœial purity as long as it is contained in the percolator, its removal from the apparatus and its exposure during drying are likely to occasion a further loss of the acid. It is therefore better to select a commercial salt which is otherwise pure, and keep it in thin layers in an atmosphere of carbonic gas until it answers to the rigid requirements of the Pharmacopœia..

Properties.—*Commercial bicarbonate of sodium* is a white inodorous powder, has a mildly saline not unpleasant and scarcely alkaline taste, and is of a slight alkaline reaction. It remains unaltered in a dry atmosphere at ordinary temperatures. It is insoluble in alcohol and ether, and requires at 15° C. (59° F.) 12 parts (*U. S.*), 13.8 parts (*P. G.*), of water. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 8.88, at 20° C. (68° F.) 9.84, and at 60° C. (140° F.) 13.68, parts of sodium bicarbonate; it dissolves in much less hot water, carbonic acid gas being given off. A similar decomposition takes place on concentrating its solution over sulphuric acid or on keeping the salt under water or in contact with moist air. It is also soluble in glycerin without change, but in the presence of borax carbonic acid gas is given off and sodium carbonate remains behind; a mixture of bicarbonate and borate of sodium is not decomposed by cold water. When heated to about 70° C. (158° F.) it begins to lose carbonic acid gas and water, the loss increasing with the temperature, so that at about 120° C. (248° F.) a salt of the composition $Na_4H_2(CO_3)_3$ is left, and above 450° C. (842° F.) Na_2CO_3 is obtained, the total loss being 36.9 per cent. The salt imparts to a non-luminous flame an intense yellow color, which on being examined through a blue glass does not, or only transiently, appear red. It dissolves with brisk effervescence in diluted acids, forming solutions in which chloride of platinum causes no precipitate. If the salt is treated with a small quantity of water, insufficient for solution, the liquid frequently reacts in the cold with a solution of sulphate of magnesium, producing a white precipitate, and causes with a solution of corrosive sublimate a dark brown-red precipitate, both reactions being due to carbonate of sodium, which is usually present in small amount.

Pure bicarbonate of sodium has the same appearance as the commercial article, but differs from it in the absence of those reactions which are occasioned by the impurities, and in the somewhat larger amount of carbonic acid gas which it yields.

Composition.—The formula of bicarbonate of sodium given above represents 36.90 per cent. Na_2O, 52.38 per cent. CO_2, and 10.72 per cent. H_2O.

Tests.—"A 1 per cent. solution of the salt, supersaturated with nitric acid, should yield at most only a slight opalescence with test solution of nitrate of silver (limit of chloride) or chloride of barium (limit of sulphate)."—*U. S.* The same test is given by the P. G., but a 5 per cent. solution is used, and the opalescence is required not to make its appearance, the first in 10 minutes, and the second in 2 minutes; the test of the U. S. P. is more in accordance with obtainable results. "On heating a small quantity of the salt with solution of soda no ammoniacal vapor should be given off. If 2 Gm. of the salt are dissolved, with very gentle agitation, in 30 Ccm. (left in contact for 10 minutes with 15 Ccm., *P. G.*) of cold water, and the solution added to a cold solution of 0.3 Gm. of mercuric chloride in 6 Ccm. of water, only a white cloud, but neither a red (red-brown, *P. G.*) precipitate nor a red (red-brown, *P. G.*) color should make its appearance within three minutes (5 minutes, *P. G.*) (absence of more than about 3 per cent. of carbonate)."—*U. S.*, *P. G.* To avoid loss of carbonic acid gas, agitation should be avoided as much as possible, and should be very gentle; it is unnecessary to dissolve the bicarbonate completely in the water, since monocarbonate and sesquicarbonate of sodium are more readily soluble in water, and therefore accumulate in a solution made with a quantity of water insufficient for completely dissolving the salt. Hager modifies this test by diluting the mercuric solution with the water directed above and pouring this liquid upon the powder, which in the presence of carbonate acquires a yellow or red-brown color. "The solution of the salt acidulated with acetic acid should not be colored or precipitated by hydrosulphuric acid (metals)."—*P. G.* "To neutralize 4.2 Gm. of bicarbonate of sodium should require not less than 49.5 Ccm. of the volumetric solution of oxalic acid (corresponding to at least 99 per cent. of bicarbonate of sodium of the required degree of purity)."—*U. S.* This test is of no value unless the absence of a notable proportion of carbonate of sodium has been proved.

The pharmacopœial tests for the purity of *commercial bicarbonate of sodium* are as follows: "A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not yield an immediate precipitate with test solution of nitrate of silver (limit of chloride) or of chloride of barium (limit of sulphate). If a portion of the salt be agitated with a quantity of water insufficient to dissolve it, the cold filtrate should not yield more than a slight precipitate with a concentrated solution of sulphate of magnesium (limit of carbonate). To neutralize 4.2 Gm. of the salt should require not less than 47.5 Ccm. of the volumetric solution of oxalic acid (corresponding to at least 95 per cent. of pure bicarbonate of sodium)."—*U. S.* Sodium carbonate, if present in small quantity, is not indicated by a cold solution of magnesium sulphate, but the test is sufficiently delicate for commercial bicarbonate. Minute quantities of carbonate are shown by solution of corrosive sublimate, which produces a brown-red precipitate of mercuric oxychloride. A mixture of calomel and pure sodium bicarbonate moistened with cold water remains white, but will assume a more or less deep-gray color in the course of a few hours, in proportion to the amount of carbonate of sodium present.

Off. Prep.—Liquor sodæ effervescens, *Br.*; Mistura rhei et sodæ, Pulv. effervescens comp., *U. S.*; Sodæ citro-tartras effervescens, *Br.*; Troch. sod. bicarbonatis, *U. S.*, *Br.*

Physiological Action.—Bicarbonate of sodium is much less apt than the carbonate of the same base or than the carbonates of potassium to derange the stomach, because, it may be, that it belongs to the natural constituents of the body, and is not so promptly eliminated with the urine. This statement has been illustrated by the comparative results of injecting into the veins of animals sodium and potassium carbonates. The latter occasion sudden death, while the former produce no ill effects whatever. The protracted administration of carbonate of sodium gives rise to symptoms which will be pointed out under that article. They are, to a greater or less degree, observed when the system is saturated with the bicarbonate. Although, when taken moderately and for a short time, no ill effects are produced, and although in many cases it is habitually used without sensible injury, it nevertheless tends to augment the acid secretions of the stomach and to perpetuate the evil it was designed to cure. It probably tends to diminish the richness of the blood, and hence to impair nutrition. According to Rutherford and Vignal, it does not appreciably affect the biliary secretion. If it is taken by persons who lead a sedentary life, and in whom there is usually a predominance of acids in the gastric and renal secretions, it may be less injurious than when active and laborious pursuits restrain the formation and accumulation of acids. For the same reason, probably, a very large amount of bicarbonate of sodium may be used, not only without injury, but with conspicuous advantage, in diseases distinguished by an excess of acid in the humors, as in inflammation, gout, acid gravel, rheumatism, and diabetes; while it uniformly aggravates affections in which the crasis of the blood is impaired, as in the so-called putrid fevers and chronic affections attended with impoverishment of the blood, as albuminuria, anæmia, scurvy, etc. It is stated that the eminent chemist Thénard produced in himself a real alkaline cachexia by continuing for several months to take bicarbonate of sodium in the daily dose of nearly an ounce. The danger of taking habitually large doses is also made very striking by their cachectic effects in Bright's disease, and by the excessive and unduly prolonged administration of Vichy waters, even in appropriate cases, such as gout, gravel, and rheumatism.

Medical Uses.—The form of *dyspepsia* in which bicarbonate of sodium is peculiarly useful is that attended with acidity of the primæ viæ, and of which the chief symptoms are sour eructation and vomiting, heartburn, flatulence, and acid liquid stools. In many cases the disorder is exclusively gastric, as in acid dyspepsia. In not a few hypochondriac symptoms are superadded. But in all of them the bicarbonate of sodium can do no more than palliate the special symptoms due to an acid fermentation of ingesta; a radical curative treatment must be attempted by other means, of which tonic medicines and regimen are the most influential. The palliative symptomatic treatment referred to is of essential service in the case of children, in whom interference with the primary digestion leads to grave and even fatal disorders. This is especially the case when their sole aliment consists of cow's milk, and the mischief can often be mitigated by adding a small portion of the bicarbonate to each portion of their food. It is essential in all cases of acid gastric dyspepsia that the bicarbonate should be taken after, and not before, meals.

In *lithiasis* a tendency to the formation of acid sand and *gravel* may be obviated by the use of this sodium salt after every meal. But it must not be overlooked that, according to competent testimony, the potassium salt is even more efficacious; and the plausible reason is assigned for the alleged fact that the latter passes off more readily than the former by the urine, and therefore tends more to maintain this fluid in a normal if not in an alkaline state. There is some reason to believe that bicarbonate of sodium is capable of producing the solution of urinary concretions already formed. It is reported to be singularly efficient in *suppression of urine* from renal disease, and even in that form of Bright's disease of the kidney in which the cause of the obstruction of the renal tubules with casts is proved by their abundance in the urinary sediment.

In *saccharine diabetes* occurring in persons of an obese habit there is little doubt that the prolonged use of the salt under consideration is sometimes of marked benefit. It is less so when the patients are thin and of a nervous constitution. Such has been the result of observations at Vichy, Carlsbad, and other alkaline mineral springs renowned for their virtues in this affection. The same waters are celebrated for their utility in *gout*. They are especially so in the simple and regular forms of the disease occurring in persons of good constitution and not yet exhausted by repeated attacks or by the complications to which the gouty become subject. In the latter case the system is already impaired, and unable to sustain the debilitating influence of an alkaline treatment. Under such circumstances a free use of alkaline water is apt to occasion a transference of the gout to internal organs, and sometimes it has led to a fatal termination of the disease. What has been said of gout applies in many respects to *biliary calculi*, for which alkaline mineral waters have always been used. According to some, the potash salt is preferable to the soda salt, but this notion is more than doubtful.

In *acute articular rheumatism*, and notably in those cases of it in which many joints are involved, and in which there is high fever, acid sweats, and loaded urine, the bicarbonate of sodium is of inestimable benefit, provided that it be given so as to maintain a neutral condition of the urine. Its efficacy is increased when the affected joints are swathed in compresses saturated with a solution of the salt. In the treatment of recent *burns* a saturated solution of this salt has been applied, with the effect of immediately relieving the pain and producing a rapid cure. This method was first proposed by Peppercorne (1844), and again recommended in 1882 (*Practitioner*, xxviii. xv.). Excellent reports of its virtues have been made by Troiski (*Med. News*, 1881, p. 679) and Koller (*Amer. Jour. Phar.*, June, 1880, p. 319). The part should be kept constantly wet with the solution. In the case of a burn of the second degree involving two-thirds of the face and both ears, and extending over the whole back of the neck down to between the shoulders, this result was obtained (Rogers). In 1881, Armangué and Giné treated acute *tonsillitis* by the direct application of powdered bicarbonate of sodium in the forming stage of the disease, and claimed to have prevented its development in most instances (*Practitioner*, xxviii. 448). The same treatment was subsequently used in this country by Stuver (*Med. News*, xli. 567), Skinner (*Ibid.*, xlii. 156), and Vinke (*Ibid.*, xliii. 216.) It has not yet been sufficiently tested, but it has at least the advantage of being harmless. A somewhat similar application has been made in contagious *ophthalmia* attended from the first with chemosis and granulations, as well as in chronic cases of granular conjunctivitis (*Times and Gaz.*, Oct. 1881, p. 516).

Bicarbonate of sodium may be prescribed in *doses* of from 5 to 30 grains (Gm. 0.30–2) and upward. The largest doses are required in acute rheumatism. When the doses must be large the medicine is most conveniently administered in carbonated water.

SODII BISULPHIS, *U. S.*—BISULPHITE OF SODIUM.

Natrium bisulfurosum, *Bisulphis sodicus.*—*Bisulphite de soude*, Fr.; *Natriumbisulfit*, G.
Formula $NaHSO_3$. Molecular weight 104.

Preparation.—This salt is employed in the arts for bleaching, and was called *leucogene* by Chaudet, who recommended it for this purpose. It is also used as *antichlor* for neutralizing the excess of chlorine after bleaching fabrics or paper-pulp, and has been recommended for the preservation of fermentable liquids and articles of food. It is prepared by saturating a solution of sodium carbonate with sulphurous acid gas and crystallizing in a cool place. Warm concentrated solutions treated in this manner usually separate on cooling *pyrosulphite of sodium*, $Na_2S_2O_5$.

Properties.—Bisulphite of sodium is in "opaque, prismatic crystals or a crystalline or granular powder, slowly oxidized and losing sulphurous acid on exposure to air, having a faint, sulphurous odor, a disagreeable sulphurous taste, and an acid reaction; soluble in 4 parts of water and in 72 parts of alcohol at 15° C. (59° F.), in 2 parts of boiling water, and in 49 parts of boiling alcohol. When strongly heated the salt decrepitates, and is converted into sulphur and sulphate of sodium. A small fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On adding hydrochloric acid to an aqueous solution of the salt sulphurous vapors are evolved, and the solution does not become cloudy (difference from hyposulphite)."—*U. S.* According to Muspratt, the salt on being heated gives off sulphur and sulphurous acid gas, the residue left being sodium sulphate. The salt being easily affected by exposure, it is difficult to keep it unaltered, even in stoppered bottles, and to preserve for it the purity required by the tests given below. Pyrosulphite of sodium resembles the pharmacopœial salt in its properties.

Tests.—"A 1 per cent. aqueous solution of the salt, acidulated with hydrochloric acid, should not yield more than a faint cloudiness with test solution of chloride of barium (limit of sulphate). If 0.26 Gm. of the salt be dissolved in 10 Ccm. of water, and a little gelatinized starch added, at least 48 Ccm. of the volumetric solution of iodine should be required before a permanent blue tint appears after stirring (corresponding to at least 96 per cent. of pure bisulphite of solution)."—*U. S.*

Medical Uses.—The action and uses of the bisulphite of sodium are essentially the same as those of the sulphite; it is, however, supposed to derive greater efficiency from the larger proportion of sulphurous acid in its composition. *Dose*, from 10 to 30 grains (Gm. 0.60–2).

SODII BORAS, *U. S.*—BORATE OF SODIUM.

Borax, Br., P. G.; *Natrium biboricum (pyroboricum)*, *Boras sodicus.*—*Borax*, E., Fr., G.; *Borate de soude*, *Bauracon*, *Sel de Perse*, Fr.; *Natrium pyroborat*, G.
Formula $Na_2B_4O_7.10H_2O$. Molecular weight 382.

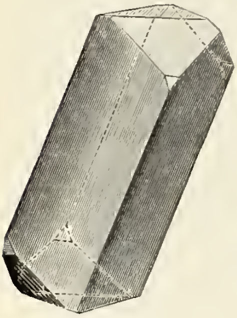
Origin and Preparation.—It is uncertain whether borax was known to and used by the ancients, and even in the Middle Ages it was frequently confounded with other salts. The observations of Homberg (see page 37). Geoffroy (1732), and others did not lead to correct views regarding the chemical nature of borax until Baron (1747) showed that the "sedative salt" exists in it combined with soda. Borax is found native as *tincal* in Persia, Thibet, and other localities, as a saline incrustation on the shores of certain lakes, and as a crystalline deposit at the bottom of the borax lake in California. The incrustation and the deposit are continually renewed by crystallization from the lake waters as fast as the borax is removed. Tincal requires to be washed with a solution of caustic soda for effecting the removal of fatty matter with which the crystals are covered, and on being afterward recrystallized from water yields borax. Borax is also prepared from various native borates which are found in Nevada, in certain parts of South America, Europe, and Asia, and which are known as the minerals *boracite*, *borosodocalcite*, *cryptomorphite*, etc. These consist of boric acid combined in varying proportions with sodium, calcium, and magnesium, and mixed with sulphates, chlorides, and silica, and yield borax on being treated with carbonate of sodium and after recrystallization from water.

Most of the borax is at present prepared from commercial crude boric acid, which is either boiled with a solution of soda, or, more generally, is fused together with calcined sodium carbonate. The Italian boric acid yields with the carbonic acid gas ammonia, which is also utilized. The fused mass is then dissolved in water, and this solution separated from the ferric hydrate and other impurities suspended in the liquor, and evaporated sufficiently, when it is permitted to cool slowly, so that large crystals are obtained, from which the mother-liquor is rapidly withdrawn.

Previous to 1880 the importation into the United States of borax amounted to about 3500 pounds annually, but in 1880 and in 1882 it exceeded 15,000 pounds, and in 1883 over four and one-third million pounds of boric acid were imported.

Properties.—Borax forms large, colorless, monoclinic prisms, which are transparent, inodorous, have a mild sweetish, cooling, and afterward alkaline taste, and in dry air effloresce superficially and become opaque. When heated it melts in its water of crystallization, and is converted into a light white spongy mass, which at a red heat fuses, and on cooling forms a transparent glass. Borax has the specific gravity 1.72, has a weak alkaline reaction, is insoluble in alcohol, but dissolves at 80° C. (176° F.) in 1 part of glycerin and at 15° C. (59° F.) in 16 parts of water. The glycerin solution imparts a green color to flame (Senier and Lowe, 1878). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 4.65 parts, at 20° C. (68° F.) 7.88 parts, at 30° C. (84° F.) 11.90 parts, at 40° C. (104° F.) 17.90 parts, and at 100° C. (212° F.) 201.43 parts, of crystallized borax. If a saturated solution of borax is prepared at an elevated temperature and kept at a temperature exceeding 56° C. (133° F.), borate of sodium containing $5H_2O$ will crystallize in octahedral crystals which are harder than borax. A cold solution of borax absorbs considerable quantities of carbonic acid and sulphuretted hydrogen, both gases being again expelled on heating and evaporating the liquid. On adding a mineral acid to a hot saturated solution of borax in water, a scaly crystalline precipitate is obtained on cooling, the alcoholic solution of which burns with a green flame, and the acidulated aqueous solution changes the color of turmeric-paper to brown. Borax held in a non-luminous flame imparts to it an intense yellow color.

Fig. 282.



Crystal of Borax.

Composition.—The water of crystallization amounts to 47.12 per cent., Na_2O to 16.23, and B_2O_3 to 36.65 per cent. The crystallized and the anhydrous salt, $Na_2B_4O_7$, are compounds of pyroboric acid (see p. 38).

Tests.—The solution of borax should not effervesce with acids (absence of carbonate), should not be colored or precipitated by sulphuretted hydrogen (heavy metals), and should not yield any precipitate or turbidity with carbonate of sodium or of ammonium (salts of calcium, etc.), nor, if acidulated with nitric acid, with barium chloride (sulphate) or with nitrate of silver (chlorides). These tests are applied in a 2 per cent. solution, and a slight opalescence within five minutes with the two last tests is permitted by the P. G., while the U. S. P. requires that no turbidity should appear in a 1 per cent. solution. Traces of chloride are always, and of sulphate occasionally, present in good commercial borax. "191 grains of borax dissolved in 10 fluidounces of distilled water require for saturation 1000 grain-measures of the volumetric solution of oxalic acid."—*Br.*

Off. Prep.—Glycerinum boracis, Mel boracis, *Br.*

Allied Salt.—Ammonii boras.—Borate of ammonium, *E.;* Borate d'ammoniaque, *Fr.;* Borsaures Ammonium, *G.* Formula $2(NH_4HB_2O_4).3H_2O$. Molecular weight 264.—For preparing it, 1 part of boric acid is dissolved in 3 parts of warm ammonia-water spec. grav. .960, and the solution allowed to cool slowly. The crystals are rapidly dried between bibulous paper and preserved in a well-stopped bottle. The salt crystallizes in white or transparent octahedrons which have a strong ammoniacal odor, and on exposure are converted into an acid salt; they dissolve in 12 parts of cold water, and the solution, when heated, evolves ammonia, and on evaporation separates transparent octahedral crystals of an acid salt which has no ammoniacal odor.

Physiological Action.—In the dose of 6 drachms borax has created no unpleasant effects except a temporary sense of oppression in the stomach, or, at most, nausea and vomiting. Continued large doses produce the same consequences as the prolonged use of other salts of sodium—viz. liquefaction of the blood and scorbutic symptoms, and sometimes an impetiginous eruption on the skin. Since borax was introduced into the treatment of epilepsy, Dr. Gowers has shown that an eruption of characteristic psoriasis may result from its use. Several cases of the sort which came to his knowledge were relieved of the cutaneous affection by arsenic (*Lancet*, Sept. 24, 1881). It is largely eliminated with the urine, either unchanged, or, after decomposition, as urate of sodium. It is secreted also with the saliva. Physiological experiment does not illustrate the action of this salt upon the uterine system, for it is only in certain special conditions of that system that its powers are manifested. According to Polli, borax is a powerful antiseptic and anti-fermentative.

Borax is well known to be hostile to the lower forms of animal life. It is a common domestic remedy for destroying cockroaches. In a solution of even less than 1 per cent. of this salt bacteria cannot be developed. In 1874 and subsequently it was found a very efficient preparation for the purposes of antiseptic surgery.

Medical Uses.—This substance is supposed to be described by Pliny under the name of chrysocolla; by the Arabians it was called tankâr (Sontheimer). The former speaks of its drying and healing action upon wounds when applied as a powder—of its use in sore throat, and in collyria for removing opacities of the cornea, and in plasters for effacing scars. The latter allude to its cleansing and astringent virtues, to its application in caries of the teeth, etc., and to its use by goldsmiths as a flux for gold. A solution of borax (gr. xxx to f℥j) (Gm. 2 to Gm. 32) is quite efficient in diminishing and even removing *freckles*, *chloasma*, and those unseemly eruptions by which some women are annoyed at the menstrual periods. A drachm of borax in half an ounce of cold cream forms an excellent ointment for *chilblains*. As a lotion for *ringworm of the scalp* a solution has been recommended of 1 drachm of borax in 2 ounces of distilled vinegar. Borax has also been applied with good effect in *pityriasis versicolor* and for removing *opacities of the cornea*. It is used to heal *ill-conditioned ulcers*, and especially those of the mouth occurring in *ulcerative stomatitis*, and also to restore their firmness to *spongy gums*. In the last cases particularly it should be associated with honey and myrrh. Borax is less efficient in them than chlorate of potassium, but like it acts only as a local stimulant. It is of constant use for the cure of *aphthæ* of the mouth and fauces occurring in nursing children. In the first-named affections it should be finely powdered with white sugar and applied directly to the affected part. It is equally efficacious in *thrush*, which proceeds from the acid fermentation of the milk and occurs in the buccal cavity, about the anus, etc. Mixtures of borax with honey and with glycerin will answer the same purpose, but perhaps less efficiently. These, or the powder, or a simple watery solution, may be applied to aphthous sores of the *vulva* and *vagina*, to fissures of the *nipples*, and to similar lesions. It is sometimes advantageous to associate with the borax Peruvian balsam, benzoin, or some analogous agent to modify or strengthen its action. They may be incorporated in a mixture made with yelk of egg, oil of almonds, etc. A solution of borax is one of the best topical applications in *prurigo pudendi*, and one of the most efficient vaginal injections for *leucorrhœa*, especially when it is due to superficial ulcers of the cervix.

In subacute *laryngitis*, especially as it occurs in children, a mixture of powdered borax with honey or syrup has been found serviceable by its stimulating action upon the adjacent pharyngeal mucous membrane. A like effect has been observed in *hoarseness* and in *aphonia* due to laryngeal congestion merely or to exhaustion of the larynx by an excessive use of the voice. The best mode of using it is to allow a piece of borax of the size of a pea gradually to dissolve in the mouth.

Very few writers upon therapeutics admit that borax stimulates the uterine system, *promoting menstruation* and *labor* and checking *hæmorrhage*. The difficulty of determining the precise value of an emmenagogue medicine is notorious, and in this case, at least as much as in others, large assertion is mixed with little proof. The power attributed to borax of exciting the gravid uterus to contraction does not appear to us susceptible of well-grounded doubt, and, while believing that it is efficacious in uterine hæmorrhage, we should find a demonstration of its value difficult.

Dr. Gowers (*Times and Gaz.*, April, 1880, p. 447) states that in some inveterate cases of *epilepsy*, in which the bromides had no effect, he tried borax without advantage sometimes, but in a certain number of instances its value was distinct. The doses were 10 or 15 grains twice or three times a day. Sometimes it occasioned gastro-intestinal disturbance, and rarely a form of dysenteric diarrhœa. A tendency, which it showed, to cause a scaly eruption has been noticed above.

The utility of solutions of borax in cases of *uric-acid gravel* is very great. Entering the urine nearly unchanged, a great part of the borax taken presents itself to the uric acid, which decomposes it, forming a soluble urate of sodium, which, with the freed boracic acid, is discharged. Borax may be given internally in the *dose* of from 5 to 30 grains (Gm. 0.30–2), in watery solution largely diluted.

BORATE OF AMMONIUM was proposed as a remedy for disorders of the *urinary secretion* attended with an excess of acid or of earthy phosphates and irritability of the bladder.

It does not, however, seem to have answered these purposes, since it has completely fallen into disuse. Yet it would seem to be nearly as well fitted for them as borate of sodium. The *dose* is from 10 to 20 grains (Gm. 0.60–1.30), in an abundant watery solution.

SODII BROMIDUM, *U. S., Br.*—BROMIDE OF SODIUM.

Natrium bromatum, P. G.; *Bromuretum sodicum.—Bromure de sodium*, Fr.; *Bromnatrium*, G.

Formula NaBr. Molecular weight 102.8.

Preparation.—Bromide of sodium may be prepared in a manner similar to bromide of potassium (see page 1210). A solution of ferrous bromide, boiled with a solution of carbonate of sodium, yields a precipitate, the filtrate from which is evaporated and crystallized.

Properties.—At a temperature of about 20° C. (68° F.) and below colorless, transparent, oblique-rhombic prisms are obtained having the composition $NaBr.2H_2O$ (mol. weight 138.8), and when heated melt and give off the water of crystallization. But when the solution is kept at a temperature above 30° C. (86° F.), anhydrous cubes of bromide of sodium are obtained, which have a saline, somewhat alkaline, and scarcely bitterish taste, and a neutral or faint alkaline reaction. The salt is usually met with in the form of a white crystalline, inodorous powder which is permanent in dry air, and is stated to be soluble in 0.5 part of boiling water, in 11 parts of boiling alcohol (*U. S.*), and at 15° C. (59° F.) in 1.2 (*U. S.*) or 1.8 (*P. G.*) parts of water and in 13 (*U. S.*) or 5 (*P. G.*) parts of alcohol. According to Kremers (1856), 1 part of the anhydrous salt is soluble at 0° C. (32° F.) in 1.29, at 20° C. (68° F.) in 1.13, and at 100° C. (212° F.) in 0.87, parts of water, and the saturated solution boils at 121° C. (250° F.). According to Hager, the anhydrous salt is soluble in 10 parts of 90 per cent. alcohol and in 3 parts of 60 per cent. alcohol, while the hydrated salt requires 7 parts of the former and 2.25 parts of the latter for solution. The hydrated salt melts in its water of crystallization, but the anhydrous salt requires a red heat for fusion, and then volatilizes slowly without decomposition. The salt imparts to a non-luminous flame an intense yellow color, which, when observed through a blue glass, should not appear permanently red (*U. S., P. G.*). "If disulphide of carbon be poured into a solution of the salt, then chlorine-water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint."—*U. S.* The P. G. employs ether for this test of identity. Hager recommends the following as simple and efficient: Pour slowly 3 Ccm. of solution of copper sulphate, containing 20 per cent. of the salt, upon 0.3 Gm. of powdered sodium bromide, which will at once become black or black-brown (potassium bromide remains white, ammonium bromide turns red-brown); on agitation a nearly clear blue or greenish-blue solution will result (a green turbid liquid indicates presence of iodide); on the further slow addition of 1 Ccm. of concentrated sulphuric acid black cupric bromide is separated. The salt differs from bromide of potassium in imparting a yellow color to flame, and in not being precipitated from its concentrated solution by a strong solution of acid tartrate of sodium.

Tests.—The pharmacopœias give nearly identical tests for alkalinity, bromate, iodide, sulphate, and chloride, as follows: "Fragments of the salt placed upon moistened (not wet) red litmus-paper should not at once turn it blue (limit of alkalinity)."—*P. G.* "If diluted sulphuric acid be dropped on a portion of the salt, the latter should not at once assume a yellow color (absence of bromate). On adding to 1 Gm. of the salt, dissolved in 20 Ccm. of water, 5 or 6 drops of test solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 Ccm. (in 100 Ccm. *P. G.*) and 10 Ccm. of this solution be treated with a few drops of test solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 29.8 Ccm. (29.6 Ccm. *P. G.*) of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than 3 per cent. of chloride)."—*U. S., P. G.* "If 1 Gm. of the salt be dissolved in 10 Ccm. of water, some gelatinized starch added, and then a few drops of chlorine-water be carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids (absence of iodide)."—*U. S.* "If 20 Gm. of a 5 per cent. solution of the salt be mixed with a few drops of solution of ferric chloride, and then agitated with chloroform, the latter should not acquire a violet color (iodine)."—*P. G.* 1 Gm. of the salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.824 Gm. of dry bromide of silver; in the presence of sodium chloride the precipitate will weigh more.

Medical Action and Uses.—Although various theoretical considerations have been regarded as sufficient to prove the bromide of sodium preferable as a medicine to the potassium bromide, physiological experiment and clinical observation agree in teaching that sodium bromide possesses in a less degree the characteristic sedative and hypnotic properties of bromide of potassium. It has been claimed to be more eligible than the latter salt, because it does not excite an eruption of acne nor occasion hebetude of mind or body; but the latter symptom is the very index of the efficiency of the potassium salt, at least in epilepsy; and if it fails to occur under bromide of sodium, the occurrence can only be taken as a proof that the latter is inoperative in cases for which the potassic bromide is appropriate. It is given in the same *doses* as bromide of potassium. In point of fact, however, bromization of the nervous system is produced by the sodium salt when taken in large doses. Cutler has related (*Boston Med. and Surg. Jour.*, Mar. 1884, p. 248) the case of a man who took about 4 ounces of this compound in one week. Torpor, sopor, and lethargy succeeded one another; the skin was dusky and cool, the pulse and breathing slow; the urine was nearly suppressed, and reflex irritability abolished. The patient lay in a sound sleep for 18 days. Similar cases have before been observed (Schweig, *Med. Record*, xi. 841). In one of them there were "incoherency of speech and action, hallucinations of sight and hearing, delusions of various sorts, a general aspect of imbecility, and an almost entire absence of rational conduct." Yet the patient on recovery recollected perfectly many occurrences that had taken place during his period of mental darkness.

In regard to the relative value of the sodic and potassic bromides in the treatment of *epilepsy*, it would appear that the former is inferior to the latter, because it exerts less of that sedative influence on the nervous system which the mitigation of the disease requires. Dujardin-Beaumetz and Voisin entirely reject the use of the sodium salt in epilepsy, and the weightiest evidence is on the same side of the question. Nevertheless, this salt should be used when the other disagrees with the patient or is contraindicated by a state of debility. There is no doubt, as already said, that its action is less depressing, that its taste is less offensive, that it does not tend to produce an acneïform eruption, and that it is not so apt to render the breath fetid. Hence it is to be preferred in all the affections, except epilepsy as a rule, in which the bromides are indicated, and especially when the patients are young or delicate persons. The practice of using the bromides to prevent *sea-sickness*, by producing a mild bromization, which has become very common since 1880, is reprobated by those who have had the best opportunity of forming a correct judgment of it as merely a mode of narcotic intoxication. In 1882 the case was published of Dr. F. R., who took an inordinate quantity of bromide of sodium (11 oz.) for the purpose referred to, and who under its influence became insane, jumped overboard, and was drowned.

Lactate of sodium has also been proposed as possessing hypnotic qualities (*London Med. Record*, Dec. 15, 1879), but none were shown among seventeen patients of Kroemer, even after very large doses of the salt had been taken. Others condemn it from its tendency to disorder the stomach and produce diarrhœa.

This medicine has been credited with antiseptic and germicide powers. Brackenridge attributed to its use the favorable issue of fifty cases of *scarlatina*. Pernot considers it a specific for *whooping cough* when the fumes given off by heating it impregnate the atmosphere breathed by the patients (*Edinb. Med. Jour.*, xxiv. 89). Dr. J. W. White (*The Mouth and the Teeth*, p. 136) says of this preparation that it is an antacid, an astringent, a sedative, a styptic, an antiseptic, and a disinfectant. As a wash for the mouth it is highly useful (when there are no local exciting mechanical causes) where the gums are spongy, swollen, and soft, and bleed at the slightest touch. It checks excessive bleeding after the extraction of teeth and relieves the subsequent soreness of the gums. It gives prompt relief to the distressing pains which sometimes follow extraction, corrects unpleasantness of the breath caused by decayed teeth or by the unhealthy secretions of the mouth, neutralizes acidity, and prevents putrefaction.

Carbolate of sodium may be given to adults in the *dose* of from 15 to 30 grains (Gm. 1–2) several times a day; the former of these doses may be administered to children without any risk.

SODII CARBONAS, *U. S.*, *Br.*—CARBONATE OF SODIUM.

Sodæ carbonas, Br.; *Natrium carbonicum*, P. G.; *Carbonas sodicus*, *Sal sodæ depuratus.*—*Pure carbonate of sodium*, E.; *Carbonate de soude*, Fr.; *Natriumcarbonat*, *Kohlensaures Natron*, G.

Formula $Na_2CO_3.10H_2O$. Molecular weight 286.

Origin and Preparation.—Both carbonate of sodium and of potassium were known at a very remote period, and by the ancients were called *nitron* and *nitrum*, which names were afterward applied to other salts (see page 1234). A distinction between the alkali carbonates was not made until after Duhamel's observation (1736) had shown table-salt to be the compound of an alkali, and until Marggraf (1759) had proved this alkali to differ from the vegetable alkali procured from the ashes of plants.

Carbonate of sodium exists in a large number of mineral waters, mostly, however, as bicarbonate. It is contained in the waters of certain lakes in India, Egypt, Central Africa, Mexico, and South America, and is found in the ashes of many plants growing near the seashore, such as Salsola, Statice, Salicornia, Atriplex, Mesembryanthemum, and others. These ashes are known in commerce as *barilla*, *salicor*, etc., the former containing nearly 30 per cent., the latter about 14 per cent., of sodium carbonate. *Kelp* and *varec*, the ashes of various marine Algæ, contain much less soda, and are at present not employed for obtaining this salt. Egyptian *trona*, a native carbonate of sodium, contains both carbonate and sesquicarbonate. In Hungary and some other countries carbonate of sodium effloresces from the earth.

The most important sources of this salt are cryolite and the sulphate and chloride of sodium. *Cryolite* is a mineral found in Greenland, and consists of fluoride of sodium and aluminium. When boiled with an excess of caustic lime, insoluble fluoride and aluminate of calcium are obtained and caustic soda remains in solution; and when a mixture of cryolite and chalk is cautiously heated to redness, but not to fusion, fluoride of calcium and aluminate of sodium are produced, this last compound being soluble in water and decomposed by carbonic acid, which precipitates aluminium hydrate, retaining a little sodium carbonate, while pure carbonate of sodium remains in solution.

The production of soda directly from sodium chloride has led to numerous investigations, and as early as 1838 it was accomplished by H. Dyar and J. Hemming; but the process, and more particularly the apparatus for the successful working of it, attained greater perfection since E. Solvay began to use it in 1865 on an extensive scale. It consists in conducting, under pressure, into a cold concentrated solution of chloride of sodium, first ammonia gas and afterward carbonic acid, when bicarbonate of sodium and chloride of ammonium are formed; most of the former salt is deposited, and after having been heated to redness requires to be dissolved in water and crystallized in order to obtain carbonate of sodium. In the first part of this process the reaction takes place between bicarbonate of ammonium and chloride of sodium, but the conversion of the latter salt into bicarbonate is never complete.

Carbonate of sodium is obtained by *Leblanc's process* from sulphate of sodium, which is mixed with chalk and coal and the mixture ignited; the mass is exhausted with water and the solution concentrated, the carbonate separating from the hot liquid being removed, while fresh portions of the solution are added until the carbonate becomes too much contaminated with foreign salts, when it is calcined with charcoal and afterward recrystallized. In the first part of this process carbonate of sodium and sulphate of calcium are formed by double decomposition, and the sulphate is reduced by the coal to sulphide; but the ignited mass contains also caustic soda, sulphate and hyposulphite of sodium. The crude product obtained by evaporating the first solution to dryness is sent to market as *soda-ash*, and of this 165,502,900 pounds were imported into the United States in 1876, and in addition to this 20,074,269 pounds of carbonate of soda and 32,093,691 pounds of caustic soda. The importation of soda-ash in 1883 reached 323,726,726 pounds, and in 1882, of carbonate and caustic soda, 29,842,140 and 56,878,896 pounds, respectively. Large quantities of these compounds are also manufactured here.

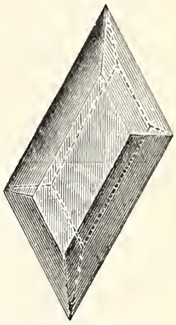
Properties.—As obtained in commerce, carbonate of sodium is in large, colorless, oblique-rhombic crystals, or frequently in crystalline lumps, inodorous, and with a harsh alkaline taste and a decided alkaline reaction. On exposure it becomes white and friable from the loss of water of crystallization, and ultimately falls into a soft white powder; the amount of this loss depends upon the temperature, and is in ordinarily dry air of 12.5° C. (54.5° F.) 31 per cent., and at about 35° C. (95° F.) 56.6 per cent.; the last molecule of water is expelled below the boiling-point of water. The salt melts between 32.5° C. (90.5° F.) and 34.5° C. (94° F.) in its water of crystallization, and after this has been expelled melts again at a red heat, at the same time parting with a portion of carbonic acid. In water heated to above the melting-point of the crystallized salt the solubility of the latter does not vary much; 1 part of it dissolves, according to Loewel (1851),

at	0°	10°	15°	20°	25°	30°	38°	104° C.,
in	4.7	2.44	1.6	1.08	0.67	0.37	0.088	0.185 parts of water.

The salt is insoluble in alcohol and ether. It effervesces strongly on the addition of an acid, and it imparts an intense yellow color to a non-luminous flame.

Sodii carbonas venalis, Natrium carbonicum crudum, *P. G.;* Sal sodæ, Soda cruda.—Sal soda, Washing soda, *E.;* Sel de soude, *Fr.;* Soda, *G.*—This is the salt generally met with in commerce. It should contain at least 32 per cent. of anhydrous sodium carbonate (*P. G.*); in other respects it resembles the pure salt. It is used for preparing the latter by recrystallizing from hot water until the crystals respond to the pharmacopœial tests of purity, and it is advisable to agitate the cooling solution, so as to obtain small crystals or a crystalline powder, which is readily freed from the mother-liquor by draining and washing with a little cold water. The pure salt should be kept in a well-stopped bottle in a cool place. 20 grains of it neutralize 9.7 grains of citric acid or 10½ grains of tartaric acid.

Fig. 283.



Crystal of Sodium Carbonate.

Tests.—Commercial carbonate of sodium contains small but variable quantities of sulphate and chloride, and its solution in water acidulated with nitric acid therefore produces precipitates with barium chloride and with nitrate of silver. Cryolite is the source of an impurity which is sometimes met with, and which consists of alumina rendered soluble in water by the soda; it is best detected by acidulating its solution in water with hydrochloric acid, heating to boiling, and then supersaturating with ammonia, when gelatinous aluminium hydrate will be precipitated. "The aqueous solution should be free from suspended or colored impurities, and, after being supersaturated with nitric acid, should not yield more than a trifling precipitate with test solution of nitrate of silver (limit of chloride) or of chloride of barium (sulphate). The aqueous solution should remain unaffected by hydrosulphuric acid, either before or after being supersaturated with hydrochloric acid (absence of metals). A solution of the salt acidified by the last-named acid, when supersaturated with ammonia and boiled, should not yield a gelatinous precipitate (alumina)."—*U. S.* With the exception of the last one, the tests of the P. G. are similar to those given above, and are applied in a 2 per cent. solution acidulated with acetic acid; the following delicate test for arsenic is added: Dissolve 2 Gm. of the salt in 10 Ccm. of diluted sulphuric acid; add a few drops of iodine (for converting sulphurous acid, if present, into sulphuric acid), afterward zinc, and proceed in the same manner as directed for the testing of hydrochloric acid (see page 65); the paper, moistened with solution of silver nitrate, should not be colored yellow or brown in 30 minutes.

The P. G. requires the salt to contain 37 per cent. of anhydrous carbonate or to be nearly chemically pure. Both the U. S. P. and Br. P. limit the purity to at least 96 per cent. of pure crystallized salt, when for neutralizing 7.15 Gm. of carbonate of sodium not less than 48 Ccm. of the volumetric solution of oxalic acid should be required (or for 143 grains of the salt 960 grain-measures of the solution).

Composition.—Pure crystallized carbonate of sodium contains 62.9 per cent. of water, 21.7 per cent. of Na_2O, and 15.4 per cent. of CO_2. When boiled with a little water a salt is deposited containing only 14.5 per cent. of water = $1H_2O$. Several other salts are obtainable, which crystallize with 3, 5, and $7H_2O$. Besides the carbonate and bicarbonate of sodium, another compound of intermediate composition may be obtained; this *sesquicarbonate* requires about 7 parts of water for solution, and contains nearly 22 per cent. of water.

Pharmaceutical Uses.—Carbonate of sodium is used in preparing Aluminii hydras, *U. S.;* Antimonii oxidum, Calcii carbonas, *Br.;* Liquor sodæ, Liquor sodæ chloratæ, *U. S.*, *Br.;* Magnes. carbonas, *Br.;* Massa ferri carbonatis, Pil. ferri comp., *U. S.;* Soda tartarata, Sodæ bicarbonas, *Br.;* Sod. carbonas exicc., *U. S.*, *Br.;* Sod. phosphas Zinci carbonas præcipit., *Br.*

SODII CARBONAS EXSICCATUS, *U. S.*—DRIED CARBONATE OF SODIUM.

Sodii carbonas exsiccata, Br.; *Natrium carbonicum siccum*, P. G.—*Dried carbonate of soda*, E.; *Carbonate de soude sec*, Fr.; *Getrocknete Soda*, G.

Formula $Na_2CO_32H_2O$. Molecular weight 142 (anhydrous $Na_2CO_3 = 106$).

Preparation.—Carbonate of Sodium 200 parts (4 oz.); to make 100 parts (2 oz.). Break the salt into small fragments, allow it to effloresce by exposure to warm air for several days, then expose it to a temperature of about 45° C. (113° F.) until it has been converted into a white powder weighing 100 parts. Pass the powder through a sieve and preserve it in well-stopped bottles.—*U. S.*

This is also the process of the German Pharmacopœia, and was admitted so as to facilitate the dispensing of carbonate of sodium. The warm air to which the crystallized salt is to be exposed in the beginning should be of a lower temperature than the melting-point (32.5° C.) of the salt, when a light and voluminous powder will be obtained. Working strictly according to the pharmacopœial directions, the salt will have the composition given above, and probably is a mixture of the mono- and terhydrated carbonate. Near and above 40° C. (104° F.) a salt of the formula $Na_2CO_3.HO_2$ is readily obtained, weighing 1⅜ oz., from 4 oz. of the crystallized salt. The product of the British Pharmacopœia is denser, the salt being at first fused in its water of crystallization, and afterward rendered anhydrous.

Properties.—Dried sodium carbonate is a soft white powder which answers to the tests and reactions of the crystallized salt. It is permanent at a temperature of 30° or 35° C. (86° or 95° F.), but at low temperatures absorbs moisture. 2.65 Gm. of the anhydrous salt, if pure, require for neutralization 50 Ccm. of the volumetric solution of oxalic acid; for the pharmacopœial salt not less than 36.3 Ccm. should be necessary, showing the presence of at least 72.6 per cent. Na_2CO_3.

History.—Under NITRATE OF POTASSIUM allusion has been made to the confusion between nitrum and natron, nitre and soda, in medical and natural history. It is probable that anciently they were not clearly distinguished from one another. It appears that originally the term *nitre* was applied to native carbonate of sodium, and that the same name was afterward given to the substance procured by lixiviation from the ashes of the beech, oak, and other trees.

Soda was used by the ancients only as an external remedy for repressing fungous granulations, stimulating indolent sores, curing eruptions of the skin, lessening perspiration, whitening the teeth, and destroying vermin. It was habitually dissolved in water and applied as soap is at present, and baths of a strong solution of it were employed in the treatment of gout, tetanus, etc.

Physiological Action.—The nature of the action of carbonate of sodium must be closely analogous to that of the bicarbonate, but it differs in being much more irritating. In experiments on animals the continued use of it in large doses occasions loss of appetite, vomiting, diarrhœa, and sometimes albuminuria, followed by death. On dissecting, the gastro-intestinal mucous membrane is tumid, the follicles are enlarged, the Malpighian corpuscles of the spleen increased in size and number, the acini of the liver are degenerated, the renal tubules obstructed, and the gums swollen and spongy. In experiments on man the secretions at first diminish and the body gains weight; subsequently, a reverse effect occurs. These changes chiefly affect the watery element of the urine; the urea is undiminished, but the uric acid at first declines, to rise again subsequently, notwithstanding the continued use of the alkaline carbonate. However these things may be, carbonate of sodium is certainly diuretic when duly administered. According to current chemico-physiological doctrines, the carbonates are converted by the gastric juice into chloride of sodium, which in its turn increases the secretion of acid in the stomach and promotes the digestion of food. It may also tend to dissolve the glairy mucus which in certain dyspeptic conditions coats the interior surface of the stomach, hinders the close contact of the food with the mucous membrane, and thereby diminishes the acid secretion. It may also neutralize the fatty acids generated in the stomach, and which prevent the due digestion of starchy food, for which a feebly alkaline menstruum is necessary (Husemann).

Carbonate of sodium is generally assumed to promote the secretion of all mucous surfaces and glands, which is altogether probable on clinical grounds, although experiments do not demonstrate it.

Experimental researches have shown that when from 1 to 5 drachms of this salt are daily taken by men for ten successive days the blood grows lighter in color, the proportion of its white corpuscles and water increases, while that of its other solid constituents declines and the clot exhibits a diminished firmness. Meanwhile, the strength is impaired and the skin grows pale. In excessive doses carbonate of sodium is irritant and corrosive, but not so much so as carbonate of potassium. Its proper *antidotes* are vinegar, lemon-juice, or a solution of tartaric acid. Subsequently cream or olive or almond oil may be administered.

Medical Uses.—In regard to the internal uses of carbonate of sodium little need be said in detail. They are the same as those of the bicarbonate, but they are much less frequently resorted to, on account of the greater mildness of the action of the latter salt. The carbonate is especially used now, as it was in ancient times, for the treatment of *diseases of the skin.* It is most frequently applied in a general bath, from 4 to 16 ounces of the salt being dissolved in a sufficient quantity of water at a temperature of about 80° F. Each bath should last for at least an hour. The effect of it is to redden the skin, to stimulate the affected portions to assume a more healthy action, and to remove the sebaceous and acid secretions adhering to it. If the skin is already in an irritable condition, very little of the alkali should be used, and its acrimony should be blunted by the addition of mucilage or bran to the water. Naturally, the dry eruptions (lichen, prurigo, lepra, psoriasis, pityriasis) are most apt to be benefited by this treatment, while pustular and vesicular affections (impetigo, eczema) are unsuited for its use, unless the solution is very weak. Lotions containing carbonate of sodium are useful in many local eruptions, as those of the scalp, in herpes circinatus, lichen agrius, intertrigo, and *pruritus of the vulva.* In some cases of inveterate scaly diseases, and in a less degree in chronic papular and pustular affections, the long-continued internal use of this medicine is sometimes curative, but seldom until it has produced more or less of the cachetic phenomena above mentioned.

Carbonate of sodium has also been employed in glandular *scrofula*, *whooping cough*, *congestion of the liver*, etc., but, except in the form of alkaline mineral waters, without notable advantage.

This salt is seldom administered internally, but its *dose* may be stated to be from 5 to 20 grains (Gm. 0.30–1.30), dissolved in water and largely diluted. From 2 to 8 ounces (Gm. 60–250) may be used in a general bath for diseases of the skin. A lotion for the same purpose should contain 15 or 20 grains to the ounce (Gm. 1.30 in Gm. 32) of water for scaly affections, and about half that proportion for lichenoid eruptions. A solution of the latter strength is appropriate as a wash for the mucous membrane of the female genital organs. An ointment for diseases of the skin may be made with about 1 drachm of the salt to an ounce (Gm. 4 in Gm. 32) of lard, with the addition of 1 or 2 fluidrachms (Gm. 8) of laudanum.

The medicinal qualities of dried carbonate of sodium are identical with those of the common carbonate. It is represented to be convenient for administration in pills, but the irritant qualities of the salt render this mode of prescribing it not only ineligible, but imprudent. The *dose* of it is stated to be from 3 to 10 grains (Gm. 0.20–0.60).

SODII CHLORAS, *U. S.*—CHLORATE OF SODIUM.

Natrium chloricum, *Chloras sodicus.*—*Chlorate de soude*, Fr.; *Natriumchlorat*, G.

Formula $NaClO_3$. Molecular weight 106.5.

Chlorate of sodium should be kept in well-stopped bottles, and should not be triturated with readily oxidizable or combustible substances.

Preparation.—This salt is most conveniently obtained, according to Wittstein, by preparing sodium bitartrate from 9 parts of crystallized sodium carbonate and 9.5 parts of tartaric acid, and adding the hot solution to one containing 8 parts of potassium chlorate. The cold liquid is filtered from the precipitated potassium bitartrate, evaporated, and crystallized. The last traces of bitartrate may be removed by recrystallization from alcohol. The yield is about 7.5 parts. The salt is also formed, like the corresponding potassium salt (see p. 1218), by passing chlorine into solution of soda and boiling; the resulting chlorate requires to be freed from chloride by repeated crystallization, involving considerable loss, owing to the ready solubility of both salts.

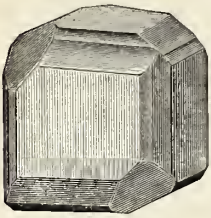
Hager recommends the following: Dissolve 100 parts of potassium chlorate and 60 parts of officinal dry sodium carbonate in 600 parts of warm water; allow to cool, add 300 parts of alcohol, set aside in a cool place for two days, decant the solution, distil off the alcohol, evaporate to crystallization, and purify by recrystallization. The yield is about 85 parts.

Properties.—Sodium chlorate crystallizes in the form of regular cubes, combined with the dodecahedron and tetrahedron. The crystals are colorless and transparent, or the salt is seen in a white crystalline powder, and is permanent in the air, inodorous, and has a cooling saline taste and a neutral reaction. According to Kremers (1856), it dissolves

at	0°	20°	40°	60°	80°	100° C.,
in	1.22	1.01	.81	.68	.57	.49 parts of water.

The saturated solution boils at 132° C. (269.5° F.). The salt dissolves at 16° C. (60.8° F.) in 34 parts of 83 per cent. alcohol (Wittstein), in 40 parts of alcohol at 15° C., and in 43 parts of boiling alcohol (*U. S.*). When heated it melts, gives off oxygen and chlorine, and leaves a residue having an alkaline (neutral, *U. S.*) reaction. This residue is soluble in water, imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass, and its aqueous solution, acidulated with nitric acid, yields with test solution of silver nitrate a white precipitate soluble in ammonia.—*U. S.*

Fig. 284.



Crystal of Sodium Chlorate.

Tests.—"The aqueous solution of the salt should not produce a white crystalline precipitate on the addition of a saturated solution of bitartrate of sodium (absence of potassium). A dilute, aqueous solution should yield no precipitate with test solution of chloride of barium (sulphate) or of oxalate of ammonium (calcium). and at most only a faint cloudiness with test solution of nitrate of silver (limit of chloride)."—*U. S.*

Medical Action and Uses.—This salt is identical in the nature of its properties with chlorate of potassium, but its action is milder. It has been but little used. The *dose* may be stated at from 5 to 20 grains (Gm. 0.30–1.30). but it can seldom be needed as an internal medicine. As a gargle or wash a solution of from 2 to 5 per cent. may be prescribed.

SODII CHLORIDUM, *U. S., Br.*—Chloride of Sodium.

Natrium chloratum, P. G.; *Chloruretum sodicum*, *Sal commune*, *s. culinare.*—*Common salt*, *Table-salt*, *Sodium chloride*, E.; *Chlorure de sodium*, *Sel commun*, *Sel de cuisine*, Fr.; *Chlornatrium*, *Kochsalz*, G.

Formula NaCl. Molecular weight 58.5.

Origin and Preparation.—Chloride of sodium is found native in extensive beds and in different geological formations, though mostly associated with clay and sulphate of calcium, and constitutes *rock-salt* or *sal gem* if very pure and transparent. This is mined, mechanically freed from the adhering impurities, and sold as rock-salt or purified by recrystallization. In some places holes are dug into the rock and filled with water, which is pumped up when nearly saturated with salt and evaporated.

Most saline springs contain chloride of sodium. If the salt is present in sufficiently large proportion, it is recovered by evaporation; but if present in the solution only in limited proportion, the spring water is first concentrated. in some parts of France and Germany, by pumping it up on a high scaffolding and causing it to trickle over layers of brushwood, whereby, from the largely-extended surface exposed to the air, much water is evaporated, and a brine is obtained which may be economically concentrated by artificial heat. Sometimes the brine contains also considerable proportions of gypsum and sulphate of sodium, which salts are deposited from the boiling brine and raked out; when nearly free from these salts and sufficiently concentrated the liquor is no longer mixed with fresh portions of the brine, but is maintained at an elevated temperature and the salt removed as it crystallizes. The size of the crystals, called grain of the salt, varies with the heat, and increases as the temperature falls.

Sea-water is a solution of various salts, prominent among which is chloride of sodium, which is contained in the waters of the large oceans to the amount of from 2.6 to 2.9 per cent., but is much less in the large bays and seas which are surrounded by land, and sinks—for instance, in the water of the Baltic Sea—to ½ per cent. The extraction of the salt from sea-water depends upon the climate, the water being removed either by freezing or by evaporation. When frozen, sea-water yields pure ice and leaves a more concentrated saline solution. In warmer countries the concentration is effected by spontaneous evaporation in shallow pits, the brine as it concentrates being conducted into other pits, and finally into reservoirs, where the salt is deposited.

The mother-liquors which are obtained in the several processes described are solutions of various salts, usually sulphates and chlorides, in some cases also of bromides of sodium, potassium, calcium, and magnesium, and they frequently yield salts or double salts of definite composition by being concentrated and exposed to either a low or an elevated temperature; they are used up in the preparation of sulphate of sodium, sulphate of magnesium, and bromine.

In addition to the large quantities of salt obtained in the United States, about 750,000,000 pounds of it are annually imported.

Properties.—When crystallized by spontaneous evaporation, chloride of sodium forms transparent cubes; but when the solution is evaporated at an elevated temperature, the crystals aggregate on the surface of the liquid in the form of white or translucent hollow pyramids. It is very frequently kept in the form of a white, granular, crystalline powder, which is inodorous and permanent in the air, unless contaminated with chloride of magnesium, when it becomes moist in a damp atmosphere. On the application of heat, chloride of sodium usually decrepitates, and at a red heat it melts and is slowly volatilized. It has a neutral reaction to test-paper, a density of 2.16, and a purely saline taste. It is very sparingly soluble in strong alcohol, and requires a little less than 3 parts of hot or cold water for solution. 100 parts of water dissolve at 0° C. (32° F.) 35.52 parts, at 14° C. (57.2° F.) 35.87 parts, at 25° C. (77° F.) 36.13 parts, at 60° C. (140° F.) 37.25 parts, and at 100° C. (212° F.) 39.61 parts, of chloride of sodium (Poggiale). On cooling the saturated aqueous solution to below the freezing-point of water, transparent colorless prisms, $NaCl.2H_2O$, are obtained, which melt above 0° C. (32° F.) and deposit a granular powder of the anhydrous salt. Dilute aqueous solutions of sodium chloride produce at a low temperature ice which is free from the salt, and concentrated solutions deposit crystals of the salt before they freeze. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass; the aqueous solution, acidulated with nitric acid, yields with test solution of nitrate of silver a white precipitate soluble in ammonia.—*U. S.*

Composition.—Chloride of sodium contains 60.6 per cent. of chlorine and 39.4 per cent. of sodium. Heated with sulphuric acid, hydrochloric acid is given off.

Tests.—The aqueous solution of chloride of sodium should not be precipitated by carbonate of sodium (absence of calcium, magnesium, etc.), chloride of barium (sulphate), sulphuretted hydrogen, or sulphydrate of ammonium (metals). "If 2 Gm. of the salt be digested with 20 Gm. of alcohol, the cold and filtered alcoholic solution evaporated to dryness, the residue dissolved in water, a little gelatinized starch added, and subsequently chlorine-water drop by drop, no colored tint should make its appearance at the line of contact of the two liquids (absence of iodide or bromide)."—*U. S.* Hager recommends for the same purpose the following simple test: Put into a dry test-tube sufficient of the powdered salt to form a layer about an inch (25 Mm.) thick; press it firmly with a glass rod, and add carefully twice this volume of a cold saturated solution of copper sulphate; the salt must retain its color and remain free from dark spots. (See SODII BROMIDUM.) "1 Gm. of chloride of sodium, when completely precipitated by nitrate of silver, should yield 2.450 Gm. of dry chloride of silver."—*U. S.*

Pharmaceutical Uses.—Chloride of sodium is used in the preparation of chlorine, hydrochloric acid, corrosive sublimate, and calomel.

History.—The economic and dietetic value of salt has been known from the remotest antiquity, and this, as well as its medicinal virtues, were dilated upon by Dioscorides, Pliny, and later authorities. Pliny, after speaking of its wonderful influence upon grazing animals, adds: "Ergo hercule vita humanior sine sale non quit degere: adeoque necessarium elementum est, ut transierit intellectûs ad voluptates animi quoque. Nam ita sales appellantur." According to Dioscorides, salt is drying, astringent, and tonic. It preserves animal bodies from putrefaction for ages. Medicinally, it is stimulating, cleansing, and resolutive. Mixed with various oils and other substances, it is used as an application for the stings of insects, the bites of serpents and other animals, etc.; it relieves headaches, cures bruises, heals ulcers, pustules, and papules, and represses the growth of warts and fungous granulations. It cures ulcers and swellings of the throat, mouth, and tongue, and a variety of cutaneous eruptions; mixed with wine, it is a wholesome purgative and anthelmintic; heated and enclosed in bags, it relieves muscular and other pains; and it is also an antidote to opium-poisoning. The Arabians dwell upon its dietetic virtues when eaten with fish, cheese, and food prepared with vinegar, and upon its power of sharpening the appetite and promoting digestion. They pronounced it fitter for full-blooded persons than for the thin and nervous, and they used it as a topical application in leucoma, pterygium, granular lids, etc.

Physiological Action.—A strong solution of salt stimulates the skin and is generally said to irritate the mucous membrane, but a weak one smarts the nasal passages less than simple water—a fact which the use of the nasal douche has made familiar. Kept in contact with the skin, a strong solution excites a papular eruption. There is no evidence of the absorption of salt by the unbroken skin. The serum of the blood contains from 4 to 6 parts per 1000 of chloride of sodium, while the red corpuscles contain chloride of potassium. The former abounds more in arterial than in venous blood, and in the portal more than in the hepatic veins. Salt exists in all the secretions, and is the chief source of the muriatic acid secreted by the stomach. Its special action in the blood is held to be that it promotes the passage of albumen to and from the cells by the perpetual changes which it occasions in the relative densities of the fluids within and without them. A large increase in the proportion of salt used with the food causes a corresponding increase in the excretion of urea; at the same time it quickens tissue-change and raises the temperature of the body. A few days after the complete withdrawal of salt from the food gastric oppression occurs, with a sense of tightness in the head and general weariness. Albumen may appear in the urine, and, on the other hand, in albuminuria it sometimes diminishes the abnormal excretion. Salt in excess retards the coagulation of the blood and reddens it; and, conversely, when salt is deficient the blood grows dark.

In due proportion salt increases largely the secretions of the salivary and gastric glands, stimulating the appetite. It appears not to increase the secretion of bile. It promotes the digestion of vegetable food and renders it more apt for absorption. Hence, probably, the greed for salt of all herbivorous animals, and the utility of those "salt-licks" to which the bison, deer, and other wild animals resort. For this reason also, in part, it is customary to mix salt with the fodder of horses and horned cattle. It is related that during a famine in Cornwall, Eng., when the poor had only potatoes to eat, they declared that they would be contented if only they had salt to eat with them. "In Holland the ancient laws ordained men to be kept on bread alone, unmixed with salt, as the severest punishment that could be inflicted. The effect was terrible; these wretched criminals are said to have been devoured by worms engendered in their own stomachs" (Somerville).

Salt is useful also by exciting a thirst for liquids, which aid in the solution of the food and render it fitter for absorption. In moderate quantities it augments the urine, but if long and largely consumed it lessens this excretion and renders it irritating, unless the thirst which it excites is gratified with copious draughts of water. It is notorious that an exclusive diet of salt food tends to produce scurvy, one of the most deplorable incidents of a sailor's life on long voyages. In this disease there is an extravasation of the blood, which may be illustrated by the experiment of immersing a frog's foot in salt water; a free transudation of the red corpuscles takes place.

In very large quantities salt occasions vomiting or diarrhœa, or both. The case is recorded of a man who swallowed a pound of salt in a pint of ale. He died within 24 hours with all the symptoms of irritant poisoning. His stomach and intestines were found excessively inflamed (Christison). Taylor relates the case of a girl who took half a pound of salt to relieve herself of intestinal worms; general paralysis ensued, and death.

Medical Uses.—It has been proposed to use salt for the cure of *intermittent fever*, upon the ground that it causes contraction of the spleen enlarged by the disease. From half an ounce to an ounce has been given for this purpose during the apyrexia, and usually, unless dissolved in too much water, it neither vomits nor purges. This is said to be a popular medicine in some river localities and among boatmen, who usually swallow a tablespoonful or so of salt mixed with gin. It has also been recommended to be taken after being roasted in a pan over a gentle fire (*Med. Record*, xiv. 198). There is no sufficient proof of the efficacy of the medicine. A similar remark may be applied to its use in pulmonary *phthisis*, notwithstanding certain physicians of repute have attested its benefits. This judgment does not apply to an ordinary incident of consumption, *hæmoptysis*, for which a teaspoonful of dry table-salt may be given at intervals of 15 or 20 minutes. Nothing appears to be so successful in arresting this form of hæmorrhage, but all the ingenious hypotheses invented to explain its apparent action are chimerical. If the hæmorrhage, like most others, did not usually cease spontaneously when the patient is kept perfectly still, the action of the salt would be less ambiguous. The same remarks are more or less applicable to the use of salt to arrest *epistaxis*, in which, however, it generally fails to give any evidence of hæmostatic virtues.

In the various forms of *scrofula* affecting the glands, the skin, or the bones salt has been used internally and externally, but chiefly in the latter mode, in sea-baths, and the baths of various mineral springs; and doubtless these agents are often useful through their stimulant operation, without any reference to their special saline constituents, in so far as they promote tissue-change. Gargles of salt water have been used with some advantage to promote the separation of the false membranes in *diphtheria*.

As salt is essential to the digestion of food, so is it of use in certain forms of *dyspepsia*, doubtless by promoting the secretion of the gastric juice, and perhaps also by its direct solvent action upon some kinds of aliment. It is especially indicated in those forms of dyspepsia which are attended with decomposition of the food in the stomach, causing flatulence, acidity, and pain, and either diarrhœa, as in children, or constipation, as in adults. It may be best administered in the form of natural mineral waters rich in this ingredient or in carbonic acid water.

In epidemic *cholera* the injection of salt and water into the veins has frequently been followed by temporary improvement; and it is claimed that a tablespoonful of a solution of 1 ounce of salt in ½ pint of water, given by the stomach at intervals of a quarter of an hour, has repeatedly arrested the disease. If such be the fact, its explanation may probably be that the saline solution acts directly upon the cholera poison, whose influence upon the gastro-intestinal mucous membrane produces the serous exhalation which constitutes the primary element of the disease. In a number of cases life has been saved from impending death from *hæmorrhage* by injecting gradually into the median vein about 2 pints of distilled or boiled water holding in solution about 90 grains of common salt and 15 grains of carbonate of sodium (*Centralbl. f. Therapie*, i. 387, 389). Salt is an ancient, and continues to be a popular, remedy for intestinal *worms*, especially for lumbricoid worms. There is no doubt that their production is favored by food that does not contain salt, and that a diet of salt food tends to dislodge them. Enemas of salt water form an excellent remedy for *ascarides* of the rectum. Probably in both cases the parasites are destroyed by the salt abstracting the water from their tissues. In a similar manner, when leeches are sprinkled with salt they are made to disgorge the blood which they have swallowed. It has been supposed that the anthelmintic virtues of helminthocorton, or Corsican moss, depend upon the saline element which saturates it.

Salt has been employed with some effect in *diabetes*, and certainly some of the mineral waters used in that disease contain it. But given in simple watery solution, it is alleged to reduce the proportion of sugar and the amount of urine voided.

It is a familiar fact that salt meat, olives, and other saline articles tend to prevent *alcoholic intoxication*, and enemas of salt water have been repeatedly employed with success to rouse drunkards from their lethargy or abate their delirious pugnacity. Similar injections are in common use to relieve *congestion of the brain*, which they do more speedily than can be explained by the mere removal of fæces from the rectum. A teaspoonful of dry salt swallowed on the threatening of the *epileptic* paroxysm is a remedy that commands popular belief. Salt water is often employed as an emetic to empty the stomach gorged with food or containing *narcotic* or other *poisons*. Salt is a direct antidote to *nitrate of silver*, converting it into the comparatively innocuous chloride.

The local applications of salt are numerous. It is used to limit the action of nitrate of silver applied to the *eye*, *throat*, *vagina*, etc., in an atomized solution for the treatment of subacute and chronic affections of the *pharynx* and *larynx*, and by the nasal douche in *catarrh of the nostrils* and *ozæna*. The solution used for the latter purpose should not contain more than 20 grains of salt to a pint of water. Stronger solutions are apt to be painful and to aggravate the disease. A similar solution inspired from the hands while the head is bent forward almost horizontally will often answer the purpose as well. Salt and water may also be used as a wash for *mercurial sore mouth*, as an injection in vaginal *leucorrhœa*, as a wash for indolent *ulcers*, for *pruritus vulvæ*, and for the *stings and bites of insects*. Hot salt enclosed in bags is an excellent application in *colic*, *dysmenorrhœa*, *toothache*, and *muscular rheumatism;* a solution of it in whiskey is a popular remedy for the last-named disease and for discussing *bruises*, *glandular swellings*, etc.; and, finally, a warm salt footbath (100° F.) is one of the best palliatives of congestive *headache*, *uterine pain*, and similar disorders.

SODII HYPOPHOSPHIS, *U. S., Br.*—HYPOPHOSPHITE OF SODIUM (SODA).

Sodæ hypophosphis, Br. Add.; *Natrium hypophosphorosum, Hypophosphis sodicus.—Hypophosphite de soude*, Fr.; *Unterphosphorigsaures Natron*, G.

Formula $NaH_2PO_2.H_2O$. Molecular weight 106.

Preparation.—An aqueous solution of 6 parts of hypophosphite of calcium is accurately precipitated by a solution of 10 parts of crystallized carbonate of sodium; insoluble carbonate of calcium and soluble hypophosphite of sodium are produced and separated by filtration; on evaporating the filtrate, the latter salt is left behind, and if necessary may be freed from carbonate of sodium by redissolving it in alcohol, filtering, and evaporating. Berlandt (1865) recommends its preparation with granulated phosphorus (see p. 1172), of which 23½ parts are macerated in a flask at 10° C. (50° F.) with 25 parts of caustic soda and 100 parts of water; after the phosphorus has been dissolved, the liquid is mixed with four times its volume of alcohol, neutralized with sulphuric acid, filtered, and evaporated. During the evaporation decomposition with explosion has occasionally been noticed, which was caused by too high a heat; the temperature of the evaporating solution should therefore be kept below that of boiling water.

Properties.—Hypophosphite of sodium is usually obtained in the form of a white granular powder, but by the slow evaporation of its alcoholic solution may be procured in pearly rectangular, tabular crystals, which, when dried over sulphuric acid and afterward heated not quite to 200° C. (392° F.), lose nearly 17 per cent. of water. At a higher heat spontaneously inflammable phosphoretted hydrogen is evolved, and a porous mixture of pyrophosphate and metaphosphate of sodium is left. The salt is inodorous, has a peculiar bitterish (sweetish, *U. S.*) saline taste, is deliquescent in the air, though less so than hypophosphite of potassium, and is easily soluble in water, and likewise in absolute alcohol, but is insoluble in ether. The U. S. P. states it to be soluble in 1 part of water and in 30 parts of alcohol at 15° C. (59° F.), in 0.12 part of boiling water and in 1 part of boiling alcohol. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On triturating or heating the salt with an oxidizing agent the mixture will explode. The aqueous solution yields with test solution of nitrate of silver a white precipitate, which rapidly turns brown and black; and when acidulated with hydrochloric acid and added to excess of test solution of mercuric chloride, it first produces a white precipitate of calomel, and on further addition metallic mercury separates.—*U. S.* When evaporated with dilute nitric acid and finally ignited, a residue is obtained weighing 97 per cent. of the weight of the hypophosphite, and consisting of metaphosphate of sodium. Like all hypophosphites, the salt is oxidized on exposure to the air to phosphite and phosphate, and must therefore be preserved in well-stopped bottles.

Tests.—The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate), and should not be precipitated nor be rendered cloudy by test solution of oxalate of ammonium (absence of calcium) nor by a saturated solution of bitartrate of sodium (absence of potassium). After being acidulated with hydrochloric acid it should not produce a white precipitate or cloudiness with test solution of chloride of barium (sulphate). On mixing the aqueous solution with test mixture of magnesium, not more than a slight cloudiness should make its appearance (limit of phosphate).—*U. S.* 5 gr. of the salt dissolved in ½ oz. of water, and boiled for ten minutes with 11½ gr. of potassium permanganate, yields a nearly colorless filtrate.—*Br.*

Medical Action and Uses.—This salt has been administered in chronic *bronchitis* and in cases of *nervous depression* with a sense of heaviness or numbness in the limbs, in sexual *impotence*, and various other exhausted states of the nervous system, including those produced by *scrofula, syphilis*, and *anæmia*. This and the other alkaline and earthy phosphites and hypophosphites have also been used with alleged success in *phthisis*, but the allegations have been unsupported by the results of experience. The apparent value of the phosphatic compound in the above-named diseases is to be explained by the associated medicinal and hygienic treatment. The *dose* of hypophosphite of sodium is 8 grains (Gm. 0.50) or more given during digestion.

SODII HYPOSULPHIS, *U. S.*—HYPOSULPHITE OF SODIUM.

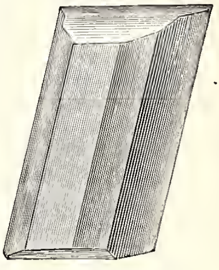
Natrium subsulfurosum (hyposulfurosum), Hyposulphis sodicus.—Sodium thiosulphate, E.; *Hyposulphite de soude, Sulfite sulfuré de soude*, Fr.; *Unterschwefligsaures Natron*, G.

Formula $Na_2S_2O_3.5H_2O$. Molecular weight 248.

Preparation.—The process proposed by Walchner is as follows: A mixture of 3 parts of exsiccated carbonate of sodium and 1 part of sulphur is heated in a porcelain dish gradually to the fusing-point of sulphur, and repeatedly stirred to facilitate contact with the air. Sulphide of sodium is first formed, and then oxidized to sulphite, Na_2SO_3; this salt is dissolved in a little water, and by boiling with more sulphur converted into hyposulphite; the solution is filtered from the excess of sulphur, and the nearly colorless filtrate concentrated for crystallization.

In the purification of illuminating gas prepared from coal by dry lime, the *gas-lime* contains carbonate, hyposulphite, and pentasulphide of calcium, and is utilized for the manufacture of hyposulphite of sodium by a process proposed by Graham. The gas-lime is exposed to the air so as to convert the sulphide into hyposulphite; $2CaS_5 + 3O_2$ yields $2CaS_2O_3 + 3S_2$. It is then treated with its weight of cold water, and the filtrate, which contains the hyposulphite of calcium, is converted into the sodium salt by double decomposition with sodium carbonate, whereby insoluble calcium carbonate is produced and a solution of hyposulphite of sodium obtained, which is concentrated and crystallized; $CaS_2O_3 + Na_2CO_3$ yields $CaCO_3 + Na_2S_2O_3$. The residue left in the preparation of soda, called *soda waste*, contains sulphide of calcium, and is converted into hyposulphite of sodium by a process nearly identical with the one just described. In decomposing hyposulphite of calcium the sodium carbonate may be replaced by sodium sulphate, in which case sulphate of calcium is precipitated.

Fig. 285.



Crystal of Sodium Hyposulphite.

Properties.—Hyposulphite of sodium is in large, transparent, colorless, monoclinic prisms or plates which have the specific gravity 1.74, are neutral or faintly alkaline, are inodorous, and have a cooling, bitter, slightly alkaline, and sulphurous taste. It is permanent in the air, but over sulphuric acid it slowly parts with most of its water of crystallization (Letts, 1873), and in the atmosphere begins to effloresce at about 33° C. (91.4° F.) (Pape, 1865). When slowly heated it parts with all its water of crystallization (36.3 per cent.) at 100° C. (Letts), but if rapidly heated not below 215° C. (419° F.), and at about 225° C. (437° F.) it is decomposed, with the separation of sulphur (Pape); at a red heat it forms a black (after cooling brown-yellow) mass of sodium sulphate and polysulphide, and a non-luminous flame is colored intensely yellow by the salt. This is fusible between 45° and 50° C. (113° and 122° F.), and if melted in a clean flask, the liquid heated to boiling, and the flask instantly corked and slowly cooled, the mass will remain liquid until the cork is removed and the surface of the liquid is touched with a hard substance, when the whole will suddenly congeal, a considerable elevation of temperature being observed at the same time. The crystallized salt dissolves at 0° C. (32° F.) in .92 part, at 20° C. (68° F.) in .56 part, and at 40° C. (122° F.) in .25 part, of water, and readily forms supersaturated solutions (Kremers, 1856); it is slowly soluble in oil of turpentine, the odor of the latter being modified (Edison, 1876), but it is insoluble in alcohol, and is precipitated by the latter from its concentrated solution as an oily liquid. The aqueous solution is gradually, or in the presence of free alkali more rapidly, decomposed, sulphur being deposited, and in the presence of zinc and free acid sulphuretted hydrogen is formed; on acidulating the solution of the salt, thiosulphuric acid is liberated, and at once decomposed into sulphurous acid and sulphur, which forms a white precipitate (difference from sulphites).

Hyposulphite of sodium dissolves chloride, iodide, and other compounds of silver readily, and is employed for this purpose by photographers, and such a solution may be used for silvering copper and brass. Iodine is decolorized by a solution of hyposulphite of sodium, iodide and *tetrathionate of sodium* being formed, according to the equation $2Na_2S_2O_3 + I_2 = 2NaI + Na_2S_4O_6$. This reaction affords a convenient method for the estimation of iodine, 126.6 parts of which are decolorized by 248 parts of the hyposulphite. A similar reaction takes place with chlorine, and makes the salt a useful and cheap *antichlor* for the removal of chlorine retained by fabrics and other substances which have been bleached by chlorine. Hyposulphite of sodium is also a solvent for the insoluble salts of lead and other metals. It affords a white precipitate in a concentrated solution of chloride of barium, which is soluble in water.

Impurities.—If contaminated with sulphate or carbonate of sodium, the dilute solution of hyposulphite of sodium produces a white precipitate with solution of chloride of barium. "A solution of the salt in 80 parts of water should not be rendered cloudy by a few drops of test solution of chloride of barium (absence of sulphate), and a concentrated solution should not effervesce when added to diluted acetic acid (absence of carbonate). A solution of 2 Gm. of the salt in 10 Gm. of water, agitated for a short time with 1 Gm. of iodine, should yield a colorless liquid with at most only a faint white opalescence (corresponding to about 98 per cent. of pure hyposulphite of sodium."—*U. S.*

Medical Action and Uses.—This, among the compounds of sulphurous acid, has been perhaps most largely employed for the purpose of correcting the hypothetical fermentation to which a large number of febrile and other diseases has been attributed. But the results of experience are far from confirming faith in the hypothesis. The success of the medicine—in *erysipelas*, for example—is equally great whether the administration be internal or external; in other words, its direct action is purely negative, but indirectly it saves the sick from heroic perturbative treatment and allows the disease to run its normal course toward cure. The influence of the medicine over the course and issue of *typhus* and *typhoid fevers*, the *eruptive fevers*, *yellow fever*, *diphtheria*, and *purulent infection* has been loudly proclaimed, but the proofs of its efficacy are wanting. On the other hand, there is some evidence in favor of its utility in *intermittent fever;* and although the natural tendency of this disease to cure under various circumstances must be admitted, the apparently almost uniform curative influence of the hyposulphite cannot rationally be denied.

A much more tangible evidence of its value is furnished by its use in the treatment of *dyspepsia*—not that it in the least acts upon any of the vital conditions accompanying gastric disorders, but it effectually prevents fermentation in the stomach and bowels, and thereby prevents acidity and flatulence, with their accompanying distress and their ulterior mischievous effects. In like manner, this medicine may be used to destroy the products of putrefactive fermentation, whether within the body or not. It will deodorize all *putrid products*, either after their discharge or while they are still in the stomach, rectum, bladder, vagina, uterus, etc. Atomized solutions of this and the allied compounds may be inhaled in *gangrene of the lung*, in *fetid bronchitis*, etc. Lancereaux has reported a number of cases of the latter disease cured by this medicine, given internally to the extent of 60 or 70 grains a day (Gm. 4–5) (*Bull. de thérap.*, ciii. 433). The dyspeptic fermentation referred to above is accompanied by the rapid development of low vegetable organisms, to which the compounds of sulphurous acid are hostile; and this mode of action has been invoked in the local treatment of *sycosis*, *favus*, *impetigo*, etc. by means of a solution of about 40 grains of the hyposulphite, or, still better, of the sulphite, of sodium in an ounce of water (Gm. 3 in Gm. 32). A similar solution is useful as a lotion in *prurigo pudendi*. A saturated solution may be used in the proportion of about one-sixth to decolorize tincture of iodine.

The *dose* of hyposulphite of sodium is 15 grains (Gm. 1) and upward in copious watery solution.

SODII IODIDUM, *U. S., Br.*—Iodide of Sodium.

Natrium iodatum, P. G.—*Iodure de sodium*, Fr.; *Jodnatrium*, G.

Formula NaI. Molecular weight 149.6.

Preparation.—This salt may be obtained by processes analogous to those which afford iodide of potassium (see page 1229), either from iodine and solution of caustic soda or from decomposing a solution of iodide of iron with carbonate of sodium. The latter process is the more profitable one, since on the reduction of iodate of sodium by charcoal a portion of the salt is converted into carbonate of sodium.

Properties.—When crystallized at a temperature above 40° C. (104° F.), anhydrous iodide of sodium is obtained in cubes which are deliquescent on exposure and should therefore be kept in well-stopped bottles. This salt melts at a dull-red heat, and when fused in contact the air parts with a little iodine, at a higher temperature volatilizes slowly, but more readily than the chloride, and on cooling congeals to a pearly radiating crystalline mass. At ordinary temperatures the solution yields short monoclinic prisms or plates which have the composition $NaI.2H_2O$ and the molecular weight 185.6, effloresce in dry air, on exposure are deliquescent, melt at a moderate heat in the water of crystallization, and become anhydrous. The U. S. P. describes the hydrated salt, but states that it melts without losing weight. The salt is usually prepared by evaporation to dryness in the form of a white crystalline powder, which is inodorous, of a saline somewhat sharp and bitterish taste, and has a neutral or faint alkaline reaction. According to Kremers (1856), 1 part of the anhydrous salt dissolves at 0° C. (32° F.) in .63 part, at

20° C. (68° F.) in .56 part, at 60° C. (140 F.) in .39 part, of water, the solubility increasing gradually to 1 part in .30 part of water at 141° C. (286° F.), at which temperature the saturated solution boils. The salt is also soluble in glycerin, in 3 (*P. G.*) or 1.8 (*U. S.*) parts of alcohol at 15° C. (59° F.), and in 1.4 parts of boiling alcohol. It differs from potassium iodide in not being precipitated from its concentrated aqueous solution by a concentrated solution of sodium bitartrate, and in imparting a yellow color to flame, which on being observed through a blue glass should not, or only transiently, appear red. On adding a little chlorine-water to the aqueous solution and agitating it with chloroform or carbon disulphide, these liquids will acquire a violet color.

Tests.—Contamination with iodide, chloride, bromide, and carbonate may be detected in the same manner as described on pp. 1230 and 1231. "The aqueous solution of the salt, mixed with gelatinized starch, and afterward with diluted hydrochloric acid, should not at once acquire a blue color (absence of iodate). If 1 Gm. of the salt be dissolved in 10 Ccm. of water of ammonia, then shaken with a solution of 1.2 Gm. of nitrate of silver in 20 Ccm. of water, and the filtrate be supersaturated with 7 Ccm. of nitric acid, no cloudiness should make its appearance within ten minutes (absence of more than about 0.5 per cent. of chloride or bromide)."—*U. S.* The silver nitrate ordered in the last test is equivalent to 70.9 Ccm. of the volumetric solution of this salt, while 67 Ccm. are sufficient for completely precipitating 1 Gm. of the anhydrous iodide. The P. G. uses for this test .2 Gm. of anhydrous sodium iodide dissolved in 2 Ccm. of ammonia-water, then mixed with 14 Ccm. of the volumetric silver solution, and afterward acidulated with nitric acid. "On adding to 1 Gm. of the salt, dissolved in 20 Ccm. of water, 5 or 6 drops of test solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). 1 Gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.566 Gm. of dry iodide of silver."—*U. S.* In addition to these tests, the P. G. directs testing for metals by hydrosulphuric acid, and for nitrate by nascent hydrogen (hydrochloric acid and zinc; see page 1231).

Medical Action and Uses.—In 1865 this salt was used with alleged advantage as a substitute for iodide of potassium in the treatment of constitutional syphilis, but it does not appear that the results then claimed have been confirmed by other observers.

SODII NITRAS, *U. S., Br.*—NITRATE OF SODIUM (SODA).

Sodæ nitras, Br.; *Natrium nitricum*, P. G.; *Nitras (Azotus) sodicus*, *Nitrum cubicum*. —*Cubic nitre*, E.; *Azotate (Nitrate) de soude*, *Nitre cubique*, *Nitrate de Chili*, Fr.; *Natriumnitrat*, *Chilisalpeter*, G.

Formula $NaNO_3$. Molecular weight 85.

A native salt, purified by crystallization from water.

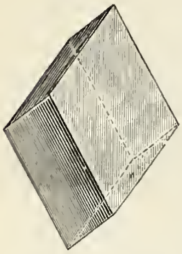
Origin and Preparation.—Nitrate of sodium was first observed by Bohn (1683) on distilling a mixture of table-salt and nitric acid, and was prepared by Marggraf (1761) from calcium nitrate and sodium sulphate. In 1820 it became known through Mariano de Rivero that it exists in immense quantities in certain districts of Chili and Peru, where it is imbedded in clay and sand and more or less mixed with sulphates and chlorides of sodium, calcium, and magnesium. The stratum containing this saline mass, which is called *caleche* or *terra salitrosa*, is blasted, the salt extracted by boiling with water, and the decanted solution crystallized. In this condition nitrate of sodium is brought into the market in damp crystalline masses, which are more or less colored by intermixed earth and require to be purified by recrystallization. Previous to 1879 the United States imported about 50,000,000 pounds, but 184,598,857 pounds in 1882.

Properties.—Purified nitrate of sodium crystallizes in colorless, transparent rhombohedrons of the hexagonal system, which are permanent in dry air, slightly deliquescent on exposure, have a neutral reaction, and, according to Maumené (1864), dissolve

at	0°	10°	20°	40°	60°	80°	100°	119.5° C.
in	1.41	1.28	1.14	.92	.77	.65	.56	.47 part of water.

They are soluble in about 100 parts of strong alcohol, in 17 parts of 68 per cent. alcohol, in about 6 parts of 40 per cent. alcohol, in 40 parts of boiling alcohol, and slightly soluble in wood-spirit. The salt is inodorous, has a cooling, saline, and somewhat bitter taste, melts when heated to about 312° C. (594° F.), and congeals on cooling to a white mass. It is decomposed when heated to redness, oxygen being given off and sodium nitrite formed; but on continuing the heat, nitrogen and hyponitric acid are evolved and sodium oxide and dioxide are produced. If thrown upon red-hot coal the salt deflagrates, and when mixed with inflammable substances it detonates less violently than nitrate of potassium. The hot aqueous solution, mixed with chloride, carbonate, or sulphate of potassium, yields crystals of potassium nitrate, and the cold solution, mixed with strong sulphuric acid and ferrous sulphate, acquires a blackish-brown color. Non-luminous flames are colored intensely yellow by the salt, and when observed through a blue glass show merely transiently a red color.

Fig. 286.



Crystal of Sodium Nitrate.

Tests.—The aqueous solution (5 per cent., *P. G.*) should remain unaffected by hydrosulphuric acid and sulphide of ammonium (absence of metals), also by carbonate of sodium (alkaline earths), by oxalate of ammonium (calcium), by a saturated solution of bitartrate of sodium (potassium), by nitrate of barium (sulphate), or by nitrate of silver (chloride or iodide). The P. G. permits the presence of a minute trace of sulphate, and the U. S. P. admits a minute quantity of chloride, but to show that the faint opalescence by the silver salt was not produced by iodide, it directs testing the solution by mixing it with a few drops of hydrosulphuric acid and some gelatinized starch, and pouring a few drops of chlorine-water on top, when no blue zone should make its appearance near the surface; iodate would give the same color. The P. G. directs testing for iodate by adding to the solution a little rasped tin, followed by 10 drops of nitric acid; the liberated iodine may be recognized by the violet color it imparts to chloroform or by the blue color it gives with starch. 1 Gm. of the salt, treated with an excess or about 1 Ccm. of sulphuric acid and afterward heated to redness until vapors cease to be given off, yields a residue weighing .835 Gm.—*U. S.*

Pharmaceutical Uses.—Nitrate of sodium is used in preparing nitric acid and arseniate of sodium.

Allied Salt.—Sodii nitris, Nitrite of sodium, $NaNO_2$; molecular weight 69. It is conveniently prepared, according to Warington (1865), by introducing, in small portions, into a heated iron crucible a mixture of 7 parts of sodium nitrate and 1 of starch. The decomposition is less violent than if charcoal be employed. The residue is dissolved in water, and on evaporation yields colorless somewhat deliquescent prisms which have an alkaline reaction and are nearly insoluble in strong alcohol. On exposure to the air the salt is slowly oxidized to nitrate.

Medical Action and Uses.—Nitrate of sodium, according to experimental investigations of its action, does not directly lessen the force or frequency of the pulse, nor lower the animal temperature, nor increase the elimination of urea. In large doses, acting as a purgative, it may produce these effects. Its solution dissolves false membranes. It has hence been used with the atomizer to diminish *fibrinous exudations* in the pharynx and larynx. In chief medicinal virtue is that of a mild purgative, and it has been used with advantage in *diarrhœa* and in *dysentery*. For these purposes it may be given in *doses* of 1 or 2 ounces (Gm. 32–64), dissolved in a large quantity of water.

Nitrite of Sodium. According to the experiments of Binz, it produces active hyperæmia of the stomach and paralyzes the nervous system, beginning at the brain, without inducing any excitation (*Archiv f. Pathol. u. Phar.*, xiii. 133). Hay took on three occasions 5, 10, and 20 grains of this salt. The larger doses produced a feeling of fulness in the head and eyes, accompanied by a throbbing sensation which continued for an hour or more—effects resembling those of nitro-glycerin (*Practitioner*, xxx. 179). Hay prescribed it in a well-marked case of *angina pectoris* associated with defective aortic valves, in which, in doses of 2 or 3 grains, it relieved the patient of excruciating pain without producing any physiological phenomena. In 1882, Law proposed sodium nitrite for the treatment of *epilepsy*, and found it very useful in a single case (*Practitioner*, xxviii. 420). Shortly afterward Ralfe reported the results of the treatment in seventeen cases (*Med. Times and Gaz.*, Dec. 2, 1882, p. 707). The dose, according to him, should just fall short of producing its physiological effects. His conclusions were—1. That cases in which the bromides did good were not apt to be benefited by the nitrate, and *vice versâ*. 2. When the bromides begin to lose their effect or cause bromism, sodium nitrite is useful as a substitute. 3. It seemed to be especially useful in minor seizures and in convulsive attacks occurring at night.

SODII PHOSPHAS, *U. S., Br.*—PHOSPHATE OF SODIUM (SODA).

Sodæ phosphas, Br.; *Natrium phosphoricum*, P. G.; *Phosphas sodicus* (*natricus*).—*Phosphate de soude*, Fr.; *Natriumphosphat*, *Phosphorsaures Natron*, G.

Formula $Na_2HPO_4.12H_2O$. Molecular weight 358.

Origin.—Phosphate of sodium exists in the urine of carnivorous animals and in other animal liquid. It was probably known to the ancients, since the *chrysocolla* used for soldering (see SODII BORAS) was at least partly obtained from urine. Hellot (1735) recognized it as distinct from the ammoniacal salts of urine, and Haupt (1740) named it *sal mirabile perlatum*, because it melts before the blowpipe to an opaque pearly bead. Proust (1775) stated it to be a compound of soda, and Klaproth and Scheele (1785) proved also the presence of phosphoric acid. The salt was employed medicinally by Pearson (1787), and was usually prepared by neutralizing phosphoric acid with sodium carbonate, but at present it is exclusively prepared from bone phosphate.

Preparation.—Take of Bone-Ash, in powder, 10 pounds; Sulphuric Acid 56 fluidounces; Distilled Water 4½ gallons or a sufficiency; Carbonate of Soda 16 pounds or a sufficiency. Place the bone-ash in a capacious earthenware or leaden vessel, pour on the sulphuric acid, and stir with a glass rod until the whole powder is thoroughly moistened. After 24 hours add gradually and with constant stirring a gallon of the water; digest for 48 hours, adding distilled water from time to time to replace what has evaporated. Add another gallon of the water, stirring diligently, digest for an hour, filter through calico, and wash what remains on the filter with successive portions of distilled water till it has almost ceased to have an acid reaction. Concentrate the filtrate to a gallon, let it rest for 24 hours, and filter again. Heat the filtrate to near the boiling-point, add the carbonate of soda, previously dissolved in 2 gallons of the water, till it ceases to form a precipitate and the fluid has acquired a feeble alkaline reaction. Filter through calico, evaporate the clear liquor till a film forms on the surface, and set it aside to crystallize. More crystals will be obtained by evaporating the mother-liquor, a little carbonate of soda being added if necessary to maintain its alkalinity. Dry the crystals rapidly and without heat on filtering-paper placed on porous bricks, and preserve them in bottles.—*Br.* 1867.

The inorganic matter of bones consists of tricalcium phosphate, which is decomposed by sulphuric acid, with the formation of sulphate and acid phosphate of calcium, according to the equation $Ca_32PO_4 + 2H_2SO_4 = 2CaSO_4 + CaH_42PO_4$. The decomposition is known to be completed when the mixture is uniformly smooth and free from grittiness. On being treated with water the freely-soluble acid phosphate of calcium enters into solution, together with a small quantity of sulphate of calcium and any excess of sulphuric acid which may have been employed. On adding carbonate of sodium to the solution, the calcium salt is decomposed, one-half the phosphoric acid forming insoluble calcium phosphate, while the other half unites with the sodium of the sodium carbonate, forming disodium phosphate, liberating carbonic acid gas, and producing water; $CaH_42PO_4 + Na_2CO_3$ yields $CaHPO_4 + Na_2HPO_4 + CO_2 + H_2O$. The filtrate from the phosphate of calcium contains the sodium salts of phosphoric, sulphuric, and carbonic acids, of which the last two should be present in small quantity only, and requires to be evaporated to crystallization. If sulphuric acid and carbonate of sodium have not been used too largely in excess, the first crop or two of crystals will be pure phosphate of sodium, but those subsequently obtained are usually contaminated with carbonate and sulphate, and should be purified by recrystallization from water. 100 parts of calcined bones require from 60 to 70 parts of concentrated sulphuric acid and from 100 to 110 parts of crystallized carbonate of sodium, and yield between 100 and 105 parts of crystallized phosphate of sodium.

Properties.—This salt crystallizes in colorless, transparent, obliquely four-sided, monoclinic prisms, which have the specific gravity 1.55, react slightly alkaline upon test-paper, are inodorous, and have a cooling saline taste. The crystals effloresce rapidly in dry air, melt to a colorless liquid when heated to 35° C. (95° F.) (Kopp; 40° C. *U. S.*, *P. G.*), and congeal on cooling to a crystalline mass. At 100° C. (212° F.) they part with their water of crystallization, amounting to 60.3 per cent., and are converted into a white saline mass. Above 300° C. (572° F.) the basylous water is expelled and pyrophosphate of sodium is left. Crystallized phosphate of sodium requires for solution, according to Mulder (1864),

at 0°	10°	15°	30°	40°	60°	80°	99°	105° C.
24.12	15.5	10.4	2.5	.95	.66	.625	.611	.731 parts of water.

The solution saturated at a higher temperature deposits near 35° C. (95° F.) transparent crystals, which contain only 47 per cent. of water of crystallization and have the formula $Na_2HPO_4.7H_2O$. Phosphate of sodium is insoluble in alcohol, and imparts a yellow color to flame, which, if observed through a blue glass, is not red, or only transiently so. The aqueous solution gives with silver nitrate a yellow precipitate soluble in nitric acid and in ammonia; with test mixture of magnesium, a white precipitate soluble in acetic acid; and with ferric chloride, a white precipitate insoluble in acetic acid.

Tests.—The solution should not effervesce with acids (absence of carbonate), should not be rendered turbid by ammonia (magnesium or traces of calcium), and should remain clear on the further addition of sulphide of ammonium. A 5 per cent. solution acidulated with hydrochloric acid should remain unaffected by hydrosulphuric acid (metals), and when acidulated with nitric acid should merely become faintly cloudy with barium nitrate (sulphate) or silver nitrate (chloride). Arsenic is detected by adding to the solution sulphuric acid, zinc, and a few drops of iodine solution (for oxidizing sulphite to sulphate), and covering the test-tube with filtering-paper moistened with a drop of solution of silver nitrate, which, if arsenic be present, will be colored yellow or brown (see page 65). If 1 Gm. of phosphate of sodium is completely precipitated by test mixture of magnesium, the washed, dried, and ignited precipitate should weigh 0.31 Gm.—*U. S.*

Composition.—This officinal salt is disodic orthophosphate or disodium hydrophosphate, and represents, in 100 parts, 19.9 parts of P_2O_5, 17.3 parts of Na_2O, 2.5 parts of basylous H_2O, and 60.3 parts of water of crystallization.

Pharmaceutical Uses.—For the preparation of Ferri phosphas, *U. S.*, *Br.;* Sodii pyrophosphas, *U. S.;* and Syrupus ferri phosphatis, *Br.*

Allied Salts.—SODII ET AMMONII PHOSPHAS, $NH_4NaHPO_4.4H_2O$ (mol. weight 418). This is the *microcosmic salt* of the alchemists, and was formerly prepared from urine. It is obtained by dissolving 5 parts of crystallized sodium phosphate and 2 parts of ammonium phosphate in 20 parts of hot water, adding a little ammonia until the liquid is alkaline, and crystallizing. The salt crystallizes in colorless, transparent, monoclinic prisms which are inodorous and have a cooling saline taste, and a neutral or faint alkaline reaction. It effloresces superficially on exposure, losing a little ammonia, melts readily to a colorless liquid in its water of crystallization, and at a red heat forms a colorless glass of sodium metaphosphate, which is used in blowpipe analysis.

POTASSII PHOSPHAS, *Phosphate of potassium*, K_2HPO_4 (mol. weight 174). This may be obtained from calcined bones in precisely the same manner as phosphate of sodium, only substituting in the process carbonate of potassium for carbonate of sodium, or by adding carbonate of potassium to dilute phosphoric acid until the liquid has a slight alkaline reaction, and by evaporating. The so-called neutral phosphate of potassium or dipotassium orthophosphate is with difficulty obtained in irregular crystals; usually it is a white amorphous or crystalline mass, of a saline taste, deliquescent in the air, and freely soluble in water. On the application of heat it melts, and at a red heat is converted into pyrophosphate of potassium, which is likewise very deliquescent. When dissolved in water it yields with nitrate of silver a yellow precipitate soluble in nitric acid, and with sodium bitartrate a white crystalline precipitate of cream of tartar. Both the mono- and tripotassium orthophosphates crystallize more readily than the preceding salt, and are easily soluble in water.

Medical Action and Uses.—Phosphate of sodium in solution injected into the veins is almost entirely eliminated with the urine. Taken internally, it is said to diminish the discharge of chloride of sodium by the kidneys. According to Rutherford and Vignal, it is a hepatic stimulant of considerable power. It has a cooling, saline, but not disagreeable taste, and has been used upon theoretical grounds as a remedy for *scrofula*, *rachitis*, *diabetes*, etc., but without encouraging results. Luton, however, claims that it rapidly and effectually cures those cases of *scrofulous ophthalmia* which are remarkable for lachrymation, photophobia, ulceration of the cornea, and associated impetiginous eruptions. In such cases from 40 to 70 grains (Gm. 3–5) must be given daily in divided doses (*Études de thérap.*, p. 387). It has been much recommended in the *bowel complaints* of children, for which its mild purgative action renders it well adapted when the use of purgatives of any sort is indicated. It is said, however, to be most suitable for the *diarrhœas* which are apt to occur at the period of weaning. It has been used with alleged success in correcting the acidity of the uterine and vaginal secretions, which was believed to destroy the spermatozoa after copulation. It was employed in injection before the act, and a course of alkaline mineral waters was at the same time prescribed (Charrier, *Bull. de thérap.*, xcviii. 492). Its purgative *dose* for an adult is about an ounce (Gm. 32); for children affected with diarrhœa the dose should be small, from 3 to 10 grains (Gm. 0.20–0.60), and may conveniently be given in milk and water.

SODII PYROPHOSPHAS, *U. S.*—PYROPHOSPHATE OF SODIUM.

Natrium pyrophosphoricum, *Pyrophosphas sodicus.*—*Pyrophosphate de soude*, Fr.; *Natriumpyrophosphat*, G.

Formula $Na_4P_2O_7.10H_2O$. Molecular weight 446.

Preparation.—10 ounces of crystallized sodium phosphate are exposed to a warm atmosphere until effloresced, and then heated to dull redness until a small portion of the mass, dissolved in water, causes with silver nitrate a white precipitate free from yellow tint. The white salt is dissolved in 5 pints of boiling water and the solution filtered if necessary and crystallized. The total yield will be 6 ounces.

Properties.—The salt crystallizes in colorless or whitish transparent or translucent monoclinic prisms or plates which are inodorous and have a cooling saline taste and a feeble alkaline reaction. It is permanent in the air, but when moderately heated it gradually parts with its water of crystallization, and at a red heat melts to a transparent liquid which on cooling congeals to a white, opaque, crystalline mass. The salt is insoluble in alcohol, but, according to Poggiale (1863), it dissolves

at	0°	10°	20°	40°	60°	80°	100° C.
in	18.5	14.7	9.2	4.01	2.27	1.58	1.07 parts of water.

It colors non-luminous flames intensely yellow, and when observed through a blue glass a red color must only transiently appear. The aqueous solution causes a white precipitate with silver nitrate, and if an excess of the latter has been used the filtrate has a neutral reaction (difference from sodium phosphate). On boiling the aqueous solution with free mineral acids the salt is gradually converted into orthophosphate.

Tests.—"The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate). Acidified with hydrochloric acid, it should remain unaffected by hydrosulphuric acid or sulphide of ammonium (absence of metals), and when acidified with nitric acid it should not yield more than a faint opalescence with test solution of nitrate of barium (limit of sulphate) or nitrate of silver (limit of chloride)." —*U. S.*

Off. Prep.—Ferri pyrophosphas, *U. S.*

Uses.—It is said that its action and uses are the same as those of sodium phosphate, but that it should be given in doses one-third less. Its pharmaceutical uses give it its chief value.

SODII SALICYLAS, *U. S.*, *Br.*—SALICYLATE OF SODIUM.

Natrium salicylicum, P. G.—*Salicylate de soude*, Fr.; *Natriumsalicylat*, G.

Formula $2NaC_7H_5O_3.H_2O$. Molecular weight 338.

Preparation.—In addition to the processes on page 88, the following by Hager may be given: Dissolve 100 parts of salicylic acid in diluted alcohol, and add gradually pure sodium bicarbonate until effervescence ceases; 60 to 61 parts of the latter or from 38.2 to 38.4 of exsiccated sodium carbonate will be required; filter and evaporate. The yield is about 130 parts. If the solution of salicylic acid is added to the solution of the carbonate, the resulting salt will be colored.

Properties.—Sodium salicylate is a white crystalline powder or forms small white crystalline plates, is permanent in the air, inodorous or nearly so, and has a sweetish saline and mildly alkaline taste and a feebly acid reaction. It dissolves at 15° C. (59° F.) in 1.5 (*U. S.*), 0.9 (*P. G.*) parts of water and in 6 parts of alcohol, and is more freely soluble in boiling water and boiling alcohol. By heat the salt is decomposed, inflammable vapors are given off, and a carbonaceous residue of sodium carbonate is left, weighing about 31 per cent. of the salt used, and imparting to a non-luminous flame an intense yellow color, which should appear not more than transiently red when observed through a blue glass. Ferric chloride added to the concentrated aqueous solution of the salt colors it red-brown, but a very diluted solution is colored violet. The rather concentrated aqueous solution, when strongly acidulated with hydrochloric or sulphuric acid, gives a white crystalline precipitate, which is soluble in ether and in hot water and has all the properties of salicylic acid (see p. 87).

Tests.—"The aqueous solution should be colorless and should not effervesce on the addition of acids (absence of carbonate). Agitated with about 15 parts of concentrated sulphuric acid, the salt should not impart color to the acid within 15 minutes (absence of foreign organic matter). If a solution of 1 Gm. of the salt in a mixture of 50 Ccm. of alcohol and 25 Ccm. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test solution of chloride of barium (absence of sulphate) or of nitrate of silver (absence of chloride)."—*U. S.* The tests ordered by the P. G. are nearly identical with the above. In the last test the addition of alcohol is made for the purpose of keeping in solution the salicylic acid liberated by the nitric acid, whereby filtration is avoided. The salt should not have the odor of phenol.

Allied Salts.—Potassii salicylas, $(KC_7H_5O_3)_2.H_2O$, is prepared like the sodium salt, 100 parts of salicylic acid requiring 72.5 parts of potassium bicarbonate. The salt crystallizes in colorless silky needles, is permanent in dry air, and is freely soluble in water.

Sodii formias, $(NaCHO_2.H_2O)$, prepared by neutralizing formic acid with pure sodium carbonate or bicarbonate, crystallizes in colorless rhombic plates or prisms which are inodorous, have a saline bitter taste, melt in their water of crystallization, are deliquescent in moist air, and dissolve freely in water.

Medical Action and Uses.—The great solubility of this salt, which is partly the reason of its milder action than that of the potassium salicylate, renders it in many cases preferable to the latter. Rutherford and Vignal declare it to be "a very powerful hepatic stimulant in the dog," but no such action has been observed in man. Its medicinal uses are precisely the same as those of Salicylic Acid, under which the subject is fully treated. Its mode of action has been there considered, and shown to be quite inadequate to explain its therapeutical effects. The judgment of so eminent an authority as Vulpian may be here subjoined to illustrate still further the facility with which in such matters phrases take the place of facts: "The curative effects of sodium salicylate in acute articular rheumatism are due to the action of the salt upon the anatomical elements of the joints which are primarily affected by the disease. The medicine, becoming incorporated with them, renders them insusceptible to the specific irritation from which the rheumatism proceeds. If they are not already involved, as soon as the medicine acts upon them the acute rheumatism will no longer take hold of them in the greater number of cases. If they are affected, the irritation will rapidly decline. As soon as it has ceased the articular pains will abate, and then the swelling, and soon afterward the fever also. The disease, however, is not certainly cured when these phenomena subside, ... for if the treatment is suspended they reappear; and not only so, but even while the medicine continues to be given, and several days after the joint affection has ceased, inflammation of the endocardium, the pericardium, or the pleuræ may arise" (*Du Mode d'Action du Salicylate de Soude*, 1881).

The dose of salicylate of sodium (as already stated under Salicylic Acid) should be about 20 grains, repeated five or six times a day in acute articular rheumatism. Smaller doses are not to be depended upon for checking the development or arresting the disease.

Potassium salicylate has been used as a substitute for the sodium salt in the treatment of *rheumatism*, and with alleged advantage (*Trans. Amer. Med. Assoc.*, xxxiii. 151), but confirmation of the statement is wanting.

Formiate of sodium has been proposed as a substitute for the salicylate in cases in which there may be danger from the renal congestion sometimes induced by the latter salt. According to Arloing (*Archives gén.*, Nov. 1879, p. 602), a 5 per cent. solution of the formiate of sodium gradually introduced into the blood of a dog or horse slows the heart and dilates the capillaries; in excessive doses it arrests the heart. Corresponding effects are produced on the respiration and calorification. We are not acquainted with any clinical experience with this compound.

SODII SANTONINAS, *U. S.*—Santoninate of Sodium.

Natrium santoninicum, s. santonicum.—*Santonate de soude*, Fr.; *Natriumsantoninat*, G.
Formula $2NaC_{15}H_{19}O_4.7H_2O$. Molecular weight 698.

Preparation.—Heat in a water-bath 3½ ounces of solution of soda diluted with 1 ounce of water, add 1 ounce of santonin, digest until the latter is dissolved, filter, wash the filter with a little hot water, and set aside in a cool place to crystallize. The decanted mother-liquor, concentrated by evaporation, will yield more crystals; when these are no longer obtained colorless, the mother-liquor is acidulated with hydrochloric acid, and the santonin which separates is collected separately. The yield is about 1¼ ounces of sodium santoninate.

Lepage (1876) proposed to prepare this salt by first forming santoninate of calcium, precipitating this solution by carbonate of sodium, evaporating the filtrate nearly to dryness, and exhausting the residue with strong alcohol to remove excess of sodium carbonate; on evaporating the solution the salt crystallizes, leaving finally a colored mother-liquor.

Properties.—The salt crystallizes from alcohol in fine felt-like needles or small white prisms, and from water in rather large colorless and transparent or translucent rhombic tables or laminæ, in which form it is usually seen. These crystals are nearly permanent in the air, a slight efflorescence being observed only after long keeping, and they are very slowly tinged yellow when kept in diffused daylight. The Pharmacopœia directs the salt to be kept in dark amber-colored, well-stopped vials, and not to be exposed to light. The salt is inodorous and has a saline and bitter taste and a slight alkaline reaction. It is soluble in 3 parts of water and in 12 parts of alcohol at 15° C. (59° F.), and it dissolves in .5 part of boiling water and in 3.4 parts of boiling alcohol (*U. S.*). It is insoluble in ether. At 100° C. (212° F.) it parts with its water of crystallization (18 per cent.), and at a somewhat higher heat it becomes bright red, the mass having a glassy lustre after cooling and becoming colorless by water; at a red heat the salt is completely decomposed, and an alkaline residue is left which imparts an intense yellow color to flame. The aqueous solution of the salt, acidulated with hydrochloric acid, deposits santonin, which is readily soluble in chloroform, and yields with alcohol, in the presence of caustic alkali or earth, a bright-red solution, becoming gradually colorless.

Tests.—"A 5 per cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by test solution of carbonate of sodium (absence of alkaline earths), nor by picric or tannic acid (absence of alkaloids)."—*U. S.* The aqueous solution is not colored violet by ferric chloride (difference from salicylate).

Off. Prep.—Trochisci sodii santoninatis, *U. S.*

Allied Compound.—Sodii santoninas albuminatus. Digest santonin 1 part, sodium bicarbonate 4 parts, and dry soluble albumen 2 parts with about 50 parts of water at 60° C. (140° F.) until solution has been effected; filter, evaporate at a gentle heat, and dry on glass plates (Pavesi, 1876). This compound forms brilliant white scales having a pearly lustre and a bitter alkaline taste; its solution in water is decomposed by mineral acids with effervescence of carbonic acid gas, santonin and albumen being precipitated.

Medical Action and Uses.—This salt has over santonin the advantage of greater solubility—if that be indeed an advantage—for not only is its taste thereby rendered more distinct and disagreeable, but it is more readily absorbed from the stomach, and is therefore less apt to come into contact with the intestinal parasites it is given to destroy. In animals it produces poisonous effects more speedily than the proportion of santonin contained in it would do. Nevertheless, santoninate of sodium has been used with success as an anthelmintic, especially for *lumbricoid worms*. It may be prescribed for adults in doses of 8 or 10 grains (Gm. 0.50–0.60) twice a day, and for children in doses of from 2 to 5 grains (Gm. 0.10–0.30), mixed with sugar. After the second day a laxative, such as confection of senna or jalap and cream of tartar, should be administered to remove the worms. Enemata of water containing this salt may be used for rectal *ascarides*.

SODII SILICAS.—Silicate of Sodium.

Silicate de soude, Fr.; *Natriumsilikat*, G.

(For preparation, properties, and tests see pp. 926, 927.)

Physiological Action and Medical Uses.—Silicate of sodium is remarkable for its power of arresting the putrefaction of organic matter. When 15 grains of it are added to 6 drachms of finely-hashed meat, mixed with 50 Ccm. of water, putrefaction will not occur. Pus, blood, bile, and egg albumen are in like manner preserved by the addition of a 3 per cent. solution of the salt, which also prevents alcoholic fermentation. Given to dogs, it soon renders the urine turbid with silicic acid and the silicate, phosphate, and carbonate of sodium, but uric acid and its compounds disappear. On killing the animals, congestion of the kidneys and infarction of the renal tubules with silicic acid and its salts are found. Silicic acid is also detected in the muscles and the spleen, and the gastro-intestinal mucous membrane is inflamed or ecchymosed. Injected into the veins, a solution of silicate of sodium is fatal to life. Given to rabbits in the dose of 15 grains, it has produced alterations in the shape of the blood-corpuscles and fatty degeneration of the liver.

This salt has been applied to correcting the odor and preventing the consequences of putrefactive fermentation. Its solutions have been injected into the vagina in certain cases of *leucorrhœa* and *uterine ulceration*, into the urethra in *gonorrhœa*, into the bladder in chronic *cystitis*, and into the nostrils in *ozæna;* but for all these purposes it is inferior to other stimulant antiseptics and astringents. Solutions containing the salt in the proportion of ½ of 1 per cent. are employed. It has been applied in the same manner as collodion to the treatment of *erysipelas* of the face and other parts, care being taken that the preparation is neutral in its reaction. It has also been used, like starch and other substances whose solutions harden in drying, to prepare the so-called immovable bandages used in treating *fractures* and other surgical injuries. Silicate of potassium has been employed for the same purpose, and the solutions of both have been known as soluble glass.

SODII SULPHAS, *U. S., Br.*—SULPHATE OF SODIUM (SODA).

Sodæ sulphas, Br.; *Natrium sulphuricum*, P. G.; *Sulfas sodicus* (*natricus*).—*Glauber's salt*, E.; *Sulfate de soude*, *Sel de Glauber*, Fr.; *Glaubersalz*, G.

Formula $Na_2SO_4.10H_2O$. Molecular weight 322.

Origin.—Sulphate of sodium is found native in the anhydrous state and crystallized, and also in combination with sulphate of calcium. It is present in the water of many mineral springs and in that of certain lakes in Russia and in the western part of the United States. It is stated to have been known in Saxony for a century before it was obtained artificially by Glauber (1658) from the saline residue left in the preparation of hydrochloric acid, and was named after him *Sal mirabile Glauberi*. The same salt, prepared from the mineral spring at Friedrichshall, became known in 1767 as *Sal aperitivum Fridericianum*. It is largely manufactured in the United States, but small and variable quantities of it are also imported from abroad, the importation being 285 pounds in 1877 and 384,392 pounds in 1882.

Preparation.—This salt is largely obtained in many chemical processes, either as an intermediate or a secondary product, as in the preparation of soda by Leblanc's process; from the mother-liquors of the Stassfurt potash-works; in the preparation of carbonate of magnesium; in the manufacture of hydrochloric and nitric acids from chloride and nitrate of sodium; in the preparation of table-salt from many saline springs; in the manufacture of sal ammoniac from sulphate of ammonium and chloride of sodium; in preparing carbonic acid for the manufacture of mineral waters from bicarbonate of sodium and sulphuric acid; and in several other processes. Sulphate of sodium, as thus obtained, is purified by crystallizing it repeatedly from water, if necessary, after neutralization with sodium carbonate.

Properties.—Sulphate of sodium crystallizes in large, transparent, colorless, monoclinic prisms, which do not alter the color of red and blue litmus-paper, are inodorous, have a cooling, saline, and distinctly bitter taste, and rapidly effloresce on exposure to the air, leaving a white powder. The crystallized salt must therefore be kept in well-stopped bottles, and, on account of its low melting-point, in a cool place. At a temperature of 33° C. (91.4° F.) the salt melts, and a portion of it separates in the anhydrous state. It is insoluble in alcohol, but dissolves freely in water. Above the melting-point of the salt its solubility varies so little that 100 parts of water hold in solution, according to Mulder, at 35° C. (95° F.) 50.2 parts, and at 100° C. (212° F.) 42.5 parts, of Na_2SO_4, or 1 part of the pharmacopœial salt dissolves at 35° C. in .32 part and at 100° C. in .478 part of water. At lower temperatures 1 part of the salt requires, according to Loewel,

at	0°	10°	15°	25°	30°	33°	34° C.
	8.23	4.33	2.78	1.02	.544	.31	.243 part of water.

On carefully cooling the solution and keeping it free from dust the liquid becomes supersaturated, but crystallizes on exposure. When heated the salt parts with its water of crystallization (55.9 per cent.), and at a full red heat melts without being decomposed, and congeals on cooling to a translucent, foliaceous, crystalline mass; at a white heat the salt is volatilized, with partial decomposition. It imparts a yellow color to flame, and its solution yields, with chloride of barium, a white precipitate which is completely insoluble in dilute nitric acid.

Tests.—A 5 per cent. aqueous solution of sulphate of sodium should not effervesce on the addition of hydrochloric acid (absence of carbonate), should not be colored or precipitated by sulphide of ammonium or sulphuretted hydrogen (metals), should not become cloudy by carbonate of sodium and heating (earths) or by nitrate of silver (chloride), and should not give off ammoniacal vapors on being treated with a warm solution of caustic soda (ammonium salt). The pharmacopœias permit the presence of a minute quantity of chloride. 100 grains of it, dissolved in distilled water and acidulated with hydrochloric acid, give, by the addition of chloride of barium, a white precipitate which, after washing and drying, weighs 72.3 grains, or 1 Gm. yields .723 Gm. of $BaSO_4$.

Composition.—Crystallized sulphate of sodium contains 55.9 per cent. water of crystallization, 24.85 per cent. SO_3, and 19.25 per cent. Na_2O. Under certain circumstances the sulphate crystallizes with $7H_2O$, and then contains 47 per cent. of water of crystallization.

Sodii sulphas exsiccatus, s. Natrium sulfuricum siccum, *P. G.* It is obtained by exposing the crystallized salt to a moderate heat until its weight has been reduced to one-half, when the white powder is passed through a sieve and preserved in well-stopped bottles. 4 parts of the completely dehydrated salt represent 9 parts of the crystallized salt; it contains 56.33 per cent. SO_3 and 43.67 per cent. Na_2O.

Physiological Action.—The mode of action of Glauber's salt does not differ essentially from that of other saline cathartics. Like them, it purges only when given in solutions of a certain degree of dilution, and not even then unless the dose exceeds a certain variable limit. In the dose of a drachm, for example, dissolved in 2 or 3 ounces of water, it will not usually act as a purgative, but it will cause more or less increase of the sulphates in the urine. In doses of from half an ounce to an ounce, dissolved in half a pint of water, it causes some nausea—by its repulsive taste chiefly—and, later, colicky pain, intestinal gurgling, and copious watery stools. By the following day the evacuations are usually no longer liquid. If the salt is frequently taken in full doses, it disturbs the digestive functions, causing impaired appetite, flatulence, and constipation; but weak solutions may be repeated for a long time without such consequences. According to Rutherford and Vignal, sodium sulphate is a hepatic stimulant, but not of great power.

Various views have been entertained of the mode of action of saline cathartics, but the one most generally accepted is founded upon the physical law governing the diffusion of liquids separated by a membrane or diaphragm. According to it, a thinner liquid on one side of the membrane will pass through it to a denser liquid upon the opposite side, until an equilibrium in density is established between them. Therefore, when a saline solution of greater density than the serum of the blood is introduced into the stomach and intestine, it will attract the water from the blood and give rise to more or less liquid stools. This plausible explanation, which is generally regarded as sufficient, has been supported by the results of certain experiments in which a saline solution was injected into the veins, causing, not purgation, but constipation. These conclusions have been substantially confirmed by Hay (*Boston Med. and Surg. Jour.*, Nov. 1882, p. 417). But similar experiments by other hands have led to opposite conclusions.

There is good reason to believe that too strong or too weak a solution of a purgative salt equally tends to hinder its operation. If the solution is weak and not bulky, it will act by the kidneys rather than by the bowels. Many persons are affected by natural purgative mineral waters in this manner, whatever may be their dose. On the other hand, it is of daily observation that just in proportion to the dilution of a saline cathartic is its relative efficiency as a purgative. An ounce of Glauber's or Epsom salt, if taken in just enough water to dissolve it, will usually not purge at all; but a single drachm of either salt in a pint of water will produce liquid stools. This fact is abundantly illustrated by the familiar effects of the saline mineral waters just referred to; they are purgative in doses which contain only an inconsiderable proportion of the neutral salts.

Medical Uses.—Glauber's salt is almost entirely supplanted by Epsom salt in this country and in England, but in Germany the former is in more common use. It is employed to relieve *plethora*, overcome *constipation*, and to act as a depletory and sedative remedy in various febrile affections, inflammatory and other. It has been especially used in weak solution in *typhoid fever* and in *dysentery*, and probably with more benefit and less mischief than any other active treatment of those affections. Of late years it has been strongly recommended in the form of Carlsbad water (which contains also a little chloride and carbonate of sodium), natural or artificial, in cases of simple *ulcer of the stomach*. The water is taken to the extent of about a pint, in divided doses, early in the morning, and fasting; or half an ounce of Glauber's salt may be dissolved in a pint of water and used in the same manner. It is said that in surgical poisoning with carbolic acid repeated dressings with a 5 per cent. solution of sulphate of sodium are a very efficient antidote (*Amer. Jour. of Med. Sci.*, July, 1879, p. 280).

The *dose* of sulphate of sodium as a purgative is from half an ounce to an ounce, dissolved in from 4 to 8 fluidounces (Gm. 16–32 in Gm. 120–250) of water. Its nauseous bitterness may be partially corrected by the addition of aromatic sulphuric acid or by dissolving it in lemonade or in carbonated water flavored with syrup. Extract or fluid extract of liquorice may be used for the same purpose.

Sulphomethylate of sodium has recently (1879) been proposed by Rabuteau as a purgative salt. 10 Gm. of it, dissolved in 25 Gm. of water, injected into a dog's veins, occasioned constipation. 15 Gm. (½ ounce), dissolved in 2 wine-glassfuls of water and given to a woman in two doses, caused a free evacuation of the bowels. An examination of the urine showed that the salt was excreted as a sulphate. The salt is too unstable to become of practical value, although its freedom from unpleasant taste recommends it.

SODII SULPHIS, *U. S.*, *Br.*—Sulphite of Sodium.

Natrium sulfurosum, *Sulfis sodicus* (*natricus*).—*Sulfite de soude*, Fr.; *Natriumsulfit*, *Schwefligsaures Natron*, G.

Formula $Na_2SO_3.7H_2O$. Molecular weight 252.

Preparation.—This salt is formed on passing sulphurous acid gas into a solution of carbonate of sodium until the color of blue litmus-paper is changed to red, or the solution of a known quantity of carbonate of sodium is completely saturated with sulphurous acid gas, whereby *bisulphite of sodium* is produced; an equal weight of carbonate of sodium is dissolved in the liquid, and the solution evaporated to crystallization. The sulphurous acid decomposes the carbonate of sodium, replacing the carbonic acid which is evolved; $Na_2CO_3 + SO_2$ yields $Na_2SO_3 + CO_2$.

Properties.—Sulphite of sodium crystallizes in colorless, transparent, monoclinic prisms, which are inodorous and have a slight alkaline reaction to test-paper and a cooling, saline, and sulphurous taste. The salt effloresces on exposure, and becomes opaque from the loss of water and from oxidation to sulphate, and therefore requires to be kept in well-stopped bottles. The solution is more rapidly oxidized than the salt, but does not separate sulphur; likewise, not on the addition of hydrochloric acid (difference from hyposulphite). When heated the salt loses its water of crystallization (50 per cent.), and yields a white powder without melting, but at a red heat fuses into an orange-red mixture of sulphide and sulphate of sodium. The salt is nearly insoluble in alcohol, but dissolves readily in water, the anhydrous salt requiring, according to Kremers (1856), at 0° C (32° F.) 7.07 parts, at 20° C (68° F.) 3.49 parts, and at 40° C. (104° F.) 2.02 parts, of water. On heating the aqueous solution, saturated in the cold, anhydrous salt is deposited (Rammelsberg). The dry, anhydrous salt Na_2SO_3 (mol. weight 156) is nearly permanent in the air, and when immersed in a little water combines with it and forms a solid mass. Muspratt obtained sulphite in oblique prisms containing $10H_2O = 58.8$ per cent. of water of crystallization, but even from supersaturated solutions the salt crystallizes of the above composition (Schultz). Diluted sulphuric or hydrochloric acid, added to the salt or its solution, liberates sulphurous acid, which is recognized by its odor. If held in a non-luminous flame an intense yellow color is imparted to the latter.

Tests.—"A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should yield no precipitate, or at most only a white cloudiness, on the addition of a few drops of test solution of chloride of barium (limit of sulphate). If 0.63 Gm. of the salt be dissolved in 25 Ccm. of water, and a little gelatinized starch added, at least 45 Ccm. of the volumetric solution of iodine should be required before a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure sulphite of sodium)."—*U. S.* The absence of hyposulphite is shown by the test given above.

Composition.—The salt contains 24.6 per cent. Na_2O, 25.4 per cent. SO_2, and 50 per cent. of water of crystallization.

Other Sulphites.—(See Sodii Bisulphis, p. 1385, and Potassii Sulphis, p. 1241).

Sulphite of Ammonium, NH_4HSO_3, is precipitated in silky alkaline deliquescent needles on passing sulphurous acid into an alcoholic solution of ammonia.

Sulphite of Calcium is obtained as a white powder on mixing concentrated solutions of sulphite of sodium and chloride of calcium. It has an earthy and slightly sulphurous taste.

Sulphite of Magnesium separates as a white powder on passing sulphurous acid gas into water containing magnesia in suspension. Its sulphurous taste is more marked than that of the calcium salt.

Medical Action and Uses.—These are essentially the same as have been described in connection with sulphurous acid, sulphite of potassium, and hyposulphite of sodium; that is to say, sulphite of sodium checks putrefaction and other forms of fermentation, and thereby tends to arrest the exhalation of the fetid gases which are formed during these processes. This action, as in the case of sulphurous acid itself, is a purely chemical one, for it is neither more nor less certain in the laboratory than in the body. Like the other compounds of sulphurous acid with alkalies, sulphite of sodium has been vaunted as a remedy for the falsely-called zymotic diseases, but clinical experience has condemned this groundless assumption.

The *dose* of sulphite of sodium is from 20 to 60 grains (Gm. 1.30–4), largely diluted and frequently repeated. The solution may be flavored to conceal its taste. 1 part of the salt, dissolved in from 2 to 10 parts of water, may be applied externally, and solutions of half the latter strength or less may be injected into the bladder, vagina, etc.

SODII SULPHOCARBOLAS, *U. S., Br.*—SULPHOCARBOLATE OF SODIUM.

Sulphophenate (Phenolsulphonate) of sodium, E.; *Sulphophénate de soude*, Fr.; *Phenylschwefelsaures Natron*, G.

Formula $NaC_6H_5SO_4.2H_2O$. Molecular weight 232.

Origin and Preparation.—If 1 part of crystallized carbolic acid is dissolved in an equal weight of strong sulphuric acid, there results a new acid, *sulphocarbolic* or *orthophenolsulphonic acid*, which was discovered by Laurent (1841); $C_6H_5HO + H_2SO_4$ yields $C_6H_5HSO_4 + H_2O$. The mixture is digested for two or three days at a temperature of about 60° C. (122° F.), and then diluted with 20 parts of water. To the liquid are added in small quantities and with frequent stirring 2 parts of carbonate of barium until effervescence ceases, when a solution of *sulphocarbolate of barium* results, and a white deposit takes place, consisting of the excess of carbonate of barium employed and of sulphate of barium produced by free sulphuric acid. On adding carbonate of sodium to the filtrate double decomposition will take place, carbonate of barium being precipitated, while sulphocarbolate of sodium remains in solution and is obtained crystallized on concentrating the clear liquid. Sulphate of sodium may be substituted for the carbonate with identical results, except that the precipitate consists of sulphate of barium; and carbonate of lead may be used in place of carbonate of barium, sulphocarbolate of lead being likewise soluble in water.

Properties.—Sulphocarbolate of sodium is in "colorless, transparent, rhombic prisms, permanent in the air, odorless or nearly so, having a cooling, saline, somewhat bitter taste, and a neutral reaction; soluble in 5 parts of water, and in 132 parts of alcohol at 15° C. (59° F.), in 0.7 part of boiling water, and in 10 parts of boiling alcohol. When heated the salt loses its water and becomes a white powder. At a higher temperature it emits inflammable vapors having the odor of carbolic acid, and leaves a residue amounting to 36 per cent. of the original weight, the filtered solution of which, acidulated with nitric acid, produces a white precipitate with test solution of chloride of barium. A fragment of the salt imparts an intense yellow color to a non-luminous flame. The dilute, aqueous solution of the salt is colored violet by test solution of ferric chloride."—*U. S.* When fused together with caustic potassa, pyrocatechin is obtained. If during the preparation of sulphocarbolic acid the temperature is permitted to rise to near the boiling-point of water, *paraphenolsulphonic acid* having the same composition as the acid described above is formed; it yields a sodium salt, which crystallizes in hexagonal tables without water of crystallization, is less freely soluble in water, and when fused with potassa yields small quantities of phenol and diphenol, but neither hydroquinone or resorcin; the last-named compound is obtained in the manner stated from *metaphenolsulphonic acid* (Degener, 1879).

Tests.—"A 1 per cent. aqueous solution of the salt should not at once be rendered turbid or precipitated by test solution of chloride of barium (limit of sulphate)."—*U. S.*

Allied Compounds.—Other sulphocarbolates may be obtained by accurately precipitating a solution of sulphocarbolate of barium or of lead by a solution of the corresponding carbonate or sulphate, filtering, and crystallizing. They are all soluble in water, alcohol, and glycerin, and occasionally have a pinkish tint. The following have been employed:

SULPHOCARBOLATE OF POTASSIUM, $2KC_6H_5SO_4.H_2O$, crystallizes in shining needles, like the ammonium salt.

SULPHOCARBOLATE OF CALCIUM, $Ca2C_6H_5SO_4.6H_2O$, forms scaly crystals.

SULPHOCARBOLATE OF MAGNESIUM, $Mg2C_6H_5SO_4.7H_2O$, crystallizes in rhombic prisms or needles.

SULPHOCARBOLATE OF ZINC resembles the preceding in appearance. (See ZINCUM.)

The following acids are likewise known, but have not been employed in medicine: *Phenoldisulphonic acid*, $C_6H_4O(HSO_3)_2$, and *phenoltrisulphonic acid*, $C_6H_3O(HSO_3)_3$; they crystallize in deliquescent needles and are produced from phenol and sulphuric acid at elevated temperatures.

Sodii carbolas.—Carbolate (Phenate) of sodium, *E.;* Phénol sodique, *Fr.:* Natronphenylat, *G.*—Carbolic acid dissolves in solution of caustic soda as in other alkalies, and forms monosodium phenate, NaC_6H_5O, but, according to Berthelot (1871), neither basic nor acid compounds: such a concentrated solution may yield crystals of carbolic acid (see page 41). On treating phenol with an excess of melted alkali, Barth (1870) observed that about one-half of it is decomposed, with the formation of *diphenol*, $C_{12}H_{10}O_2$, and a small proportion of oxybenzoic and salicylic acids. On treating phenol with metallic sodium, sodium carbolate will crystallize in white needles. It is therefore difficult to obtain a definite compound in the solid state, but a solution of it is readily obtainable, and this dissolves notable quantities of carbolic acid. Such a solution was officinal in the P. G. 1872 as

Liquor natri (sodii) carbolici. It is prepared by melting 5 parts of pure carbolic acid, and adding 1 part of solution of soda spec. grav. 1.332 and 5 parts of distilled water. It is a clear liquid of a specific gravity varying between 1.060 and 1.065, has an alkaline reaction, and may be diluted with water or alcohol without being decomposed, but on the addition of acids carbolic acid is separated. Only one-seventh of the carbolic acid is combined with soda: the remaining six-sevenths are dissolved in the aqueous solution of carbolate of sodium.

Similar compounds, but made with impure carbolic acid, are often met with in commerce: on diluting them with water they separate most of the empyreumatic oils with which they are contaminated.

Medical Action and Uses.—The bodies of animals that have taken largely of this salt are said to resist putrefaction for a long time. This result is ascribed to its decomposition in the body into carbolic and sulphuric acid; or, rather, the latter acid in combination with sodium is eliminated along with the urine, while the carbolic acid exerts its characteristic influence in preventing organic decomposition. Given to man in doses of 20 or 30 grains (Gm. 1.30–2), it occasions no special symptoms; in twice or three times these doses it only causes some lightness of the head. It was at one time alleged to be a very efficient palliative in *phthisis* and to modify favorably the course of *typhoid fever* and the *eruptive fevers*, and was even vaunted as having a specific power in *scarlatina* (Sansom); but it has, in reality, as little efficacy in these diseases as the numberless other medicines to which similar virtues have been attributed. Miall claims that it arrests the *vomiting* of pregnancy. It may be useful in fermentative *dyspepsia*, like other carbolates. Like them, it exerts a more or less favorable action upon parts affected with pseudo-membranous exudation, especially when they tend to *gangrene* or become the seat of fetid decomposition, as in anginose *scarlatina* and *diphtheria;* and it also arrests the growth of *thrush*. Dr. Huse of Rockford, Ill., informs us that he cured all of thirty-six cases of diphtheria of the anginose form by giving from 15 to 40 grains of this salt every third or fourth hour. It may be administered internally in *doses* of from 10 to 30 grains (Gm. 0.60–2), and applied topically in a saturated aqueous solution. The medicinal value of the other sulpho-carbolates mentioned above is probably the same as that of the officinal compound.

SODII SULPHOVINAS.—Sulphovinate of Sodium.

Ethylsulphate of sodium, E.; *Sulfovinate de soude*, Fr.; *Weinschwefelsaures Natron*, G.

Formula $NaC_2H_5SO_4.H_2O$. Molecular weight 166.

Preparation.—The preparation of sulphovinate of sodium requires the previous formation of *sulphovinic acid* from alcohol and sulphuric acid, of which equal parts by weight are usually employed. On adding the sulphuric acid gradually to the alcohol, the mixture becomes hot and forms sulphovinic acid, by ethyl, C_2H_5, of the alcohol taking the place of 1 atom of hydrogen in the sulphuric acid, water being formed at the same time; $C_2H_5HO + H_2SO_4$ yields $C_2H_5HSO + H_2O$ (see page 122). The acid thus formed is invariably mixed with sulphuric acid, and if neutralized by caustic soda or sodium carbonate, the resulting solution requires to be mixed with an equal bulk of strong alcohol, in which the sulphate of sodium is insoluble, leaving an alcoholic solution of sulphovinate of sodium, from which the salt is obtained by evaporation. The use of alcohol for removing sulphate of sodium is best avoided by neutralizing the crude sulphovinic acid with carbonate of barium or carbonate of lead, whereby insoluble sulphate of barium or of lead is precipitated, while the corresponding sulphovinate is retained in solution, and, on being decomposed by an aqueous solution of carbonate or sulphate of sodium, and filtered from the insoluble barium or lead compound, is converted into sulphovinate of sodium, which should be evaporated at a moderate heat and crystallized. Marchand prefers adding carbonate of calcium to the crude acid, and decomposing the sulphovinate of calcium by carbonate of sodium. The yield is usually about equal to the weight of alcohol or of sulphuric acid used.

Properties.—Sulphovinate of sodium crystallizes in shining, transparent, flat, six-sided tables, which effloresce on exposure to dry air. When obtained by spontaneous evaporation the salt is granular and forms white opaque crystalline aggregations; and if crystallized from an alcoholic solution it contains alcohol in the place of water of crystallization. Heated to about 80° C. (176° F.), the crystals melt and rapidly part with their water, amounting to 10.8 per cent.; and if the heat is increased to 100° C. (212° F.) or a little above this point, the salt is decomposed, with the formation of sulphate of sodium, charcoal, heavy oil of wine, and of sulphurous acid, ethylene, and other gases. The aqueous solution of the salt when heated to boiling is decomposed, in the same manner as all sulphovinates, into alcohol, which distils off, and acid sulphate of sodium, this decomposition takes place more rapidly in concentrated than in diluted solutions. Crystallized sulphovinate of sodium dissolves at ordinary temperatures in a little more than half its weight of water, and is soluble in glycerin and ordinary alcohol, sparingly soluble in absolute alcohol, and insoluble in ether. Its solution is neutral to test-paper and has a slightly bitter afterward sweetish taste.

Tests.—The aqueous solution of the salt should yield only a slight precipitate with chloride of barium (sulphate), should not be colored by hydrosulphuric acid (absence of lead), and should not be rendered turbid by carbonate of sodium (absence of lead, barium, and calcium).

Allied Salt.—Sulphomethylate of Sodium, $NaCH_3SO_4.H_2O$. This is prepared precisely like the preceding salt, except that methylic alcohol is substituted for ordinary alcohol. It resembles the sulphovinate in properties, and has been recommended for similar purposes.

Medical Action and Uses.—This salt was proposed as a laxative, on the ground of its being almost tasteless and having but little tendency to occasion colic; but, however real these advantages may be, they are outweighed by its liability to decomposition and to occasion unpleasant symptoms in consequence of its being imperfectly prepared. The *dose* is about ½ ounce (Gm. 16) for an adult. *A tannate of sodium* has been proposed. It was made by dissolving 5 Gm. of tannic acid in 170 Gm. of water, and saturating with bicarbonate of sodium. A tablespoonful of it was administered every two hours in several cases of albuminuria, but in no instance did it lessen the discharge of albumen, and in more than one it seems to have been chargeable with producing fatal uræmia *Centralbl. f. d. ges. Therap.*, i. 186.)

SODII VALERIANAS, *Br.*—Valerianate of Sodium (Soda).

Sodæ valerianas, Br.; *Natrium valerianicum*, *Valerianas sodicus* (*natricus*).— *Valérianate de soude*, Fr.; *Baldriansaures Natron*, G.

Formula $NaC_5H_9O_2$. Molecular weight 124.

Preparation.—Take of Amylic Alcohol (Fusel Oil) 4 fluidounces; Bichromate of Potash 9 ounces; Sulphuric Acid 6½ fluidounces; Solution of Soda a sufficiency; Distilled Water ½ gallon. Dilute the sulphuric acid with 10 fluidounces of the water, and dissolve the bichromate of potash in the remainder of the water with the aid of heat. When both liquids are cold, mix them with the fusel oil in a matrass, with occasional brisk agitation, until the temperature of the mixture has fallen to about 90° F. Connect the matrass with a condenser, and distil until about half a gallon of liquid has passed over. Saturate the distilled liquid accurately with the solution of soda, remove any oil which floats on the surface, evaporate till watery vapor ceases to escape, and then raise the heat cautiously so as to liquefy the salt. When the product has cooled and solidified, break it into pieces, and immediately put it into a stoppered bottle.—*Br.*

This is a modification of Trautwein's process (1845). An excess of sulphuric acid liberates from bichromate of potassium chromic acid, which in the presence of amylic alcohol is deoxidized, and then combines with the sulphuric acid to form chromic sulphate, while the amylic alcohol is oxidized to valerianic acid. The reaction takes place according to the equation $3C_5H_{12}O + 2K_2Cr_2O_7 + 8H_2SO_4 = 3C_5H_{10}O_2 + 2K_2SO_4 + 2Cr_2 3SO_4 + 11H_2O$. On subjecting the liquid to distillation, the residue in the retort will contain the sulphates of potassium and chromium, and in the distillate will be found the valerianic acid. A small portion of the fusel oil escapes oxidation, and is contained in the distillate combined with valerianic acid to *amylo-valerianic ether* or *amyl valerianate*, also known as *apple oil* from its odor when largely diluted; its composition is $C_5H_{11}C_5H_9O_2$. On the addition of caustic soda the valerianic acid is neutralized to valerianate of sodium, and the amyl valerianate separates as an oily liquid, which may, however, be decomposed, by warming it with an additional quantity of soda, into valerianate of sodium and amylic alcohol. The latter separates as an oily stratum, which is removed, and the clear solution evaporated until all the water has been expelled.

Properties.—Thus prepared, valerianate of sodium forms a white crystalline mass which is rather unctuous to the touch, and has a neutral or slight alkaline reaction, a weak odor of valerian when perfectly dry, and a sweet and valerian-like taste. It melts at 140° C. (284° F.) without decomposition to a colorless liquid, and on cooling congeals crystalline; at a higher heat it gives off pungent acid vapors and inflammable gas, and leaves 42.75 per cent. of sodium carbonate. The salt is freely soluble in alcohol and water, and on exposure to the atmosphere liquefies from the absorption of water. On the addition of diluted sulphuric acid a strong odor of valerianic acid is given off.

Tests.—The solution of valerianate of sodium in water should not be colored by sulphuretted hydrogen and sulphydrate of ammonium (absence of metals), and should yield no precipitate with chloride of barium (absence of sulphate).

Pharmaceutical Uses.—For the preparation of Zinci valerianas, *Br.*, and of Acidum valerianicum.

Medical Action and Uses.—This preparation is active only through the valerianic acid it contains. The complaints in which it is used, slight functional derangements of the nervous system, are much more efficiently relieved by the valerianate of ammonium. The *dose* is from 1 to 5 grains (Gm. 0.06–0.30).

SOLIDAGO.—GOLDEN ROD.

Verge d'or, Fr.; *Goldruthe*, G.

The leaves and tops of Solidago odora, *Aiton.*

Nat. Ord.—Compositæ, Asteroideæ.

Description.—The *sweet-scented golden rod* is a native of the United States and Canada, and grows on the borders of woods and thickets and in dry or sandy fields. The stem is about 40 inches (1 M.) high, simple, slender, and nearly smooth, or somewhat pubescent in lines. The leaves are numerous, alternate, sessile, about 2 inches (5 Cm.) long, linear-lanceolate, entire, acute, pellucid-punctate, smooth, and on the margin somewhat rough. The flowers are in a terminal pyramidal panicle, composed of spreading racemes, bearing the flower-heads on one side; these are small, have lance-linear appressed yellowish scales, and contain three or four oblong ray-florets and several tubular disk-florets, all of a yellow color, and with terete akenes and a simple bristly pappus. The leaves when bruised have an agreeable anise-like odor and a sweetish aromatic taste. The flowers are likewise pleasantly aromatic; they appear in August and September. In some places the plant is known as *blue mountain-tea.*

Constituents.—The principal constituent is volatile oil; that obtained from the flowers differs from that contained in the leaves, which appears to be related to oil of anise.

Other Species.—SOLIDAGO VIRGA-AUREA, *Linné.* This is a variable species, indigenous to Europe, Northern Asia, and on this continent to Canada and the northern portion of the United States. It is from 2 to 3 feet (60–90 Cm.) high, branched above, has lanceolate or lance-oblong, petiolate, and more or less serrate leaves, and bears the flowers in erect simple wand-like racemes, forming a terminal panicle. The flower-heads contain eight or ten ligulate and several tubular disk-florets of a yellow color. The flowering herb has an aromatic odor and a bitterish and somewhat astringent taste, and has been used in Europe as *herba virgaureæ.* The oblique thin rhizome has likewise been employed.

Medical Action and Uses.—This plant, which grows profusely in the United States, owes its virtues to the volatile oil which it contains, and is stimulant, irritant, rubefacient, anodyne, and carminative. Its infusion is much used in country practice to produce *diaphoresis*, to allay *colic*, promote *menstruation*, and to cover the taste of nauseous medicines. For the last purpose the essential oil is to be preferred; it is also, like analogous products, sometimes used as a local anodyne in *neuralgia* and *rheumatism.*

An infusion may be prepared with an ounce of the herb and a pint (Gm. 32 in Gm. 500) of hot water, and given in *doses* of 2 or more fluidounces (Gm. 32–64). The oil may be prescribed in doses of 1 or more drops (Gm. 0.60).

SOPHORA.—Sophora.

Sophora speciosa, *Bentham.*
Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—An evergreen ornamental shrub or small tree indigenous to Western Texas. It has smooth, oddly pinnate leaves, with three to five pairs of leaflets, which are about an inch (25 Mm.) long, ovate in shape, obtuse or somewhat pointed, dark-green and glossy above and pale-green beneath. The flowers are in dense racemes, blue or tinged with white, very fragrant, and have a bell-shaped small calyx and ten nearly free stamens. The pod is indehiscent, 2 or 3 inches (5–8 Cm.) long, nearly terete, or more or less constricted between the seeds, tough, and covered with a pale brownish-gray pubescence. The seeds are globular-ovate, about $\frac{2}{5}$ inch (1 Cm.) long, somewhat depressed on the hilum, and of a bright-red color.

Constituents.—Dr. H. C. Wood (1877) isolated from the seeds an alkaloid, *sophorine*, by macerating the powder for several hours in strong alcohol, exhausting it by water acidulated with hydrochloric acid, adding to the liquid an excess of carbonate of sodium, and agitating the mixture with chloroform. The chloroform solution is agitated with dilute hydrochloric acid, the aqueous liquid evaporated to a syrup, freed from gummy matter by strong alcohol, the alcohol evaporated, and the treatment with carbonate of sodium and chloroform repeated. Sophorine is nearly white, amorphous, yields with chromic and sulphuric acids a dirty deep-purple color, passing through bright-green and bluish into yellowish-brown, and produces with tincture of chloride of iron a deep almost blood-red hue, after a time acquiring an orange tint.

Allied Plants.—Sophora sericea, *Nuttall*, is herbaceous, about 10 inches (25 Cm.) high, silky-hairy, and grows from Nebraska and Colorado to Arizona and California. Examined by F. A. Wentz (*Rep. Commiss. Agric.*, 1879), the seeds as well as the root and plant yielded an alkaloid, which was not obtained pure, and may be identical with sophorine (see also p. 1317).

Physiological Action.—According to the experiments of Dr. H. C. Wood, its properties depend upon an alkaloid which in frogs produced a rapid loss of reflex activity and power of voluntary movement, due to its action upon the spinal marrow. In a cat a large dose of it speedily occasioned marked weakness in the limbs, disturbance of the respiration, and convulsive movements, with loss of consciousness. A smaller dose excited vomiting, great muscular weakness, profound quietude, and deep sleep, lasting some hours, and ending in recovery. It is stated that sophora-beans are occasionally used by the Indians in Western Texas as an intoxicant—that half a bean will produce a delirious exhilaration followed by a sleep that lasts for several days; and it is asserted that a whole bean will kill a man. The peculiarities of sophora-beans, as thus described, invite a fuller investigation (*Phila. Med. Times*, vii. 510).

SORBUS.—Mountain-Ash.

Sorbes, Fr.; *Ebereschе*, *Vogelbeere*, G.

The fruit of Sorbus (Pyrus, *Gaertner*, Mespilus, *Scopoli*) aucuparia, *Linné*.
Nat. Ord.—Rosaceæ, Pomeæ.

Description.—This species of Sorbus, which is also known as *rowan tree*, is a medium-sized tree indigenous to Europe and Western Asia and cultivated for ornament in North America. It has oddly pinnate leaves, with obtuse, on the lower side downy leaflets, and bears numerous small, globular, juicy, berry-like fruits, which are of a bright-red color, are crowned by the calyx limb, contain three or four cells, each with two seeds, and have an acid taste.

The *American mountain-ash*, Pyrus (Sorbus, *Marshall*) americana, *De Candolle*, and P. (Sorbus, *Roemer*) sambucifolia, *Chamisso et Schlechtendal*, resemble the preceding species, and have similar but somewhat smaller fruits; the former species grows in the Alleghanies, the latter in the Rocky Mountains, and both extend to New England and far northward through Canada.

Constituents.—According to Liebig, mountain-ash berries when unripe contain tartaric acid, but when ripe malic and citric acids. Byschl (1854) determined also the presence of tannin, acrid, bitter, and coloring principles, fermentable sugar, and of an amorphous, non-fermentable sugar, which had previously been obtained by Pelouze (1852) by setting the juice aside for about a year, and then evaporating and crystallizing. This *sorbin* crystallizes in colorless, hard, very sweet prisms, separates cuprous oxide from an alkaline solution of copper, is not altered by boiling with dilute acids, and has the composition $C_{12}H_{24}O_{12}$. It is not identical with *sorbit*, $2C_6H_{14}O_6.H_2O$, obtained by Boussingault (1872) from the fermented juice; this is isomeric with mannit and dulcit, is very sparingly soluble in cold water, and melts at 102° C. (215.6° F.), and when anhydrous at 110° C. (230° F.). On preparing malic acid from the juice of mountain-ash berries, and distilling the mother-liquor after the separation of bimalate of calcium, G. Merk obtained an oily liquid which A. W. Hofmann (1859) recognized as a new acid, *parasorbic acid*. This has an aromatic odor, does not displace carbonic acid from the carbonates, is slightly soluble in water, freely so in alcohol and ether, and when heated under pressure with caustic potassa is converted into crystallizable *sorbic acid*. Both acids have the composition $C_6H_8O_2$. Wicke (1851) obtained *amygdalin* from the bark and buds of the mountain-ash.

Medical Action and Uses.—The unripe fruit and the bark of the mountain-ash and its European congeners are extremely astringent, and are used in infusions, decoctions, and poultices to constringe relaxed parts, as the throat, anus, and vagina, and internally to check *diarrhœa*, etc. The ripe fruit is much used to prepare an infusion whose astringent and acidulous qualities render it a pleasant gargle in acute affections of the *tonsils* and *pharynx*.

SPIGELIA, *U. S.*—Spigelia.

Pinkroot, E.; *Spigelie du Maryland*, Fr.; *Marylandische Spigelie*, G.

The root of Spigelia marilandica, *Linné*. Bentley and Trimen, *Med. Plants*, 180.
Nat. Ord.—Loganiaceæ.

Origin.—This plant is variously known as *Maryland pink*, *Carolina pink*, and *worm-grass*. It grows in rich shady woods, chiefly in the southern part of the United States, but is found northward to Pennsylvania and Wisconsin. The stem is from 10 to 20 inches (25–50 Cm.) high, simple, round below, quadrangular above, and has opposite, sessile, acute, ovate-lanceolate leaves, and a terminal spike of six or eight showy flowers, with funnel-form or somewhat club-shaped corollas, which are nearly 2 inches (5 Cm.) long, externally scarlet-red and internally yellow, and have the stamens exserted. The plant flowers in June and July, and produces two-celled and few-seeded capsules.

Description.—Pinkroot consists of a rhizome with numerous rootlets. The rhizome is from 2 to 4 inches (5–10 Cm.) long, simple or somewhat branched, bent in various directions, but generally horizontal, about $\frac{1}{8}$ inch (3 Mm.) thick, somewhat wrinkled longitudinally, frequently with a portion of the recent stem attached, and on the upper side with very short remnants of stems, which are from $\frac{1}{8}$ to $\frac{1}{4}$ inch (3–6 Mm.) apart and are terminated by cup-shaped scars. The numerous curved and bent fibrous rootlets emanate chiefly from below and the sides of the rhizome, and are about 4 inches (10 Cm.) long, brittle and angularly wrinkled longitudinally. The color is brown or purplish-brown; the rootlets are somewhat lighter. Pinkroot has a faint aromatic odor and a sweetish afterward slightly bitter, not disagreeable, taste. When the rhizome is cut transversely, there is seen a thin bark, with a dark outer layer and a light purplish-brown inner layer covering the pale-yellowish wood; the central pith is large, somewhat above the middle, and often discolored or decayed. The rootlets have a relatively thicker bark and no central pith.

Spigelia is occasionally seen mixed with a few roots of several plants, doubtless from careless collection, and has been observed as an accidental admixture in serpentaria. We have not observed any adulterations except earthy matter and stems, but we have frequently seen used in its place the root of Phlox, described below.

Allied Drugs.—Spigelia anthelmia, *Linné*. This is an annual plant of the West Indies and South America, and has lance-ovate acute leaves, the upper ones being in whorls of four, and pale-reddish or purplish flowers not over $\frac{1}{2}$ inch (12 Mm.) long: its root is short, blackish, and internally whitish, and is divided into numerous long, thin branches. The plant has in the fresh state a nauseous odor, is bitter and acrid, and is employed like pinkroot.

Phlox carolina, *Linné* (nat. ord. Polemoniaceæ), together with one or more allied species, is known in some of the Southern States as *Carolina* or *Georgia pink*. That much of the commercial pinkroot is derived from this plant was shown by Dr. A. W. Miller (1875). This drug is of a lighter brown or brownish-yellow color, and consists of a rather knotty rhizome with thickish, straight, and rigid rootlets, from which the bark is easily removed, exposing a straw-colored ligneous thread. The root is employed like spigelia, and is said to be equally efficient. The root of Phlox glaberrima, *Linné*, appears to be likewise used in some localities; it is somewhat darker and less rigid than the preceding, and more closely resembles spigelia.

Constituents.—Pinkroot was examined by Dr. R. H. Stabler (1857), who found in it a little volatile oil, tasteless resin, wax, tannin, and a bitter principle which was not obtained in the pure state, but was ascertained to be not precipitated by acetate of lead, to be soluble in water and alcohol, and to be insoluble in ether; it appears to be precipitated by tannin. W. L. Dudley (1879) obtained, by distilling pinkroot with milk of lime, a volatile alkaloid, *spigeline*, which gives with iodine a brownish-red precipitate, with metatungstic acid a white flocculent precipitate, and with Mayer's test a white crystalline precipitate soluble in alcohol and ether, and differing from the precipitates of other alkaloids by this test in being soluble in acids.

The West Indian plant was analyzed by Feneulle (1823) and Ricord-Madiana (1828), but the active principle was not isolated.

Off. Prep.—Extract. spigeliæ fluid., *U. S.*

History and Physiological Action.—*Spigelia anthelmia*, it is stated by Murray (*Apparatus Medicam.*, i. 545), was first brought into notice about 1750 by Browne, who said that it had long been used as a vermifuge by the Indians and the negroes of the West Indies and South America. On his recommendation it was introduced into England by Hinckley, Brocklesby, and others. Narcotic properties were attributed to it. *Spigelia marilandica* does not differ essentially from the species just described. It was used as a vermifuge by the aborigines of South Carolina, and was early employed by American physicians, who attributed to it both purgative and narcotic powers. The latter were even said to have caused death. Its toxical effects include nervous excitement of an hysterical sort, a hot and dry skin, pain in the forehead and eyes, stiffness and swelling of the eyelids, strabismus, dilatation of the pupils, temporary loss of sight, some drowsiness, but not narcotism, tremor of the tongue, general muscular trembling on making exertion, and even convulsions.

Medical Uses.—It is said that an infusion of spigelia is sometimes given as a substitute for ordinary tea to children liable to verminous disorders. It is so commonly associated with purgatives when used as an *anthelmintic* that it may be concluded to act upon intestinal worms by benumbing if not killing them, after which the associated medicine expels them from the bowels. In some states of chronic irritation simulating those which usually attend the presence of lumbricoid ascarides in the intestines spigelia is of marked advantage, but its mode of action is obscure. The most usual and the best form of the medicine is that known as "worm tea"—viz.: ℞. Spigelia ½ ounce (Gm. 16); senna and fennel-seed, of each 120 grains (Gm. 8); manna 1 ounce (Gm. 32); boiling water 1 pint (Gm. 500). Infuse. S. Half a wine-glassful three times a day for a child two years old. The fluid extract of spigelia and senna (*U. S. P.* 1870) represented this infusion sufficiently well. The proper remedies for the *toxical effects* of spigelia are wine, ammonia, and other diffusible stimulants.

SPILANTHES.—SPILANTHES.

Herba spilanthis.—Para cress, E.; *Cresson de Para*, Fr.; *Parakresse*, G.

Spilanthes oleracea, *Jacquin.*

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This annual herb is indigenous to South America, naturalized in India, and is sometimes cultivated in gardens. Its ascending stem is about 8 inches (20 Cm.) long, and much branched. The leaves are opposite, petiolate, three-nerved, ovate, often subcordate, obtuse, or somewhat acute, repand-crenate and rough on the margin, 2 inches (5 Cm.) long, and of a pale-green color or somewhat purplish. The flower-heads are on long axillary peduncles, hemispherical in shape, about ½ inch (12 Mm.) broad, have a chaffy receptacle, and contain numerous tubular florets, which are at first brown and afterward yellow. The herb is collected while flowering; it has a peculiar, not agreeable odor, and when masticated a sharp and biting taste, followed by a copious flow of saliva.

Constituents.—Lassaigne (1825) determined the presence in Para cress of tannin, producing green precipitates with ferric salts, and believed the acrid taste to be due to the volatile oil. Buchner (1831), however, attributed the taste to a soft resin resembling that contained in pellitory. Walz (1859) obtained from the alcoholic extract, by exhausting it with ether, a crystalline principle, *spilanthin*, which is not precipitated by acetate of lead, is insoluble in water, and when its solutions are rapidly evaporated is converted into a resinous mass.

Allied Plants.—Spilanthes Acmella, *Linné*, s. Acmella mauritiana, *Richard*, is an annual East Indian herb with ovate or lance-ovate, serrate, pellucid-punctate, petiolate leaves, and small obconical flower-heads having five or six ligulate ray-florets. It has a bitter balsamic afterward biting taste, and is used like the preceding species.

Xanthium strumarium, *Linné*.—Cocklebur, *E.*; Lampourde, Petit glouteron, *Fr.*; Spitzklette, Knopfklette, *G.*—This weed is common in waste places throughout North America, Europe, and Northern Asia. The stem is rough, about 18 inches (45 Cm.) high, and often spotted. The leaves are alternate, long-petiolate, triangular heart-shaped, slightly three-lobed, and rough-hairy. The sterile flowers are in short terminal spikes. The fertile flowers are numerous, in axillary clusters, and produce flat, oblong akenes, without pappus and enclosed in the enlarged involucre, which is oval or oblong in shape, nearly an inch (25 Mm.) long, beset with numerous hooked prickles, and terminates in two erect beaks. The variety echinatum has a more turgid prickly involucre and curved beaks. Zander (1881) obtained from 100 parts of the fruit 5.2 ash, 38.6 fat, 36.6 albuminoids, 1.3 xanthostrumarin and organic acids, besides sugar, resin, etc. *Xanthostrumarin* seems to be a glucoside, is yellow, amorphous, soluble in water, alcohol, ether, benzol, and chloroform, and yields precipitates with group reagents for alkaloids and with ferric chloride, lead acetate, and salts of other metals, but is not precipitated by tannin or gelatin. M. V. Cheatham (1884) obtained only 14.5 per cent. of fixed oil, and a principle which was precipitated by tannin.

Xanthium spinosum, *Linné*, Spiny clotbur. It is indigenous to Southern Europe, but has become somewhat naturalized in the United States and most civilized countries, and grows in waste places and neglected fields. The stem is about 2 feet (60 Cm.) high, and has shortly petiolate, lanceolate, or ovate-lanceolate leaves, which are either cut-toothed or the upper ones entire, and have at the base sharp, three-forked, yellowish, stipulate spines, nearly an inch (25 Mm.) long. The fertile axillary burs are crowned with one inconspicuous beak.

Pharmaceutical Preparation.—Tinctura spilanthis composita.—Compound tincture of spilanthes, *E.*; Teinture de cressen de Para, *Fr.*; Paratinktur, *G.*; also known as *Paraguay roux*.—Spilanthes herb and pellitory, of each 2 parts; alcohol sp. gr. .892, 10 parts.

Medical Action and Uses.—Every part of spilanthes has an aromatic and acrid taste, which excites free salivation. In its native country it is used as a remedy for *gout*, *rheumatism*, and *gravel*, and also as a diuretic in *dropsy* and as a *vermifuge*. In Europe it has been chiefly employed for the relief of *toothache*, and for many years a tincture made from the plant has been in popular use under the name of *Paraguay roux*. When the aching tooth is hollow the tincture is applied to the carious cavity on cotton, otherwise it is painted or rubbed upon the adjacent gum. It does not act as an irritant upon the latter.

Xanthium spinosum. In some parts of Germany the powder or infusion of this plant has a popular reputation for the cure of *intermittent fever*. In Russia it is held to be a prophylactic against *hydrophobia*. Its efficacy is attested by Dr. Grzymala of Podolia, who states that when several animals or men had been bitten by a rabid dog those only escaped who were treated with this medicine, and that such results are usual, not exceptional. These statements, made in 1876, have not been confirmed. The physiological effects of the plant are said to resemble those of jaborandi, in being sudorific, sialagogue, and slightly diuretic. The dose of the dried powder of the leaves, repeated three times a day and continued for three weeks, is about 10 grains.

SPIRÆA.—Hardhack.

Spiræa tomentosa, *Linné*.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—Hardhack, also known as *steeple-bush*, *whitecap*, and, like other species of the same genus, as *meadow-sweet*, is a small North American shrub growing from Canada southward to South Carolina. It is 3 or 4 feet (.9–1.2 M.) high, has a slender, red-brown, branching stem with hard brittle wood, and ovate-lanceolate, serrate, dark-green, and beneath rusty tomentose leaves. The root is branching, covered with a thin brown bark, and contains a whitish, hard, and tasteless wood; the taste of the bark is bitterish and strongly astringent. The small purplish-red flowers, with conspicuous stamens, are in short racemes crowded into a dense pyramidal panicle, make their appearance in July and August, and produce four or five one-seeded follicles. The plant, collected while in bloom, is often employed in preference to the root; it has an agreeable though not a strong aromatic odor, and a very astringent somewhat bitter taste.

Constituents.—Hardhack has not been analyzed; it evidently contains tannin, volatile oil, etc.

Other Species.—Spiræa Aruncus, *Linné.*—Goat's beard, *E.:* Barbe de chèvre, *Fr.;* Bocksbart, *G.*—It grows in Europe and in North America westward from the Catskill and Alleghany Mountains. It is a perennial herb about 3 feet (90 Cm.) high, has smooth thriee-pinnate leaves, with thin, lance-oblong, sharply serrate, and pointed leaflets, and produces numerous small white flowers in slender racemes. It has an agreeable odor and an aromatic, astringent, and bitterish taste.

Spiræa ulmaria, *Linné*, indigenous to Europe and cultivated in gardens, is an herbaceous perennial, with interruptedly pinnate leaves, the three to seven ovate or lance-oblong serrate leaflets being interposed with minute leaflets. The flowers are in long-peduncled corymbs, small, white, and in cultivation usually double. This, like other herbaceous species of Spiræa, contains *salicylic aldehyd* or *salicylous acid*, $C_7H_6O_2$, which may also be obtained from salicin, and is a colorless strongly aromatic oil which boils at 196° C. (385° F.), and in aqueous solution is colored dark-violet by ferric chloride.

Spiræa filipendula, *Linné*, likewise a European plant, has numerous long radicles, which near their lower end are enlarged to pear-shaped tuberous bodies, sometimes moniliform. These are 1 or 1½ inches (25–38 Mm.) long, blackish-brown externally, internally pale red-brown, and have a sweetish, bitterish, and somewhat astringent taste.

Medical Action and Uses.—The late Drs. Griffith and Ives remarked that the officinal portion of the root (1870) is the least valuable part of the plant, the bark and the leaves being more efficient. It is said to have been used by the aborigines of this country, but was first brought to the notice of physicians in 1810. Its action was compared with that of rhatany, and it was alleged not to disorder the stomach even when taken in large doses. It was used in various forms of *diarrhœa*, including that of typhoid fever, pulmonary consumption, and summer complaint, in passive *hæmorrhages* and *menorrhagia*, in decoction as an injection for *leucorrhœa*, *gleet*, etc., and as a dressing for fungous *ulcers*. The extract has an agreeable odor and an astringent bitter taste, and may be prescribed in the *dose* of 5 grains (Gm. 0.30) or more. The decoction, made by boiling an ounce of the plant in a pint (Gm. 30 in Gm. 500) of water, may be given cold, in the *dose* of 1 or 2 fluidounces (Gm. 30–60). Although S. tomentosa is somewhat aromatic, it is less so than some other species, and especially S. ulmaria, which was formerly in vogue as a stimulant in *fevers*, as serpentaria is now used, and also for its astringent action in the diseases mentioned above. It appears to have displayed diuretic virtues in several forms of *dropsy*. In Europe an infusion, a decoction, and an extract of it are employed. To S. ulmaria has been attributed the power of overcoming *retention of urine* depending upon enlarged prostate and intercurrent irritation (*Edinb. Med. Jour.*, xxviii. 1036).

SPIRITUS.—Spirits.

Alcoolats, Fr.; *Geiste*, G.

Spirits were formerly prepared almost exclusively by distilling odorous subtances with alcohol; at present, however, both the United States and British Pharmacopœias direct most of them to be prepared simply by dissolving the volatile oils and other volatile compounds in alcohol. Since odorous principles volatilize only sparingly with the vapors of alcohol, but more freely with the vapors of water, distilled spirits are made with alcohol sufficiently diluted with water, so that a portion of the latter remains in the still on the completion of the process. The German Pharmacopœia usually directs alcohol and water in the proportion of 3 parts of the former to 3 or 5 parts of the latter; after due maceration with the bruised drug 4 parts by weight of distillate are recovered. The alcoolats of the French Codex are generally made with 60 or 80 per cent. alcohol, the fresh drugs being used whenever practicable. In all cases the alcohol employed should be free from fusel oil, and the drugs should be well bruised and macerated with the alcohol for one or several days before distillation is commenced. In distilling spirits the same precautions should be adopted as in the distillation of medicated waters (see page 232), with this addition, that ample provision be made for the complete condensation of the vapors. Heat is best applied by means of steam or on a small scale by means of a salt-water bath.

SPIRITUS ÆTHERIS, *U. S., Br.*—Spirit of Ether.

Spiritus æthereus, s. Liquor anodynus mineralis Hoffmanni, P. G.; *Æther sulfuricus alcoolisatus*, F. P.—*Éther hydrique (sulfurique) alcoolisé, Liqueur anodine d'Hoffmann*, Fr.; *Hoffmannstropfen*, G.

Preparation.—Stronger Ether 30 parts (330 grains or 1 fluidounce); Alcohol 70 parts (770 grains or 2 fluidounces and 30 minims); to make 100 parts (about 3 fluidounces or 2½ ounces av.). Mix them.—*U. S.* Ether 10 fluidounces; rectified spirit 20 fluidounces.—*Br.* Ether and alcohol, of each equal weight.—*F. Cod.* Ether 1 part, alcohol 3 parts.—*P. G.*

This preparation is used in Europe as a simplified form of *Hoffmann's anodyne* and for similar purposes.

SPIRITUS ÆTHERIS COMPOSITUS, *U. S., Br.*—COMPOUND SPIRIT OF ETHER.

Hoffmann's anodyne, E.; *Liqueur nervine de Bang*, Fr.; *Zusammengesetzter Ætherweingeist*, G.

Preparation.—Stronger Ether 30 parts (10 oz. av. or 13¼ fluidounces); Alcohol 67 parts (22⅓ oz. av. or 26⅓ fluidounces); Ethereal Oil 3 parts (1 oz. av.); to make 100 parts (or 33⅓ av. oz. or 2½ pints). Mix them.—*U. S.*

Oil of wine (undiluted) 3 fluidrachms; ether 8 fluidounces; alcohol 16 fluidounces.—*Br.* For preparing oil of wine the mixture of alcohol and sulphuric acid is directed to be distilled merely until it begins to blacken. (See pp. 1041, 1042.)

Properties.—Compound spirit of ether is a colorless inflammable liquid, entirely volatilized by heat, but when ignited on glass or porcelain it leaves an almost invisible residue having an acid taste and reddening blue litmus-paper. The spirit is neutral to test-paper, or has only a very slight acid reaction. It has an aromatic ethereal odor and a pungent, slightly sweetish taste. When mixed with water a whitish turbidity is produced from the separation of oil of wine, and a slight opalescence is still observed if 40 drops of the spirit are mixed with a pint of water. If adulterated with a fixed oil, this will separate from the water as a thin film, which, when absorbed by bibulous paper, produces a permanent greasy stain, not disappearing by heat. On evaporating some of the spirit with an excess of aqueous solution of chloride of barium, a white precipitate of sulphate of barium is produced.

The commercial compound spirit of ether is rarely made by the officinal formula, but is obtained, as was ascertained by Procter (1852), in the rectification of ether, the last fraction of the distillate, which is contaminated with light and a little heavy oil of wine, being diluted with alcohol and water so as somewhat to resemble the officinal article; from this it differs in producing only a slight precipitate with chloride of barium.

Medical Action and Uses.—This preparation is stimulant, anti-spasmodic, and anodyne, as are all preparations of alcohol, but in this one the addition of ether and ethereal oil renders its action more prompt and lively. Hence it is universally employed to allay *restlessness*, *sleeplessness*, and *nervous disturbance* in general, especially in the absence of fever, and notably in the manifold manifestations of *hysteria*. It is also a convenient remedy for *flatulent* and so-called *uterine colic*. It may, indeed, be used in all the cases for which sulphuric ether is prescribed internally, and with superior advantage. The *dose* is from ½ to 1 fluidrachm (Gm. 2–4), properly diluted with sweetened water.

SPIRITUS ÆTHERIS NITROSI, *U. S., Br., P. G.*—SPIRIT OF NITROUS ETHER.

Spiritus nitri dulcis, Spiritus nitrico-æthereus.—Sweet spirit of nitre, E.; *Éther azoteux alcoolisé, Liqueur anodine nitreuse*, Fr.; *Versüsster Salpetergeist*, G.

An alcoholic solution of ethyl nitrite ($C_2H_5.NO_2$; molecular weight 75), containing 5 per cent. of the crude ether.—*U. S.*

Preparation.—Nitric Acid 9 parts (9 oz. av.); Sulphuric Acid 7 parts (7 oz. av.); Alcohol, Distilled Water, each a sufficient quantity. Add the sulphuric acid gradually to 31 parts (31 oz. av. or 36¼ fluidounces) of the alcohol. When the mixture has cooled, transfer it to a tubulated retort connected with a well-cooled condenser, to which a receiver, surrounded by broken ice, is connected air-tight, and which is further connected by means of a glass tube with a small vial containing water, the end of the tube dipping into the latter. Now add the nitric acid to the contents of the retort, and, having introduced a thermometer through the tubulure, heat rapidly, by means of a water-bath, until strong reaction occurs and the temperature reaches 80° C. (176° F.). Continue the distillation at that temperature, and not exceeding 82° C. (200° F.), until the reaction ceases. Disconnect the receiver, and immediately pour the distillate into a flask containing 16 parts (16 oz. av. or 15½ fluidounces) of ice-cold distilled water. Close the flask and agitate the contents repeatedly, keeping down the temperature by immersing the flask occasionally in ice-water. Then separate the ethereal layer, and mix it immediately with nineteen times its weight of alcohol. Keep the product in small glass-stoppered vials, protected from light.—*U. S.*

Take of nitric acid 3 fluidounces; sulphuric acid 2 fluidounces; copper, in fine wire (about No. 25), 2 ounces; rectified spirit a sufficiency. To 1 pint of the spirit add gradually the sulphuric acid, stirring them together; then add, in the same way, 3½ fluidounces of the nitric acid. Put the mixture into a retort or other suitable apparatus into which the copper has been introduced and to which a thermometer is fitted. Attach now an efficient condenser, and, applying a gentle heat, let the spirit distil at a temperature commencing at 170° F. and rising to 175° F., but not exceeding 180° F., until 12 fluidounces have passed over and been collected into a bottle kept cool, if necessary, with ice-cold water; then withdraw the heat, and, having allowed the contents of the retort to cool, introduce the remaining ½ ounce of nitric acid, and resume the distillation as before until the distilled product has been increased to 15 fluidounces. Mix this with 2 pints of the rectified spirit, or as much as will make the product correspond to the test of specific gravity and percentage of ether separated by chloride of calcium. Preserve it in well-closed vessels.—*Br.*

The second formula gives the process of Prof. Redwood (1867), and yields good results if proper attention be paid to the strength of the acids and the alcohol, and to the temperature; it is, however, best adapted for being worked on a small scale. The sulphuric acid, in the presence of nitric acid, dissolves the copper, forming sulphate of copper and setting nitrous acid free, which in its nascent state acts upon the alcohol, producing nitrous ether and water. The reaction is explained by the equation $C_2H_5HO + HNO_3 + H_2SO_4 + Cu = C_2H_5NO_2 + CuSO_4 + 2H_2O$. (An elaborate paper on the manufacture by this process of spirit of nitrous ether of the strength required by the U. S. P. was read by Prof. Diehl (1877) before the Louisville College of Pharmacy.)

Older formulas differ from Redwood's either in acting upon alcohol directly by nitric acid or in generating nitric acid from nitrate of potassium and sulphuric acid in the presence of alcohol. In either case the result is much influenced by the strength of the acid and by the temperature, and a larger quantity of aldehyd is always thus produced than in the presence of copper. The action of nitric acid upon alcohol and the production of aldehyd are explained by the equation $2C_2H_5HO + HNO_4 = C_2H_4O + C_2H_5NO_2 + 2H_2O$. The German Pharmacopœia directs a mixture of 12 parts of alcohol and 3 of nitric acid to be set aside for 12 hours, and then distilled until 10 parts are obtained, the distillate being neutralized with magnesia and rectified.

In the process of the U. S. P. the reaction likewise takes place between the nitric acid and alcohol, the sulphuric acid serving mainly the purpose of uniting with the water which is formed during the reaction. According to Prof. H. B. Parsons (1883), only about one-half the alcohol is used in the production of nitrous ether, and the process is therefore an expensive one; it is, however, easily carried out on a small scale if proper precaution is taken for not exceeding the temperature mentioned in the formula and for the condensation of the ethereal vapors. By washing with water the distillate is freed from various acid products likely to be present, and by using for this ice-cold water only a small amount of ether will be lost in the operation.

Other processes which have been at various times recommended require the previous preparation of nitrite of potassium or of sodium, and the decomposition of one of these salts by sulphuric acid in the presence of alcohol. It has likewise been suggested to prepare this spirit from pure nitrous ether or nitrite of ethyl by mixing it with alcohol in a definite proportion. This would doubtless be the most rational way of preparing the spirit, but the obstacles to it are the difficulty of obtaining the ether in the pure state, and, after it has been obtained, in the preservation of it.

NITRITE OF ETHYL, $C_2H_5NO_2$, is a thin, pale-yellow liquid having a pungent, ethereal, apple-like odor. It boils at 17.5° C. (72.5° F.), is somewhat soluble in water, and on keeping acquires an acid reaction.

Properties.—Prepared by either process, spirit of nitrous ether is a transparent, volatile, inflammable, and nearly colorless liquid, with a slight yellowish or greenish-yellow tint, and has an agreeable, ethereal, somewhat fruit-like odor, free from pungency, and a sharp and burning, or, after diluting with water, a sweetish and cooling ethereal, taste. It mixes with water in all proportions, the liquid remaining clear and transparent. It does not alter the color of blue litmus-paper or merely reddens it slightly, and should effervesce not at all on the addition of a crystal of bicarbonate of potassium. If agitated with a solution of ferrous sulphate and a little strong sulphuric acid, it acquires a dark olive-brown tint. If mixed with half its volume of officinal solution of potassa previously diluted with an equal measure of distilled water, it assumes a yellow color, which slightly deepens, but does not become brown, in 12 hours, showing the absence of undue proportions of aldehyd. The spirit of the Br. P. contains about 10 per cent. of nitrous ether and has the specific gravity 0.845; the U. S. P. requires 5 per cent. of ether and a specific gravity of 0.828–0.825.

Tests.—"A portion of the spirit, in a test-tube half filled with it, plunged into water heated to 63° C. (145.4° F.), and held there until it has acquired that temperature, should boil distinctly on the addition of a few small pieces of glass. If 10 Gm. of spirit of nitrous ether be macerated with 1.5 Gm. of potassa for 12 hours, with occasional agitation. the mixture then diluted in a beaker with an equal volume of water, and set aside until the odor of alcohol has disappeared, then slightly acidulated with diluted sulphuric acid, and a solution of 0.476 Gm. of permanganate of potassium gradually added, the color of the whole of this solution should be discharged (presence of at least 4 per cent. of real ethyl nitrite)."—*U. S.* The first test, determining the beginning of boiling at the temperature indicated, is valuable only in connection with the other properties. The quantitative determination of the nitrous ether is done by the process suggested by E. Kellstroem (1880). "10 Gm. of the spirit should not have an acid reaction after 3 drops of volumetric solution of potassa have been added (limit of free acid)."—*P. G.* The *Br. P.* requires the spirit when fresh to yield 7 times, and when old about 5 times, its volume of nitric oxide gas. Eykman (*New Remedies*, May, 1882) generates this gas by heating the spirit with an acid solution of ferrous sulphate; and Allen (*Phar. Jour.*, 1885, xv. 673) by treating the spirit with potassium iodide and sulphuric acid.

Preservation.—Spirit of nitrous ether should be kept in small well-filled and well-stopped bottles and not exposed to the direct sunlight. The concentrated spirit obtained by distillation may be preserved in the same manner, and if well washed with ice-cold water requires merely dilution with alcohol to furnish an unexceptionable preparation. The free acid which is formed by the influence of atmospheric oxygen may be neutralized by magnesia or by potassium bicarbonate, but the spirit should not be kept continuously in contact with these chemicals. It has, however, been recommended. and is now directed by the P. G., to keep in the bottle with the spirit some crystals of potassium tartrate, whereby free acid will be neutralized, a corresponding amount of potassium bitartrate being formed.

Off. Prep.—Mistura glycyrrhizæ comp., *U. S.*

Medical Action and Uses.—The vapor of this liquid, breathed by rabbits and cats, rapidly occasions spasms, followed by death, after which the blood is found liquid and dark and the lungs and brain congested. When inhaled by man it causes giddiness, headache, throbbing of the arteries, and (in excessive quantities) confusion of mind, muscular reaction, cyanosis, a thready pulse, and spasms. Prolonged immersion in its vapor has been fatal. In very large doses it irritates the stomach, especially if the preparation contain, as it often does, free acid, causing vomiting and colic. In medicinal doses it is decidedly diuretic or diaphoretic, according as the skin is cool or warm. In *febrile conditions* it is much used to promote critical sweating, which it probably does by abating the morbid activity of the heart and tension of the arteries. Its efficacy in this respect is very marked in slight and ephemeral febrile affections, especially such as are produced by an arrest of perspiration. It is usually associated with the neutral or the effervescing mixture and minute doses of some antimonial preparation.

As a *diuretic* it is commonly employed to relieve *strangury* produced by cantharides, in all painful affections of the *urinary apparatus*, whether occasioned by calculous or inflammatory disorders, and in the various affections of the *kidneys* in which congestion of those organs and diminished secretion of urine occur. In all of these cases the medicine should be associated with diluent drinks, weak saline solutions, or diuretic infusions. Of salines the most suitable are the acetate, tartrates, and carbonates of potassium, and of vegetable infusions those of digitalis and juniper. In chronic renal dropsy it is less useful than in dropsy of cardiac origin.

This medicine is often serviceable in relieving *flatulent* distension of the stomach and *nausea*, especially when it is associated with aromatic spirit of ammonia. It is in common use to quiet *nervous agitation*. It may be inhaled with advantage to allay *coughing* in diseases of the air-passages. It is a soothing application to the forehead in neuralgic *headache*, but if frequently applied it irritates the skin, especially if it is not freshly prepared. It is said to have cured certain hard swellings of the lip supposed to be cancerous (*papilloma*, *epithelioma*), but which are most generally non-malignant.

The *dose* of spirit of nitrous ether in febrile affections is from 20 to 30 drops (Gm. 1.30–2), repeated every half hour or hour and given in sweetened water. As a diuretic from ½ to 1 fluidrachm (Gm. 2–4) of it should be given every three or four hours in a diuretic mixture, solution, or infusion. As a nervous stimulant the dose should not be less than a fluidrachm (Gm. 4).

SPIRITUS AMMONIÆ, *U. S.*—SPIRIT OF AMMONIA.

Liquor ammonii caustici spirituosus; *Spiritus ammoniaci caustici Dzondii.*—*Ammoniated alcohol*, E.; *Alcoolat ammoniacal*, *Liqueur d'ammoniaque vineuse*, Fr.; *Weingeistiges Ammoniak*, G.

Preparation.—Stronger Water of Ammonia 45 parts (4½ oz. av. or 4⅞ fluidounces); Alcohol, recently distilled and which has been kept in glass vessels, a sufficient quantity. Pour the stronger water of ammonia into a flask connected with a well-cooled receiver, into which 80 parts (8 oz. av. or 9⅜ fluidounces) of alcohol are introduced. Heat the flask carefully and very gradually to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature for about 10 minutes. Then disconnect the receiver, and, having ascertained the ammoniacal strength by means of the volumetric solution of oxalic acid, add enough alcohol to make the product contain 10 per cent. by weight of ammonia. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

In the former editions of this work we have pointed out the disadvantages of the process of 1870, which directed the generation of ammonia from ammonium chloride and lime, and showed the convenience of evolving the gas from stronger ammonia-water without unduly contaminating the alcohol with water. This is the process now adopted. 45 parts of stronger ammonia-water of full strength contain 12.6 parts of ammonia, one-half of which is readily given off at a temperature not exceeding 45° C. (113° F.); but 8 parts of ammonia being required for 80 parts of alcohol, a somewhat higher heat is required, which, however, should not exceed 60° C. (140° F.). After the evolution of ammonia ceases, the ammoniacal alcohol (8.5 Gm.) is tested with oxalic acid in the manner directed by the Pharmacopœia, and if more than 50 Ccm. of the volumetric acid are needed for neutralization, the alcohol required for dilution is readily calculated; but if the liquid becomes neutral with a smaller quantity of the volumetric solution, the alcohol should be further charged with ammonia gas evolved from a fresh portion of strong ammonia-water; increasing the heat is inadmissible, since too large a proportion of water would pass over. Alcohol which has been kept in a barrel is apt to contain more or less organic matter in solution, which would be darkened in color by ammonia; hence the recommendation to use only alcohol which after rectification has been preserved in glass vessels.

Properties.—Spirit of ammonia is a colorless liquid having a strong ammoniacal and at the same time spirituous odor and a spec. grav. of about .810. When diluted with water it has the same behavior to reagents as ammonia-water, and its purity and strength may be determined in the same manner as for the latter. "8.5 Gm. spirit of ammonia, diluted with distilled water, should require for complete neutralization 50 Ccm. of the volumetric solution of oxalic acid (= 10 per cent. NH_3)."—*U. S.*

Medical Action and Uses.—The action and uses of this preparation have been described under AMMONIA. It is seldom prescribed internally, the aromatic spirit and the fetid spirit being more appropriate for this purpose as a general rule. It has the advantage of not rendering turbid mixtures containing resins and other substances which are precipitated by water, and hence it is a common ingredient in stimulating liniments, of which it should form not more than one-sixth part. Its *dose* is from 10 to 30 drops (Gm. 0.60–2) in a wine-glassful of water.

SPIRITUS AMMONIÆ AROMATICUS, *U. S.*, *Br.*—AROMATIC SPIRIT OF AMMONIA.

Alcoolat ammoniacal aromatique, Fr.; *Aromatischer Ammoniakgeist*, G.

Preparation.—Carbonate of Ammonium 40 parts (1 oz. av.); Water of Ammonia 100 parts (2½ oz. av. or 2½ fluidounces); Oil of Lemon 12 parts (131 grains or 2½ fluidrachms); Oil of Lavender-Flowers 1 part (11 grains or 12 minims); Oil of Pimento 1 part (11 grains or 10½ minims); Alcohol, recently distilled and which has been kept in glass vessels, 700 parts (17½ oz. av. or 20½ fluidounces); Distilled Water a sufficient quantity; to make 1000 parts (25 oz. av.). To the water of ammonia, contained in a flask, add 140 parts (3½ oz. av. or 3⅜ fluidounces) of distilled water, and afterward the carbonate of ammonium reduced to a moderately fine powder. Close the flask and agitate the contents until the carbonate is dissolved. Weigh the alcohol in a tared flask of suitable capacity, add the oils, then gradually add the solution of carbonate of ammonium, and afterward enough distilled water to make the product weigh 1000 parts (25 oz. av. = 27¼ fluidounces). Lastly, filter the liquid through paper in a well-covered funnel. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

Oil of nutmeg 4½ fluidrachms, oil of lemon 6½ fluidrachms, alcohol 6 pints, water 3 pints; distil 149 fluidounces. Place the last 9 oz. of distillate in a bottle with ammonium carbonate 4 oz. and strong ammonia solution 8 fl. oz.; warm gently to 140° F. until dissolved; filter through cotton and gradually mix with the distillate.—*Br.*

On adding ammonia-water to officinal carbonate of ammonium, neutral carbonate of ammonium is formed, which is readily soluble in alcohol. This is the compound aimed at by both pharmacopœias. If officinal carbonate of ammonium is treated with alcohol, neutral carbonate of ammonium will be dissolved, and bicarbonate of ammonium, being nearly insoluble, will be left behind. An insoluble saline precipitate will therefore indicate either a deficiency in the strength of the ammonia-water or a partial decomposition of the carbonate used. This salt should be employed only in translucent masses, and the effloresced portion, which contains variable proportions of bicarbonate of ammonium, should be rejected for this preparation. A. Blair (1885) has shown that oil of nutmeg is preferable to oil of pimenta, which causes the spirit to become red or brown.

Properties.—This spirit is colorless or yellowish, has an aromatic and at the same time ammoniacal odor, effervesces with acids, becomes milky on the addition of water, and has the specific gravity 0.885 *U. S.* (0.886 *Br.*).

Medical Action and Uses.—This is a mild preparation of ammonia, which is used almost exclusively for the relief of *headache*, and especially of that form of it which is attended with *acidity* of the stomach and *flatulent* eructations. It probably exerts a double action upon the stomach, neutralizing its acidity and provoking the expulsion of its gaseous contents, and upon the nervous system by a gentle stimulant action which allays nervous pain.

The *dose* of aromatic spirit of ammonia is from 30 minims to a fluidrachm (Gm. 2–4), properly diluted.

SPIRITUS AMMONIÆ FŒTIDUS, *Br.*—FETID SPIRIT OF AMMONIA.

Alcoolat ammoniacal fétide, Essence antihystérique, Fr.; *Ammoniakalischer Stinkasantgeist*, G.

Preparation.—Take of Asafetida 1½ ounces; Strong Solution of Ammonia 2 fluidounces; Rectified Spirit a sufficiency. Break the asafetida into small pieces and macerate it, in a closed vessel, in 15 fluidounces of the spirit for 24 hours; then distil off the spirit, mix the product with the solution of ammonia, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.*

On distilling the tincture of asafetida prepared as above directed, a portion of the volatile oil of asafetida passes over; the finished preparation is therefore an alcoholic solution of this volatile oil mixed with ammonia-water. *Aqua fœtida antihysterica* (*s. Pragensis*) is a weak distilled spirit free from ammonia, but contains the volatile products of galbanum, myrrh, valerian, zedoary, angelica, peppermint, wild thyme, English chamomile, and castor, in addition to the oil of asafetida.

Medical Action and Uses.—The purpose of this preparation is to associate a special nervous stimulant with ammonia. Asafetida is often indicated where ammonia is appropriate, and especially in cases of *hysterical* derangements, whether exhibited in general nervous disorder or in that of a particular organ, as the larynx, the stomach, the bowels, or the uterus. It may be usefully associated with other antacids and with carminatives in *flatulent colic* from indigestion. The *dose* is from 30 minims to a fluidrachm (Gm. 2–4).

SPIRITUS ANISI, *U. S.*—SPIRIT OF ANISE.

Alcoolat d'anis, Fr.; *Anisgeist*, G.

Preparation.—Oil of Anise 10 parts (1 oz. av. or 1 fluidounce); Alcohol 90 parts (9 oz. av. or 10½ fluidounces); to make 100 parts (10 oz. av.). Mix them.—*U. S.*

The *essence of anise* of the British Pharmacopœia has more than twice the strength in oil of anise of the foregoing (see page 592).

Medical Uses.—Spirit of anise is used for the relief of *flatulent colic* and as a flavoring ingredient of mixtures, in the *dose* of 1 or 2 fluidrachms (Gm. 4–8).

SPIRITUS ARMORACIÆ COMPOSITUS, *Br.*—COMPOUND SPIRIT OF HORSERADISH.

Esprit de raifort composée, Alcoolat antiscorbutique, Fr.; *Meerrettiggeist*, G.

Preparation.—Take of Horseradish-Root, scraped, Bitter Orange-Peel, cut small and bruised, each 20 ounces; Nutmeg, bruised, ½ ounce; Proof Spirit 1 gallon; Water 2 pints. Mix, and distil a gallon (Imperial) with a moderate heat.—*Br.*

This preparation is an alcoholic solution of the volatile oils of the drugs used.

Medical Uses.—This compound is appropriate in cases of atonic *dropsy*, especially of renal origin, but is more or less efficient in all forms of dropsy in which the use of diuretics is indicated. It may be added with advantage to various diuretic infusions, such as the compound infusion of juniper, the infusion of digitalis, etc. The *dose* is from 1 to 2 fluidrachms (Gm. 4–8).

SPIRITUS AURANTII, *U. S.*—SPIRIT OF ORANGE.

Esprit d'orange, Fr.; *Orangengeist*, G.

Preparation.—Oil of Orange-Peel 6 parts (300 grains or 6 fluidrachms); Alcohol 94 parts (4700 grains = 10¾ oz. av. or 12⅝ fluidounces); to make 100 parts (5000 grains or about 13 fluidounces). Mix them.—*U. S.*

This has been newly introduced, and contains four times the amount of oil of orange-peel (by weight) used for the elixir of orange.

Medical Uses.—Like the tinctures of orange-peel, it is well adapted for flavoring mixtures.

SPIRITUS CAJUPUTI, *Br.*—SPIRIT OF CAJUPUT.

Alcoolat de cajeput, Fr.; *Cajeputgeist*, G.

Preparation.—Take of Oil of Cajuput 1 fluidounce; Rectified Spirit 49 fluidounces. Dissolve.—*Br.*

Medical Uses.—Being merely a solution of oil of cajuput in alcohol, it might be made by extemporaneous prescription. Each fluidrachm of the spirit contains 1½ minims of the oil, and the *dose* is from half a fluidrachm to a fluidrachm (Gm. 2–4).

SPIRITUS CAMPHORÆ, *U. S.*, *Br.*—SPIRIT OF CAMPHOR.

Alcohol camphoratus, F. P.; *Spiritus camphoratus*, P. G.; *Tinctura camphoræ.—Tincture of camphor*, E.; *Esprit de camphre, Alcool camphré*, Fr.; *Kampferspiritus*, G.

Preparation.—Camphor 10 parts (5 oz. av.); Alcohol 70 parts (35 oz. av. or 41 fluidounces); Water 20 parts (10 oz. av. or 9⅝ fluidounces); to make 100 parts (50 oz. av. or about 3¼ pints). Dissolve the camphor in the alcohol, add the water, and filter through paper.—*U. S.* This is also the formula of P. G.

Take of camphor 1 ounce; rectified spirit 9 fluidounces. Dissolve.—*Br.*

Dissolve 1 part of camphor in 9 parts of alcohol.—*F. Cod.*

The present spirit contains for the same measure about two-thirds the weight of camphor as compared with that of the U. S. P. 1870.

Medical Uses.—The internal use of this preparation of camphor is seldom appropriate, chiefly because the camphor is separated immediately on coming in contact with the moisture of the mouth, fauces, etc. Externally, it is applied, as camphorated liniment is, for allaying pain in sprained, chafed, and contused parts, but it is preferable to the oily preparation whenever the local pain is *neuralgic* or is attended with inflammation, because in the latter case the evaporation of the alcohol produces a sense of coolness which is very grateful. This action is frequently invoked in bathing the mammæ in order to diminish the *secretion of milk* after parturition or to assist in drying it up for weaning. Applied on cotton to an exposed nerve-pulp, it mitigates, and may quite remove, the *toothache.* Like powdered camphor, it may be used advantageously in *hospital gangrene* and in various *ulcers* of an indolent nature.

The *dose* of spirit of camphor is from 5 to 30 minims (Gm. 0.30–2).

SPIRITUS CHLOROFORMI, *U. S., Br.*—SPIRIT OF CHLOROFORM.

Alcoolat de chloroforme, Fr.; *Chloroformspiritus*, G.

Preparation.—Purified Chloroform 10 parts (1 oz. av.); Alcohol 90 parts (9 oz. av. or 10½ fluidounces); to make 100 parts (10 oz. av. or about 11 fluidounces). Mix them. —*U. S.*

Chloroform 1 fluidounce; rectified spirit 19 fluidounces; dissolve.—*Br.*

The preparation was formerly known as *chloric ether.* Compared with that of the U. S. P. 1870, the present spirit is about 4 per cent. stronger in chloroform; the latter has been slightly reduced by the addition of a little alcohol.

Medical Uses.—This is a convenient preparation for administering chloroform by the stomach. It may be prescribed in *colic,* whether flatulent, neuralgic, or biliary, and indeed in almost all painful abdominal disorders. *Dose,* from 20 to 60 minims (Gm. 1.20–4), or more properly diluted.

SPIRITUS CINNAMOMI, *U. S., Br.*—SPIRIT OF CINNAMON.

Alcoolat de cannelle, Fr.; *Zimmtspiritus*, G.

Preparation.—Oil of Cinnamon 10 parts (1 oz. av. or 7½ fluidrachms); Alcohol 90 parts (9 oz. av. or 10½ fluidounces); to make 100 parts (10 oz. av.). Mix them.—*U. S.*

Oil of (Ceylon) cinnamon 1 fluidounce; rectified spirit 49 fluidounces.—*Br.*

Medical Uses.—It may be prescribed pure, in the *dose* of from 10 to 20 drops (Gm. 0.60–1.30), in cases of *colic* with diarrhœa, and as a flavoring addition to various mixtures. But for the latter purpose cinnamon-water is more commonly used.

SPIRITUS FRUMENTI, *U. S.*—WHISKY.

Whiskey, E.; *Eau de vie de grains*, Fr.; *Kornbranntwein*, G.

Spirit obtained from fermented grain by distillation, and containing from 44 to 50 per cent. by weight or from 50 to 58 per cent. by volume of absolute alcohol.

Origin and Preparation.—The term "whisky" is supposed to be derived from *usque*, the first two syllables of *usquebaugh*, the original name in Ireland—itself from Irish *uisge* and *beatha*, "life," *Uisge beatha*, *Aqua vitæ*, "Water of life" (Dunglison's Dictionary). In Europe whisky is often made by fermenting potatoes, but likewise from different kinds of grain; in Great Britain principally from barley, oats, and rye. In the United States rye, maize, and wheat are mostly employed for the manufacture of whisky, either in the raw state or after having been previously malted, when it furnishes a product of better flavor. The fermenting mixture is called the *mash.* During the fermentation the starch is converted into sugar, and finally into alcohol and carbonic acid gas (see page 140). The mixture is now subjected to distillation, and the weak spirit, called *low wine*, is rectified, and thus obtained stronger and less charged with fusel oil, which comes over chiefly in the last portions of the distillate. The *raw whisky* is kept in barrels or tanks for several years, during which time it acquires mellowness and is improved in flavor, doubtless in consequence of the formation of various compound ethers.

Properties.—Whisky is a spirituous liquid, usually of a yellowish or amber color, due to coloring matter and to a trace of tannin derived from the tanks in which it has been kept, and to a trace of sugar which has probably been added in the form of caramel. The density of whisky depends on the percentage of alcohol, and is to a slight extent influenced by the amount of the coloring and extractive matters; it should be not above .930, nor below .917. The disagreeable odor of raw whisky is mainly owing to a small quantity of amylic alcohol, which on keeping is changed into an ether, and perhaps partly into valerianic acid; œnanthylic and other allied acids are likewise present to a slight extent. Old whisky has a slight acid reaction, due to the formation of a minute quantity of acetic and, according to Kappel (1859), of valerianic acid. For neutralizing the acidity of good whisky 20 Ccm. require usually between 0.8 and 1.0 Ccm. of $\frac{1}{10}$ normal solution of alkali, indicating between 0.113 and 0.142 Gm. of acetic acid or its equivalent. The acidity slowly increases with age up to a certain degree; in one case 2.25 Ccm. of $\frac{1}{10}$ normal alkali were required for 20 Ccm. of whisky. For medicinal use whisky should be free from disagreeable odor and be not less than two years old.—*U. S.*

Tests.—On evaporating whisky by a moderate heat nearly to dryness, the residue which is left should have a slightly aromatic and rather insipid, but not an acrid, taste. The most convenient test for recognizing the origin of whisky is that proposed by Molnar. A small quantity of it is heated with a slight excess of caustic potassa until the alcohol has been completely evaporated; the compound ethers are thereby decomposed, and on adding an excess of sulphuric acid the volatile acids are liberated, and from their odor the source is recognized. *Apple whisky* distilled from cider gives off a decided fruit odor; the odors of whiskies of different kinds of grain are sufficiently distinct from one another, but to readily recognize them considerable experience is required. "If 100 Ccm. of whisky be very slowly evaporated in a weighed capsule on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor (absence of more than traces of fusel oil from grain or potato spirit). The remaining residue, fully dried at 100° C. (212° F.), should weigh not more than 0.233 Gm., equivalent to 0.25 per cent. (absence of an undue amount of solids). This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Ccm. of cold water, forming a solution which is colored light-green by a dilute solution of ferric chloride (traces of oak tannin from casks). 100 Ccm. of whisky should be rendered distinctly alkaline to litmus by 2 Ccm. of the volumetric test solution of soda (absence of an undue amount of free acid)."—*U. S.*

Medical Action and Uses.—Whisky has probably been made officinal because genuine brandy of good quality is not readily procured. It is one of the unfounded claims of science that bodies of apparently the same composition are identical in their action, for experience daily shows that physiological effects cannot be predicted upon chemical grounds alone. The action of whisky, both immediate and remote, differs in many respects from that of brandy, and the former liquor made from rye is not identical with that distilled from wheat, nor are potato brandy and grape brandy alike in their effects. Whisky, and also gin, besides being less palatable to all but the coarsest tastes than brandy, are much more apt than the latter to produce functional and then organic disease of the stomach, liver, and kidneys, and their immediate operation is less genial and exhilarating. In the absence of pure brandy, whisky is probably the best of the alcoholic distilled liquors, since its comparative cheapness in a great measure removes the temptation of dealers to adulterate it. The proper occasions and indications for its medicinal use, both internal and external, are described under ALCOHOL.

SPIRITUS GAULTHERIÆ, *U. S.*—SPIRIT OF GAULTHERIA.

Preparation.—Oil of Gaultheria 3 parts (90 grains or 80 minims); Alcohol 97 parts (2910 grains = 6⅝ oz. av. or 7¾ fluidounces); to make 100 parts (3000 grains or about 8 fluidounces). Mix them.—*U. S.*

"Essence of wintergreen" has been in use for a long time, but was prepared of varying strength. The pharmacopœial formula is intended to accomplish uniformity.

Medical Uses.—This preparation is more convenient than the oil of gaultheria for giving an agreeable flavor to medicinal preparations.

SPIRITUS JUNIPERI, *U. S., Br.*—SPIRIT OF JUNIPER.

Alcoolat (Esprit) de genièvre, Fr.; *Wachholderspiritus*, G.

Preparation.—Oil of Juniper 3 parts (90 grains or 110 minims); Alcohol 97 parts (2910 grains = 6⅝ oz. av. or 7¾ fluidounces); to make 100 parts (3000 grains or about 8 fluidounces). Mix them.—*U. S.*

Oil of juniper 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

Macerate for 24 hours 5 parts of bruised juniper-berries with 15 parts each of alcohol and water, and distil 20 parts.—*P. G.*

The present spirit is one-third stronger than that of the U. S. P. 1870. If made from the volatile oil distilled from juniper-berries, it is much more agreeable than if the common oil of juniper is used. Age improves the flavor.

Off. Prep.—Mistura creasoti, *Br.*

Medical Action and Uses.—This preparation is carminative and diuretic, and is useful as an addition to infusions and mixtures employed in the treatment of *dropsy*. Its *dose* is from 30 to 60 minims (Gm. 2–4).

SPIRITUS JUNIPERI COMPOSITUS, *U. S.*—COMPOUND SPIRIT OF JUNIPER.

Preparation.—Oil of Juniper 10 parts (30 grains or 37 minims); Oil of Caraway 1 part (3 grains or 3 minims); Oil of Fennel 1 part (3 grains or 3 minims); Alcohol 3000 parts (9000 grains = 20⅝ oz. av. or 24⅛ fluidounces); Water a sufficient quantity; to make 5000 parts (15,000 grains). Dissolve the oils in the alcohol, and gradually add enough water to make the product weigh 5000 parts (15,000 grains = 34¼ oz. av. or about 36 fluidounces).—*U. S.*

This spirit is an officinal substitute for *gin*, a spirit distilled in some parts of Europe from juniper-berries, to which sometimes other aromatics are added. It has the advantage of uniformity of composition over the commercial article, and if good volatile oils are used the flavor is agreeable and will improve by age.

Medical Action and Uses.—The addition of caraway and fennel oils to that of juniper in this compound increases the virtues it derives from the last-named ingredient, and especially gives it a carminative operation, which is often called for in abdominal *dropsy;* for in that disease the abdominal and intestinal walls lose their contractile power and become distended by the gases formed in the cavity of the bowel. It is commonly added to diuretic infusions. The *dose* is from 1 to 4 fluidrachms (Gm. 4–16).

SPIRITUS LAVANDULÆ, *U. S., Br.*—SPIRIT OF LAVENDER.

Alcoolat (*Esprit*, *Eau*) *de lavande*, Fr.; *Lavendelspiritus*, G.

Preparation.—Oil of Lavender-Flowers 3 parts (90 grains or 107 minims); Alcohol 97 parts (2910 grains = 6⅝ oz. av. or 7¾ fluidounces); to make 100 parts (3000 grains or about 8 fluidounces). Mix them.—*U. S.*

Oil of lavender 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

Macerate for 24 ounces lavender-flowers 5 parts, with alcohol and water each 15 parts, and distil 20 parts.—*P. G.*

For use as a perfume a small quantity of oil of bergamot, tincture of musk, or tincture of ambergris is sometimes added, the addition of the tincture being made to the distilled spirit.

Off. Prep.—Mistura ferri comp., *U. S.*

Medical Action and Uses.—Spirit of lavender—or, as it is commonly called, lavender-water—is more generally used as an agreeable and refreshing perfume than as a medicine. It is popularly employed to bathe the forehead, etc. in cases of *headache*, *fever*, etc. It may be given internally in *doses* of from 30 to 60 minims (Gm. 2–4).

SPIRITUS LIMONIS, *U. S.*—SPIRIT OF LEMON.

Essence of lemon, E.—*Alcoolat* (*Esprit*) *de citron*, Fr.; *Citronenessenz*, G.

Preparation.—Oil of Lemon 6 parts (420 grains or 1 fluidounce and 40 minims); Lemon-Peel, freshly grated, 4 parts (280 grains or ⅝ oz. av.); Alcohol a sufficient quantity; to make 100 parts (7000 grains or 16 oz. av.). Dissolve the oil of lemon in 90 parts (6300 grains = 14⅜ oz. av. or 16⅞ fluidounces) of alcohol, add the lemon-peel, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts (16 oz. av. or 18¾ fluidounces).—*U. S.*

Macerate for 2 days 500 parts of fresh rind of lemon with 3000 parts of 80 per cent. alcohol, and distil until all the alcohol has passed over.—*F. Cod.*

Off. Prep.—Syrupus acidi citrici, *U. S.*

Medical Uses.—This preparation is only used for flavoring simple syrup and medicinal mixtures.

SPIRITUS MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—SPIRIT OF PEPPERMINT.

Essence of peppermint, E.; *Alcoolat* (*Essence*) *de menthe poivrée*, Fr.; *Englische Pfefferminzessenz*, G.

Preparation.—Oil of Peppermint 10 parts (600 grains or 12 fluidrachms and 38 minims); Peppermint, in coarse powder, 1 part (60 grains); Alcohol a sufficient quantity; to make 100 parts (6000 grains). Dissolve the oil of peppermint in 90 parts (5400 grains = 12⅜ oz. av. or 14½ fluidounces) of alcohol, add the peppermint, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts (6000 grains = 13¾ oz. av. or 16 fluidounces).—*U. S.*

Oil of peppermint 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

The U. S. P. 1870 ordered the oil and alcohol very nearly in the proportion of 7 : 100; the present formula yields a preparation fully 40 per cent. stronger. The formula of the P. G. agrees with the above, except that the spirit is not colored. The spirit of the Br. P. is one-fifth, but the essentia (see p. 592) is about double, the strength of the above.

Off. Prep.—Mistura rhei et sodæ, *U. S.*

Medical Uses.—This preparation is the most convenient form for the ordinary administration of peppermint. The *dose* of the American preparation is from 5 to 15 drops (Gm. 0.30–1), taken on loaf sugar or in sweetened water. The *dose* of the British spirit is from ½ to 1 fluidrachm (Gm. 2–4).

SPIRITUS MENTHÆ VIRIDIS, *U. S.*—Spirit of Spearmint.

Essence of spearmint, E.

Preparation.—Oil of Spearmint 10 parts (600 grains or 12 fluidrachms and 38 minims); Spearmint, in coarse powder, 1 part (60 grains); Alcohol a sufficient quantity; to make 100 parts (6000 grains). Dissolve the oil of spearmint in 90 parts (5400 grains = 12⅜ oz. av. or 14½ fluidounces) of alcohol, add the spearmint, and macerate for 24 hours; then filter through paper, adding through the filter enough alcohol to make the spirit weigh 100 parts (6000 grains = 13¾ oz. av. or 16 fluidounces).—*U. S.*

The strength of this spirit has been increased like that of the preceding one. The analogous preparation used in France is distilled from fresh crisped mint, and that used in Germany as *Englische Krauseminzessenz* is made by dissolving 1 part of oil of crisped mint in 9 parts (by weight) of alcohol.

Medical Uses.—This preparation is less energetic than that of peppermint. It may be given in the *dose* of from 20 to 40 minims (Gm. 1.30–2.60).

SPIRITUS MYRCIÆ, *U. S.*—Spirit of Myrcia.

Bay-rum, E.

Preparation.—Oil of Myrcia 16 parts (320 grains or 5⅓ fluidrachms); Oil of Orange-Peel 1 part (20 grains or 24½ minims); Oil of Pimento 1 part (20 grains or 20 minims); Alcohol 1000 parts (20,000 grains = 2 pounds 13¾ oz. av. or 53½ fluidounces); Water 782 parts (15,640 grains = 2 pounds 3¾ oz. av. or 34¼ fluidounces); to make 1800 parts (36,000 grains = 5 pounds 2¼ oz. av. or 5½ pints). Mix the oils with the alcohol, and gradually add the water to the solution. Set the mixture aside, in a well-stopped bottle, for 8 days; then filter through paper in a well-covered funnel.—*U. S.*

On diluting an alcoholic solution of volatile oils rapidly with water a milkiness is apt to be produced, which is subsequently not readily removed by agitation; it is therefore directed to add the water gradually, so that the appearance of a permanent milkiness may be avoided as much as possible. If after a week the spirit cannot be decanted or filtered clear, it may be treated with paper-pulp or other material (except cotton-fibres) usually used in the preparation of medicated waters.

Bay-rum is distilled in several of the West Indian islands from the fresh leaves of Myrcia acris (see p. 1072), to which a certain proportion of the fruit is added, St. Croix rum being used for the best quality; its flavor is affected by the employment of the leaves of different varieties of the plant, or probably of different closely-allied species of myrtles. (See paper by A. H. Riise in *Amer. Jour. Phar.*, 1882, p. 278.) However, most of the bay-rum consumed in the United States is now manufactured here, a small portion being distilled from the dried leaves. The pharmacopœial formula furnishes a preparation of agreeable fragrance and of a pale-yellowish color or nearly colorless.

Medical Uses.—Bay-rum, like lavender-water, is used exclusively as a perfume and as a refreshing application to the forehead in *headache* and to other parts irritated by heat or chafing.

SPIRITUS MYRISTICÆ, *U. S., Br.*—Spirit of Nutmeg.

Alcoolat (Esprit) de muscade, Fr.; *Muskatspiritus*, G.

Preparation.—Oil of Nutmeg 3 parts (90 grains or 104 minims); Alcohol 97 parts (2910 grains = 6⅝ oz. av. or 7¾ fluidounces); to make 100 parts (3000 grains or about 8 fluidounces). Mix them.—*U. S.*

Take of volatile oil of nutmeg 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

In France this spirit is prepared by macerating for 4 days 500 parts of bruised nutmeg with 4000 parts (by weight) of 80 per cent. alcohol, and distilling as long as alcohol passes over.

Off. Prep.—Mistura ferri comp., *Br.*

Medical Uses.—Spirit of nutmeg is used as a flavoring ingredient, but less commonly than other aromatics. Its *dose* is from ½ to 1 fluidrachm (Gm. 2–4).

SPIRITUS ODORATUS, *U. S.*—PERFUMED SPIRIT.

Spiritus (Aqua) coloniensis, Alcoolatum fragrans.—Cologne-water, E.; *Eau de Cologne, Alcoolat de citrons composé*, Fr.; *Kölnisches Wasser*, G.

Preparation.—Oil of Bergamot 16 parts (2 oz. av. or 17½ fluidrachms); Oil of Lemon 8 parts (1 oz. av. or 9 fluidrachms); Oil of Rosemary 8 parts (1 oz. av. or 8½ fluidrachms); Oil of Lavender-Flowers 4 parts (½ oz. av. or 4¼ fluidrachms); Oil of Orange-Flowers 4 parts (½ oz. av. or 4⅓ fluidrachms); Acetic Ether 2 parts (¼ oz. av. or 2⅙ fluidrachms); Water 158 parts (19¾ oz. av. or 19 fluidounces); Alcohol 800 parts (100 oz. av. or 7 pints 5 fluidounces); to make 1000 parts (125 oz. av. or 8½ pints). Dissolve the oils and the acetic ether in the alcohol, and add the water. Set the mixture aside, in a well-closed bottle, for 8 days, then filter through paper in a well-covered funnel.—*U. S.*

The formula of the French Codex is similar. This spirit should be kept on hand for some time, when its fragrance will improve.

Medical Uses.—Cologne-water would seem to pertain to the perfumer rather than to the pharmacist or physician, and therefore to be quite misplaced in a pharmacopœia.

SPIRITUS ROSMARINI, *Br.*—SPIRIT OF ROSEMARY.

Spiritus anthos.—Alcoolat (Esprit) de romarin, Fr.; *Rosmarinspiritus*, G.

Preparation.—Take of Oil of Rosemary 1 fluidounce; Rectified Spirit 49 fluidounces; dissolve.—*Br.*

The preparation known in Europe, and formerly much employed, as *Aqua reginæ Hungariæ* (Eau de la reine de Hongrie, *Fr.*), is a compound spirit of rosemary, usually containing a little lavender, sage, or other aromatic oil.

Medical Action and Uses.—This preparation is but little used in the United States. It is worthy of being more generally employed, not only for its perfume, which is very grateful to most persons, but as a stimulant in nervous and *hysterical* conditions, and locally for the relief of *muscular* and *neuralgic pains.* Like the oil of rosemary, it may be added to stimulating and anodyne liniments. Each fluidrachm (Gm. 4) of the spirit contains nearly 1 minim of the oil.

SPIRITUS TENUIOR, *Br.*—PROOF SPIRIT.

Preparation.—Take of Rectified Spirit 5 pints; Distilled Water 3 pints; mix.—*Br.* It has the specific gravity 0.920 (see page 142).

Medical Uses.—This form of alcohol is employed in medicine only as a lotion for *contusions, rheumatic pains*, etc.

SPIRITUS VINI GALLICI, *U. S., Br.*—BRANDY.

Spiritus vini Cognac, P. G.—*Spirit of French wine*, E.; *Eau de vie, Cognac*, Fr.; *Franzbranntwein*, G.

The spirit obtained from fermented grapes by distillation, and containing from 39 to 47 per cent. by weight or 46 to 55 per cent. by volume of absolute alcohol.

Origin and Preparation.—Brandy is made in France by distilling different kinds of wine. The colorless spirit (*white brandy*) thus obtained is kept for some time in new oak casks, where it gradually acquires a light-amber tint (*pale brandy*). The darker-colored varieties have their color deepened by the addition of caramel. The brandies obtained in different districts of France are not esteemed alike, those of Cognac and

Armagnac being deemed the best, owing to the agreeable mildness of their flavor; next in order are those from Bordeaux and Rochelle. The lees of wines and the marc of grapes are also distilled, and furnish a spirituous liquid called in France *eau de vie de marc*, which is highly charged with odorous principles, and is used as an addition to other brandies and for imitating brandy by mixing the liquid with pure rectified spirit. The odorous constituents separated from all or most of the alcohol are sometimes met with in commerce as *oil of grapes*. Large quantities of brandy are also distilled in Spain and Portugal, and of recent years in Germany.

Considerable brandy is now made in the United States, and is usually distinguished as Catawba and California brandy. *Catawba brandy* is made in the vine-growing districts of the Ohio and Mississippi Valley, according to E. S. Wayne (1855), from the lees and from the marc. That made from the lees is the best, and has the flavor of Catawba wine. When distilled from the marc it has an unpleasant taste, and contains a large amount of fusel oil, but is mellowed down by age. *California brandy* is made from the lees and marc, which are thrown together with poor wines and distilled, the distillate being tinged by the addition of caramel (*Proc. Amer. Phar. Assoc.*, 1866, p. 64).

The British Pharmacopœia recognizes only the spirit of French wine, while the U. S. and German Pharmacopœias admit all spirits obtained from fermented grapes or wine, without designating French wine.

Properties.—Brandy is a spirituous, amber-colored liquid having a peculiar flavor, which is improved by age; hence the U. S. P. directs it to be used only when at least four years old. The flavor depends upon the variety of grapes used, upon their ripeness, upon the care bestowed upon fermentation and distillation, and upon the age of the wine, an older wine yielding a more fragrant distillate. The specific gravity of brandy is required to be between .925 and .941 *U. S.* (between .920 and .924, corresponding to between 46 and 50 per cent. by weight of alcohol, *P. G.*). It has a slight acid reaction, which is, at least in part, due to the presence of acetic acid. The P. G. states that the distillate should not be acid; it has, however, a faint acid reaction, though not an acidulous taste. We have found good brandy to require for the neutralization of 20 Ccm. from 1.3 to 1.7 Ccm. of $\frac{1}{10}$ normal alkaline solution, indicating from .185 to .241 Gm. of free acetic acid in the pint. The odor is due to minute quantities of œnanthic, acetic, and perhaps propylic and allied ethers; its quality is best ascertained by pouring some of the brandy into a wine-glass, then emptying the latter, and, without washing or wiping it, setting it aside; the peculiar fragrance becomes then more apparent, and is still noticeable after a day, while the odor of brandy which had been diluted with deodorized spirit becomes weak and disappears in the course of a few hours, during which time also the odor of whisky or similar spirits becomes apparent. Brandy assumes a dark-greenish color on the addition of ferric chloride, owing to the presence of tannin derived from the casks or from catechu, etc., purposely added. Sugar can usually be detected in the extract by Trommer's test, and is derived from caramel.

Tests.—The addition of grains of paradise, Cayenne pepper, and similar substances, sometimes used for imparting artificial strength to brandy, is detected by the sharp or burning taste of the extract left on evaporation. With sufficient practical experience the origin of brandy may be recognized by Molnar's method (see SPIRITUS FRUMENTI), but it is more difficult to distinguish, by their odors, the ethers and fusel oils of the French wines used for making brandy than the fusel oils of different kinds of grain. "If 100 Ccm. of brandy be very slowly evaporated in a weighed capsule on a water-bath, the last portion volatilized should have an agreeable odor, free from harshness (absence of fusel oil from grain or potato spirit). The residue, dried at 100° C. (212° F.), should weigh not more than 0.235 Gm., equivalent to 0.25 per cent. (absence of an undue amount of solids). This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Ccm. of cold water, forming a solution which is colored light-green by a dilute solution of ferric chloride (traces of oak tannin from casks). 100 Ccm. of brandy should be rendered distinctly alkaline to litmus by 3 Ccm. of the volumetric solution of soda (absence of an undue amount of free acid)."—*U. S.*

Off. Prep.—Mistura spiritus vini gallici, *Br.*

Medical Action and Uses.—The virtues of brandy have been set forth in the article on ALCOHOL. It may be sufficient here to repeat that true brandy—that is, made from wine—has qualities peculiar to itself and unlike those belonging to other distilled spirits. It is not only more palatable, but more cordial to the stomach and produces a more grateful exhilaration.

SPONGIA.—SPONGE.

Eponge, Fr.; *Schwamm, Badeschwamm*, G.

Spongia officinalis, *Linné.*
Class Poriphera. *Ord.* Ceratospongiæ.

Origin and Description.—Sponges belong to the lowest animals which live in water, and are attached to rocks or other substances. They consist of a framework arising from a broad base and forming a ramifying and anastomosing tissue, which is traversed by numerous canals and pores and covered with a glairy or gelatinous substance. In some genera the skeleton is formed, to a greater or less extent, of siliceous or calcareous spicules; in others the whole body consists of a gelatinous substance. The sponges which are in common use belong to a few species, the skeleton of which is entirely or nearly free from spicules, and forms cup-shaped or convex, porous, and lacunose masses, with circular vents on the surface. They are collected by divers, who tear them from the rocks, or they are detached by means of a fork fastened to the end of a long pole. The gelatinous animal matter is removed by burying them for several days in sand, and afterward soaking, squeezing, and washing them.

The best variety of sponge comes from the Mediterranean, and is chiefly collected in the neighborhood of Greece and near the coast of Syria. It is known in commerce as *Mediterranean* and *Turkish sponge*, and comes in cup-shaped pieces of various sizes, having a soft, elastic, and compressible fibrous framework. The *Bahama* or *West Indian sponge* is collected near the Bahama Islands, and forms convex or oblong pieces, with somewhat projecting lobes and of a coarser texture than the preceding. As met with in commerce, sponge generally contains a large quantity of sand, from which it is freed by beating, and various calcareous matters, which are removed mechanically or by dissolving them with the aid of dilute hydrochloric acid. After it has been cleaned it is sometimes *bleached*, either by means of solution of sulphurous acid prepared from hyposulphite of sodium and hydrochloric acid or preferably by chlorine-water. A still better process is dipping the sponge for five or ten minutes into a 2 per cent. solution of potassium permanganate, and subsequently immersing it in a 2 per cent. solution of oxalic acid to which a little sulphuric acid has been added; the latter treatment removes the brown manganic oxide and leaves the sponge white, without affecting its durability.

Composition.—The organic matter of sponge is a proteid called *spongin*, which was formerly supposed to be closely allied to, or identical with, *fibroin* or *sericin* of silk, but was proven by Schlossberger (1858) and Staedeler (1859) to be entirely distinct, in being insoluble or very slowly soluble in ammoniacal solutions of the oxides of nickel and copper, and in the behavior to hot diluted sulphuric acid, with which it yields *leucin* and *glycocoll*, while sericin yields by this treatment tyrosin and serin, and is readily dissolved by solutions of nickel and copper in ammonia. Spongin is soluble in hot solution of caustic potassa and in hot mineral acids.

Derivatives and Allied Product.—SPONGIA USTA, *Burnt sponge*, is obtained by heating clean sponge, cut into small pieces, in a closed vessel until vapors cease to be given off. The residue amounts to about one-third the weight of the sponge, and consists of about 40 per cent. of charcoal, 25 to 30 per cent. of sulphate of calcium, 10 per cent. of silica, 9 per cent. of ferrous oxide, the remainder being magnesium carbonate, potassium chloride, and calcium phosphate, and about ½ of 1 per cent. of sodium iodide (Herberger).

SPONGIÆ CERATÆ.—Sponge tent, *E.;* Eponge préparée à la cire, *Fr.;* Wachsschwämme, *G.*—Sponge is freed from foreign matters by beating and washing, then dried, cut into proper shape, dipped into yellow melted wax, pressed between hot iron plates, and when cold freed from the excess of wax.

SPONGIÆ COMPRESSÆ.—Compressed sponge, *E.;* Eponge préparé à la ficelle, *Fr.;* Pressschwamm, *G.*—Perfectly clean, fine sponge is cut into elongated pieces while moist, securely tied by means of twine into cylindrical pieces, and then dried.

VEGETABLE SPONGE, or GOURD TOWEL. The fibrous network of the fruit of Luffa ægyptiaca, *Miller* (Momordica Luffa, *Linné;* nat. ord. Cucurbitaceæ), has been used to some extent, under these and similar names, like a sponge and flesh-brush. Luffa Petola, *Seringe*, and L. fœtida, *Cavanilles*, yield similar products. The fleshy portion of these fruits is edible, though not very palatable; several other species are violently purgative and emetic.

Medical Action and Uses.—Before the discovery of iodine, roasted or so-called "burnt" sponge was generally used in the treatment of *goitre*, both internally and externally, and certainly with excellent results in appropriate cases; but it is now wholly superseded by the preparations of iodine. Sponge is familiarly employed for countless domestic purposes which require the use of a porous, compressible, and elastic substance capable of holding liquids, and, amongst others, for partial or general baths, which are of such great hygienic importance. Its use in medicine and surgery for absorbing blood, pus, and other animal liquids is equally familiar, and not less so are the dangers to which it exposes the patients in hospitals by carrying from one to another the germs of infectious diseases. Sponges that have been used in surgical operations and dressings should never be dried before being thoroughly purified with boiling water. The elasticity of sponge renders it an efficient means of dilating wounds, sinuses, the natural apertures of the body, etc. For this purpose it should be introduced in a dry and compressed state, when, by absorbing the liquids of the part, it gradually expands with irresistible force. To promote its introduction into narrow canals, such as that of the neck of the uterus, compressed sponge, saturated or merely coated with wax, is of the greatest utility. (Compare A. Smith, *Med. News*, xl. 197.) It is used to dilate wounds, etc. in order to facilitate the extraction of foreign bodies or the discharge of secretions, as well as the introduction of probes, forceps, and other surgical instruments. In the cervix uteri it is employed to relieve *dysmenorrhœa* and also to induce *premature labor.* Sometimes the sponge, before being compressed and coated with wax, is saturated with a solution adapted to stimulate or otherwise modify the condition of the part.

STANNUM.—Tin.

Etain, Fr.; *Zinn*, G.

Symbol Sn. Atomicity bivalent and quadrivalent. Atomic weight 117.7.

Origin and Preparation.—Tin is rarely found in the metallic state. Its most important ore is a binoxide, SnO_2, known as *tinstone*, which is usually imbedded in granite, quartz, or slate, and often associated with iron pyrites and with tungstate of iron and manganese, known as the mineral *wolfram.* It is rarely met with as silicate, and is present in *columbite*, *tantalite*, and allied minerals, and in minute proportions in the mineral waters of Saidschütz and other places. The most important tin-mines are in Devonshire and Cornwall in Great Britain and in Malacca and Banca, but tin is likewise obtained in Australia, Bohemia, Saxony and some parts of the United States. Australian tin sometimes contains gold. The tinstone is stamped into a coarse powder, freed from lighter minerals by washing with a stream of water, roasted to expel arsenic and sulphur, again washed with water, mixed with powdered coal and a little lime or fluor-spar for the purpose of forming a fusible slag, and then reduced on the hearth of a reverberatory furnace.

Properties.—Tin is a bluish-white metal of the specific gravity 7.3, softer than gold, but harder than lead, and when bent emitting a crackling sound. It may be rolled or hammered into *foil*, at 100° C. (212° F.) drawn into wire, and at 200° C. (392° F.) is so brittle that it may be readily reduced to powder. It melts near 230° C. (446° F.), and, according to Nies and Winkelmann (1882), on congealing increases in volume 0.7 per cent. While cooling it is readily converted into powder by trituration in a hot iron mortar; after sifting it constitutes *Stanni pulvis*, which was formerly employed. It is but superficially oxidized in moist air, and will effectually protect iron from rusting as long as the coating is perfect. Its alloy with lead forms *pewter*, *Britannia metal*, and *solder;* alloyed with copper it constitutes *gun-metal* and *bronze;* and by combining 4 parts of tin with 3 of cadmium, 8 of lead, and 15 of bismuth a fusible alloy is obtained melting at 60° C. (140° F.).

Metallic tin dissolves in hot strong sulphuric acid to stannic sulphate, evolving sulphurous acid gas. Strong hydrochloric acid dissolves it to stannous chloride, and nitromuriatic acid yields with it stannic chloride. *Stannous salts* are precipitated brown by sulphuretted hydrogen, the precipitate being soluble in ammonium sulphydrate. Chloride of gold produces a deep-purple precipitate (*purple of Cassius*), and mercuric chloride is reduced either to calomel or to a gray powder of metallic mercury. This reaction explains the value of stannous chloride as a test for salts of mercury. *Stannic salts*, of which the chloride, $SnCl_4$, is used by dyers, do not react with the chlorides of gold and mercury, but yield with sulphuretted hydrogen a yellow precipitate which is soluble in ammonium sulphydrate. *Sodium stannate*, $Na_2SnO_3.4H_2O$, is used by calico-printers as a mordant, and is prepared on the large scale by fusing tin ore with soda and sodium nitrate or by boiling it with caustic soda. Both stannous and stannic salts are precipitated white by caustic potassa; the precipitates are soluble in an excess of potassa, and the alkaline solution, when obtained from stannous salts, yields on boiling a black precipitate of stannous oxide. Of the sulphides, *stannic sulphide*, SnS_2, is of interest; it is made by heating a mixture of tin amalgam, sulphur, and sal ammoniac, when it remains behind in golden-yellow scales, ammonium chloride and sulphide and chloride of mercury subliming; when ground, stannic sulphide is known as *mosaic gold* and *bronze powder.*

Medical Action and Uses.—Since the time of Paracelsus, at least, tin filings have been used as a remedy for *tapeworms*, and a list of eminent physicians might be given, including some of the most distinguished helminthologists, who vaunted their efficacy and recommended their use. Their testimony may certainly be taken to qualify the judgment of Küchenmeister when he writes: "Once for all, I protest against the administration of tin filings, and I believe that no one can have much pleasure in giving this remedy who has seen the ecchymotic irritation of the intestine after its administration to living animals, and heard them whining or seen them writhing about during life." Even if this criticism were admitted to be just, it would not affect the question of the efficacy of the powdered metal or of tin prepared by precipitation from its chloride. The eminent authority above mentioned admits it to be real. When tin filings were employed they were supposed to act mechanically, subjecting the worms to such rude attrition as to destroy them; but since the salts of tin have sometimes proved to be tæniacide, and since precipitated tin has had a like effect, it is more probable that some inherent quality of the metal must be invoked to explain its operation. Moreover, it is stated upon good authority that in certain rural districts of France it is customary to use, as a vermifuge, sweetened wine that has been kept for 24 hours in a tin vessel. The activity of the salts of tin is illustrated by the experiments of White (*Archiv f. Exp. Path, etc.*, xiii. 53). They were seen to act upon the digestive canal and upon the central nervous system, in the former producing the symptoms and lesions of irritant poisons, and in the latter paralysis. The urine was diminished and its specific gravity increased, and it contained albumen. The author assimilates tin with lead in its action on the animal economy.

Formerly, tin filings were administered in the *dose* of 20 grains, gradually increased to $\frac{1}{2}$ ounce (Gm. 1.30–16). Powder of tin may be prescribed in the dose of about 1 drachm (Gm. 4). These preparations should be given in a syrup or electuary, and after the bowels have been completely cleansed by a purgative. The bisulphuret of tin has also been used as a tæniafuge, in doses of from 2 to 4 drachms (Gm. 8–16), in the same manner as the metal. Chloride of tin has been employed for the same purpose, "as an anti-spasmodic in epilepsy, chorea, and other convulsive diseases, as a stimulant to paralyzed muscles in paraplegia, as an antidote in poisoning by corrosive sublimate, and as an internal application in chronic skin diseases" (Pereira). It was administered internally in the *dose* of $\frac{1}{16}$ to $\frac{1}{2}$ grain (Gm. 0.004–0.03), and in an aqueous solution prepared by dissolving $\frac{1}{6}$ grain in an ounce (Gm. 0.01 in Gm. 32) of water. It acts topically as an astringent, irritant, and caustic, and in poisonous doses causes convulsions and sometimes paralysis.

STAPHISAGRIA, *U. S.*—STAPHISAGRIA.

Staphisagriæ semina, Br.; *Semen staphisagriæ, s. staphidis agriæ, s. pedicularis.*—*Stavesacre*, E.; *Staphisaigre*, Fr.; *Stephanskörner, Läusekörner*, G.

The seed of Delphinium Staphisagria, *Linné*, s. Staphisagria macrocarpa, *Spach.* Bentley and Trimen, *Med. Plants*, 4.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—This annual pubescent herb is indigenous to the countries bordering on the Mediterranean, and is cultivated in some parts of Southern Europe. It attains a height of about 40 inches (1 M.), and has alternate, long-petioled, palmately five- to nine-parted leaves, the lobes being lanceolate and entire or three-lobed. The pale-blue or purplish flowers are long-peduncled, arise from the axils of leafy bracts, have two of the petals spurred, both spurs being enclosed in that of the calyx, and produce three hairy follicles, each containing about twelve seeds. The unpleasantly odorous plant (and particularly the seeds) has been employed from an early period.

Description.—Stavesacre-seeds are from $\frac{1}{6}$ to $\frac{1}{4}$ inch (4–6 Mm.) long and $\frac{1}{8}$ to $\frac{1}{5}$ inch (3–5 Mm.) broad, acutely angled and irregularly flattish-tetrahedral, one side being somewhat convex. The brittle testa is at first of a brown or blackish-brown, afterward of a brownish-gray, color, wrinkled and pitted with flattish depressions, the intervening ridges forming net-like meshes. The nucleus is whitish, when old brownish, and consists of an oily albumen enclosing at its sharper end a small straight embryo. The seeds have a faint somewhat narcotic odor and a bitter, burning, and biting taste.

Constituents.—Marquis (1877) isolated four optically inactive alkaloids—delphinine,

$C_{22}H_{35}NO_6$; delphinoidine, $C_{42}H_{68}N_2O_7$; delphisine, $C_{27}H_{46}N_2O_4$; and staphisagrine, $C_{22}H_{33}NO_5$. *Delphinine* was discovered in 1819 by Lassaigne and Feneulle, and simultaneously by Brandes. It is nearly insoluble in water, dissolves at 20° C. (68° F.) in 21 parts of alcohol, 11 parts of ether, and 16 parts of chloroform, crystallizes in flat prisms, has a bitter taste, followed by persistent tingling, is precipitated by the group reagents, but gives no characteristic color reaction; it does not melt at 120° C. Studer (1872) found it to melt at 90° C. (194° F.), and to dissolve with a reddish color in sulphuric acid containing a trace of iron. *Delphinoidine* is amorphous, melts between 110° and 120° C. (230° and 248° F.), dissolves in 6500 parts of water, in 3 parts of ether, and is freely soluble in chloroform and alcohol. Its characteristic reactions are with sulphuric acid dark-brown, red-brown; with Fröhde's reagent, dark-brown, blood-red, cherry-red; with sugar and sulphuric acid, brown, green; with sulphuric acid and bromine-water, violet-red, cherry-red, blood-red. *Delphisine* resembles the preceding in solubility and behavior, but forms wart-like crystals and contains more nitrogen. *Staphisagrine* or *staphisaine* was first obtained by Couërbe (1833), and Dardel's *staphisine* (1864) seems to be identical with it. It melts at 90° C. (194° F.), dissolves at 15° C. (59° F.) in 200 parts of water, in 855 parts of ether, and is very freely soluble in alcohol and chloroform; its characteristic reactions are with sulphuric acid faintly cherry-red, violet; with Fröhde's reagent, brown-red, violet-brown; with sugar and sulphuric acid, dingy-brown; with sulphuric acid and bromine-water, transiently reddish; with fuming nitric acid, blood-red; with nitric acid sp. gr. 1.4, brownish resinous. The integuments of the seed appear to be the principal seat of the alkaloids, one of which yields a crystalline sparingly soluble salt with chromic acid (*Pharmacographia*).

The seeds contain from 25 to 30 per cent. of non-drying fixed oil, resins, coloring matter, and other constituents not investigated; they yield about 8 to 10 per cent. of ash.

Allied Plants.—Delphinium Consolida, *Linné*.—Larkspur, Lark's claw, Knight's spur, *E.;* Pied d'alouette, *Fr.;* Rittersporn, Lerchenklaue, Hornkümmel, *G.*—This glabrous annual herb, which is a common weed in the grain-fields of Central Europe, is often met with as an ornamental plant in gardens, and has been naturalized in some parts of the United States from Pennsylvania to Virginia. It has the leaves dissected into narrow linear lobes, and its purplish-blue (in cultivation sometimes whitish) flowers are upon rather filiform peduncles in loose terminal racemes. The five sepals are petal-like, the upper one produced into a spur longer than the calyx; the petals are united, with one spur enclosed in the calyx-spur; the pistil is single, and the smooth follicle many-seeded. The seeds are quite small, about $\frac{1}{16}$ inch (1.5 Mm.) in diameter, irregularly tetrahedral, pointed, rough, and pitted upon the surface, with a black testa and a whitish nucleus consisting of an oily albumen and a small straight embryo. All parts of the plant are inodorous and have a bitter, burning, and biting taste. The plant is said to have received its specific name from the supposed power of its flowers of healing or consolidating wounds. The *consoude* of the French is comfrey.

The leaves, flowers, and seeds have been employed in medicine, and were designated as *herba*, *flores*, and *semen consolidæ*, s. *consolidæ regalis*, s. *calcatrippæ;* the seeds as *delphinium* (*U. S. P.* 1870). Thos. C. Hopkins (1839) obtained from the seeds an alkaloid which he regarded as identical with delphinine. Masing (1883) obtained from the dry herb 0.02 per cent. of *calcatripine*, which is soluble in alcohol, ether, and chloroform, and appears to be easily decomposed by chemicals. It is colored by sulphuric acid red-brown, violet-brown, gray-brown; by Fröhde's reagent, olive-green, gray-yellow; by sugar and sulphuric acid, red-brown, greenish-blue; by sulphuric acid and a nitrate, orange-red, golden-yellow.

Delphinium Ajacis, *Linné*, of Southern Europe, is more frequently cultivated in gardens than the preceding species, has denser and longer racemes of flowers upon shorter and thick peduncles, and pubescent follicles, and possesses the same properties.

Delphinium exaltatum, *Aiton*, is 4 or 5 feet (1.2–1.5 M.) high, and has the segments of the leaves narrow and cuneiform: the bright purplish-blue numerous flowers are in a narrow raceme and have a straight spur a little longer than the calyx. The plant grows in the Middle States.

Delphinium azureum, *Michaux*, grows from Wisconsin to Arkansas and the Rocky Mountains, is 2 or 3 feet (60 or 90 Cm.) high, and has linear leaf-lobes and sky-blue or whitish flowers with a curved or ascending spur.

Medical Action and Uses.—The no longer officinal plant, or larkspur, of which the flowers, as well as the seeds, have been employed in medicine, and also the tall larkspur (D. exaltatum), appear to possess acrid and irritant qualities, and in large doses to excite vomiting and purging. They have been used in the treatment of *dropsy* and spasmodic *asthma*, generally in the form of a tincture, which has also been much employed as a lotion or in an ointment for the cure of *itch* and the destruction of *lice*. It has of late been recommended for similar purposes (*Bull. de thérap.*, civ. 480) and for ulcerated *buboes*. An infusion of the flowers in water or in vinegar, 3 parts in 100, has been used. Analogous qualities are ascribed to D. Ajacis by Benvenuti, who states that it hastens the cicatrization of wounds, as D. consolida is also believed to do. These effects are due to the alkaloid *delphinine*, which has also been obtained from D. staphisagria. It has an acrid, hot taste, irritates the fauces, and is emetic and purgative. Given to dogs and cats in doses of ⅙ to ⅔ grain (Gm. 0.01–0.04), it causes depression, evidences of nausea, and a flow of saliva from the mouth, followed by violent vomiting, with signs of distress, and sometimes diarrhœa. Gradually the animal loses the power of voluntary movement, sensibility, and reflex excitability, but from time to time is affected with spasms, and in from 2 to 24 hours of a soporose condition perishes in a tetanic convulsion. Salivation continues during the entire attack, and respiration gradually grows slower and deeper until great dyspnœa occurs, with abrupt inspiration and labored and protracted expiration. In a word, death takes place by asphyxia. After death the heart is found in diastole. The gastro-intestinal mucous membrane is inflamed. In an ointment and rubbed upon the skin, delphinine causes a burning and prickling sensation and a transient redness, such as veratrine occasions. In the case of a man affected with torpor of the brain and abnormal excitability of the spinal cord Albers observed the following effects of doses of gr. ⅕ (Gm. 0.015) repeated four times a day for several days: salivation, burning, redness, and swelling of the throat, nausea, retching, loss of appetite, straining at stool without evacuation, dysury, prickling and itching of the skin, great restlessness, and a small but otherwise normal pulse. The intelligence was not further impaired, and the muscular power was rather augmented (Albers, *Prager Vierteljahrs.*, lxii.; *Analekt.*, p. 14). According to Boehm, staphisagrin (staphisaine) is a much less powerful poison to animals than delphinine, whose action, however, resembles its own in causing death by asphyxia. But it does not produce the energetic convulsions of delphinine, nor depress the pulse like that alkaloid; nor does it affect the cerebral functions, for the animals under its influence continue to react almost until death, and do not fall into a comatose condition.

Delphinine has been used with reputed success in the local treatment of *neuralgia* by applying it over the superficial sensitive points of the affected nerves. *Earache* and *toothache* have also been relieved by it. The *dose* of delphinine is stated to be ½ grain (Gm. 0.03) repeated at intervals of three or four hours. A solution of from 16 to 30 grains of the alkaloid in an ounce of alcohol (Gm. 1–2 in Gm. 32) may be used as a liniment, and an ointment may contain from 10 to 40 grains (Gm. 0.60–2.60) of delphinine to an ounce of lard.

STATICE.—MARSH ROSEMARY.

Inkroot, Sea-lavender, E.; *Romarin des marais, Lavande triste*, Fr.; *Strandnelke*, G.

The root of Statice Limonium, *Linné*, variety caroliniana, *Gray* (Statice caroliniana, *Walter*). Bentley and Trimen, *Med. Plants*, 166.

Nat. Ord.—Plumbaginaceæ.

Origin.—Marsh rosemary is a perennial acaulescent plant which grows near the seashore and in inland salt marshes of Southern and Western Europe. The variety caroliniana is an American plant, and grows in similar localities on the Atlantic coast. It has a tuft of spatulate-oblong or oblanceolate, bristly pointed, one-ribbed leaves, and produces in August a much-branched, panicled scape, about 20 inches (25 Cm.) high, bearing numerous small lavender-colored or purplish-blue flowers; the fruit is a one-seeded utricle contained in the base of the calyx. The root should be collected in autumn.

Description.—The root of marsh rosemary is several-headed, from 1 to 2 feet (30–60 Cm.) long and an inch (25 Mm.) or more thick. The upper part is closely annulate, and the stout branches, after drying, are longitudinally wrinkled. The root has a deep brownish-purple color externally, is somewhat paler internally, fleshy in the fresh state, and after drying tough and compact. It breaks with a short fracture, exhibiting a rather thick bark, and in the meditullium narrow pale-yellowish wood-wedges. The root is without odor and has a strongly astringent and slightly bitter taste. E. L. Reed (1879) stated that when collected from swampy localities the root is long and little branched, but when grown in a sandy soil it is short and considerably branched.

Constituents.—Edward Parrish (1842) found in the root 12.4 per cent. of tannin, a trace of volatile oil, a little caoutchouc-like matter, gum, and other common vegetable principles; among the inorganic constituents the sulphates and the chlorides of sodium and magnesium were found. H. K. Bowman (1869) estimated the tannin by means of gelatin, and determined the amount to be from 14 to 18 per cent. of the air-dry root. It reacts greenish-black with ferric salts.

Allied Drugs.—The roots of most other species of Statice have similar properties. St. speciosa, *Linné*, is used in Siberia; St. latifolia, *Smith*, in Southern Russia; and St. brasiliensis in Brazil, where it is known as *baycuru* and *biacuru;* the latter contains 12.5 per cent. of tannin and 1.3 per cent. of acrid pungent resin (Ch. Symes, 1878). F. A. Dalpe (1884) obtained from the air-dry root 9.7 per cent. of ash and an alkaloid, *baycurine*, which crystallizes from ether and chloroform in small white feathery needles and dissolves in sulphuric acid with a red color. St. mucronata, *Linné*, of Morocco, has a root with a whitish meditullium, and is said to possess nervine properties.

Medical Action and Uses.—This plant was anciently renowned as a remedy for pulmonary and uterine *hæmorrhage*, and for *dysentery* and other fluxes. In recent times it has been used, like kino and other vegetable astringents, for similar purposes, and still oftener in gargles for the cure of ulcerated, aphthous, and other forms of *sore throat.* The emetic action ascribed to it is probably developed only when its dose is excessively large. It may be used in tincture, decoction, or infusion.

STILLINGIA, *U. S.*—STILLINGIA.

Queen's root, *Queen's delight*, *Silver leaf*, E.; *Stillingie*, Fr., G.

The root of Stillingia sylvatica, *Linné*, s. Sapium sylvaticum, *Torrey.* Bentley and Trimen, *Med. Plants*, 241.

Nat. Ord.—Euphorbiaceæ.

Origin.—A perennial laticiferous herb growing in dry and sandy soil in the Southern United States as far north as Eastern Virginia. The stems are erect, 2 or 3 feet (60–90 Cm.) high, and have nearly sessile, alternate, elliptic, or lance-oblong, finely serrate, smooth, and spreading leaves. The flowers are small, in dense catkin-like spikes, the upper ones with two stamens, the lower ones pistillate, fertile, and with three diverging stigmas on the thick style. The root should be collected late in autumn or early in spring.

Description.—Stillingia-root is about a foot (30 Cm.) long, nearly 2 inches (5 Cm.) in diameter above, tapering downward, little branched, but somewhat fibrous. It is crowned with the short remnants or scars of numerous stems, is fleshy when fresh, after drying compact and wrinkled longitudinally. Externally, it is of a light brown-gray color, and internally of a pinkish tint. The root is tough and tenacious and breaks with a fibrous fracture. On transverse section are seen a rather thick bark, the inner layer of which is pale pinkish-brown and dotted with numerous brown-yellow resin-cells, and a radially striate porous meditullium containing resin-cells in the medullary rays. The odor of the fresh root is rather strong and disagreeable, but after drying is much weaker and less unpleasant; its taste is bitter and acrid, leaving a burning impression on the palate.

Constituents.—From some experiments made by Wm. Saunders (1868), it appears that, though the odor of the root may be diminished on drying and keeping, the pungency is scarcely lessened by exposure for a year to light and air. The pungency seems to be due to a resinous constituent which is readily soluble in alcohol. The so-called *oil of stillingia*, as found in the market, is intended to be the ethereal extract, but sometimes possesses scarcely any of the persistent acrimony of the root. Stillingia contains also starch, tannin, and, according to J. H. Harmanson (1882), another principle, which, like tannin, discharges the blue color of iodide of starch, and which is insoluble in alcohol and ether, but readily soluble in hot water, and is destroyed on being boiled with diluted acids.

Allied Species.—STILLINGIA (Excœcaria, *Müller*, Croton, *Linné*, Sapium, *Roxburgh*) SEBIFERA, *Michaux.* This is a medium-sized tree indigenous to China and somewhat cultivated in tropical countries. The ovate three-celled fruit contains three seeds imbedded in a solid inodorous fat, which consists principally of palmitin, with a little stearin, melts at 44.5° C. (112° F.), and is known as *Chinese tallow.* After separating the tallow by boiling water, the seeds yield by pressure a drying oil which melts at 35° C. (95° F.), and then remains liquid for a long time.

Off. Prep.—Extractum stillingiæ fluidum, *U. S.*

Medical Action and Uses.—The root, when chewed and the juice swallowed, causes heat in the mouth and fauces and along the œsophagus, increased salivation, and burning in the stomach, and in susceptible persons vomiting also. It loses these qualities by drying (Frost). Stillingia was originally introduced as an emetic and alterative, and has been more or less used, especially in the Southern States, for the cure of *scrofula*, *syphilis*, and *cutaneous* and *hepatic* disorders. The evidences of its power do not appear to be very convincing. Thus, it is credited with curing phagedenic chancres which nothing else could arrest, but it appears that with each dose of a decoction of stillingia 4 drops of nitric acid were given. Now, nitric acid is reputed to cure syphilis. In 1846, Frost claimed for it curative virtues in scrofula and syphilis, but he associated with it sarsaparilla, guaiac, and sassafras (*Charleston Jour.*, i. 617). A similar estimate must be formed of the judgment expressed by Lopez (*New Orleans Med. and Surg. Jour.*, ii. 40), and by Cornell (*Boston Med. and Surg. Jour.*, Aug. 1857, p. 37). Stillingia is best given in a decoction made with an ounce of the bruised root in 1½ pints (Gm. 32 in Gm. 750) of water, gradually reduced to a pint. *Dose*, a wine-glassful two or three times a day. The *dose* of the powder is from 15 to 30 grains (Gm. 1–2).

STRAMONII FOLIA, *U. S., P. G.*—STRAMONIUM-LEAVES.

Herba stramonii.—Thornapple-leaves, E.; *Feuilles de stramoine*, Fr.; *Stechapfelblätter*, G.

STRAMONII SEMEN, *U. S.*—STRAMONIUM-SEED.

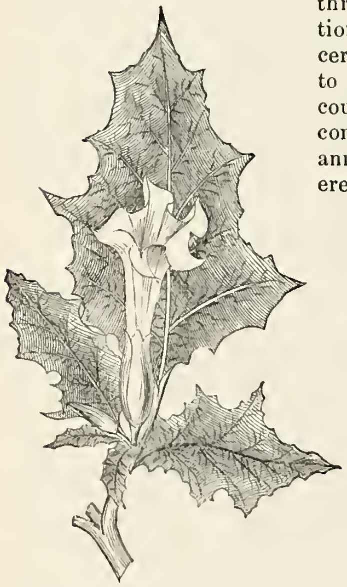
Stramonii semina, Br.; *Stramonium-seeds*, E.; *Semences (graines) de stramoine*, Fr.; *Stechapfelsamen*, G.

The leaves and seeds of Datura Stramonium, *Linné.* Woodville, t. 74; Bentley and Trimen, *Med. Plants*, 192.

Nat. Ord.—Solanaceæ.

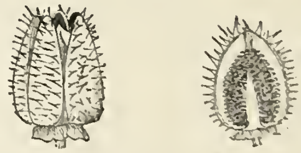
Origin.—Stramonium is known in the United States as *Jamestown weed* and *Jimson weed.* It is very unequally distributed, being quite common in some localities and rare in others, and grows in waste places and along roadsides throughout the greater part of the world, with the exception of the colder countries. Its native country is not certainly known, but it is now by most botanists believed to be indigenous to Asia. De Candolle refers it to the countries bordering on the Caspian Sea; others regard it as coming from Northern India. It is a coarse-looking annual weed, with a white, conical, branching root and an erect, nearly smooth, pale-green, and succulent stem, attaining, with its repeatedly forking branches, a height varying from 2 to 5 feet (0.6–1.5 M.). The flowers are on short stalks singly in the forks, have a long tubular five-angled calyx with a short five-toothed limb, and a white, tubular, funnel-shaped, five-plaited, and five-pointed corolla about 4 inches (10 Cm.) long. The capsule is 2 to 3 inches (5–7 Cm.) long, surrounded below by the spreading base of the calyx, ovate in shape, obtusely quadrangular, covered with spines, in the lower portion four-celled, but only two-celled above, opens by four valves, and contains numerous seeds.

FIG. 287.



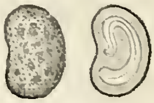
Datura Stramonium, *Linné:* flowering branch.

FIG. 288.



Capsule, mature, and with two valves removed, showing partitions and position of seeds (reduced).

FIG. 289.



Stramonium-seed and section, magnified 3 diam.

DATURA TATULA, *Linné*, resembles the officinal plant very closely, is found in similar localities, and is distinguished by its purple-colored stem, the darker-green foliage with occasionally purplish petioles and nerves, and by the purple color of the flowers and anthers. Many botanists regard it merely as a variety of Stramonium, but there are evident hybrids between the two forms, and, according to Naudin (1852), the seedlings from these are again either D. Stramonium or D. Tatula. De Candolle considers this species to be indigenous to South America, but it has spread over the greater part of the world.

Description.—1. THE LEAVES. These should be collected while the plant is in bloom, which commences early in summer. They are situated on the forks on long petioles, vary in length from 3 to 8 inches (7–20 Cm.) and in width from 2 to 5 inches (5–12 Cm.), are ovate in shape, and have an unequal base, one side being decurrent on the petiole. The apex is pointed and the margin coarsely and unequally sinuate-toothed. The leaves are rather fleshy when fresh, and have a disagreeable narcotic odor, but after drying are thin, brittle, and nearly inodorous. Young leaves are downy; older ones are smooth or slightly downy on the nerves beneath, and frequently perforated with nearly circular holes. Their taste is unpleasant, saline, and bitter.

2. THE SEEDS. When ripe the seeds are of a dull brownish-black color, about $\frac{1}{6}$ inch (4 Mm.) long, $\frac{1}{10}$ inch (2.5 Mm.) broad, and about $\frac{1}{25}$ inch (1 Mm.) thick; they are reniform, flattened, finely pitted, and somewhat coarsely reticulate, and have the hilum on the sinus. The testa is hard, and encloses a white oily albumen in which is imbedded the cylindrical embryo, curving parallel with the edges of the seed. The seeds are inodorous or nearly so, except after being bruised, when they emit a heavy unpleasant odor; their taste is oily and bitter.

Constituents.—The alkaloid *daturine* was discovered in the seeds by Geiger and Hesse (1833), and subsequently found in other parts of the plant. According to Brandes, the seeds contain it combined with malic acid. Von Planta (1850) pronounced this alkaloid to be identical with atropine in composition, solubility, and fusibility. But the physical experiments performed by Von Schroff (1852) demonstrated the two alkaloids, though acting qualitatively alike, to be very unequal in their effects, daturine being about twice as strong as atropine. Subsequently, Erhard (1866) observed also some of their salts to differ in their crystalline forms. These differences have been explained through the researches of Ladenburg (1880), according to which daturine is a mixture of *atropine* and *hyoscyamine* (see pp. 283 and 802), the latter usually predominating; but Ernst Schmidt (1881) obtained also daturine which consisted principally of atropine. The other constituents of the seeds are about 25 per cent. of a bland fixed oil, mucilaginous, resinous, and other common principles, and about 3 per cent. of ash. Trommsdorff isolated *stramonin* as a white tasteless powder, insoluble in water, readily soluble in fixed and volatile oils, soluble in ether, and sparingly soluble in alcohol; it does not appear to have been further investigated. The leaves contain only about .02 per cent. of alkaloid, besides mucilage, albumen, nitrate of potassium, etc.; they yield about 17 per cent. of ash.

Allied Drugs.—DATURA ALBA, *Nees*, of India, has rather small subglobular and sharply spinous capsules and irregular triangular yellowish-brown, roughish seeds, which are used like those of the preceding species.

DATURA METEL, *Linné*, which grows in Africa and Southern Asia, has obliquely cordate, somewhat sinuate-toothed or nearly entire, soft-hairy leaves, and pendulous spiny capsules with brownish-yellow seeds.

DATURA SANGUINEA, *Ruiz et Pavon*, a shrub or small tree of Peru, has oblong, pointed, and sinuate-toothed, on the lower side downy, leaves, and large flowers with a corolla, the lower half of which is yellow and the upper half blood-red.

Off. Prep.—Of the seed: Extract. stramonii fluidum, *U. S.;* Extract. stramonii, Tinct. stramonii, *U. S.*, *Br.*

History.—It is almost certain that stramonium was unknown to the ancients; it was described by Gerarde in the sixteenth century, but it was first introduced into medical practice by Stoerck in 1762. The dried leaves and seeds are said to have been brought from Asia into Europe in the Middle Ages by the gypsies, who employed their smoke to intoxicate and delude their dupes.

Physiological Action.—*On Animals:* Insects of the caterpillar tribe feed upon stramonium and goats devour it without injury. A decoction of the leaves applied to the skin of a young rat caused alternate debility and convulsive movements. Very large doses given to the horse have induced gaping, drowsiness, and even death.

On Man: Stramonium and belladonna and their respective alkaloids, daturine and atropine, are almost identical in their action upon man. Indeed, they are held to be quite identical by some of the highest authorities (*Archives gén.*, Jan. 1881, p. 12). The powdered leaves of stramonium in 2-grain (Gm. 0.12) doses slightly increase the fulness and frequency of the pulse, occasion a little giddiness, and render the skin warm and the hands and face moist. 5-grain (Gm. 0.30) doses cause dilatation of the pupils, difficulty of speech, nausea, thirst, dryness of the throat, relaxation of the bowels, an increased flow of urine, and some feverishness. Poisonous doses produce a condition like that of high fever with delirium; the patient may talk volubly and laugh, or become violent, biting and striking furiously, and usually there is evidence of various, and sometimes grotesque, hallucinations; the movements may resemble those in chorea or in alcoholic intoxication; the head is dizzy, heavy, or light, and there is a tendency to faint; the face is flushed, and occasionally swollen, the eye bright, the conjunctiva injected, the pupil dilated, and the sight confused; the skin is sometimes covered with a bright-red eruption, which may be followed by a crop of minute vesicles, or the eruption may resemble erysipelas at first and measles afterward. In some cases hydrophobic phenomena occur, the sight of water or the attempt to drink producing a convulsive paroxysm. In rare fatal cases the phenomena of excitement sooner or later are succeeded by stupor, insensibility, relaxation, and even paralysis; the pupils are inordinately dilated, the pulse is rapid and thready, and the skin hot and perspiring. In no case is there any tendency to sleep, but, on the contrary, persistent insomnia. When recovery takes place there is no distinct recollection of what has occurred. Among the perversions of the senses it has been noticed that all black objects appear green. A fatal case in a healthy man of fifty is reported by Newton (*Med. Record*, xviii. 289), and recent cases of recovery have been published by Terry (*Boston Med. and Surg. Jour.*, Feb. 1882, p. 123), Rubio, etc. (*Phila. Med. Times*, xii. 458; xiii. 280). A curious illustration of stramonium intoxication is presented by the narrative of its use in Mecca for criminal purposes (*Jour. Am. Med. Assoc.*, i. 22). Daturine occasions phenomena essentially identical with the above and with those caused by atropine, but with more depression, failure of the pulse, and insensibility; according to some observers, it dilates the pupils more rapidly, although less persistently, than atropine. Other reporters, however, furnish a different result, asserting that as a mydriatic daturine is three times as strong as atropine and its action more prolonged. It is generally accepted, as being proved by the above phenomena, that stramonium and daturine expend their power mainly upon the vaso-motor nerves, in small doses contracting, but in large doses paralyzing, the capillaries. These actions are identical with those which experiment and observation have shown to be exerted by hyoscyamine. Regnault and Valmont concluded from their experiments that daturine is identical with atropine, and that hyoscyamine is often really impure atropine (*Archives gén.*, Jan. 1881, p. 16), and Oliver reached the same conclusion in regard to the action of daturine and hyoscyamine (*Amer. Jour. of Med. Sci.*, July, 1882, p. 102).

Medical Uses.—At one time stramonium was believed to be a valuable remedy in various forms of *insanity*, in *mania* as well as in *melancholia*, but experience has not confirmed the favorable judgment. Yet there are isolated cases in which phantasmal delirium appears to have been removed by this medicine. A similar statement may be made respecting its use in *epilepsy*, and there is at least every reason to regard it as not less efficacious than belladonna in that disease. The utility of stramonium in *spasmodic asthma* cannot rationally be called in question; the evidence in its favor is drawn from too many and too widely different sources to be gainsaid. The scepticism upon this point expressed by certain writers may fairly be attributed to their having failed to discriminate between pure asthma and asthma or dyspnœa connected with pulmonary or cardiac disease. In the latter category the medicine must usually fail, either partially or wholly, and may even aggravate the symptoms, while in pure nervous asthma there can be no doubt of its power to relieve the paroxysms. It should be used as follows: About 15 grains (Gm. 1) of dried stramonium-leaves or half that quantity of the fibres of the dried root may be smoked at once, mixed with sage-leaves or tobacco in a pipe or a cigarette. Or else tobacco steeped in a strong decoction of stramonium may be smoked in a pipe, or cigars impregnated with the same liquid may be used. If possible, the smoke should be drawn into the lungs. An atomized decoction of stramonium has been used, but is less efficient. Of other spasmodic affections more or less benefited by this medicine may be mentioned *whooping cough*, *dysmenorrhœa*, and *retention of urine* caused by spasm of the neck of the bladder. In the latter case bruised fresh stramonium-leaves may be used or stramonium ointment may be rubbed upon the perineum. The rectal tenesmus, burning pain, etc. due to *hæmorrhoids*, *fissure*, and other affections of the anus and rectum may be greatly palliated by stramonium. A convenient formula for this purpose is the following: ℞. Ung. stramon., Ung. gallæ, Cerat. plumbi subacet., āā q. s. —M. S.—Apply within the anus after defecation and washing.

The apparent identity of the physiological actions of stramonium and belladonna and of their respective alkaloids naturally suggested an identity in their therapeutic powers.

But it does not really exist. Their differences are most conspicuous in the treatment of *neuralgic* affections. In these belladonna is much more efficient than stramonium; indeed, while the former and atropine are among the most reliable of anti-neuralgic medicines, stramonium is comparatively inefficacious and daturine has been but little used. Moreover, stramonium is much more employed as a local anodyne in superficial neuralgia, while belladonna is even more active as an internal than as a topical remedy for these as well as the deeper-seated neuralgic affections. If stramonium is prescribed for them internally, it should be given in such repeated doses as will develop the specific action of the medicine.

In subacute and chronic articular and in muscular *rheumatism* bruised fresh stramonium-leaves produce an anodyne effect, and the ointment may be applied with some benefit, but the action of either is inferior to that of belladonna or of opium. There is some authority for attributing to stramonium in full and repeated doses a certain control over the course of acute articular rheumatism, but the evidence is too scanty and ambiguous to inspire much confidence.

In the absence of belladonna, stramonium may be used to produce *dilatation of the pupil.* It has this effect whether it is given internally or is topically applied. Daturine has been employed for the same purpose, and, as before stated, by some is held to be less irritating to the eye than atropine, while others make the opposite statement.

The average *dose* of the leaves or the root of stramonium is about 2 grains (Gm. 0.12), and of the seeds about 1 grain (Gm. 0.06), repeated at intervals of several hours and until it begins to dilate the pupil. The *dose* of daturine, hypodermically, is from $\frac{1}{60}$ to $\frac{1}{20}$ grain (Gm. 0.001–0.003).

The physiological and clinical antidote to stramonium is opium. Numerous cases are reported in which opium or its liquid preparations, and especially morphine hypodermically, have apparently saved the lives of persons poisoned by stramonium. In the case of an adult 15 grains (Gm. 1) of muriate of morphine were administered by the mouth before the safety of the patient was secured (Anderson, *Ranking's Abst.*, xxx. 276).

STRYCHNINA, *U. S., Br., F. Cod.*—STRYCHNINE.

Strychnia, Br., U. S. 1870; *Strychninum.—Strychnine*, Fr.; *Strychnin*, G.
Formula $C_{21}H_{22}N_2O_2$. Molecular weight 334.

Preparation.—Take of Nux Vomica 1 pound; Acetate of Lead 180 grains; Solution of Ammonia a sufficiency; Rectified Spirit a sufficiency; Distilled Water a sufficiency. Subject the nux vomica for 2 hours to steam in any convenient vessel; chop or slice it; dry it in a water-bath or hot-air chamber, and immediately grind it in a coffee-mill. Digest the powder at a gentle heat for 12 hours with 2 pints of the spirit and 1 of the water; strain through linen, express strongly, and repeat the process twice. Distil off the spirit from the mixed fluid, evaporate the watery residue to about 16 ounces, and filter when cold. Add now the acetate of lead, previously dissolved in distilled water, so long as it occasions any precipitate; filter; wash the precipitate with 10 ounces of cold water, adding the washings to the filtrate; evaporate the clear fluid to 8 ounces, and when it has cooled add the ammonia in slight excess, stirring thoroughly. Let the mixture stand at the ordinary temperature for 12 hours; collect the precipitate on a filter, wash it once with a few ounces of cold distilled water, dry it in a water-bath or hot-air chamber, and boil it with successive portions of rectified spirit till the fluid scarcely tastes bitter. Distil off most of the spirit, evaporate the residue to the bulk of about ½ ounce, and set aside to cool. Cautiously pour off the yellowish mother-liquor (which contains the brucia of the seeds) from the white crust of strychnia which adheres to the vessel. Throw the crust on a paper filter, wash it with a mixture of 2 parts of rectified spirit and 1 of water till the washings cease to become red on the addition of nitric acid; finally, dissolve it by boiling it with an ounce of rectified spirit, and set it aside to crystallize. More crystals may be obtained by evaporating the mother-liquor.—*Br.*

This process is a modification of the one proposed by Wittstein. The tincture, prepared with about 55 per cent. alcohol, is concentrated, and the resinous and other insoluble matter separated by filtration. Acetate of lead precipitates from the filtrate igasuric acid and coloring matter, and leaves the alkaloids in solution as acetates. These are decomposed by ammonia, and the precipitated alkaloids treated with hot alcohol, from the concentrated solution of which strychnine crystallizes, and is entirely purified from brucine and coloring matter by washing with alcohol of about 55 per cent. and by recrystallization from strong alcohol.

O. Henry (1830) recommended the exhaustion of nux vomica by means of alcohol acidulated with sulphuric acid and the liberation of the alkaloids by lime. Duflos recommended a similar process, using acidulated water for exhausting the drug; and this is frequently followed when working on the large scale, and was adopted by the U. S. P. 1870. Powdered nux vomica, or the drug softened by steam and while hot crushed between rollers, is exhausted by boiling with very dilute hydrochloric or sulphuric acid; the decoction contains the alkaloids as hydrochlorates or sulphates, together with the liberated igasuric acid, mucilaginous compounds, coloring matter, and other principles. On the addition of slaked lime the salts of the alkaloids are decomposed, chloride or sulphate of calcium is formed, and strychnine and brucine are precipitated, together with the excess of lime employed, and with calcium sulphate. On washing this precipitate with water, the foreign principles are mostly removed, and by treatment with cold diluted alcohol the brucine is dissolved. The residue now consists essentially of lime and strychnine, the latter of which is taken up by boiling alcohol, and further purified by converting it into sulphate soluble in water, decolorizing with animal charcoal, and precipitating with an alkali; or, the washed and dried precipitate by lime is at once exhausted with boiling alcohol, and the mixed strychnine and brucine are purified by treatment with sulphuric acid, animal charcoal, and ammonia, and separated by dissolving in hot alcohol, when, on cooling, strychnine will crystallize and brucine remain in the mother-liquor.

Various other processes have been proposed, differing mainly in the manner in which the alkaloids are liberated and afterward separated from each other. Magnesia or carbonate of sodium may be substituted for the lime and ammonia in the above processes; and benzol was suggested by Boiraux and Léger (1875) for dissolving strychnine from the mixed alkaloids, brucine, it is stated, being completely insoluble in that menstruum.

Properties.—Strychnine is seen in commerce as a white crystalline powder or crystallized in colorless, short, quadrangular prisms or octahedrons of the rhombic system. It is permanent in the air, inodorous, has a very persistent bitter taste, which is still perceptible if strychnine is dissolved in 600,000 or 700,000 parts of liquid. The alkaloid has an alkaline reaction, melts below 300° C. (572° F.), is sublimable only when very minute quantities are carefully heated (Hellwig, 1864), and is decomposed at a higher heat. Pelletier and Caventou, who discovered this alkaloid in 1818, found it soluble in about 6700 parts of cold and 2500 parts of boiling water, and to be insoluble in absolute ether. It requires 120 parts of cold and 10 parts of boiling 80 per cent. alcohol for solution (Wittstein); but it is very sparingly soluble in absolute and in dilute alcohol; it dissolves in 110 parts of alcohol (*U. S.*); in 107 parts of 95 per cent. alcohol, 180 parts of amylic alcohol, 165 parts of benzol, and in 1250 parts of commercial ether (Dragendorff); in about 5 parts of chloroform (Pettenkofer); in 300 parts of glycerin (Cass and Garot); and is also soluble to some extent in volatile and fixed oils and in creasote. Its solubility in water is not increased by ammonia or caustic potassa, but dilute acids render it much more soluble, with the formation of neutral salts, which are mostly crystallizable and are precipitated by alkalies, alkali carbonates, chromates, and, after some time, by soluble bicarbonates. Lextrait (1881) obtained long needles of a compound consisting of 3 molecules of strychnine and 1 of iodoform; it becomes yellow at 90° C. (194° F.), is very sparingly soluble in alcohol, and dissolves freely in ether and chloroform, decomposing when kept in solution.

Strychnine and its salts dissolve in concentrated sulphuric acid without color, but on the addition of a little peroxide of lead a beautiful blue color is produced, passing into violet, red, and finally into yellow (Marchand). If a small crystal of potassium bichromate is used instead of the lead oxide, a deep-violet color is produced, or a blue color if strychnine is in excess (Otto). A similar color is obtained with sulphuric acid and ferricyanide of potassium (Davy); it passes like the preceding, though more slowly, through red into yellow, and finally fades. The solution of strychnine in sulphuric acid containing some nitric acid yields on the addition of binoxide of manganese a purplish-violet color (Mack, Erdmann), and a similar color, but rapidly fading to yellow, is produced with chloric, chlorous, and iodic acids and their salts, with manganic sulphate and potassium permanganate (Lefort). If much contaminated with organic matter, the alkaloid is best purified by dissolving it in a dilute acid, so as to free it from fatty and resinous matters, liberating it by ammonia, and dissolving it by agitation with chloroform; if necessary, the process is repeated, and the residue from the evaporation of chloroform is tested as above. If the above tests are carefully applied, a very minute quantity may be detected, according to Wenzell (1870), in a solution containing the $\frac{1}{900000}$ part of strychnine.

The composition of strychnine is expressed by the formula $C_{21}H_{22}N_2O_2$ (Regnault); according to Schützenberger (1858), it sometimes contains 22 or 20 C.; Claus (1881) observed a strychnine with 22C.

Tests.—The freedom from inorganic matters is readily proven by the absence of ash on incinerating a portion. Concentrated nitric acid should not produce a red color, or only a very faint one, showing the absence of more than traces of brucine.

Off. Prep.—Liquor strychniæ, *Br.;* Ferri et strychn. citras, Syrup. ferri quin. et strychn. phosphatum, *U. S.*

STRYCHNINÆ SULPHAS, *U. S.*—SULPHATE OF STRYCHNINE.

Strychninum sulfuricum.—*Sulfate de strychnine*, Fr.; *Schwefelsaures Strychnin*, G.

Formula $(C_{21}H_{22}N_2O_2)_2H_2SO_4.6H_2O$. Molecular weight 874.

Preparation.—In preparing this salt it is best to use the strychnine in the form of powder, and add it in slight excess to warm dilute sulphuric acid; the filtrate from the undissolved strychnine will yield the salt on being evaporated spontaneously to dryness; on the cooling of the hot saturated solution a salt with $5H_2O$ crystallizes in long thin prisms.

Properties.—Sulphate of strychnine crystallizes in transparent and colorless quadratic octahedrons containing 12.36 per cent. water of crystallization, the whole of which is given off below 200° C. (Rammelsberg, 1881); according to Regnault (1838), the loss at 135° C. (275° F.) is 13.08 per cent. The salt has a neutral reaction, is inodorous, and has the intensely bitter taste and the color reactions of strychnine salts. On exposure it becomes superficially opaque. It is stated to be soluble in 48 parts (Abl) and in less than 10 parts (Pelletier and Caventou) of water; according to the U. S. P., it is soluble in 10 parts of water and in 60 parts of alcohol at 15° C. (59° F.), in 2 parts of boiling water, and in 2 parts of boiling alcohol; also soluble in 26 parts of glycerin, but insoluble in ether. M. W. Coleman (1883) determined it to be soluble at 15° C. in 42.76 parts of water, to contain $6H_2O$, to become anhydrous at 185° C. (365° F.), without previously melting, and to be decomposed at about 225° C. (437° F.). Lextrait (1882) recommends the salt with $5H_2O$, which is uniformly obtained by crystallizing from alcohol of more than 50 per cent. strength. The aqueous solution of the salt gives with barium chloride a white precipitate of barium sulphate, and with potassa or ammonia a white precipitate of strychnine which shows the reactions described above. When heated to redness the salt should leave no residue.

From the observations of Rammelsberg and of Lextrait it appears that in Europe the normal and acid sulphates are used indiscriminately; the former (pharmacopœial) salt contains 75.43 per cent. of strychnine, while the latter contains 71.36 per cent., its formula being $C_{21}H_{22}N_2O_2H_2SO_4.2H_2O$, and it becomes anhydrous at 150° C. (302° F.).

Other Salts of Strychnine.—STRYCHNINÆ ACETAS. The neutral salt crystallizes with difficulty, and on evaporating its solution loses a portion of the acid; it dissolves in 96 parts of water and in 15.1 parts of chloroform.

STRYCHNINÆ HYDRIODAS, $C_{21}H_{22}N_2O_2.HI$; molecular weight 461.6. It is sparingly soluble in cold water, but dissolves more freely in alcohol. It is prepared by adding solution of potassium iodide to the solution of a strychnine salt, dissolving the precipitate in alcohol, and crystallizing. It forms quadrangular needles or white scales, has a very bitter taste, and contains 72.3 per cent. of strychnine.

STRYCHNINÆ HYDROBROMAS, $C_{21}H_{22}N_2O_2.HBr$; molecular weight 414.8. Bullock (1875) recommended its preparation from 45 grains of sulphate of strychnine dissolved in a mixture of 1 fluidounce of water and 2 fluidrachms of alcohol. To this solution is added a solution of 11.7 grains of potassium bromide in 1 fluidrachm of water and 1 fluidounce of alcohol. The precipitated potassium sulphate is filtered off, the filtrate is mixed with a fluidounce of water, concentrated, and crystallized. It forms prismatic needles which are sparingly soluble in alcohol, more readily soluble in dilute alcohol, and require about 32 parts of cold water for solution. It contains 80 per cent. of strychnine.

STRYCHNINÆ HYDROCHLORAS, $2(C_{21}H_{22}N_2O_2.HCl).3H_2O$; molecular weight 794.8. It is best prepared by dissolving strychnine in warm dilute hydrochloric acid, and crystallizes in silky needles, which lose their water of crystallization at 120° C. It dissolves in 50 parts of cold water, and contains 84 per cent. of strychnine.

STRYCHNINÆ NITRAS; Strychninum nitricum, *P. G.* On dissolving strychnine in warm very dilute nitric acid the solution yields, on cooling, colorless needles of a silky lustre and very bitter taste. The salt is soluble in 90 parts of cold and in 3 parts of boiling water, and in 70 parts of cold and 5 parts of boiling alcohol. It is less freely soluble in absolute alcohol and fixed oils, is insoluble in ether, but dissolves in 26 parts of glycerin. Its composition is $C_{21}H_{22}N_2O_2.HNO_3$; molecular weight 397. It contains 84 per cent of strychnine.

History.—It is singular that the history of any powerful and peculiar medicine should be so obscure as that of nux vomica, the original source of strychnine. The very name that it bears, nux vomica, is a misnomer, since vomiting is not a symptom which is often produced by it in any dose. It is, however, more apt to be caused by nux vomica than by strychnine. It was known to the Hindoos as a poison, and seems to have been introduced into Europe in the sixteenth century. It is very curious that during the sixteenth, seventeenth, and a part of the eighteenth centuries, although it was well known to be poisonous to animals, it was affirmed not to be so to man. So delusive is negative testimony!

Physiological Action.—*On Plants:* Very minute portions of strychnine in the soil will destroy the life of growing plants. The same effect follows its inoculation into their branches.

On Animals: It acts poisonously upon all animals, but in different degrees. Flies die in convulsions, and intestinal worms are destroyed by it. Fishes placed in water containing the $\frac{1}{2500}$ part of muriate of strychnine or of brucine die within 10 minutes, and in a solution containing about 1 part of strychnine to 150,000 parts of water a minnow died within 20 minutes in a state of lateral rigidity (Gray). It is alleged, on the other hand (Falck), that serpents and fish exhibit no tetanic phenomena, but disturbance of the breathing, trembling, and jerking of the muscles, exhaustion, insensibility, and death. The frog is generally considered to be so exceptionally sensitive to the action of strychnine as to be employed as a test of the presence of this alkaloid in solution; for if $\frac{1}{1000}$ of a grain be dissolved in a drop of water and applied to the skin of the animal's back, previously dried, tetanoid spasms occur in from a quarter of an hour to one hour. The same effect is produced by the subcutaneous injection of the $\frac{1}{2000}$ of a grain of the acetate of strychnine under the skin of a healthy frog, or by that of $\frac{1}{20000}$ of a grain in the case of a frog exhausted by drying its skin, so as to impede the natural elimination of the poison through the integument. It is claimed by some experimenters that, in proportion to its weight, the frog is really less susceptible to strychnine than various mammals, and that it requires four times the dose needed by dogs, cats, rabbits, etc. to produce an equal effect on frogs (Falck). Birds appear to be comparatively insusceptible to the poisonous action of this substance. Thus in one experiment nux vomica was given to a hen in progressively increasing doses, until it took 2½ drachms of the poison every day. Ruminating animals are less easily affected than other quadrupeds, at least when the poison is given by the mouth; for while 10 grains thus administered may fail to kill a sheep, ¼ or ½ grain of strychnine will be fatal if introduced hypodermically or injected into the pleural cavity or into the veins. A similar result of experiment on the goat has been observed. Dogs very readily manifest the power of this substance, but cats resist it singularly, whether it be administered by the mouth or veins or subcutaneously. Vulpian states that the hypodermic injection of 1 Mgm. (gr. $\frac{1}{64}$) of muriate of strychnine, dissolved in water, is sufficient to kill a full-grown rabbit, and that from two and a half to three times this quantity will be fatal to a medium-sized dog. When strychnine has been employed in fulminating balls to kill whales, it has been observed that these mammals perish in spasms. Guinea-pigs and monkeys are said to be comparatively insusceptible to it. The phenomena in the various cases in which its specific operation is developed consist of tremors, twitchings, and startings of the voluntary muscles, followed by tetanoid spasms, during which the heart's action is accelerated, the temperature raised, and the respiration and consciousness suspended. Between the spasms the circulation generally becomes normal, the consciousness returns, and cutaneous hyperæsthesia is observed, but the spasms may be renewed by any excitation, as a touch, a loud sound, or a sudden impression on the eye. Death may occur through asphyxia from tonic spasm of the respiratory muscles, by syncope, or by exhaustion. The heart continues to pulsate after the respiratory movements have ceased. Of these modes of death, that during spasm is by far the most frequent in cases of strychnine-poisoning. No lesion is uniformly found after death; the heart may be distended with black blood or empty, and, although congestion and serous effusion within the meninges of the brain and spinal cord are usual, they are not uniformly met with, and in the substance of these organs no characteristic alterations have been observed.

The experiments of Dr. W. H. Klapp (1878) led him to conclusions which may thus be summarily expressed: 1. Strychnine produces no primary lesion of the nerve-substance proper. 2. Its convulsions are not cerebral. 3. It does not affect either the sensory or motor nerves at their periphery. 4. These nerves are unaffected by it in their course. 5. Its tetanizing effects depend upon its action on the gray matter of the spinal cord.

6. In small doses it excites the vaso-motor centre. 7. In large doses it paralyzes that centre. 8. It slows the pulse by an immediate action upon the excito-motor ganglia of the heart. 9. It does not act on the pneumogastrics, but decreases the number of respiratory movements, at first from too little blood, and afterward from too much blood flowing to the respiratory centres. 10. Artificial respiration always moderates the spasms, not by a reflex stimulation of the pneumogastrics, but by maintaining the oxygenation of the blood until the poison is eliminated.

It may, then, reasonably be believed—1, that strychnine does not act upon the muscles, the nervous extremities, or the nerve-trunks; 2, that it does act upon the nerve-centres in the medulla oblongata and medulla spinalis; and, 3, that it acts upon those centres first by stimulating them when given in small doses, and by exhausting them, and thereby exaggerating their reflex irritability, when poisonous doses are used, in this respect falling under the general law that the actions of small and of large doses of an active agent are antagonistic to one another. (Compare Poole, *Med. Record*, xix. 201.) The latter of the two effects are probably dependent, in part at least, upon the power of strychnine to contract the arteries and the heart and to slow the pulse. It is essentially through spasm, in so far as it throws the respiratory muscles into tonic contraction and by rendering the chest immovable, that it tends to produce asphyxia, with its usual symptoms of dark venous congestion of the eyes and interior of the mouth. This explanation renders clear the agency of artificial respiration in saving the life of animals in strychnine-poisoning (Richet, *Med. News, etc.*, Nov. 1880, p. 659), and the effect of keeping the frog's skin moist in preventing or delaying the fatal action of the poison upon this animal. In both cases the blood continues to be oxygenated until the poisonous excess of strychnine has been eliminated.

The antagonisms presented by strychnine relate chiefly to chloral hydrate, aconite, hydrocyanic acid, and nicotin, or the special heart-poisons. In regard to the first, it has been shown by J. Hughes Bennett—1, that after a lethal dose of strychnine life may be saved by bringing the animal under the influence of chloral hydrate; 2, that chloral hydrate is more likely to save life after a fatal dose of strychnine than strychnine is to save life after a fatal dose of chloral hydrate; 3, that after a dose of strychnine producing severe tetanic convulsions these convulsions may be much reduced, both in force and frequency, by the use of chloral hydrate; 4, that the extent of physiological antagonism between the two substances is so far limited that (*a*) a very large fatal dose of strychnine may kill before the chloral hydrate has had time to act, or (*b*) so large must the dose of chloral hydrate be to antagonize an excessive dose of strychnine that there is danger of death from the effects of the former; 5, chloral hydrate mitigates the effects of a fatal dose of strychnine by depressing the excess of reflex activity excited by that substance, while strychnine may mitigate the effects of a fatal dose of chloral hydrate by rousing the activity of the spinal cord, but it does not appear capable of removing the coma produced by the action of chloral hydrate on the brain. The experiments of Dr. J. Milner Fothergill appear to show that the antagonism of strychnine and aconitine is very marked, so far as the influence of the former upon lethal doses of the latter is concerned; those of Brunton and others give equivocal evidence of the antidotal power of hydrocyanic acid in poisoning with strychnine. The experiments of Dr. Francis L. Haynes led him to these conclusions: 1, strychnine and nicotin are in no degree antagonistic poisons; 2, strychnine increases the convulsive action, and does not diminish the motor paralysis, of nicotin; 3, nicotin (even in paralyzing doses) increases the convulsive action of strychnine; 4, both poisons cause death by paralyzing the respiratory apparatus: they may affect respiration in different ways, but the result is the same; 5, animals may be killed by injecting together doses of the two drugs which, singly, are not fatal.

On Man: Powdered nux vomica and also strychnine rubbed upon the skin persistently act as local irritants; this action is greatly intensified if they are applied to the raw cutis, and may be attended with specific general symptoms. In small doses, internally, they are tonics, increasing the appetite and the urinary secretion, and the fecal discharges also when these are infrequent, but diminishing the latter when their frequency is due to atony of the bowels. Like other bitter tonics, their prolonged and excessive use deranges the digestion. They appear to augment the biliary and pancreatic secretions. Strychnine is excreted with the urine, and occasions an increased frequency of urination, but in excess produces spasm of the neck of the bladder, and ultimately impaired contractile power in this organ. It probably excites uterine contraction, promotes menstruation, disposes to venery, and provokes erections of the penis. It exerts no perceptible action upon the brain, but seems to increase the functional activity of the special senses. In medicinal doses it usually produces no definite and direct effects upon healthy persons, or only a slight formication of the skin and a transient rigidity of the lower jaw and limbs, but in recently paralyzed parts the same doses may excite spasm. Like many medicines which act upon the nervous system, strychnine readily induces tolerance, so that enormous doses of it may be taken without evidences of poisoning. But, on the other hand, extremely minute doses sometimes develop the toxical effects of the preparation.

As experiments upon animals demonstrate, strychnine is absorbed by the veins and the lymphatics and when introduced into the connective tissue or the serous cavities; it is said to be more readily absorbed from the rectum than from the stomach, and but little from the urinary bladder. By the stomach it is, like other soluble substances, much more readily absorbed when in solution than in the solid state. If taken mixed with the food or immediately after a meal, and especially a meal of fatty substances, its action may be greatly retarded, and hence even excessive doses may under such circumstances fail to act poisonously. In like manner, if the food contain a large proportion of tannin, an insoluble tannate of strychnine will be formed and the action of the poison mitigated or prevented. As a general rule, the more rudimentary or the more feeble the nervous system is, the more readily it is acted upon by strychnine; thus females and children are disproportionately affected by it, notwithstanding the rapidity with which it is eliminated with the urine of the latter. On the other hand, old persons are very susceptibls to the action of small doses, perhaps because the medicine is in them slowly excreted by the kidneys. It would appear that sleep retards the poisonous action of the medicine; it, at all events, restrains an open manifestation of it by spasm, etc., just as perfect repose in man or animals under the toxical operations of the drug tends to prevents spasm, while excitement is apt to develop or to aggravate it. Active disease of the central portions of the brain or of the spinal cord induces an exaggerated morbid action under the administration of strychnine, but old paralytic disorders are not affected by it. It aggravates the functional disturbances of tetanus.

When strychnine acts poisonously but gradually, owing to the moderate dose taken or to its slow absorption from the stomach, the patient complains first of general uneasiness, restlessness, soreness and heaviness of the limbs, and stiffness of the joints and muscles, particularly of those of the chest and lower jaw; and these effects are succeeded by spasmodic symptoms. When the dose has been large and the conditions are favorable to its rapid absorption, the phenomena may be clonic convulsions or violent muscular twitchings, which, with the accompanying sensation, have been compared to the effects of an electric shock. Whether rapid or slow in their access, these phenomena are excited and intensified by all external stimuli. They are succeeded by tetanic muscular spasms, during which the arms are rigidly bent and the legs extended, the hands being clenched and the feet extended and arched, the lower jaw firmly fixed against the upper, and the body arched forward. The rigid contraction of the respiratory muscles renders breathing laborious or even temporarily suspends it, and, as a consequence of the immobility of the chest, the blood accumulates in the veins and gives a livid color to the skin. The pulse is rapid and unequal both in volume and force, and the heart-beat is also rapid and fluttering. The retracted corners of the mouth disclose the set teeth, and foam issues from between them, while the staring eyes with dilated pupils and the contracted brows give to the countenance an expression of anguish mingled with fright. The mind generally remains unaffected, and pain is not often complained of. The convulsions may be altogether tonic, and so continue without interruption until death, but more usually they are clonic also, and are interrupted by intervals of calm, or rather of exhaustion. But during such intervals the slightest stimulus may suddenly renew them, but superficial contact rather than firm pressure. Generally the spasms grow less violent, but not so the disorder of the circulation and the exhaustion of muscular power; they become more and more marked until death, which may be due immediately to asphyxia or to asthenia, according as life terminates during a paroxysm or not.

In fatal poisoning by strychnine death may take place within five minutes, and is hardly ever delayed more than five or six hours. Even when poisonous doses are not followed by death, their effects may continue to be observed in extreme fatigue and exhaustion, paralysis of the bladder, and sometimes muscular stiffness and neuralgic pains of several days' duration.

The smallest fatal dose of nux vomica on record is said to have been 3 grains of the alcoholic extract and of strychnine taken by an adult $\frac{1}{12}$ grain (Husemann). Taylor, however, says: "A fatal dose of strychnine for an adult may be assigned at from ½ grain to 2 grains." A child between two and three years of age died in four hours from taking $\frac{1}{16}$ grain of strychnine. On the other hand, recovery has taken place after the ingestion of 3, 4, and even 7 or 8 grains, and in one case 8 grains of nitrate of strychnine and 12 grains of the pure alkaloid were taken without fatal effect. In the last instance the poison was suspended in bitter-almond water holding in solution 10 grains of acetate of morphine, and swallowed after a meal consisting of porridge and cranberries; chloroform also was inhaled. The natural effects of the strychnine seem to have been prevented by the mass of food in the stomach, by the precipitation of the strychnine as an insoluble tannate formed with it by the tannic acid of the cranberries, and finally by the antagonistic action of the hydrocyanic acid and the morphine (Tschepke, *Deutsche Klinik*, No. 10, 1861). The mode of access and the course of the symptoms are not always the same; *e. g.* muscular rigidity may first be felt in the spine and attended with neuralgic pains of the trunk or limbs, or the attack may commence abruptly with shrieks as of pain or alarm, or it may set in with giddiness, insensibility, or clonic convulsions, or, again, among the earliest symptoms vomiting may occur.

After death caused by strychnine cadaveric rigidity is usually marked with opisthotonos, clenching of the hands, and flexion of the arms across the chest. The face is usually pale, but sometimes livid. The muscles are rigid, and all the internal organs are gorged with dark blood, the cerebral and spinal membranes not more so nor more uniformly than the rest; the latter may contain a serous effusion; the heart may either be contracted, dilated, or natural. The urinary bladder is generally contracted. It is remarkable that the muscular rigidity may persist for months after death. These lesions indicate the effects rather than the mechanism of strychnine-poisoning. But they agree with the symptoms in showing that the cause of death by this poison is primarily asphyxia produced by rigidity of the muscles of respiration. This view does not exclude, as a possible factor in producing the result, exhaustion of the heart or spasm of that organ.

Medical Uses.—Strychnine was first employed medicinally in the treatment of *paralysis*, and continues to be used for this affection more than for any other. But it is not equally beneficial in all forms of the disease. As already stated, it is apt to aggravate those paralyses which depend upon a recent central lesion, but it is appropriate in the same cases when the acute stage has passed and the symptoms remain stationary. In such cases the paralyzed muscles are the first to exhibit the specific action of the medicine. It is now demonstrated, as it was long ago observed, that strychnine is most efficient in the cure of functional paralyses, whether depending directly upon anæmia of the spinal cord or upon general exhaustion. Such are cases due to venereal excesses, hysteria, intense mental emotion, concussion of the spinal marrow, abuse of opium or alcohol, lead-poisoning, gout, rheumatism, etc. It is claimed by some (Jewell, *Practitioner*, xxvii. 377) that even in advanced *myelitis* this medicine will cause improvement after the failure of other remedies. Contrary to what would have been expected on theoretical grounds, the efficient doses were large. *Diphtherial paralysis* is, more than any other form, benefited by strychnine, whose special stimulus co-operates with that of electricity, mechanical excitants, tonics, nutrients, etc. The semi-paralytic condition sometimes induced by the *bromides* is benefited by this medicine. It is less necessary, yet of very great utility, in *paralysis from lead*. *An ecbolic* action has been ascribed to strychnine on the ground of its having seemed to produce tonic contractions of the uterus and premature delivery of a woman in the eighth month of pregnancy (Lewis Smith, *Med. Record*, xviii. 578).

Although physiological experiments do not lead to the suggestion that strychnine acts upon the peripheral ends of nerves, clinical observation, as in so many other cases, is supposed to have demonstrated what the former method has failed to show. For more than forty years strychnine has been well known to be efficacious in cases of *amaurosis* when applied endermically around the orbit; more recently it has been used by friction and hypodermically, by the instillation of dissolved strychnine in the eye, and also internally. These methods have greatly ameliorated and often cured the disease, not only in cases of purely functional disorder, but of a greater or less alteration of the retina as revealed by the ophthalmoscope. Inflammatory affections of the eye in their active stage are unsuitable for this medication, and so is impairment of vision depending upon intracranial causes, but it is often useful in disorders of accommodation. The greater number of ophthalmic surgeons insist upon the application of the medicine to the neighborhood of the eye, but others admit that it is equally efficacious wherever introduced. The latter are probably right. It has been employed with marked success in *night-blindness*.

Nux vomica and also strychnine have been used with unquestionably good results for the cure of *prolapsus of the rectum* by enema, by hypodermic injection (Weber, *Med. Record*, xviii. 682), and by their application to the blistered skin. *Paralysis of the bladder*, occasioning either retention or incontinence of urine, and the latter affection in the form of *nocturnal incontinence* in children, has frequently been cured by the use of strychnine by the mouth, sometimes by injecting a solution of it into the bladder, and again by the hypodermic injection of nitrate of strychnine. *Sexual impotence* is often diminished or even cured by this medicine when it depends upon asthenia of the spinal cord or upon general debility. Generally, however, it should form only one element of a complex treatment adapted to the peculiarities of each case. Saccharine *diabetes* is alleged to have been cured by nux vomica (*Practitioner*. xxiii. 51); and Brunton claims that it will control the *night-sweats* of phthisis (*St. Bart's Rep.*, xv. 119).

Among spasmodic diseases *tetanus* has been cured by strychnine, contrary to all expectations founded upon the accepted mode of action of the medicine; nevertheless, the method has found few imitators. The same remark is nearly as applicable to *chorea*, and also to *epilepsy;* but in regard to both diseases it may be observed that where the patients are extremely feeble, excitable, and timid, this medicine may well form part of the general plan of tonic treatment which is then indicated, and which includes the administration of quinine and iron. A like statement may also be made respecting various local *spasms*, as that of the *œsophagus*, *facial tic*, etc. It is said that *writer's cramp* has been cured by the hypodermic use of strychnine, and the *vomiting of pregnancy* by its internal use. It is alleged that the medicine has the power of arresting the development and preventing the usual effects of *alcoholic intoxication* (Luton, *Bull. de thérap.*, xcix. 241; cii. 473; Dujardin-Beaumetz, *Ibid.*, cvi. 1). These physicians have not feared to use hypodermic injections of 5 Mgm. or gr. $\frac{1}{12}$ in cases of *delirium tremens* and *mania-à-potu*, without adverting to the fact that the affections in question terminate spontaneously in cure in nearly all uncomplicated instances if treated with exercise and well-seasoned food. It is one of the numerous remedies which have seemed to moderate *hay fever*. It has been known to cure facial *neuralgia*, *lead colic*, *dysmenorrhœa*, etc., but its efficacy is too inconstant to inspire confidence. There is one form of neuralgia, *gastralgia*, in which it is often of signal benefit, doubtless more by its power as a bitter tonic than as a nervine. The cases in which it is most useful are those in which the gastralgia is associated with gastrodynia attended by flatulent dyspepsia, eructations, and sometimes vomiting of food, along with habitual constipation. In some of these cases strychnine, or, still better, nux vomica, should be combined with antacids and stimulant carminatives. It is, on the whole, best suited to combat the element gastric debility, with whatever symptoms that condition may be associated. Its tonic action upon the intestine renders nux vomica and strychnine appropriate remedies for *constipation* depending upon atony of the bowel. But for this purpose it should be prescribed in small doses taken immediately after meals, or should be associated with aloes, rhubarb, and soap, or with the first only, in a pill, which is most conveniently taken at bedtime. A similar mode of action makes it one of the best remedies for the so-called *spasmodic obstruction* of the bowel, which is really, in most cases, constipation with fecal accumulations at one part of the intestine and flatulent distension at another. *Tympanites* from intestinal debility is favorably influenced by this medicine, especially if associated with lime-water or some anti-fermentative, as salicylic acid. On the other hand, *chronic diarrhœa* and *dysentery*, affections in which the discharges are apt to be prolonged by the exhausted state of the bowel, are often benefited by nux vomica or strychnine. The latter is alleged to have been found useful in *epidemic cholera*. It is also reported to act as a *vermifuge*. Finally, it has been used with alleged benefit in various forms of *dyspnœa* depending upon pulmonary and cardiac obstruction, including *emphysema*, *bronchitis*, and, along with digitalis, in cases of *fatty heart* (Fothergill).

Administration.—The first dose of strychnine should not be greater than from $\frac{1}{20}$ to $\frac{1}{12}$ grain (Gm. 0.003–0.005); as a general rule, it is better to begin with $\frac{1}{30}$ grain (Gm. 0.002), and cautiously increase the dose until a slight manifestation of its specific effects occurs or until the object of its administration is attained. It is usually prescribed in pills of bread-crumb or of confection of roses, care being taken to mix the mass thoroughly and divide it accurately. A convenient form, which its bitterness alone renders objectionable, is to dissolve 1 grain of strychnine in 2 fluidrachms (Gm. 0.06 in Gm. 8) of rectified spirit with the aid of 2 minims of sulphuric, acetic, or muriatic acid, so that every 10 minims of the solution shall contain gr. $\frac{1}{12}$ (Gm. 0.005) of the salt of strychnine. For hypodermic injection a solution of 4 grains of sulphate or muriate of strychnine in a fluidounce of water is used (Gm. 0.26 in Gm. 32). Each minim contains the $\frac{1}{120}$ grain (Gm. 0.0005) of the salt. 2 minims or $\frac{1}{60}$ grain (Gm. 0.001) of strychnine may be used as a primary dose. In all cases in which strychnine is used the modifying operation of idiosyncrasies and of the existing disease must be regarded.

Treatment of Poisoning by Strychnine: As in the case of other poisons taken into the stomach, so in poisoning by strychnine, free vomiting should be produced by mustard and warm water, or, as has been found successful in one case, by the hypodermic injection of $\frac{1}{3}$ grain (Gm. 0.02) of apomorphine, after which the bowels should be purged with castor oil, croton oil, or a saline laxative. When asphyxia threatens, artificial respiration should be resorted to. As mechanical antidotes which retard the absorption of the poison, lard, sweet oil, and milk have been used with apparent success immediately after the poison was taken and before its spasmodic action had been developed. Animal *charcoal*, and also *tannin*, have been used with the same view. Of the other alleged antidotes, all are more or less sedatives of the nervous system, and therefore antagonists of the spasm produced by the poison. The first of these is the medicine which has been so much employed in the treatment of tetanus, *opium*, or *morphine*, and from which, *a priori*, so much was to be expected. But experimentally and clinically the expectation has proved to be unfounded. Opium and its salts are useless in strychnine-poisoning, however efficient they may be in relieving the symptoms produced by the alkaloid when its medicinal operation is but slightly exceeded, or in delaying the absorption of the poison, and therefore the manifestation of its symptoms. *Aconitine* and *woorara* are also regarded as physiological antidotes to strychnine, but we are unacquainted with any instances of their use as such in human poisoning. The same remark applies to *prussic acid*. Moreover, the physiological antagonism of woorara and strychnine has been denied by Vulpian, Brown-Séquard, and others. *Camphor*, internally, is said to have arrested the toxical symptoms. There is more evidence in favor of *chloroform*, which unquestionably has in several cases controlled the spasm and apparently prevented death, while in others it has rendered the phenomena of death less distressing. The antagonism shown by experiments upon animals to exist between *chloral* and strychnine is more or less exhibited in cases of poisoning by the latter. Chloral counteracts the spasmodic effects of strychnine, and thus conserves force, while it gains time for the elimination of the poison. In the case of a woman who had taken 40 Cgm. of strychnine (gr. vi.) recovery ultimately took place, and was evidently due to the administration of chloral by the mouth and rectum and hypodermically (Faucon, *Archives gén.*, Jan. 1883, p. 74). Another case, in which the estimated dose of the poison was 5 grains, recovered after the use of chloral hydrate, but apparently in doses quite inadequate to control the action of the strychnine (*Boston Med. and Surg. Jour.*, July, 1881, p. 8). Two cases are reported by Moore (*Med. News*, xli. 566), the one illustrating the virtues of strychnine in chloral-poisoning, and the other (in a dog) of chloral in poisoning by strychnine. (On the relations between the two agents see Husemann, etc., *Amer. Jour. of Med. Sci.*, Apr. 1882, p. 608.) *Nitrite of amyl*, which appears to be more or less antidotal to strychnine in dogs and frogs, does not seem to have been sufficiently tested in poisoning by this substance in man. *Bromide of potassium* is credited with several striking cures of strychnine-poisoning. In three of them the doses of strychnine were very large and the effects characteristic; but repeated doses of the bromide, varying in their totality from 80 grains to $\frac{1}{2}$ ounce (Gm. 5–16), saved the patients. Experiments on animals demonstrate the power of the bromide to prevent or mitigate strychnine spasms. In several cases the bromide has been associated with chloral (*Med. Record*, xix. 208), but the experiments of Husemann (1880) seem to show that the former medicine was superfluous (*Bull. de thér.*, xcix. 429). *Calabar bean* and strychnine appear to be truly antagonistic, in that the one counteracts the operation of the other, provided that their doses and the time of their administration be duly adjusted. But there is great danger that death by asphyxia may be escaped only by encountering the risk of death from exhaustion. In two cases which terminated favorably this untoward result was prevented by the use of stimulants internally and externally. In one of these cases $\frac{3}{4}$ grain (Gm. 0.05) of the extract of physostigma was exhibited three times within an hour, and in the other case 1 grain (Gm. 0.06) in a single dose. These conclusions concerning the efficiency of chloroform, chloral, bromide of potassium, and physostigma have been experimentally confirmed by Husemann (1878). *Tobacco* and *nicotine* have been employed experimentally as antidotes to strychnine, and, on the whole, with not unfavorable results. Whether or not they may be so regarded in a physiological sense, matters little, provided that they save lives which would otherwise be lost. That tobacco has done so is proved by at least four recorded cases. Possibly it may have acted in part by hastening the elimination of the poison with the urine. The uncertainty and possible danger of these antidotes should exclude them when chloral can be obtained. *Belladonna* and *atropine* have also been suggested as antidotes to strychnine, and a case is recorded in which, atropine having been injected subcutaneously, the patient recovered. $\frac{1}{6}$ grain (Gm. 0.01) was thus used three times at intervals of ten minutes. In two more recent cases recovery was attributed to the administration of atropine (*Phila. Med. Times*, x. 323).

STYRAX, *U. S.*—STORAX.

Styrax præparatus, Br.; *Styrax liquidus*, P. G.; *Balsamum styracis.*—*Liquid storax*, E.; *Styrax liquide*, Fr.; *Flüssiger Storax*, G.

A balsam prepared from the bark of Liquidambar orientalis, *Miller*, s. L. imberbe, *Aiton.* Bentley and Trimen, *Med. Plants*, 107.

Nat. Ord.—Hamamelaceæ, Balsamifluæ.

Origin.—The tree yielding liquid storax closely resembles the sweet-gum tree of North America (see p. 890), from which it differs in having smooth leaves with obtuse, often three-lobed, and finely serrulate lobes, and in producing smaller heads of fruit. It has been found only in the south-western part of Asia Minor, where it forms forests.

Production.—The extraction of liquid storax was described by Hanbury (1857) from accounts received from S. H. Maltass and Lieut. Robert Campbell. The outer bark is stripped off on one side of the tree, made into bundles, and reserved for the purpose of fumigation. The inner bark is then scraped off with a semicircular or sickle-shaped knife, and thrown into pits until a sufficient quantity has been collected. It is then boiled in water, upon which the resinous matter comes to the surface, and is skimmed off. The boiled bark is next put into hair-sacks and pressed, boiling water being added to assist in the extraction of the resin, or, as it is termed, *yagh*—*i. e.* oil. According to Maltass, the fresh bark is pressed in strong horsehair bags by means of a wooden lever press, hot water being afterward thrown over the bags, and these subjected to pressure a second time. Dr. McGrath states that the storax is chiefly collected by a tribe of wandering Turcomans called *Yuruks*, and that the liquid resin, separated from the bark by boiling and pressure, is run into barrels.

Description.—Liquid storax has the consistence of thick honey, and is sticky, opaque, and of a gray color, caused by the water which is diffused through it. By long standing it separates a heavier dark-brown (in thin layers transparent) stratum. When heated it becomes thinner and more transparent, the water separating slowly, and when ignited it burns with a bright sooty flame. It becomes harder by age and on exposure, is heavier than water, and has a strong agreeable odor, somewhat resembling that of vanilla. Its taste is pungently balsamic. With the exception of the water and the impurities contained in it, storax dissolves in alcohol, ether, chloroform, and most of the volatile oils. With an equal weight of warm alcohol it yields a turbid gray-brown solution having an acid reaction; when cooled and filtered the solution, on evaporation, yields not less than 70 per cent. of the weight of the balsam in the form of a brown semi-liquid residue, which deposits crystals only after a long time, and which, with the exception of a few floccules, is completely soluble in ether and in carbon disulphide (*U. S.*, *P. G.*). It is insoluble in cold petroleum benzin, but dissolves partly in it while hot, the colorless solution depositing crystals of cinnamic acid and styracin on cooling. Examined under the microscope, storax is seen to consist of minute globules, intermixed with larger drops of water and with tabular crystals of cinnamic acid, and when left on the object-glass feathery crystals of styracin make their appearance.

STYRAX PRÆPARATUS, *Br.*, is storax purified by melting and straining (*F. Cod.*), or by dissolving in rectified spirit (benzol, *P. G.*), filtering, and evaporating the solvent. It has a brown-yellow color, is semi-transparent or transparent in thin layers, and otherwise resembles the crude balsam.

Constituents.—E. Simon (1839) obtained from this balsam styrol, cinnamic acid, styracin, and two resins. In addition to these, W. von Miller (1876–77) found a little benzoic acid, cinnamic ethyl, and a fragrant compound melting at 65° C. (149° F.), probably ethyl vanillin; in larger proportion were found the alcohol storesin in two modifications—the cinnamic ether of this alcohol and cinnamate of phenylpropyl. *Styrol* or *cinnamene* has the composition C_8H_8, and is obtained by distilling storax with water. The yield is very variable. It is a colorless, thin liquid, very refractive to light, and of a very fragrant odor and burning taste. It has been artificially obtained by heating acetylene gas, and from ethyl-benzol bromide by heating it with baryta. Its specific gravity is

0.924, and it boils at 146° C. (294.8° F.); but when heated to 200° C. (392° F.) it is rapidly converted into a polymeric compound, *metacinnamene*, which is a colorless, amorphous, tough solid of the specific gravity 1.054, insoluble in alcohol and ether, and reconverted into styrol when distilled. *Cinnamic acid* (see page 1055) may be obtained by treating storax with a solution of sodium carbonate and precipitating the acid by means of hydrochloric acid. The ethers are obtained from storax previously deprived of cinnamic acid by treating it with hot petroleum benzin, on the cooling of which white or colorless needles are deposited which require repeated treatment with hot benzin. *Styracin* melts at 38° C. (100.4° F.), and after prolonged heating congeals to a transparent mass, in which crystals are formed very slowly. It is *styryl* (*cinnamyl*) *cinnamate*, $C_9H_9.C_9H_7O_2$, and when in alcoholic solution treated with caustic soda, or when heated with an aqueous solution of soda, is converted into cinnamate of sodium and *cinnam-alcohol*, also known as *styryl alcohol* and *styron*, $C_9H_{10}O$. This crystallizes in colorless silky needles, has an agreeable hyacinthine odor, melts at 33° C. (91.4° F.), and boils at 250° C. (482° F.). Styracin and cinnamic acid yield with oxidizing agents oil of bitter almonds and benzoic acid, and when styrol is treated with chromic acid and then boiled with water benzoic acid is obtained. After saponifying storax with an alkali, and subjecting the alcohols to fractional distillation, Laubenheimer (1872) obtained a distillate having the properties of *benzyl alcohol;* this is a colorless liquid of a weak but fragrant odor, having the specific gravity 1.06 and the composition C_7H_8O. *Storesin*, $C_{36}H_{58}O_3$, is amorphous, melts at 168° C. (β storesin at 145° C.), and dissolves readily in alcohol, ether, petroleum benzin, and potassa, forming with the latter a crystalline compound. Mylius (1882) prepared *styrogenin*, $C_{26}H_{40}O_3$, from that portion of storax which is soluble in boiling benzin; after treating it with an equal weight of sulphuric acid, boiling with water, and washing with ether, white crystals are left which are easily soluble in chloroform, melt at 350° C., dissolve in cold sulphuric acid, being reprecipitated by water, and yield with warm sulphuric acid a yellowish-red solution, which with water precipitates uncrystallizable resin.

Commercial storax contains from 10 to 20 per cent. of water and from 13 to 18 per cent. of fragments of bark and inorganic impurities (*Pharmacographia*).

Adulterations.—Storax is said to be sometimes adulterated with turpentine. Hager (1874) proposed to detect the adulteration by dissolving the storax in a little warm alcohol and exhausting it with petroleum benzin by agitation. On evaporating the benzin solution the residue should have a bluish opalescence and an agreeable odor, while if turpentine be present the color will be yellowish and the odor of turpentine will be apparent.

Allied Products.—CORTEX THYMIAMATIS. This is the bark from which storax has been obtained. It is in brown foliaceous cakes, consisting of thin pieces of bark and having the odor of storax.

STYRAX CALAMITA. As now found in the market, it consists of sawdust mixed with liquid storax, and contains numerous minute crystals of styracin. The drug known by this name in ancient times and during the last century was a solid balsamic resin, most likely obtained from Styrax officinale, *Linné*, which is indigenous to Western Asia and South-eastern Europe. This is no longer an article of commerce.

Off. Prep.—Tinct. benzoini comp., *U. S.*, *Br.*

History.—The tree from which storax is derived being indigenous to the countries bordering on the Levant, its juice attracted attention from an early period. The storax of Celsus, Pliny, Galen, and Paulus Ægineta is taken to be a solid resin; it was classed by them with the aromatics and balsams, particularly with myrrh, frankincense, and galbanum, and they attributed to it stimulant, cleansing, astringent, and discutient properties, and stated that it was used medicinally in the treatment of coughs, catarrhs, defluxions, and menstrual disorders. But Dioscorides, who was a contemporary of Celsus, states expressly that one variety of storax was liquid, although it is not clear that it was so in its natural condition. The true styrax, or liquidambar, is said to have been first described by Aëtius and by Paulus Ægineta in the sixth and seventh centuries respectively. In the thirteenth century Ebn Baithar stated, on the authority of Hobaisch, that storax is useful for pains in the chest and coughs and for catarrhs, that it controls diarrhœa and flatulence, that externally it is of special service in the treatment of ulcers, and that when mixed with oil it cures the itch and both moist and dry eruptions of the skin.

Medical Action and Uses.—The medicinal action and uses of this substance are almost identical with those of copaiba, like which it was formerly employed in the treatment of chronic catarrhs, particularly of the lungs, but also to some extent in similar affections of the digestive and urinary organs, and especially in *gonorrhœa*. It has been highly recommended as a dressing for ulcers following *frost-bite.* Within a few years its use as a remedy for *scabies* has been revived. As of old, it is mixed with olive oil for this purpose; a mixture of 1 part of storax with 2 or 3 parts of oil is rubbed diligently into the affected parts, and in the course of 12 hours a warm bath with soap is used, after which the skin is again covered with the liniment. This treatment generally suffices for a cure in nearly all of the cases. It is convenient for its cheapness, as well as for its acceptableness, particularly when balsam of Peru is added to the storax in the proportion of about one-fourth. The latter ingredient improves the odor of the mixture. Of 124 cases of itch treated by Unna with styrax frictions, nine are said to have had albuminous urine during or immediately after the treatment, the albumen varying in proportion from one-tenth to one-half. On the successive application of heat and nitric acid the precipitate was apparently albuminous; but the counter-proof of attempting its solution with alcohol, which would have dissolved a possible resinous deposit, does not seem to have been tried. (Compare *Virchow's Archiv.*, lxxiv. 424, and Lassar, *ibid.*, lxxvii. 558.) The following formula is recommended as more efficient than the mixture described above: ℞. Liquid storax ℥j; Alcohol fʒij; Olive oil fʒj.—M. S.—For two frictions. The *dose* of storax internally is from 10 to 20 grains (Gm. 0.60–1.30).

Styracin, or *styrone*, is said to be an antiseptic and deodorizer. When pure it is slightly irritating to raw surfaces, but dissolved in 6 parts of oil or water it is no longer so. 1 part in 12 forms a convenient solution for an antiseptic dressing (*Boston Med. and Surg. Jour.*, Mar. 1880, p. 249).

SUCCI.—JUICES.

Sucs végétaux, Fr.; *Pflanzensäfte*, G.

These preparations are made by bruising the fresh drugs, expressing them forcibly, and mixing the expressed juices with a definite proportion of alcohol for preservation. They must necessarily vary in the amount of their active constituents, and perhaps more so than the dried and carefully-preserved drugs. They have been dismissed from the U. S. P., and tinctures of fresh herbs admitted in place thereof. (See TINCTURÆ HERBARUM RECENTIUM.)

SUCCUS BELLADONNÆ, *Br.*—JUICE OF BELLADONNA.

Suc de belladone, Fr.; *Belladonnasaft*, G.

Preparation.—Take of fresh leaves and young branches of Belladonna 7 pounds; Rectified Spirit a sufficiency. Bruise the belladonna in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of the spirit. Set aside for 7 days, and filter. Keep it in a cool place.—*Br.*

Medical Uses.—The *dose* of this preparation is from 5 to 15 minims (Gm. 0.30–1).

SUCCUS CONII, *Br.*—JUICE OF CONIUM.

Juice of hemlock, E.; *Suc de grande ciguë*, Fr.; *Schierlingsaft*, G.

Preparation.—Bruise fresh Conium-Leaves, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside the liquid for 7 days, and filter. Keep it in a cool place.—*Br.*

Medical Uses.—The *dose* of juice of hemlock is stated at from ½ to 1 fluiddrachm (Gm. 2–4), but the characteristic effects of the drug are not manifested in the slightest degree by doses of less than 2 drachms (Gm. 8), and ordinarily they are not well marked by less doses than ½ ounce (Gm. 16). Doses of 1, 2, or even 4 ounces (Gm. 64–128), have been given without occasioning alarming symptoms. But in whatever dose the medicine is administered, it should not be increased beyond the point at which it begins to render deglutition and voluntary movement imperfect. This preparation is relatively less powerful in children than in adults.

SUCCUS HYOSCYAMI, *Br.*—JUICE OF HYOSCYAMUS.

Suc de jusquiame, Fr.; *Bilsensaft*, G.

Preparation.—Bruise fresh leaves and young branches of Hyoscyamus in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside for 7 days, and filter. Keep it in a cool place.—*Br.*

Medical Uses.—The *dose* is from ½ to 1 fluidrachm (Gm. 2–4).

SUCCUS SCOPARII, *Br.*—JUICE OF BROOM.

Suc de genêt à balais, Fr.; *Besenginstersaft*, G.

Preparation.—Bruise fresh Broom-Tops in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside for 7 days, and filter. Keep in a cool place.—*Br.*

Medical Uses.—This juice may be prescribed in *doses* of 1 or 2 fluidrachms (Gm. 4–8).

SUCCUS TARAXACI, *Br.*—JUICE OF DANDELION.

Suc de pissenlit, Fr.; *Löwenzahnsaft*, G.

Preparation.—Bruise fresh Dandelion in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside the liquid for 7 days, and filter. Keep it in a cool place.—*Br.*

Medical Uses.—This preparation is a convenient form for the administration of dandelion, but it may be surmised that even the small proportion of alcohol which it contains may impair its virtues in those hepatic derangements for which dandelion is a reputed remedy. The *dose* is from 2 to 4 fluidrachms (Gm. 8–16).

SULPHUR, *U. S., Br., P. G.*—SULPHUR.

Soufre, Fr.; *Schwefel*, G.

Symbol S. Atomicity bivalent, quadrivalent, and sexivalent. Atomic weight 32.

Officinal Forms of Sulphur.—1. SULPHUR (SULFUR) SUBLIMATUM, *U. S.*, *Br.*, *P. G.;* Flores sulphuris.—Sublimed sulphur, Flowers of sulphur, *E.;* Soufre sublimé, Fleur (Crême) de soufre, *Fr.;* Schwefelblumen, Schwefelblüthe, *G.*—Sulphur sublimed and condensed in powder.

2. SULPHUR LOTUM, *U. S.;* Sulfur depuratum, s. Flores sulfuris loti, *P. G.*—Washed sulphur, *E.;* Soufre lavé, *Fr.;* Gereinigter Schwefel, *G.*—Sublimed sulphur thoroughly washed with water.

3. SULPHUR (SULFUR) PRÆCIPITATUM, *U. S.*, *Br.*, *P. G.;* Lac (Magisterium) sulphuris. —Precipitated sulphur, Milk of sulphur, *E.;* Soufre précipité, Magistère (Lait) de soufre, *Fr.;* Schwefelmilch, *G.*

Origin.—Sulphur is a constituent of the volatile oils of mustard, garlic, and asafetida, and of albumen and other proteids. It is found in many mineral waters as sulphuretted hydrogen and in the form of sulphates, and is widely distributed in the mineral kingdom in combination with metals, forming iron pyrites, FeS_2, galena, PbS, blende, ZnS, black antimony, Sb_2S_3, cinnabar, HgS, and other sulphides, and as sulphate in gypsum, heavy spar, and many other minerals. But sulphur is most abundantly obtained from *native sulphur*, which is found in volcanic countries. Beds of native sulphur have been discovered in California, Nevada, Utah, and other parts of the Western United States, in Mexico, the West Indies, etc.; the chief supply of sulphur, however, comes from Italy, where extensive beds are worked near Latera and Scrofano, and from the provinces of Girgenti, Caltanisetta, Catania, and Palermo in the island of Sicily. Sulphur-beds on the surface of the earth are called *solfatare*, and when they are found underground are known as *solfare*. The latter are the most important, and yield nearly the whole of the commercial sulphur.

Extraction and Purification.—Sulphur is obtained in Sicily by melting it from the mineral in semicircular pits called *calcaroni*, which have a diameter of about 30 feet and a depth of about 8 feet, and are internally covered with a layer of gypsum. The bottom is inclined toward one side, which has an opening, closed during the operation with a thin wall of gypsum. The pit is filled with the mineral, and this is heaped up above so as to form an obtuse cone, the whole being covered first with a layer of powdered sulphur ore, and finally with a stratum of spent ore in powder. Fire is now applied to the heap, and after an hour all openings are closed until, after about nine days, the melted sulphur begins to collect on the floor of the pit. Through a small opening made into the gypsum wall the melted sulphur is removed two or three times a day and run into moistened moulds made of poplar wood, where it solidifies in the form of blunt pyramids, in which condition it enters commerce. The *rough sulphur* thus obtained contains from 3 to 4 parts of earthy impurities, which are removed by distilling the sulphur from iron retorts and conducting the vapors into large brick chambers, where they condense in the form of a fine powder, which is from time to time removed before the condensing-chamber becomes too hot, and constitutes *sublimed sulphur.* If, however, the operation is not interrupted, the brick walls of the chamber become hot enough to melt the sulphur, which is run into wooden moulds. The cylindrical pieces thus obtained enter commerce as *brimstone* or *roll sulphur.*

In Nevada the sulphur ore is placed in upright cast-iron retorts, in shape resembling a blast-furnace; superheated steam is admitted and the pressure raised to about 70 pounds to the square inch; the pressure is slowly reduced to 50 pounds as the melted sulphur flows through a grate into a receiving-pan, where mechanical impurities are allowed to subside, the sulphur being run into large cylindrical moulds, and after cooling broken into irregular lumps before it is refined.

Sulphur is also obtained from pyrites by a process of roasting in heaps or in suitable furnaces built for the purpose, a portion of the sulphur being burned in the operation.

In 1877 the United States imported 96,236,448 pounds of crude sulphur, 2,622,600 pounds of roll sulphur, and 260,600 pounds of sublimed sulphur; and in 1883 respectively 211,769,600 pounds, 258,340 pounds, and 177,250 pounds.

Preparation.—SUBLIMED SULPHUR. The process by which this is procured has been described above. The other officinal forms of sulphur are prepared as follows:

WASHED SULPHUR. Sublimed sulphur 12 parts (24 oz. av.); water of ammonia 1 part (2 oz. av. or 2 fluidounces); water a sufficient quantity. Add the sulphur to 12 parts (24 oz. av. or 23 fluidounces) of water previously mixed with the water of ammonia, and digest for 3 days, agitating occasionally. Then add 12 parts (24 oz. av.) of water, transfer the mixture to a muslin strainer, and wash the sulphur with water until the liquid running from the strainer ceases to produce a precipitate in test solution of chloride of barium. Then allow it to drain, press the residue strongly, dry it at a very gentle heat, and pass it through a No. 30 sieve.—*U. S.* The P. G. orders for 10 parts of sublimed sulphur 7 parts of water and 1 part of ammonia-water, the mixture to be macerated for a day. Prolonged digestion is unnecessary for the removal of the free acid, but it is important that after thorough washing the sulphur be well dried to prevent its slow oxidation.

PRECIPITATED SULPHUR. Sublimed sulphur 100 parts (2 pounds av.); lime 50 parts (1 pound av.); hydrochloric acid, water, each a sufficient quantity. Slake the lime, and make it into a uniform mixture with 500 parts (10 pounds or 9½ pints) of water. Add the sulphur, previously well dried and sifted, mix well, add 1000 parts (20 pounds or 19 pints) of water, and heat the mixture to boiling over a fire for 1 hour, stirring constantly and replacing the water lost by evaporation. Then cover the vessel, allow the contents to cool, pour off the clear solution, filter the remainder, and to the united liquids add, gradually, hydrochloric acid previously diluted with an equal volume of water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction. Collect the precipitate on a strainer, and wash it with water until the washings are tasteless. Then dry it with a gentle heat. —*U. S.*

The British Pharmacopœia uses 5 oz. of sulphur and 3 oz. of slaked lime, but directs the decanted and filtered solution to be mixed with hydrochloric acid until the mixture acquires an acid reaction.

In the processes described hyposulphite and sulphide of calcium are first produced, from which, on the addition of an acid, sulphur is precipitated. Both formulas direct too large a quantity of lime, resulting in a corresponding waste of hydrochloric acid, but the second formula employs nearly the theoretical quantity of sulphur. In order to obtain good results it is advisable to dissolve in the lime as much sulphur as can be taken up, the reaction taking place as follows: $3CaH_2O_2 + 6S_2$ yields $2CaS_5 + CaS_2O_3 + 3H_2O$. Therefore, 168 parts of burned lime or 222 parts of slaked lime require 384 parts of sulphur, or 50 parts of the calcium compounds need respectively 115 and 87 parts of sulphur. It is, however, advisable to employ an excess of sulphur, the undissolved portion of which may be utilized in a subsequent operation; for 1 pound of lime 2⅜ or 2½ pounds, and for 1 pound of slaked lime 1¾ pounds, of sulphur should be used. The resulting liquid has a dark orange-red color. Diluted hydrochloric acid should now be added in a thin stream and with continued stirring, when the calcium pentasulphide will be decomposed, calcium chloride remaining in solution, while sulphur is precipitated and hydrosulphuric acid is liberated, which should be carried off through a chimney. This reaction occurs according to the equation $2CaS_5 + 4HCl = 2CaCl_2 + 4S_2 + 2H_2S$. If the acid be added with the precaution that the liquid retains its alkaline reaction, calcium sulphydrate, $Ca(HS)_2$, will remain in solution, and with it any arsenic which may have been present in the sulphur or in the acid; but in the presence of iron black ferrous sulphide will be precipitated with the sulphur, and impart to it a dark-gray color. The latter impurity may be easily removed by washing first with water, followed by dilute hydrochloric acid, and this again by water.

Operating in this manner, as directed by the U. S. P., the solution will become colorless, but the calcium hyposulphite will not be decomposed. The further addition of acid will decompose this compound, sulphur being liberated, together with sulphur dioxide (sulphurous acid), and the latter, by reacting with the sulphydric acid, will liberate an additional quantity of sulphur, with the formation of water. The result of the entire complicated reaction is expressed by the equation $2CaS_5 + CaS_2O_3 + 6HCl = 6S_2 + 3CaCl_2 + 3H_2O$. It will be observed that by acidulating the solution of lime and sulphur, as directed by the British Pharmacopœia, a larger amount of precipitated sulphur is obtained; but it was shown by Fordos and Gélis (1851), and by Berthelot, that that resulting from the hyposulphite is soft and only partially soluble in carbon disulphide. Arsenic, if present in the lime solution, will separate as yellow sulphide of arsenic. If the hydrochloric acid is replaced by sulphuric acid, the precipitated sulphur is contaminated with calcium sulphate; it has been proposed to restrict the appellation *lac sulphuris* to this preparation, which is often demanded in Great Britain as milk of sulphur.

Properties.—Sulphur exists in several modifications, and is either *crystalline* and soluble in carbon disulphide, *amorphous* and insoluble in the same liquid, or *soft* or *oily* at common temperatures, and either soluble or insoluble in this menstruum. When sulphur is fused and kept near the temperature of 90° C. (194° F.), octahedral or rhombic crystals are formed, fusing at 115° C. (239° F.); but if the crust which forms on cooling is broken and the liquid sulphur poured out, the vessel will afterward be filled with long oblique prisms, which melt to a yellowish liquid at 120° C. (248° F.). On gradually increasing the heat to near 180° C. (356° F.) sulphur becomes brown, and ultimately black, opaque, and very viscid. If the heat be continued, the mass liquefies again at 260° C. (500° F.), and at about 450° C. (842° F.) is converted into orange-brown vapors. On agitating sublimed sulphur with carbon disulphide about two-thirds of it are dissolved, while the remainder is amorphous and remains undissolved. The different varieties of sulphur differ also in specific gravity, that of amorphous and soft sulphur being 1.96, of prismatic sulphur 1.98, and of octahedral sulphur 2.05; this last variety is more stable than the other two, which are under various circumstances converted into it. Heated in the air, sulphur ignites at about 150° C. (302° F.), and burns with a blue flame to sulphurous anhydride or sulphur dioxide, SO_2. This gas always contains a small quantity of the trioxide or sulphuric anhydride, SO_3, according to Lunge and Salathé (1883), if the combustion takes place in dry air, the amount being 2.5 or 2.8 per cent., and the quantity being increased in the presence of ferric oxide. The two oxides named are the only oxygen compounds which have been obtained in the isolated state, though several others are known in combination, of which the most important is hyposulphurous (thiosulphuric) acid. (See SODII HYPOSULPHIS.) The other oxygen compounds of sulphur are as yet only of scientific interest; they are *hydrosulphurous* (H_2SO_2), *dithionic*, *trithionic*, *tetrathionic*, and *pentathionic acids*, and the last four contain, in combination with a bivalent basylous radical, 6 atoms of oxygen, and respectively 2, 3, 4, and 5 atoms of sulphur. These four acids, when liberated from their salts, are readily decomposed into sulphuric and sulphurous acids, the last three separating also sulphur.

Sulphur combines also with most of the non-metallic and metallic elements, forming sulphides, the most important of which to the pharmacist are the sulphides of antimony, mercury, iron, potassium, ammonium, and hydrogen. When treated at an elevated temperature with volatile and fixed oils, it dissolves, and forms with the fats compounds which were formerly known as *balsams of sulphur*. Sulphur is insoluble in water, but dissolves in hot solutions of the fixed alkalies and alkaline earths, forming sulphides, and is somewhat soluble in hot absolute alcohol, ether, chloroform, and benzol, being deposited on cooling in crystals.

SUBLIMED SULPHUR is a yellow or somewhat greenish-yellow, slightly gritty powder, which is free from odor and taste, or generally has a slight sulphurous odor and a faint acidulous taste, and has a slight acid reaction to litmus. To heat and solvents it shows the behavior described above.

WASHED SULPHUR has the same appearance and behavior as the preceding, except that it is entirely inodorous and nearly tasteless, and does not change the color of litmus-paper, which properties are demanded by the Br. P. for its sulphur sublimatum.

PRECIPITATED SULPHUR is a yellowish-white or grayish, very fine powder, free from grittiness and from the odor of sulphuretted hydrogen, and nearly tasteless. When examined under the microscope it is seen to consist of opaque globules which are free from crystalline matter. It is not altered on exposure to air when kept dry, and on fusion it is converted into ordinary sulphur.

Tests.—Water agitated with washed or sublimed sulphur (*U. S.*), or these varieties of sulphur moistened with water (*P. G.*), should not redden blue litmus-paper; the last is the more delicate test. Pure sulphur should completely evaporate by heat, and when ignited in the air should burn without leaving any fixed residue (clay, gypsum, etc.). The pharmacopœias permit a trace of fixed residue for sublimed and washed, but none for precipitated, sulphur. The latter, if precipitated by sulphuric acid, is more readily miscible with water than pure precipitated sulphur, and leaves on ignition a large amount of fixed residue. For the detection of this and other fixed impurities the U. S. P. gives the following additional but unnecessary tests: "If precipitated sulphur be boiled with diluted hydrochloric acid, the liquid filtered, and the filtrate divided into two portions, one portion should not be precipitated by test solution of chloride of barium, and the other portion should not be rendered more than slightly turbid by test solution of carbonate of ammonium with excess of water of ammonia (absence of sulphate of calcium). When digested successively with water, hydrochloric acid, and water of ammonia, these liquids, after filtration, should leave no residue on evaporation (absence of alkalies, alkaline earths, or sulphide)." Sulphur obtained from pyrites usually contains arsenic, which is most conveniently detected, unless present in very minute quantities, by digesting it with 2 parts (*U. S.*) (20 parts, *P. G.*) of ammonia-water, filtering, and adding hydrochloric acid, when yellow sulphide of arsenic will be precipitated; on the further addition of sulphydric acid, arsenious acid, if present, will yield a yellow precipitate of sulphide of arsenic. While arsenious acid may be present in sublimed and in washed sulphur, it is obvious from the above explanation of the process that precipitated sulphur may be contaminated with sulphide, but not with the oxide of arsenic. Very minute quantities of this metal are best detected by Marsh's test. Selenium, which is sometimes present in sulphur, is detected by heating a sample with nitro-muriatic acid, diluting with water, filtering, and concentrating the filtrate, which contains selenious acid, and yields, on the addition of sulphite of sodium, a bright-red or reddish-black precipitate of selenium. Precipitated sulphur frequently has a slight odor of sulphuretted hydrogen, which is more apparent on being warmed; such sulphur acquires a more or less black color when agitated with a solution of acetate of lead; the pharmacopœias give no chemical test, almost complete freedom from odor being sufficient.

Off. Prep.—1. Of sublimed sulphur: Empl. hydrargyri, *Br.;* Emplast. ammoniaci cum hydrargyro, Potassa (sulphurata), Sulphur præcip., Sulphuris iodidum, Ung. sulphuris, *U. S.*, *Br.*

2. Of washed sulphur: Confectio sulphuris, *Br.;* Pulv. glycyrrh. comp., Sulphuris iodidum, Unguent. sulphuris alkalinum, *U. S.*

History.—The word "sulphur" is derived, according to some, from *sal*, salt, and *πυρ*, fire; and according to others, from *solum*, earth, and *πυρ*, fire. Brimstone is from A.-S. *byrne*, burning, and *stoan*, stone. Its fumes were very anciently employed to purify bodies, clothing, and dwellings: Hippocrates refers to it in his treatise on the diseases of females; Pliny attributed to it a heating and restorative quality, states that it discusses swellings, and for that purpose may be used in plasters and poultices; that it relieves lumbago when rubbed upon the loins in an ointment; that in combination with resins it removes lichenous and leprous eruptions, and as an electuary moderates dyspnœa and cough with purulent expectoration. Dioscorides, and later Paulus Ægineta, spoke of its virtues in itch. The value of sulphurous mineral waters was well known.

Physiological Action.—*On Vegetables and Animals:* The use of powdered sulphur for limiting fermentation has come down from a remote period, and it has also long been used for destroying parasitic fungi upon plants, as well as parasitic insects upon plants and animals. Recent experiments appear to show that these effects, as well as others which are usually attributed to sulphur, are in reality due to the sulphurous and sulphuric acids with which it is nearly always impregnated or which form by the action of the oxygen of the air upon it. If this view be correct, the therapeutic applications of sulphur will need revision. More than a century ago (1745) Langrish showed that when the body of a dog was exposed to the fumes of burning sulphur the animal suffered no inconvenience, but all the fleas that infested it were killed. Powdered sulphur given to animals in moderate but repeated doses impregnates the perspiration, the eructations, the feces, and sometimes the expired breath with sulphuretted hydrogen. Larger doses operate as laxatives, and, if continued, occasion diarrhœa, but do not materially affect the intestinal membrane. The flesh of sheep that have eaten food mixed with sulphur tastes and smells of sulphuretted hydrogen.

On Man: In doses of from 20 to 40 grains sulphur occasions soft stools, generally without colic, and the flatus discharged has the odor of sulphuretted hydrogen. The greater part of the sulphur passes unchanged. When small doses are repeated day after day, the exhalations of the lungs and skin have a sulphurous smell, the linen is sometimes stained yellow by the perspiration, and silver articles worn near the skin are blackened by the formation of sulphide of silver. The expired air also, the urine, and the milk contain combinations of sulphur. It has happened, when a course of mercury followed the administration of sulphur, that parts of the skin have been discolored by sulphide of mercury. Sulphur may continue to be used for a long time and in full doses without untoward effects, but, on the other hand, a case has been recorded of a person who took 120 grains of sulphur in wine four or five times a day, and who on the sixth day was seized with nausea, bloody diarrhœa, cramps in the legs, fever, dysury, etc., and for several years suffered from irritable stomach. There can be little doubt that these peculiar symptoms were occasioned by a great excess of free acids in the sulphur, for those acids have been found to be present in the proportion of from 10 to 30 parts in 10,000 parts of ordinary sublimed sulphur. They are the chief source of the increased proportion of sulphates found in the urine of those who use sulphur medicinally. The proportion of uric acid and of urea in this secretion is also said to be increased.

So long as the stomach contains only its normal acid secretions, sulphur undergoes no changes in that organ, but if the gastric liquids are rendered alkaline by disease, sulphuretted hydrogen may be evolved, as it normally is, in the intestinal canal by a reaction between a portion of the sulphur in the food and the alkaline secretions of the liver and pancreas. That such is the case is proved by the odor of the dejections, and, when the medicine has been for some time employed, by that of the cutaneous and pulmonary exhalations also. Even the skin appears to absorb it in some degree, since those who are subjected to frictions with sulphur ointment discharge fetid gas from the bowels. This may, however, possibly arise from the inhalation of the sulphur, which is volatilized at the temperature of the body. Dolan, however, states that he has found sulphur in the milk, sweat, and urine of persons taking it, and that it acts as a mild purgative on nursing infants through the mother's milk (*Practitioner*, xxvii. 170). The laxative action of the medicine can only be explained by its forming compounds with the aforesaid alkaline secretions. Its irritant and laxative operation is doubtless hindered by the coating of undissolved sulphur which lines the bowel. The alkaline compounds of sulphur in the blood appear to be partially converted into sulphates and to be discharged with the urine. The remainder are secreted chiefly in the form of sulphuretted hydrogen by the lungs and the skin. The extreme depression of the circulatory and nervous systems that has occasionally followed the use of sulphur may be attributed to the same compound absorbed from the digestive canal.

Medical Uses.—The most important therapeutic application of sulphur is to the cure of *scabies.* As already stated, it was used for this purpose in ancient times. Within the last generation its efficacy has been greatly enhanced by softening the patient's skin by means of warm baths before the sulphur is applied, and by associating the latter with some substance which, with the aid of friction, mechanically breaks up the burrows of the acari and brings the insects under the poisonous influence of the sulphur. Some writers, even among the most recent, distinctly assert that sulphur is not efficient *per se*, and can cure the itch only when the presence of a free or carbonated alkali favors the formation of a sulphide, which is the true agent of the cure, and hence that all sulphurous itch ointments should contain such an alkaline ingredient. Others affirm that the sulphur in an ointment only acts mechanically, by breaking up the burrows of the itch insect, while the sulphides destroy its life. These writers appear to have overlooked the presence and potency of sulphurous acid in sulphur ointment, as well as to have forgotten the long period in which simple sulphur ointment continued to be an efficient cure for the itch. The greatest dermatologist of the age was not, apparently, of their opinion. Hebra, after referring to the comparative value of several insecticide agents, says of sulphur: "It was found to be equally effectual whether it was used alone or in combination with potassa, soda, or lime." He also distinctly points out the advantage of there being mixed with the sulphur some coarse and insoluble substance to mechanically rupture the burrows of the acarus and permit the true insecticide to reach at once the insect and its eggs. But as many of the substances used for that purpose irritate the skin, causing artificial vesicular and pustular eruptions, those remedies only should be employed which, without irritating the skin, will destroy the itch insect and its ova. In hospitals this precaution may be less imperative than in private practice, but in all cases irritating ointments should be applied to those parts only, and especially the hands and the feet, which are distinctly the seat of the parasitic eruption.

The first compound sulphur ointment was that of Helmerich (1812–13), and consisted of 2 parts of sulphur, 1 of carbonate of potash, and 8 of lard, which was said to cure the itch in 18 hours when applied by vigorous and repeated friction, aided by warm baths. The method was revived in 1844 by Hebra, whose perfected formula was as follows: ℞. Flor. sulphuris, Ol. fagi vel cadini, āā ʒvj; Saponis viridis, Adipis, āā Oj; Cretæ ʒiv.—M. He, however, employed successfully a much simpler preparation, made of equal parts of flowers of sulphur and powdered soap, reduced to a semi-fluid mass with water. These agents effect a cure in two or three days when duly supplemented by warm baths. Hardy reduced the time of treatment to two hours. The patient was first rubbed for half an hour with soft soap, and placed in a warm bath for half an hour, the skin being again thoroughly rubbed, after which he was vigorously anointed with Helmerich's ointment or with one composed of 1 part of carbonate of potassium, 2 parts of sublimed sulphur, and 12 parts of lard. The method variously ascribed to Bourguignon and to Vlemingkx consisted in the use of the following lotion: ℞. Calcis vivæ lb.j; Sulphuris citrini lb.ij. Boil with 20 pints of water until reduction to 12 pints. When cold, filter. The patient is immersed in a warm bath, and for half an hour rubbed with flannel cloths and potash soap, and is allowed to remain for another half hour in the bath. During the third half hour he is again rubbed vigorously with flannel dipped in the solution of sulphuret of calcium, and passes the fourth half hour in the bath. Any particles of sulphur adhering to the skin may be washed off with cold water. This completes the cure. The objection to these methods consists in the harshness of the application and the artificial eruptions they excite.

Sulphur is useful in other diseases of the skin, and especially in *acne*, *alopecia*, *pityrodes*, *sycosis*, and *tinea versicolor*, and in certain cases of *psoriasis*. In the last-named affection, unless very circumscribed, all sulphurous applications are painful and often aggravate the disease. In tinea versicolor sulphur baths and the internal use of sulphur waters should be conjoined. In the different forms of acne the seat of the eruption should every night be bathed with warm water to soften the skin, after which a paste made with flowers of sulphur and water, or an ointment prepared with equal parts of sulphur, carbonate of potassium, and simple ointment, should be smeared over the affected part and allowed to remain all night. In the morning it should be thoroughly washed off with soft water, with the addition, if necessary, of bran or Indian corn meal, but without soap. A simpler but very efficient plan consists in dusting the skin with pure precipitated sulphur every night, after washing it with soft water. Tinea tonsurans, or *trichophyton*, is curable by sulphur ointment after the hair has been closely cropped. Chloasma, or *tinea versicolor*, is sometimes cured by drinking sulphurous mineral waters and by baths of the same, but whether by their local or by their indirect action is not easily determined.

The fumes of burning sulphur, conveyed into a wooden chest enclosing all of the patient but his head, have sometimes been used in the treatment, especially of inveterate cases, of cutaneous diseases, such as *eczema*, *psoriasis*, *impetigo*, and *prurigo*, and also for the cure of *rheumatic* and *scrofulous* affections, *paralysis*, *amenorrhœa*, etc. The method, however, sometimes gave rise to great cutaneous irritation, syncope, etc., and is now seldom if ever employed. Sulphurous baths, both natural and artificial, have always enjoyed a great vogue, especially in the treatment of *rheumatism* and *gout* and of some *cutaneous affections*. For the former thermal waters are to be preferred, and for the latter partial douche baths are more efficacious than general baths, and are more useful in limited than in extensive eruptions. Sulphurous mineral waters generally contain earthy and alkaline sulphates, which render them, when taken internally, more or less laxative and diuretic, and therefore depurative, while the sulphurous acid disengaged from them in the body promotes diaphoresis. (See AQUÆ MINERALES.) Probably by the latter operation sulphur is useful as an internal remedy for chronic rheumatism, especially of the muscles and tendons, but not of the joints. It forms an ingredient of the laxative compound known as the "Chelsea pensioner," thus: R. Flowers of sulphur ʒij; Cream of tartar

℥j; Powdered rhubarb ʒij; Guaiacum ʒj; Clarified honey lb.j; one Nutmeg, finely powdered.—M. S.—2 large teaspoonfuls to be taken night and morning, and at bedtime a hot alcoholic draught.

In *chronic coughs* with profuse expectoration the virtues of sulphur are sometimes conspicuous. Its reputation in such affections at one time was so great as to obtain for it the title of *balsamum pulmonum.* It was often used for this purpose in the form of the compound liquorice powder, which is now more generally employed as a mild and efficient laxative. It has been claimed that sulphurous mineral waters are curative of certain cases of phthisis (Candellé, *Bull. de thérap.*, cii. 305, 366). Undoubtedly, in certain cases they tend to eliminate the bronchitic element of the disease, but nothing more. (Compare Aitken, *Practitioner*, xxxi. 259.) The mildness of the laxative operation of sulphur renders it appropriate in *piles;* for this and similar purposes it is often administered with cream of tartar, of each 1 drachm (Gm. 4), mixed with molasses.

Nebulized sulphurous waters are useful as a local application in *granular pharyngitis* and *laryngitis*, and powdered sulphur itself was long ago recommended to be applied by insufflation to the same parts in *diphtheria* and *croup*, but of its efficacy there is not sufficient proof, at least in the latter disease. In the former, however, there is some reason for believing that finely-powdered or precipitated sulphur applied in this manner has had the effect of rapidly removing the exudation (Stuart, *Practitioner*, xxii. 248; xxiii. 272). It is said that malarial fevers do not prevail where the air is impregnated with sulphurous emanations (D'Abbadie, *Practitioner*, xxix. 466).

Administration.—Sulphur is given as a laxative in the *dose* of from 60 to 250 grains (Gm. 4–15). For other purposes the dose is about 30 grains (Gm. 2). It may be administered in milk, or molasses or other syrup.

SULPHURIS IODIDUM, *U. S., Br.*—IODIDE OF SULPHUR.

Sulfur iodatum, Ioduretum sulfuris.—Iodure de soufre, Fr.; *Jodschwefel*, G.

Preparation.—Washed Sulphur 1 part (1 oz. av.); Iodine 4 parts (4 oz. av.). Rub them together until they are thoroughly mixed. Introduce the mixture into a flask, close the orifice loosely, and apply a gentle heat, so as to darken the mass without melting it. When the color has become uniformly dark throughout, increase the heat so as to produce liquefaction, and incline the flask in different directions in order to return into the liquid any portion of iodine which may have been condensed on the inner surface of the flask. Then withdraw the heat, and, after the liquid has become solid, break the flask, reduce the fused mass to pieces, and keep them in a glass-stoppered bottle.—*U. S., Br.*

On warming a mixture of iodine and sulphur the two elements unite, and at a somewhat higher heat melt together. The operation is readily performed in an ordinary vial if this is carefully heated by means of a sand-bath. The use of washed sulphur directed by the U. S. P. is an unnecessary refinement in view of the qualities demanded for sublimed sulphur, the trace of acid present in the latter not affecting the quality of the preparation.

Properties.—Thus prepared, iodide of sulphur is a grayish-black mass of a radiated crystalline appearance and with a metallic lustre. It resembles iodine in smell and taste, and on exposure to the air gradually loses iodine. If exposed to a gradually-increased heat it sublimes, the first portion of the sublimate consisting of iodine, and the portion subsequently obtained containing sulphur; only a minute trace of fixed residue should be left. Iodide of sulphur is insoluble in water, but dissolves in about 60 parts of glycerin, and is soluble in carbon bisulphide, on the spontaneous evaporation of which at a low temperature iodine crystallizes first, and afterward rhombic pyramids of *sulphuric iodide* are obtained, having the formula SI_6 (Vom Rath, 1860), and on exposure to the air leaving sulphur in the form of a delicate crystalline skeleton (Lamers, 1861). Alcohol, ether, volatile oils, and cold solutions of potassa and of potassium iodide decompose iodide of sulphur by dissolving the iodine. A similar decomposition is effected by boiling the iodide of sulphur with water, with the vapors of which the iodine passes off, leaving a residue of sulphur amounting to 20 per cent. of the weight of the iodide of sulphur employed; this is recommended as a test of purity by the U. S. P.

Composition.—Sulphur and iodine are employed in the proportion of their atomic weights, the compound being regarded as *subiodide of sulphur*, S_2I_2. Guthrie (1861) obtained this compound in tabular crystals by acting with subchloride of sulphur, S_2Cl_2, upon iodide of ethyl, C_2H_5I.

Off. Prep.—Ungu. sulphuris iodidi, *Br.*

Medical Action and Uses.—This preparation was originally employed in the treatment of tuberculated *diseases of the skin* in an ointment which contained from 1 part of the iodide in 12 parts to 1 part in 3 parts of lard. It acts as a stimulant or caustic according to the strength of the ointment applied. It is seldom used, chiefly on account of its tendency to become decomposed. (See UNG. PLUMBI IODIDI.)

SUMBUL, *U. S.*—SUMBUL-ROOT.

Sumbul radix, Br.; *Racine de sumbul*, Fr.; *Sumbulwurzel*, *Moschuswurzel*, G.

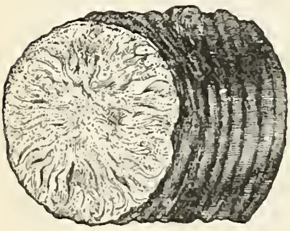
The root of Ferula (Euryangium, *Kauffmann*) Sumbul, *Hooker filius*, s. Sumbulus moschatus, *Reinsch*. Bentley and Trimen, *Med. Plants*, 131.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The sumbul-plant is indigenous to Turkestan, Bucharia, Eastern Siberia, and probably to other parts of Central Asia, and was discovered by Fedschenko (1869) in the mountains of Maghian, south-eastward of Samarkand. It is a perennial growing to the height of 8 feet (2.4 M.), and has large, triangular, tripinnate radical leaves and a few small cauline leaves, the upper ones being reduced to sheathing bracts. The flowers are polygamous, and the fruit is about ½ inch (12 Mm.) long, oblong-oval, dorsally compressed, and when ripe is free from oil-tubes, but in the unripe state has in each mericarp four large dorsal and two small commissural vittæ. The root was sent to Western Russia in 1835 as a substitute for musk, and was afterward used in medicine.

Description.—Sumbul-root enters commerce by way of Russia. It is spindle-shaped, simple, about 12 inches (30 Cm.) long, and is met with in transverse segments, varying in diameter from 1 inch to 4 or 6 inches (2–15 Cm.), and in thickness from ¾ inch to 2 inches (2–5 Cm.), occasionally intermixed with pieces scarcely ¼ inch (6 Mm.) in diameter. The root is light, of a spongy texture, annulate in the upper part, and below with longitudinal wrinkles, covered with a thin brown bark, is internally whitish, sprinkled with yellowish-brown resinous dots, and consists of white parenchyma and pale-brownish fibro-vascular bundles, which are easily separated, are irregular-wavy, and more numerous near the bark than in the centre. Sumbul-root breaks with an irregular, farinaceous, and fibrous fracture, and has a strong, persistent musk-like odor and a bitter balsamic taste.

FIG. 290.



Sumbul-Root.

Constituents.—The ethereal tincture of sumbul-root, on being evaporated and treated with alcohol, leaves waxy matter behind, and on evaporating the alcoholic solution Reinsch's (1848) *sumbul balsam* is obtained, which on being heated in a narrow tube acquires a green afterward blue color, and subsequently yields oily distillates of a yellow, green, and blue color, and containing umbelliferon. When added to sulphuric acid the balsam acquires a purple color, and after having been heated with potassa it yields to a small quantity of water angelicate of potassium, the potassium salt of *sumbulamic acid* remaining undissolved. Valerianic acid is probably likewise contained in the resinous extract. Murawjeff (1853) reported having obtained from sumbul-root an alkaloid, *sumbuline*, yielding crystallizable salts. The chemistry of sumbul-root requires further researches.

Allied Root.—In India a root is employed as sumbul-root which, according to Pereira, differs from the Russian root in being of a closer texture, firmer, denser, and of a more yellow tint. Dymock showed it to be the root of Dorema Ammoniacum, which has no musk-like odor.

Off. Prep.—Tinctura sumbul, *Br.*

Medical Uses.—This root first attracted attention in Russia about 1840 as a specific for cholera—how uselessly the history of that disease demonstrates. Afterward its strong musky odor led to its being prescribed in various functional nervous disorders, including *hysteria* and *delirium tremens*. Its combined resin and essential oil caused it to be employed in mucous profluvia, such as chronic *bronchitis*, *leucorrhœa*, and *gleet*. It is now but little used. The *dose* of the root in powder is from 10 to 20 grains (Gm. 0.60–1.30).

SUPPOSITORIA.—Suppositories.

Suppositoires, Fr.; *Stuhlzäpfchen*, G.

Suppositories are solid medicinal preparations intended to be introduced into the rectum or vagina, and of such a consistence that they will slowly melt at the temperature of the body or liquefy in the presence of moisture. The material best adapted for the vehicle is undoubtedly butter of cacao, since at ordinary temperatures it is sufficiently firm to be handled, and at the same time has such a low fusing-point that it will slowly but completely liquefy after introduction into the rectum. In addition to this, it is not prone to become rancid, and may be mixed with most medicinal substances commonly employed in this form of medication without having its fusing-point lowered. The volatile oils, camphor, carbolic acid, creasote, and chloral hydrate, exert a marked influence upon the consistence of cacao butter, and liquefy with it at a temperature lower than its fusing-point. But even these substances may be added in small quantities without occasioning unusual trouble in preparing the suppositories; if, however, added in full medicinal doses, the cacao butter may be replaced by about 10 per cent. of spermaceti.

In the selection of the base for suppositories the United States Pharmacopœia very properly follows the French Codex, while the British Pharmacopœia employs a mixture of cacao butter and wax, or curd soap with powdered starch or with starch and glycerite of starch. Suet is also occasionally used in Europe for this purpose. Another vehicle, which is more particularly adapted for vaginal suppositories, is a combination of 3 parts of gelatin, 7 of glycerin, and 1 of alcohol, as proposed by H. B. Brady.

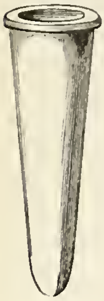
The size of suppositories adopted by the different pharmacopœias varies very much, their weight, according to the British Pharmacopœia, being 15 grains; according to the United States Pharmacopœia, 2 Gm. (30 grains); and according to the French Codex, 4, or for children 2, Gm. (30 or 60 grains).

Preparation.—Suppositories are prepared by the following general formula: Mix the medicinal portion with a small quantity of oil of theobroma by rubbing them together, and add the mixture to the remainder of the oil of theobroma previously melted and cooled to the temperature of 35° C. (95° F.). Then mix thoroughly without applying more heat, and immediately pour the mixture into suitable moulds. The moulds, previously made cold, must be kept so by immersion in iced water. All difficulty in removing suppositories from the moulds may be obviated by having the moulds previously dusted with lycopodium. In the absence of suitable moulds, suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing it into parts of a definite weight each, which may be made into a conical or other convenient form for a suppository. Unless otherwise specified, suppositories shall be made to weigh 2 Gm. (30 grains).—*U. S.*

These directions, which agree with those of the U. S. P. 1870, are sufficiently minute for the proper preparation of suppositories having cacao butter for their base. The directions of the British Pharmacopœia when other vehicles are used are given below. In making suppositories with gelatin, this material is well soaked in water, and when thoroughly saturated and softened is melted together with the requisite quantity of glycerin, and the fused mass is mixed with the alcohol containing the medicinal substance in solution or suspension. Since tannin forms an insoluble compound with gelatin, drugs owing their virtue to tannin cannot be combined with this vehicle, which is likewise not well adapted for various salts unless the amount of gelatin be somewhat increased.

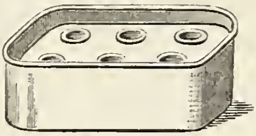
To obtain suppositories of a uniform shape, they are generally moulded. The simplest mould is made of thin writing-paper folded into the shape of a cone and having the edge secured with a little sealing wax or paste; after the material has solidified the paper is unrolled. Or the moulds are made of pewter or other suitable metal and suspended in a tray, which is filled with cold water or fragments of ice to thoroughly chill the moulds before the melted mass is poured out. The suppositories will readily congeal, and may be removed by inverting the mould and striking it suddenly on a slab. Moulds have also been made of brass with a number of conical cavities of the desired size and shape, and arranged in such a manner that after the suppositories have congealed the mould may be taken apart either by removing the top portion or the sides, when the suppositories are easily lifted or pushed out by slight pressure. Serviceable suppository moulds may be made by the pharmacist from plaster of Paris, as was suggested by Charles E. Dwight (1872), by pouring the plaster, mixed with water to the consistence of thick cream, into a suitable vessel, and inserting into the soft mass a convenient number of wax suppositories in such a manner that the broad end is near one side, and the suppositories are immersed only to one-half their diameter. When the plaster has set the wax is removed, the surface is smoothed with a knife, taking care that the edges of each mould be sharp, and small cavities are dug between the depressions. This represents one-half of the mould, the surface of which is well greased, and after replacing the wax the other half is obtained by pouring mixed plaster upon the greased surface to the depth of an inch or more. When hard the two parts can be easily separated, the edges trimmed off, and each part boiled for about an hour in linseed oil, which will prevent the adhesion of the substance to be moulded. The adhesion of suppositories to metallic moulds sometimes causes inconvenience; it is frequently due to the imperfect cleaning or to insufficient chilling of the moulds, and may be prevented by dusting them lightly with lycopodium.

Fig. 291.



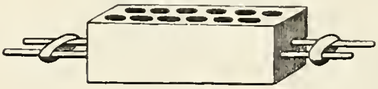
Suppository Mould.

Fig. 292.



Tray for Suppository Moulds.

Fig. 293.



Suppository Mould.

In making suppositories it is of importance that the medicinal ingredients are uniformly mixed with the vehicle, and if not soluble in the latter the rapid congelation of the mixture after it has been poured into the moulds is absolutely necessary. The difficulty thus experienced has led many pharmacists to abandon this method and prepare suppositories by a process rendering fusion of the cacao butter unnecessary. This vehicle is either grated or by means of a sharp knife cut into very thin slices, and mixed by trituration, either in a mortar or on a slab, with the other ingredients; in this condition the mass may be easily rolled out, in the same manner as a pill mass, and cut into the requisite number of pieces, each of which is then shaped into a cone with the fingers or a spatula. Several apparatuses have been constructed by means of which the mass, as obtained by mixing the cold ingredients, may be compressed into conical moulds. The simplest machine for this purpose has been constructed by Prof. Emlen Painter (1878), and is very similar to Remington's machine for compressed pills, figured on page 1166, from which it differs in the greater thickness of the cylinder and in the conical shape of the cavity used for compressing the material.

Special formulas for suppositories are no longer given by the U. S. Pharmacopœia, but the following synopsis explains the composition and manipulation for those which were recognized by the U. S. P. 1870; twelve suppositories are made in each case:

Suppositoria	Medicinal ingredients.	Incorporate with cacao butter.	Add to cacao butter.
Acidi carbolici.	Carbolic acid 12 grains.	60 grains.	288 grains.
Acidi tannici.	Tannin 60 grains.	60 "	240 "
Aloes.	Powd. purif. aloes 60 grains.	60 "	240 "
Asafœtidæ.	Tinct. asafetida 1 fluidounce; evaporate spontaneously.	60 "	260 "
Belladonnæ.	Alcoh. extract belladonna 6 grains; water sufficient.	60 "	294 "
Morphiæ.	Morphine sulphate 6 grains.	60 "	294 "
Opii.	Extract opium 12 grains; water sufficient.	60 "	288 "
Plumbi.	Lead acetate 36 grains.	60 "	264 "
Plumbi et opii.	Lead acetate 36 grains; extract opium 6 grains; water sufficient.	60 "	260 "

Urethral suppositories are made in precisely the same manner as those intended for use in the rectum or vagina, the chief difference being in the shape, which should be cylindrical and slender, and in the greater stiffness of the vehicle. J. L. Lemberger (1871) made use of the well-known candle-mould, modified merely by making the tubes much smaller; and others have forced the mixture of cacao butter, wax, and medicinal substances through a narrow tube, and cut the cylinders thus obtained into pieces of a suitable length.

SUPPOSITORIA ACIDI CARBOLICI CUM SAPONE, *Br.*—CARBOLIC ACID SUPPOSITORIES.

Suppositoires d'acide phénique, Fr.; *Carbolsäure-Stuhlzäpfchen*, G.

Preparation.—Take of Carbolic Acid 12 grains; Curd Soap, in powder, 180 grains; Glycerin of Starch 40 grains or a sufficiency. Mix the ingredients so as to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository. Each suppository contains 1 grain of carbolic acid.—*Br.*

Medical Uses.—This suppository is disinfectant and stimulant, and may be used in chronic *dysentery*, *hæmorrhoids*, *cancer*, and other diseases of the *rectum* attended with mucous, purulent, or bloody secretions or with fetor.

SUPPOSITORIA ACIDI TANNICI, *Br.*—TANNIC ACID SUPPOSITORIES.

Suppositoires de tannin, Fr.; *Tannin-Stuhlzäpfchen*, G.

Preparation.—Take of Tannic Acid 36 grains; Oil of Theobroma 144 grains. Rub the tannic acid with 44 grains of the oil of theobroma in a slightly warmed mortar, and add them to the remainder of the oil of theobroma previously melted at a low temperature; mix thoroughly, and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

SUPPOSITORIA ACIDI TANNICI CUM SAPONE. Take of tannic acid 36 grains; glycerin of starch 30 grains; curd soap, in powder, 100 grains; starch, in powder, a sufficiency. Mix the tannic acid with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository.—*Br.*

Medical Uses.—Tannic acid suppositories are chiefly used to allay rectal or vaginal irritation, diminish local discharges, and constringe the flabby mucous membrane of these parts.

SUPPOSITORIA HYDRARGYRI, *Br.*—MERCURIAL SUPPOSITORIES.

Suppositoires mercuriels, Fr.; *Mercurial-Stuhlzäpfchen*, G.

Preparation.—Take of Ointment of Mercury 60 grains; Oil of Theobroma 120 grains. Melt the oil of theobroma with sufficient heat, then add the ointment of mercury, and having mixed them thoroughly, without applying more heat, immediately pour the mixture, before it has congealed, into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

Medical Uses.—These suppositories appear to have been contrived for the purpose of affecting the system with mercury when for any reason it cannot be administered by the mouth.

SUPPOSITORIA MORPHINÆ, *Br.*—MORPHINE SUPPOSITORIES.

Suppositoires morphinés, Fr.; *Morphin-Stuhlzäpfchen*, G.

Preparation.—Take of Hydrochlorate of Morphine 6 grains; Oil of Theobroma 174 grains. Rub the hydrochlorate of morphine with 24 grains of the oil of theobroma in a slightly warmed mortar and add this to the remainder of the oil previously melted at a low temperature; mix the whole thoroughly, and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository, which will contain ½ grain of hydrochlorate of morphine.—*Br.*

SUPPOSITORIA MORPHINÆ CUM SAPONE. Take of hydrochlorate of morphine 6 grains; glycerin of starch 30 grains; curd soap, in powder, 100 grains; starch, in powder, a sufficiency. Mix the hydrochlorate of morphine with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository.—*Br.*

Medical Uses.—Each of these suppositories contains half a grain of hydrochlorate of morphia, which is quite too large a dose for ordinary use.

SUPPOSITORIA PLUMBI COMPOSITA, *Br.*—COMPOUND LEAD SUPPOSITORIES.

Suppositoires de plomb opiacés, Fr.; *Stuhlzäpfchen von Opium und Bleizucker*, G.

Preparation.—Take of Acetate of Lead 36 grains; Opium, in powder, 12 grains; Oil of Theobroma 132 grains. Rub the acetate of lead and opium with 42 grains of the oil of theobroma in a slightly warmed mortar, and add them to the remainder of the oil previously melted at a low temperature; mix the whole thoroughly and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

Medical Uses.—The combined astringent, soporific, and anodyne qualities of these suppositories render them appropriate in many affections of the *rectum*, *vagina*, and *uterus* attended with altered secretion and pain, such as *leucorrhœa*, *diarrhœa*, *dysentery*, *cancer*, etc.

SYMPHYTUM.—COMFREY-ROOT.

Radix symphyti, *Radix consolidæ majoris.*—*Consoude*, Fr.; *Schwarzwurz*, *Beinwurz*, G.

The root of Symphytum officinale, *Linné.*

Nat. Ord.—Boraginaceæ.

Origin.—Comfrey is a European perennial growing on the banks of streams and in meadows, and now found in similar places in the United States, where it has escaped from gardens. It is a coarse-looking plant, with a bristly stem 20 to 40 inches (.5–1 M.) in height, and with lance-ovate or lanceolate alternate and rough leaves, which are narrowed into a winged petiole. The flowers are in racemose cymes, have a five-toothed calyx and a tubular bell-shaped yellowish-white or purplish corolla, with spreading teeth and linear scales closing the throat, and produce four smooth, glossy, brown-black akenes. The flowers appear in June. The root is collected in autumn or early in spring, and yields about 20 per cent. of air-dry drug.

Description.—Comfrey-root is fleshy, 6 or 8 inches (15–20 C.) long, about an inch (25 M.) thick above, several-headed, tapering, and with few branches. After drying it is deeply wrinkled longitudinally, often bent, of a purplish-black color externally, and breaks readily with an even somewhat waxy fracture, or in damp weather is rather tough. The bark is about one-eighth the diameter of the root, and has a thick black corky layer, the inner bark being whitish. The meditullium consists of broad medullary rays and narrow wood-wedges, and is of a whitish color, or when old brownish. Comfrey-root is inodorous and has a mucilaginous, sweetish, and faintly astringent taste.

Constituents.—The most important principle contained in comfrey-root appears to be the large quantity of *mucilage*. The root contains also sugar, a little tannin, and a few starch-granules, but acquires with iodine only a brown, not a blue, color. Plisson (1829) isolated from the root a small quantity of *asparagin*.

Medical Uses.—Comfrey-root is both demulcent and astringent, and was esteemed in ancient times for hastening the cure of bruises and the cicatrization of wounds; hence its name, *consolida*. A popular method in France of treating *fissures of the nipple* is to apply a hollow section of the fresh root over the sore organ. A decoction of it is prescribed in *hæmoptysis*, *hæmaturia*, *metrorrhagia*, *diarrhœa*, and *dysentery*. It is made with from 2 to 4 drachms in a pint of water (Gm. 8–16 in Gm. 500).

SYRUPI.—SYRUPS.

Sirops, Fr.; *Syrupe*, G.

Syrups are concentrated solutions of sugar in water or in aqueous or very slightly alcoholic solutions of medicinal substances. In a few instances vinegar or dilute acetic acid is the solvent, and in Europe certain syrups are made with wine. Syrup made of sugar and water is called *simple syrup*; all others are distinguished as *medicated syrups*, and these may be again classified into *simple* and *compound medicated syrups*, in accordance with the number of drugs represented by them.

Preparation.—In preparing syrups only the best refined sugar should be employed, which is free from impurities, and when dissolved in water is less prone to fermentation than partially-refined sugar. The pharmacopœias direct most of the syrups to be prepared with the aid of heat. The necessary quantity of sugar is mixed with the liquid, a moderate heat is applied to the mixture, and this is frequently stirred until the sugar is dissolved, when the heat is raised to the boiling-point, and the syrup is strained for the purpose of removing dust and other accidental impurities that may have been contained in the sugar, and albumen, which is coagulated by heat from some aqueous infusions of drugs. After straining, the U. S. Pharmacopœia directs the weight of simple syrup to be adjusted by passing a sufficient quantity of water through the strainer. In following these directions literally the syrup may become too much diluted through the use of a large-sized strainer, which, with the vessel in which the syrup was made, would retain considerable of the latter; the strainer should therefore be as small as possible, and water equal to only about one-half the weight to be made up should be used until the vessel and strainer have been thoroughly rinsed with it, when more water may be added. All undue dilution may be avoided by ascertaining the weight of the syrup previous to straining, and afterward rinsing the vessel and strainer only with sufficient water to make up the difference. The German Pharmacopœia very properly directs the adjusting of the weight to be done *before* the syrup is strained or filtered, and the U. S. P. has adopted the same precaution for all syrups made without heat.

Most syrups of the U. S. P. are now directed to be made by dissolving the sugar in the proper liquid without heat, with the view of avoiding the evaporation of volatile ingredients and the inverting influence of hot acid liquids upon the cane-sugar. L. Orynski (1871) proposed to extend this process to all syrups, and the method has been found by R. Hunstock (1875) and others not only much easier and more economical than the officinal process, but likewise to yield syrups which, as a rule, are less liable to ferment. This latter quality may probably be directly referred to the avoidance of heat, since the continued application of heat is known to produce changes in the sugar resulting in the formation of glucose. Simple syrup, made by dissolving the sugar at the boiling-point very soon after it has been prepared, reduces alkaline solutions of copper, showing the formation of grape-sugar, while simple syrup made from the same sugar, but without heat, forms grape-sugar more slowly. This so-called *cold process* for preparing syrups therefore deserves the attention of pharmacists. The menstruum is in all cases prepared as directed by the Pharmacopœia; the requisite quantity of sugar is then introduced into a conical percolator, the lower orifice of which is closed with a cork, and into the neck of which a piece of loose sponge or cotton, previously moistened, is introduced. The liquid is now poured into the percolator, and the whole set aside in a moderate temperature until the sugar has been partially dissolved and melted down to about one-half of its original volume, when the cork may be removed and the syrup allowed to drop; it should be perfectly clear and transparent, or the turbid portion returned to the percolator. If the sugar is not all dissolved when the liquid has passed, this is to be again percolated through the sugar. With proper management a repetition of the process will be rarely required. Syrups prepared in this manner with perfect emulsions will be opaque. If made with aqueous infusions of drugs, such syrups will contain the soluble albuminous principles, and probably not be quite as unchangeable as those prepared with the aid of heat; but if the drug had been exhausted by an alcoholic liquid, as directed by the U. S. P. for most of the syrups to which these remarks apply, albumen is not present.

If heat is employed, as directed by the pharmacopœias for most syrups, the loss occasioned by evaporation should be rectified by the addition of water. This is easily accomplished by taking the weight of the vessel with its contents before and after boiling, and adding enough water to compensate for the loss occasioned by heating. If clarification by means of white of egg should be necessary, this is best added to the cold aqueous liquid. Paper-pulp may be used for the same purpose.

The preparation of the aqueous liquid used for dissolving the sugar is of great importance. The pharmacopœias have very properly discarded the exhaustion of the crude drugs by boiling them with water, since thereby starch and other principles are dissolved which easily undergo chemical changes and interfere with the stability of the syrups. The United States Pharmacopœia has, for the same reasons, abandoned the employment of hot water in exhausting the drugs. The most stable medicated syrups are obtained if the drug is treated with cold water, diluted alcohol, or alcohol, as the case may be, either by maceration or preferably by percolation. For this part of the process all the precautions are required which have been pointed out in another place (see pp. 605–609). The percolate is concentrated, and, if necessary, deprived of alcohol, particular care being required to prevent the evaporation of volatile principles and the change of others by the influence of an elevated temperature. Filtration of the concentrated liquid is usually required, and it should be borne in mind that it is much easier to pass a concentrated aqueous infusion of a drug or an aqueous solution of an alcoholic extract through a filter than to perform the same operation with a syrup.

The proper proportion of sugar to menstruum ensures the stability of the syrup. Should the sugar be deficient in quantity, it could not efficiently protect the other organic principles contained in the syrup, and it would be liable to ferment. On the other hand, if too much sugar be employed, the excess would crystallize after cooling, and dispose an additional quantity to separate in a like manner, thus leaving the syrup weaker in sugar than it should be, and subject to similar alterations as if an insufficient quantity of sugar had been used. The proper proportion of sugar is a little less than twice the weight of water, or 35 parts of water to 65 parts of sugar, as directed by the United States Pharmacopœia for simple syrup. For colder climates a little more water may be employed; the German Pharmacopœia directs 40 parts of water to 60 parts of sugar. If the liquid contains already much organic matter in solution or if it is partially alcoholic, a correspondingly smaller amount of sugar will be required.

A process was recommended by Isaac Davis (1878) in which the principle adopted by Orynski is still further extended. Mr. Davis proposed to make the medicated syrups by percolating the powdered drugs with simple syrup prepared by the cold process.

(For remarks on the preparation of *fruit-syrups* see SYRUPUS MORI and SYR. RUBI IDÆI.)

Preservation.—The finished syrups should be introduced into dry bottles, so as to avoid diluting them with water; if bottled while warm, condensation of aqueous vapors in the neck of the bottle will cause dilution of the upper stratum and disposition to fermentation, unless the syrup be thoroughly mixed after cooling. Properly prepared, syrups may generally be kept unaltered, even in partially filled bottles, at the ordinary temperatures, but it is best to keep them in a place where the temperature will not vary materially between about 15° and 20° C. (59° and 68° F.). The addition of small quantities of spirit of ether, Hoffmann's anodyne, chlorate of potassium, and more recently of salicylic acid, has been recommended for the purpose of preserving syrups; but all these additions are more or less objectionable, and generally unnecessary if, in the exhaustion of the drug, heat is avoided.

Restoration.—When fermentation sets in, the carbonic acid gas disengaged causes the syrups to assume a frothy appearance, and a vinous odor is noticed. As soon as these signs make their appearance the syrup should be heated to boiling, strained, and afterward properly preserved. The medicinally active principles will rarely have undergone any alteration, except in the case of syrups of acacia and of almond; but syrups which owe their virtues wholly or in part to volatile principles, or in which fermentation has proceeded beyond the incipient stage, cannot be thus restored without being impaired in their properties. For syrups prone to fermentation the employment of glycerin in place of a corresponding quantity of liquid and sugar has been recommended.

Properties.—Syrups should be perfectly transparent, with the few exceptions noted below. When heated to boiling they have the density indicated by 30° B. = 1.26 (*F. Cod.*). At 15° C. (59° F.) the density of simple syrup is 1.310 (*U. S.*), 1.32 (*F. Cod.*), 1.330 (*Br.*), and most of the medicated syrups have about the same specific gravity. The employment of carbonate of magnesium in the preparation of syrups renders them unfit for being dispensed with salts of morphine, strychnine, or other poisonous alkaloids. (See AQUÆ MEDICATÆ, p. 232.)

SYRUPUS, *U. S., Br.*—SYRUP.

Syrupus simplex, P. G.; *Syrupus sacchari*, F. Cod.; *Syr. albus.—Simple syrup*, E.; *Sirop de sucre*, *Sirop simple*, Fr.; *Weisser Syrup*, G.

Preparation.—Sugar, in coarse powder, 65 parts (4 lbs. 1 oz. av.); Distilled Water a sufficient quantity; to make 100 parts (6¼ lbs. av.). Dissolve the sugar, with the aid of heat, in 35 parts of distilled water, raise the temperature to the boiling-point, and strain the solution while hot. Then incorporate with the solution enough distilled water, added through the strainer, to make the syrup weigh 100 parts (6¼ lbs. av. or 73¼ fluidounces).—*U. S.* To make 1 gallon of simple syrup use 7 lbs. 1¾ oz. av. of sugar and 3 lbs. 13¼ oz. av. or 58¾ fluidounces of distilled water.

The Pharmacopœia states that syrup thus prepared has the specific gravity 1.310, which is too low. The syrup of the U. S. P. 1870 contained 65.455 per cent. of sugar, and its specific gravity was given as being 1.317, which figure closely corresponds with the results of Balling, Brix, Gerlach, and others. The British Pharmacopœia orders 5 pounds of sugar and sufficient distilled water to make 7½ pounds of syrup, which contains 66.667 per cent. of sugar and is stated to have the density of 1.330. The French Codex orders 64.286 per cent. of sugar, and gives the density 1.32.

Pharmaceutical Uses.—Simple syrup is used in the preparation of certain confections, mixtures, and syrups, and as an excipient in several pill masses.

Medical Uses.—Syrup—or "simple syrup," as it was formerly and more definitely called—is a most important member of the pharmacopœia, not only because it preserves medicines associated with it from undergoing change, but because it renders them more acceptable to the palate and mitigates their action upon the alimentary canal. It should, however, not be used in large doses nor for a long time together, lest it impair the appetite and digestion. It may be employed as a protective for superficial *burns* and *abrasions.*

SYRUPUS ACACIÆ, *U. S.*—Syrup of Gum-Arabic.

Syrupus gummosus.—Sirop de gomme, Fr.; *Gummisyrup,* G.

Preparation.—Mucilage of Acacia 25 parts (¼ oz.); Syrup 75 parts (¾ oz.); to make 100 parts (1 oz.). Mix them. This syrup should be freshly made when required for use.—*U. S.*

This is the formula of the P. G. 1872, from the revised edition of which this syrup has been dismissed. While it is desirable to prepare this syrup extemporaneously, it should be remembered that mucilage of acacia, which is not preserved by sugar, is readily altered on exposure, and likely to induce decomposition when used in mixtures; it is therefore important that the mucilage be of good quality.

The formula of the French Codex is similar to the following, which is the formula of the U. S. P. 1870: Dissolve 2 troyounces of gum-arabic in 8 fluidounces of water, without heat; then, having added 14 troyounces of sugar, dissolve it with a gentle heat and strain.

Medical Uses.—Syrup of gum-arabic is chiefly used to aid in suspending more active substances in mixtures and impart an agreeable flavor to them, as a demulcent in catarrhal affections of the *throat* and *larynx,* and as a palatable addition to drinking water.

SYRUPUS ACIDI CITRICI, *U. S.*—Syrup of Citric Acid.

Sirop d'acide citrique, Sirop de limon, Fr.; *Citronsäuresyrup,* G.

Preparation.—Citric Acid 8 parts (½ oz. av.); Water 8 parts (½ oz. av.); Spirit of Lemon 4 parts (¼ oz. av.); Syrup 980 parts (61¼ oz. av. or 45 fluidounces); to make 1000 parts (62½ oz. av. or 46 fluidounces). Mix the spirit of lemon with the syrup contained in a bottle; then add gradually the citric acid dissolved in the water, shaking the bottle after each addition until the whole is thoroughly mixed.—*U. S.*

This syrup resembles lemon syrup. Its flavor has been improved by the use of spirit in place of oil of lemon, formerly ordered.

Medical Uses.—This syrup is used as a flavoring ingredient chiefly. It is intended as a substitute for lemon syrup made from the recent fruit, for which, however, it is by no means an equivalent.

SYRUPUS ACIDI HYDRIODICI, *U. S.*—Syrup of Hydriodic Acid.

Sirop d'acide iodhydrique, Fr.; *Jodwasserstoffsyrup,* G.

A syrupy liquid, containing 10 per cent. of absolute hydriodic acid, HI. Molecular weight 127.6.

Preparation.—Iodine 10 parts (140 grains); Alcohol 80 parts (1120 grains or 3 fluidounces); Syrup 150 parts (2100 grains or 3½ fluidounces); Sugar 500 parts (1 lb. av.); Spirit of Orange 5 parts (70 grains or 90 minims); Distilled Water in sufficient quantity; to make 1000 parts (2 lbs. av. or 24¼ fluidounces). Dissolve the iodine in the alcohol, with a very gentle heat, in a loosely-stoppered flask, avoiding loss of iodine from vaporization. Add the solution to the syrup previously mixed with 150 parts (60 oz. av. or 5¾ fluidounces) of distilled water, and pass through the mixture a current of hydrosulphuric acid gas until it acquires a pure yellowish color and ceases to turn brown on shaking. Filter the liquid through white filtering-paper, returning the first portions until it runs off clear; wash the filter with a little distilled water, and evaporate the filtrate and washings, in a tared porcelain capsule on a water-bath. at a temperature not exceeding 55° C. (131° F.), constantly stirring until all odor of hydrosulphuric acid has disappeared. Then set the capsule aside, well covered, and allow the contents to cool. When cold add the spirit of orange, the sugar, and enough distilled water to make the whole weigh 1000 parts (2 lbs. av.). When the sugar has been dissolved by stirring, strain the syrup through a pellet of cotton placed in the neck of the funnel, which is to be kept covered, and transfer the filtered syrup to small vials, which should be completely filled, securely corked, and kept in a cool and dark place.—*U. S.*

The reactions occurring in the preparation of this acid have been described elsewhere. On adding the alcoholic solution of iodine to the syrup the iodine will separate as a fine powder, which will rapidly settle in the liquid; therefore. to avoid loss, the precaution pointed out on page 59, to add the iodine gradually to the liquid in which the conversion into hydriodic acid takes place, should also be observed in this case.

Properties.—This syrup is described as "a transparent, colorless, or not more than pale straw-colored liquid, odorless, having a sweet and acidulous taste and an acid reaction. Sp. gr. 1.300. If disulphide of carbon be poured into a small portion of the syrup, a little chlorine-water then added, and the whole agitated, the disulphide will separate with a violet color."—*U. S.* Sugar will in a measure, but not completely, prevent the oxidation of the acid and the liberation of iodine; hence a pale straw-color of the otherwise colorless syrup is permitted.

Tests.—"Gelatinized starch added to the syrup should not impart to it more than a faint bluish tint (absence of more than traces of free iodine). Test solution of chloride of barium added to a portion of the syrup, should produce no precipitate (absence of sulphuric acid). Test solution of nitrate of silver produces a precipitate which is nearly insoluble in water of ammonia (absence of hydrochloric acid). To neutralize 25.5 Ccm. of syrup of hydriodic acid should require 20 Ccm. of the volumetric solution of soda."—*U. S.* The volumetric test is useful only after the absence of other organic as well as inorganic acids has been proven. The test designed to show the absence of hydrochloric acid should be supplemented by the direction that the ammoniacal filtrate from the silver precipitate, on being acidulated, should not be rendered more than faintly turbid.

Medical Uses.—As was mentioned under HYDRIODIC ACID. the virtues of that compound are chiefly of a local stimulant and caustic nature: the evidence of its utility as an internal medicine are, in our judgment, too slender to entitle it to an officinal position in the comparatively stable form of a syrup. The *dose* of the syrup is stated at a fluidrachm (Gm. 4), largely diluted. It has been given in chronic bronchitis, chronic malarial poisoning, etc. It appears to be a superfluous addition to the Pharmacopœia.

SYRUPUS ALLII, *U. S.*—SYRUP OF GARLIC.

Sirop d'ail, Fr.; *Knoblauchsyrup*, G.

Preparation.—Fresh Garlic, sliced and bruised, 15 parts (3 oz. av.); Sugar, in coarse powder, 60 parts (12 oz. av.); Diluted Acetic Acid 40 parts (8 oz. av. or 7½ fluidounces); to make 100 parts (20 oz. av. or about 14 fluidounces). Macerate the garlic with 25 parts (5 oz. av. or 4¾ fluidounces) of the diluted acetic acid in a glass vessel for four days, and express the liquid. Then mix the residue with the remainder of the acid, and again express until enough additional liquid has been obtained to make the whole, when filtered, weigh 40 parts (8 oz. av.). Lastly, pour the filtered liquid upon the sugar contained in a suitable bottle, and agitate until it is dissolved. Keep the syrup in well-stopped, filled bottles in a cool place.—*U. S.*

Thus prepared, syrup of garlic is somewhat opalescent and has the odor of the drug in a marked degree.

Medical Uses.—This is the form in which garlic is generally employed internally. It is very commonly used in subacute and chronic *catarrhs* of the respiratory passages in children and infants, and particularly in the decline of *whooping cough.* The *dose* is about a teaspoonful (Gm. 4).

SYRUPUS ALTHÆÆ, *U. S., P. G.*—SYRUP OF ALTHÆA.

Syrup of marshmallow, E.; *Sirop de guimauve*, Fr.; *Eibischsaft*, G.

Preparation.—Althæa, cut in small pieces, 4 parts (1 oz. av.); Sugar, in coarse powder, 60 parts (15 oz. av.); Water a sufficient quantity; to make 100 parts (20 oz. av. or about 18 fluidounces). Having washed the althæa with cold water, pour upon it 60 parts (15 oz. av. or 14⅜ fluidounces) of cold water, and macerate for 1 hour, stirring frequently; then strain through flannel without expressing. To 40 parts (10 oz. av. or 9 fluidounces) of the strained liquid add the sugar, and dissolve it by agitation without heat. This syrup should be freshly made when required for use.—*U. S.*

This is the formula of the P. G. 1872, with the marshmallow-root somewhat increased, but the sugar decreased in quantity; which changes will not render the syrup more permanent. Cold water must be used for maceration to avoid dissolving the starch, but the duration of maceration may very properly be prolonged for one or two hours, and by increasing the sugar the tendency to ferment will be lessened. The following formula yields a syrup less liable to these objections, and by doubling the quantity of marshmallow-root a syrup of the same mucilaginous strength as the above will be obtained: Macerate for 3 hours althæa 1 part, cold water 25 parts, and alcohol 1 part; strain without pressure, and in 20 parts of the liquid dissolve 30 parts of sugar.—*P. G.*

The syrup has a yellowish color and a slight agreeable odor.

Medical Uses.—This syrup, now for the first time officinal, is universally employed in France to sweeten ptisans used in sore throat and inflammations of the air-passages.

SYRUPUS AMYGDALÆ, *U. S.*—SYRUP OF ALMOND.

Syrupus amygdalarum, s. *Syr. emulsivus*, P. G.—*Sirop d'amande*, *Sirop d'orgeat*, Fr.; *Mandelsyrup*, G.

Preparation.—Sweet Almond 10 parts (2½ oz. av.); Bitter Almond 3 parts (¾ oz. av.); Sugar, in coarse powder, 50 parts (12½ oz. av.); Orange-Flower Water 5 parts (1¼ oz. av. or 9½ fluidrachms); Water a sufficient quantity; to make 100 parts (25 oz. av. or about 18 fluidounces). Having blanched the almonds, rub them in a mortar to a very fine paste, adding during the trituration 3 parts (6 fluidrachms) of water and 10 parts (2½ oz. av.) of sugar. Mix the paste thoroughly with the orange-flower water and 30 parts (7½ oz. av. or 7¼ fluidounces) of water; strain with strong expression, and add enough water to the dregs to obtain, after renewed expression, 60 parts (15 oz. av. or nearly 13 fluidounces) of strained liquid. To this add the remainder of the sugar, dissolve it by agitation without heat, and strain through muslin. Keep the syrup in well-stopped, filled bottles in a cool place.—*U. S.*

This formula is modified after that of the French Codex, but endeavors to avoid heat by dissolving the sugar by agitation or percolation. The pharmacopœias direct for 100 parts of sugar 10 parts, *U. S.* (9 parts *F. Cod.*, and 5 parts, *P. G.*), of orange-flower water. The syrup is whitish and opaque, and in order to obtain it free from dark color the integuments of the seeds must be completely removed, for which purpose the almonds are for a few minutes steeped in warm water.

Medical Uses.—Almond or orgeat syrup is an agreeable addition to expectorant and diuretic mixtures, and is possibly a feeble sedative of mild forms of febrile and nervous disorder through the minute proportion of hydrocyanic acid it contains. It is much used, mixed with water, in irritation of the *urinary passages.*

SYRUPUS AURANTII, *U. S., Br.*—SYRUP OF ORANGE.

Syrupus aurantii corticis, P. G.—*Syrup of orange-peel*, E.; *Sirop d'écorce d'orange amère*, Fr.; *Pomeranzenschalensyrup*, G.

Preparation.—Sweet Orange-Peel, recently separated from the fresh fruit, deprived of the inner white layer, and cut into small pieces, 5 parts (2½ oz. av.); Alcohol 5 parts (2½ oz. av. or 3 fluidounces); Precipitated Phosphate of Calcium 1 part (½ oz. av.); Sugar 60 parts (30 oz. av.); Water a sufficient quantity; to make 100 parts (50 oz. av. or about 2¼ pints). Macerate the orange-peel with the alcohol for 7 days; then express the liquid. Rub this with the precipitated phosphate of calcium and 30 parts (15 oz. av. or 14⅜ fluidounces) of water, gradually added; filter the mixture, and pass enough water through the filter to make the filtrate weigh 40 parts (20 oz. av. or 19 fluidounces). Lastly, add the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

Tincture of orange-peel 1 fluidounce; syrup 7 fluidounces. Mix.—*Br.*

The corresponding syrups of the French and German Pharmacopœias are made with bitter orange-peel, which, according to the former authority, is exhausted with alcohol of 6 per cent., and, according to the latter, with white wine; in the tincture thus obtained the sugar is dissolved. The U. S. P. makes the syrup from fresh sweet orange-peel, the volatile oil of which, together with some coloring matter, is dissolved by maceration with alcohol and expression; this tincture is treated in a manner similar to the volatile oils in the preparation of medicated waters (see page 232). Syrup of orange has a yellowish color and an agreeable odor and taste.

Medical Uses.—This syrup is merely an agreeable flavoring ingredient of medicinal mixtures. Its more decided taste, as compared with that of lemon and other simple officinal syrups, constitutes its special advantage.

SYRUPUS AURANTII FLORUM, *U. S., P. G.*—SYRUP OF ORANGE-FLOWERS.

Syrupus aurantii floris, Br.—*Sirop de fleur d'oranger*, Fr.; *Pomeranzenblüthensyrup*, G.

Preparation.—Orange-Flower Water 35 parts (14 oz. av. or 13½ fluidounces); Sugar, in coarse powder, 65 parts (26 oz. av.); to make 100 parts (2½ lbs. av. or 29 fluidounces). Dissolve the sugar in the orange-flower water by agitation, without heat.—*U. S.*

With the exception of a decrease of the sugar to 64.29 parts, the formula of the French Codex is identical with the above. The Br. P. directs the orange-flower water to be diluted with twice its weight (equal weight, *P. G.*) of water. The German Pharmacopœia permits this syrup to be dispensed in the place of *Syrupus capillorum Veneris*, or syrup of maidenhair (see p. 122).

Medical Uses.—Syrup of orange-flowers is a pleasant flavoring agent, with a possibility of exercising a slight sedative influence upon morbidly sensitive persons, since one-third of it consists of orange-flower water.

SYRUPUS CALCII LACTOPHOSPHATIS, *U. S.*—SYRUP OF LACTOPHOSPHATE OF CALCIUM.

Sirop de lactophosphate (*phospho-lactate*) *de chaux*, Fr.; *Calciumphospholactatsyrup*, G.

Preparation.—Precipitated Phosphate of Calcium 22 parts (440 grains = 1 oz. av. and 2½ grains); Lactic Acid 33 parts (660 grains or 9 fluidrachms and 34 minims); Orange-Flower Water 80 parts (1600 grains or 3½ fluidounces); Sugar, in coarse powder, 600 parts (12,000 grains or 27½ oz. av.); Hydrochloric Acid, Water of Ammonia, Water, each a sufficient quantity; to make 1000 parts (20,000 grains = 2 lbs. 13¾ oz. av. or about 33 fluidounces). To the precipitated phosphate of calcium, mixed with 300 parts (13¾ oz. av. or 13¼ fluidounces) of cold water, add enough hydrochloric acid to dissolve it. Filter the solution, dilute it with 1200 parts (55 oz. av. or 52¾ fluidounces) of cold water, and then add water of ammonia until it is slightly in excess. Transfer the mixture at once to a fine, wetted muslin strainer. As soon as the liquid has run off return the magma to the vessel, mix it quickly with 1200 parts (55 oz. av.) of cold water, and again transfer it to the strainer. When it has drained mix the magma at once with the lactic acid, and stir until it is dissolved. Then add the orange-flower water and enough water to make the solution weigh about 350 parts (7000 grains = 1 lb. av.); filter, and pass enough water through the filter to make the filtrate weigh 400 parts (8000 grains = 18¼ oz. av. and 16 grains). Lastly, add to this the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

This formula is a modification of the one proposed by Dr. Neergaard, by whom the syrup was first made in 1871. The first portion of the process has for its object the preparation of freshly-precipitated calcium phosphate, which is readily soluble in lactic acid. In this operation, as well as in dissolving the sugar, heat must be avoided, else a precipitate will be produced; the addition of a little lactic acid to the syrup will render the lime compound permanently soluble, provided the syrup be kept in a cool place.

The formula of the French Codex (1884) has been given on p. 355. Replacing the lactic acid by a sufficient quantity of hydrochloric acid, *sirop de chlorhydrophosphate de chaux* is obtained. *Sirop de phosphate acide de chaux* is made in the same manner, using sufficient phosphoric acid for dissolving the lime salt.

Medical Uses.—Not the least evidence exists that this preparation is endowed with medicinal virtues. It is intended especially to act as a reconstituent, but the proportion of lime contained in it is so minute that its action, of any sort, must be quite illusory. Moreover, as the greater part of the compound consists of sugar, it tends to produce or to prolong the gastric fermentation that exists in cases which require the use of true reconstituents. The *dose* of this preparation is at the option of the prescriber, from a teaspoonful to a wine-glassful, diluted.

SYRUPUS CALCIS, *U. S.*—SYRUP OF LIME.

Liquor calcis saccharatus, Br.; *Syrupus calcariæ.—Saccharated solution of lime*, E.; *Sirop de chaux*, Fr.; *Kalksyrup*, G.

Preparation.—Lime 5 parts (1 oz. av.); Sugar, in coarse powder, 30 parts (6 oz. av.); Water a sufficient quantity; to make 100 parts (20 oz. av. or about a pint). Triturate the lime and sugar thoroughly in a mortar; then add the mixture to 50 parts of boiling water contained in a bright copper or tinned-iron vessel, and boil the mixture for five minutes, constantly stirring. Dilute it with an equal volume of water and filter through white paper. Finally, evaporate the syrup to 100 parts (20 oz. av.).—*U. S.*

Take of slaked lime 1 ounce; refined sugar, in powder, 2 ounces; distilled water 1 pint. Mix the lime and the sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and, having closed this with a cork, shake it occasionally for a few hours. Finally, separate the clear solution with a siphon, avoiding unnecessary exposure to the air, and keep it in a well-stoppered bottle.—*Br.*

Water containing sugar dissolves a larger quantity of lime than pure water. Peligot ascertained the solubility for 100 parts of sugar in solutions of 40 per cent. to be 26.57 parts; of 20 per cent., only 23.15 parts; and in solutions of 5 per cent., only 18.06 parts of lime. According to these observations, the first formula must yield a preparation stronger in lime than that of the Br. P. Cane-sugar boiled with a strong solution of an alkali is gradually turned brown, while weak alkaline liquids have very little effect upon it (Hochstetter, 1843); and a concentrated solution of cane-sugar may be boiled with lime for a long time before decomposition commences (Dubrunfaut, Soubeiran).

This preparation is a thin, syrupy, colorless liquid, and has a bitter alkaline and somewhat sweet taste and an alkaline reaction. On exposure to air it absorbs carbonic acid gas, and must therefore be preserved in well-stopped bottles. Prepared according to the Br. P., it has the specific gravity 1.052, and 460.2 grains (1 fluidounce) require for neutralization 254 grain-measures of volumetric solution of oxalic acid, which corresponds to 7.11 grains of lime in 1 fluidounce (Imperial), or 1.546 per cent. of CaO.

Medical Uses.—The benefits which the lime in this preparation is fitted to produce are more or less prevented by the associated sugar. For all useful purposes pure lime-water is to be preferred. In Germany it has been recommended in poisoning by certain acids, as carbolic and oxalic acids. Its *dose* is not fixed, but may be stated at a teaspoonful or more, diluted.

SYRUPUS CHLORAL, *Br.*—SYRUP OF CHLORAL.

Sirop de chloral, Fr.; *Chloralsyrup*, G.

Preparation.—Take of Hydrate of Chloral 80 grains; Distilled Water 1½ fluidrachms; Simple Syrup a sufficiency. Dissolve the hydrate of chloral in the water, and add the syrup until the mixed product measures a fluidounce.—*Br.*

The syrup of the F. Cod. contains only 5 per cent. of chloral hydrate, and is flavored with spirit of peppermint.

Medical Uses.—This preparation is a convenient vehicle for the administration of chloral in definite doses. Each fluidrachm of it contains 10 grains of hydrate of chloral. The ordinary *dose* is from ½ to 1 fluidrachm (Gm. 2–4).

SYRUPUS FERRI BROMIDI, *U. S.*—SYRUP OF BROMIDE OF IRON.

Syrupus ferri bromati.—Sirop de bromure de fer, Fr.; *Eisenbromürsyrup*, G.

A syrupy liquid, containing 10 per cent. of ferrous bromide, $FeBr_2$. Molecular weight 215.5.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 30 parts (1¼ oz. av.); Bromine 75 parts (3 oz. av.); Sugar, in coarse powder, 600 parts (24 oz.

av.); Distilled Water a sufficient quantity; to make 1000 parts (40 oz. av. or about 28 fluidounces). Introduce the iron into a flask of thin glass of suitable capacity; add to it 200 parts (8 oz. av. or 7 fluidounces and 5½ fluidrachms) of distilled water, and afterward the bromine. Shake the mixture occasionally until the reaction ceases and the solution has acquired a green color and has lost the odor of bromine. Place the sugar in a porcelain capsule, and filter the solution of bromide of iron into the sugar. Rinse the flask and iron wire with 90 parts (3⅝ oz. or 27½ fluidrachms) of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling-point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts (2½ lbs. oz.). Lastly, shake the bottle, and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.—*U. S.*

The union of bromine and iron generates heat, which may rise to such a degree as to volatilize a portion of the bromine. Mr. W. S. Thompson, who published a formula for this syrup in 1870, advised to add the iron in small quantities to the bromine contained under water; this avoids annoyance by the irritating vapors of bromine, and toward the close of the reaction the iron may be added more freely. The reaction is known to be completed when the liquid is green and entirely free from the reddish tint and from the odor of bromine.

Properties.—Syrup of bromide of iron is a pale-green, transparent liquid, which is bleached on exposure to sunlight. It is inodorous, has a sweet and strongly ferruginous taste and a slightly acid (neutral, *U. S.*) reaction, shows to reagents the behavior of ferrous salts (see page 697), and the addition of a little chlorine-water liberates bromine, which has to solvents and to starch the behavior described on page 333. In contact with air it is slowly oxidized, and the yellow or brownish color disappears again on heating.

Tests.—"It should not deposit a sediment on keeping, and should not tinge gelatinized starch yellow (absence of free bromine). 10 Gm. of the syrup should require for complete precipitation not less than 1.57 Gm. of nitrate of silver (corresponding to 10 per cent. of ferrous bromide)."—*U. S.*

Medical Uses.—We have stated elsewhere (p. 673) the reasons which appear to render the bromide of iron an unnecessary, if not a dangerous, preparation. Its presumed medicinal effects may be more certainly secured by the administration of a salt of iron and one of bromine, alternately or conjointly. The quantities of this syrup representing the average doses of ferrous bromide would be from 5 to 20 drops (Gm. 0.06–1.30), but much larger doses have been prescribed, as f℥ss to f℥j (Gm. 2–4).

SYRUPUS FERRI IODIDI, *U. S.*, *Br.*—SYRUP OF IODIDE OF IRON.

Syrupus ferri iodati, P. G.; *Sirop d'iodure de fer*, Fr.; *Eisenjodürsyrup*, G.

A syrupy liquid, containing 10 per cent. of ferrous iodide, FeI_2. Molecular weight 309.1.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 25 parts (1 oz. av.); Iodine 82 parts (3 oz. av. and 122½ grains); Sugar, in coarse powder, 600 parts (24 oz. av.); Distilled Water a sufficient quantity; to make 1000 parts (40 oz. av. or about 28 fluidounces). Introduce the iron into a flask of thin glass of suitable capacity; add to it 200 parts (8 oz. av. or 7 fluidounces and 5½ fluidrachms) of distilled water, and afterward the iodine. Shake the mixture occasionally until the reaction ceases and the solution has acquired a green color and has lost the odor of iodine. Place the sugar in a porcelain capsule and filter the solution of iodide of iron into the sugar. Rinse the flask and iron wire with 90 parts (3⅝ fluidounces or 27½ fluidrachms) of distilled water, and pass the washings through the filter into the sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling-point on a sand-bath, and, having strained the syrup through linen into a tared bottle, add enough distilled water to make the product weigh 1000 parts (2½ lbs. av.). Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.—*U. S.*

On bringing iodine together with an excess of iron in the presence of water, ferrous iodide is formed and dissolves with a pale-green color. This compound has the formula FeI_2, and contains very nearly 82 per cent. of iodine. The aqueous solution, which should not be filtered until it has a pale-green color entirely free from any brown tint, is prone to change, but when protected by sugar, as proposed by Frederking (1839), and preserved with some precautions, it keeps unaltered. The details of the process given above are very similar to those of the German Pharmacopœia, both authorities directing the solution of ferrous iodide to be filtered upon the sugar, which is subsequently dissolved in the liquid by the aid of heat. Heretofore, the U. S. P., in common with the British Pharmacopœia, had adopted the plan of preparing a concentrated solution of ferrous iodide and filtering this into warm syrup, in which it sinks, owing to its greater density, and is thus perfectly protected against the oxidizing influence of the air. We prefer this manipulation to that at present recommended, and the process may be thus modified by dissolving the sugar in one-third its weight of water with the aid of heat, and in the mean time combining the iodine by adding it gradually to the iron kept under about two-thirds of the remaining water, the last portion being used for rinsing the flask and the filter. The strength of this syrup varies in the different pharmacopœias, that of the French Codex being much weaker than the others: 1 part of iodine (= 1.2 part of ferrous iodide) is represented by about 12.2 (*U. S.*), 21.5 (*Br.*), 24.4 (*P. G.*), and 244 (*F. Cod.*) parts of the syrup; or 1000 parts of the syrup contain 82 (*U. S.*), 46.5 (*Br.*), 41 (*P. G.*) and 4.10 (*F. Cod.*) parts of iodine.

Properties.—Syrup of iodide of iron is transparent, pale-green, nearly inodorous, and has a sweet, strongly ferruginous taste and a slightly acid (neutral, *U. S.*) reaction. It shows the behavior of solutions of ferrous salts (see page 697), and the addition of a little bromine-water liberates iodine, which has to solvents and to starch the behavior described on page 832. On exposure to the air the color of the syrup slowly changes to yellow and afterward to brown, the change of color proceeding from the exposed surface downward. Diffused daylight seems to somewhat accelerate the decomposition, but exposure to the direct sunlight entirely prevents the change, or, if it has taken place, restores the original color, and finally renders the syrup colorless. The effects of oxidation become manifest first by the production of ferric compound, and soon afterward by the liberation of iodine, recognized by the blue color produced with starch-paste; subsequently hydrate of iron containing variable quantities of iodine is precipitated, and after a short time this precipitate is not wholly redissolved again under the influence of sunlight, though the solution becomes colorless, perhaps from the formation of hydriodic acid. The application of heat has a similar effect. Syrups of the density of the above officinal syrups are not easily affected by exposure to the air, and we have known them to be kept in half-filled vials for months without apparent change. But if, from want of attention to the details of the process, the syrup should become colored from iodine, we prefer to restore it by exposure to sunlight, in preference to using a hyposulphite or other deoxidizing agents, which have been recommended for this purpose.

Should the iron used in preparing the solution of ferrous iodide be contaminated with other metals, these are likely to be dissolved. We have occasionally observed the syrup to contain a minute quantity of copper. On evaporating the syrup with due care to dryness, a yellowish-white powder is obtained, which is again soluble in water, yielding a slightly turbid solution (see page 685).

Tests.—"It should not deposit a sediment on keeping, and should not tinge gelatinized starch blue (absence of free iodine). 10 Gm. of the syrup should require for complete precipitation not less than 1.09 Gm. of nitrate of silver (corresponding to 10 per cent. of ferrous iodide)."—*U. S.*

The syrup of the French Codex is flavored with orange-flower water and contains gum; the solution of ferrous iodide is filtered, afterward mixed with syrup, and finally protected from the light.

Medical Uses.—In the treatment of *scrofula*, especially of the glandular form, in those numerous cases in which *anæmia* is owing to scrofula, tuberculosis, or syphilis, and in chronic affections of the *skin*, chronic *rheumatism*, *amenorrhœa* from exhaustion, *leucorrhœa*, etc., this compound was at one time greatly in vogue. It is now, however, very probable that its alleged virtues in the greater number of those diseases depended more upon the iron than upon the iodine in its composition. It has the disadvantage of being the least agreeable in its taste of all the officinal preparation of iron. This syrup may be given in *doses* of from 10 to 40 drops (Gm. 0.50–2.50) after meals. It should be largely diluted with water, and taken through a tube to prevent its injuring the teeth. As an additional precaution the mouth should be rinsed with water after each dose.

SYRUPUS FERRI PHOSPHATIS, *Br.*—Syrup of Phosphate of Iron.

Sirop de phosphate de fer, Fr.; *Eisenphosphatsyrup*, G.

Preparation.—Take of Granulated Sulphate of iron 224 grains; Phosphate of Sodium 200 grains; Bicarbonate of Sodium 56 grains; Concentrated Phosphoric Acid 1¼ fluidounces; Refined Sugar 8 ounces; Distilled Water 8 fluidounces. Dissolve the sulphate of iron in 4 ounces of boiling water, and the phosphate of sodium in a similar quantity of cold water; mix the solutions, add the bicarbonate of sodium dissolved in a little water, and, after careful stirring, transfer the precipitate to a calico filter, and wash it with distilled water till the filtrate ceases to be affected by chloride of barium. Mix the residue on the filter in a mortar with the phosphoric acid. As soon as the precipitate is dissolved, filter the solution, add water and the sugar, and dissolve without heat. The product should measure exactly 12 fluidounces, any water which may be necessary beyond that introduced with the precipitate or with the sugar being added to form the stated bulk.—*Br.*

Sulphate of iron and phosphate of sodium react on each other, forming ferrous phosphate and sulphate of sodium, the resulting free sulphuric acid, which would keep a portion of the ferrous phosphate in solution, being nearly neutralized with sodium bicarbonate. (See Ferri Phosphas, p. 692.) After washing, the precipitate is dissolved in phosphoric acid, and this solution is converted into syrup, which is therefore presumed to contain acid ferrous phosphate. But during the washing the originally white precipitate has turned blue from the formation of ferroso-ferric phosphate, and this oxidation continues to some extent in the syrup notwithstanding the protective influence of the sugar. The change produced in the color of the syrup on exposure is thus accounted for. The syrup has the density 1.305, and 1 fluidrachm contains about 1 grain of anhydrous ferrous phosphate.

Allied Syrups.—Syrup of Pyrophosphate of Iron is made by dissolving 10 parts of the officinal pyrophosphate of iron in 20 parts of water, and adding 970 parts of simple syrup (*F. Cod.*). This syrup contains 1 per cent. of the salt, and has a green color.

Numerous other formulas for syrups containing phosphate of iron in solution have been proposed, in some of which the free phosphoric acid has been wholly or partly replaced by hydrochloric acid, resulting in the formation of ferric chloride. H. W. Jones (1875) showed that a more satisfactory syrup is obtained by preparing the ferrous phosphate from iron and phosphoric acid; and E. B. Shuttleworth (1876) proposed the following formula: 38 grains of clean iron filings or fine iron wire are dissolved in a mixture of 6 fluidrachms each of water and phosphoric acid spec. grav. 1.5; the solution is filtered as soon as the iron is dissolved and mixed with 8½ fluidounces of simple syrup. Thus prepared, it is free from ferric salt, but otherwise represents the officinal syrup, and contains 1 grain of phosphate in the fluidrachm. Mr. Howie (1877) suggested dispensing with the acetate of sodium of the officinal formula, mixing the solutions of the other two salts while boiling hot, letting the mixture cool to about 50° C. (122° F.), and adding 45 grains of bicarbonate of sodium; the precipitate is washed with boiling water by decantation, and subsequently treated as directed in the officinal formula.

Syrupus phosphatum compositus, or Chemical Food. This was proposed by Edward Parrish (1857), whose formula is as follows: 600 grains of ferrous sulphate and 720 grains of sodium phosphate are separately dissolved in boiling water, the solutions mixed, and the precipitate thoroughly washed; 720 grains of calcium phosphate are dissolved in 4 ounces of hot water with the aid of hydrochloric acid; the solution is precipitated by ammonia and the precipitate well washed. The recently-obtained phosphates are dissolved in 1200 grains of glacial phosphoric acid previously dissolved in water; 40 grains of carbonate of sodium and 60 grains of carbonate of potassium are added to the solution, and if a precipitate should form it is redissolved by sufficient hydrochloric, or, preferably, by phosphoric, acid. The solution is now diluted with water to 20 fluidounces; 120 grains of powdered cochineal and 36 troyounces of sugar are added, and when the latter is dissolved the syrup is strained and flavored with 10 minims of oil of orange. Each teaspoonful is stated to contain about 1 grain of phosphate of iron, 2½ grains of phosphate of calcium, and smaller proportions of the phosphates of sodium and potassium. E. C. Saunders (1876), however, showed that a syrup thus prepared cannot contain the amounts of phosphates stated, and proposed to dissolve 240 grains of fine iron wire in 3 ounces (avoirdupois) of tribasic phosphoric acid spec. grav. 1.75 and 4 ounces of water; 923 grains of recently-slaked lime in 9½ ounces of phosphoric acid and 14 ounces of water; and 54 grains of crystallized sodium carbonate and 72 grains of potassium carbonate in ½ ounce of the phosphoric acid and 1 ounce of water. The three solutions are mixed and diluted with water to the measure of 28 fluidounces; the mixture, with 52 ounces of sugar and 85 grains of powdered cochineal, is made into a syrup, and this is flavored with 2 fluidounces of orange-flower water and diluted with water to 64 fluidounces.

Medical Uses.—This is a convenient and mild preparation of iron, which is assumed to have a special influence upon the nervous system. The *dose* is 1 fluidrachm (Gm. 4). Other non-officinal syrups have been devised, such as those above described, which, besides phosphorus and iron, contain lime, soda, and potassa, or else quinine and strychnine.

The latter are the most efficient. They have the disadvantage in many cases, however, of confining the bowels.

SYRUPUS FERRI QUININÆ ET STRYCHNINÆ PHOSPHATUM, *U. S.*—Syrup of the Phosphates of Iron, Quinine, and Strychnine.

Syrupus ferri phosphorici cum chinino et strychnino, Syrupus Eatoni.—Sirop tonique d'Eaton, Fr.; *Eaton'ssyrup*, G.

Preparation.—Phosphate of Iron 133 parts (200 grains); Quinine 133 parts (200 grains); Strychnine 4 parts (6 grains); Phosphoric Acid 800 parts (1200 grains or $2\frac{3}{4}$ oz. av.); Sugar, in coarse powder, 6000 parts (9000 grains or $20\frac{5}{8}$ oz. av.); Distilled Water a sufficient quantity; to make 10,000 parts (15,000 grains = $34\frac{1}{4}$ oz. av. or about 24 fluidounces). Add the phosphate of iron to 2500 parts ($8\frac{1}{2}$ oz. av. or 8 fluidounces) of distilled water in a tared bottle large enough to hold the finished syrup, and agitate frequently until the salt is dissolved. Having added the phosphoric acid to the solution, triturate the quinine and strychnine gradually with the mixture in a mortar until they are dissolved; then return the solution to the bottle and add enough distilled water to make the liquid weigh 4000 parts (6000 grains = $13\frac{3}{4}$ oz. av.). Lastly, add the sugar, dissolve it by agitation, without heat, and filter through paper. Keep the syrup in small, well-stopped vials in a cool and dark place.—*U. S.*

This syrup is known as *Eaton's syrup.* In the original formula freshly-precipitated ferrous phosphate was dissolved in phosphoric acid, and subsequently became oxidized on exposure to ferric salt. The phosphate of iron now employed is the pharmacopœial scaled sodio-ferric citrophosphate (see p. 691).

Medical Uses.—The association of iron, quinine, and strychnine is a very valuable one, but it is not judicious to make use of a preparation in which their proportion to one another is invariable, nor of one whose solid bulk is mainly sugar. Moreover, the present preparation is very liable to undergo changes that impair its qualities. *Dose*, 1 or 2 teaspoonfuls (Gm. 4–8).

SYRUPUS HEMIDESMI, *Br.*—Syrup of Hemidesmus.

Sirop de hemidesmus, Fr.; *Hemidesmussyrup*, G.

Preparation.—Take of Hemidesmus-Root, bruised, 4 ounces; Refined Sugar 28 ounces; boiling Distilled Water 1 pint (Imperial). Infuse the hemidesmus in the water, in a covered vessel, for four hours, and strain. Set it by till the sediment subsides; then decant the clear liquor, add the sugar, and dissolve by means of a gentle heat. The product should weigh 2 pounds 10 ounces, and should have the specific gravity 1.335. —*Br.*

Medical Uses.—The syrup of Indian sarsaparilla probably possesses no definite or peculiar medicinal virtues; it is used chiefly as a flavoring agent.

SYRUPUS HYPOPHOSPHITUM, *U. S.*—Syrup of Hypophosphites.

Syrupus calcii hypophosphitis compositus.—Sirop d' hypophosphite de chaux composé, Fr.; *Hypophosphitsyrup*, G.

Preparation.—Hypophosphite of Calcium 35 parts (700 grains = $1\frac{1}{2}$ oz. av. and 44 grains); Hypophosphite of Sodium 12 parts (240 grains); Hypophosphite of Potassium 12 parts (240 grains); Citric Acid 1 part (20 grains); Spirit of Lemon 2 parts (40 grains or 50 minims); Sugar, in coarse powder, 500 parts (10,000 grains = $22\frac{7}{8}$ oz. av.); Water a sufficient quantity; to make 1000 parts ($45\frac{3}{4}$ oz. av. or about 2 pints). Mix the hypophosphites, and dissolve them, by trituration, in 350 parts (16 oz. av. or $15\frac{3}{8}$ fluidounces) of water. Should there be a trifling residue undissolved, allow the solution to settle, pour off nearly all of it, and add the citric acid so that the residue may be dissolved. Then, having mixed the liquids, add the spirit of lemon, and filter through paper, adding through the filter enough water to make the whole weigh 500 parts ($22\frac{7}{8}$ oz. av.). In this liquid dissolve the sugar by agitation without heat, and strain. Keep the syrup in well-stopped bottles.—*U. S.*

Medical Uses.—As we have elsewhere insisted, there is no ground for believing in the efficiency of the pharmaceutical hypophosphites. The dose of this preparation has been stated at from ½ to 1 fluidrachm (Gm. 2–4), but no reason appears why more or less than this would not be quite as efficient.

SYRUPUS HYPOPHOSPHITUM CUM FERRO.—Syrup of Hypophosphites with Iron.

Preparation.—Lactate of Iron 1 part (100 grains); Syrup of Hypophosphites 99 parts (9900 grains = 22⅝ oz. av. or about 1 pint); to make 100 parts (10,000 grains = 22⅞ oz. av.). Dissolve the lactate of iron in the syrup by trituration. Keep the syrup in well-stopped bottles.—*U. S.*

This and the preceding syrup have been in use since 1857, but have been admitted into the Pharmacopœia for the first time in 1880. Formerly hypophosphite of iron was used, but this salt has been replaced in the above formula by the lactate. In preparing both syrups heat should be avoided, and they should be kept in well-stopped bottles to lessen the chances of gradual oxidation.

Medical Uses.—The remarks made on the analogous preparation immediately preceding apply to this one also. *Dose*, ½ to 1 fluidrachm (Gm. 2–4).

SYRUPUS IPECACUANHÆ, *U. S., P. G.*—Syrup of Ipecac.

Sirop d' ipécacuanha, Fr.; *Ipecacuanhasyrup*, G.

Preparation.—Fluid Extract of Ipecac 5 parts (500 grains); Syrup 95 parts (9500 grains = 21¾ oz. av.); to make 100 parts (10,000 grains = 22⅞ oz. av. or about 17 fluidounces). Mix them.—*U. S.*

The difficulties encountered in the preparation of fluid extract of ipecac which would mix with water without turbidity have been explained on page 641. The mixture of fluid extract and syrup is usually clear in the beginning, but a flocculent matter begins to separate after some time, and settles slowly. In this case it is best to modify the process as follows: Dilute 500 grains of the fluid extract with 7 oz. av. of distilled water, and set aside for a day; then pass through a filter and wash the precipitate with distilled water until the filtrate weighs 8¾ oz. av.; in this liquid dissolve 14⅛ oz. av. of sugar. either by agitation or preferably by percolation. In this connection an inconsistency of the present U. S. Pharmacopœia should be noticed in directing the fluid extracts to be prepared measure for weight, and in weighing these same fluid extracts when using them for other preparations. Since the density of fluid extracts must necessarily vary somewhat, syrup of ipecac and similar preparations will obviously represent only approximately definite weights of the drug.

The syrup of the German Pharmacopœia represents 1 per cent. of its weight of ipecacuanha-root, and that of the French Codex 1 per cent. of extract of ipecacuanha.

Medical Uses.—This syrup is used chiefly as an emetic for infants, and as an expectorant in cases of acute *laryngitis* and *bronchitis*. For the former purpose the dose is from ½ to 1 fluidrachm (Gm. 2–4), repeated every ten minutes until it operates; and for the latter it may be given to infants and children in doses of from 5 to 20 drops (Gm. 0.30–1.30), and to adults in double those quantities. It forms a very useful ingredient of expectorant mixtures in the diseases named.

SYRUPUS KRAMERIÆ, *U. S.*—Syrup of Krameria.

Syrupus ratanhæ.—*Syrup of rhatany*, E.; *Sirop de ratanhia*, Fr.; *Ratanhasyrup*, G.

Preparation.—Fluid Extract of Krameria 35 parts (7 oz. av.); Syrup 65 parts (13 oz. av.); to make 100 parts (20 oz. av.). Mix them.—*U. S.*

The U. S. P. 1870 directed for this syrup the mixing of fluid extract of rhatany 12 fluidounces and syrup 24 fluidounces. The present fluid extract is about 5 per cent. weaker. The syrup of the French Codex is made with the aqueous extract of rhatany, of which it contains 2.5 per cent. of its weight.

Syrupus iodo-tannicus (see also p. 833). Guilliermond recommends extract of rhatany for this syrup, which may be made by dissolving 2 grains of iodine, with a little alcohol, in 200 grains of syrupus krameriæ (*U. S. P.*), and adding 800 grains of simple syrup.

Medical Uses.—Syrup of rhatany is chiefly used as a medicine for infants and children affected with *bowel complaints* independent of organic or inflammatory disease, and is usually associated in mixtures with chalk and other antacids and astringents. The *dose* for a child a year or two old is from ½ to 1 fluidrachm (Gm. 2–4).

SYRUPUS LACTUCARII, *U. S.*—Syrup of Lactucarium.

Sirop de lactucarium, Fr.; *Lactucariumsyrup*, G.

Preparation.—Fluid Extract of Lactucarium 5 parts (500 grains); Syrup 95 parts (9500 grains = 21¾ oz. av.), to make 100 parts (10,000 grains = 22⅞ oz. av. or about 17 fluidounces). Mix them.—*U. S.*

As formerly prepared, syrup of lactucarium was of a turbid and unsightly appearance. Since alkalies destroy the bitter taste of lactucarium, neither potassa, soda, nor magnesia should be used in making the syrup. The turbidity was due to lactucerin, and could be removed, according to Kenworthy (1868), without impairing the virtues of the syrup by triturating the concentrated tincture with powdered pumice-stone, or, according to Lemberger (1878), by previously exhausting lactucarium with petroleum benzin. Paper-pulp or other insoluble material may be used with the same effect. But the present fluid extract, if properly prepared, will yield a clear mixture with syrup, which may be prepared extemporaneously.

Sirop de lactucarium opiacé, *F. Cod.*, contains in each tablespoonful 0.005 Gm. (1/14 grain) of extract of opium and 0.01 Gm. (1/7 grain) of alcoholic extract of lactucarium.

Medical Uses.—It is very doubtful whether this preparation possesses any hypnotic powers at all. It may be used as a *placebo* for mothers in certain cases of infantile disorder in the *dose* of 1 or more fluidrachms (Gm. 4).

SYRUPUS LIMONIS, *U. S., Br.*—Syrup of Lemon.

Syrupus succi citri.—*Sirop de suc de limon* (*de citron*), Fr.; *Citronensyrup*, G.

Preparation.—Lemon-Juice, recently expressed and strained, 40 parts (20 oz. av.); Fresh Lemon-Peel 2 parts (1 oz. av.); Sugar, in coarse powder, 60 parts (30 oz. av.), Water a sufficient quantity; to make 100 parts (50 oz. av. or about 2¼ pints). Heat the lemon-juice to the boiling point; then add the lemon-peel, and let the whole stand, closely covered, until cold. Filter, add enough water through the filter to make the filtrate weigh 40 parts (20 oz. av.), dissolve the sugar in the filtered liquid by agitation without heat, and strain.—*U. S.*

The present formula is nearly identical with that of the Br. P., which differs in ordering 2 ounces of lemon-peel and 36 ounces of sugar. The U. S. P. 1870 omitted the lemon-peel, and its syrup was but slightly aromatic.

Medical Uses.—This syrup is scarcely medicinal. It is used habitually with water as a beverage, and thus forms a pleasant and suitable drink in febrile affections generally, especially when mixed with carbonic acid water.

SYRUPUS MORI, *Br.*—Syrup of Mulberries.

Syrupus mororum.—*Sirop de mûre*, Fr.; *Maulbeersaft*, G.

Preparation.—Take of Mulberry-Juice 1 pint (Imperial); Refined Sugar 2¼ pounds; Rectified Spirit 2½ fluidounces. Heat the mulberry-juice to the boiling-point, and when it has cooled filter it. Dissolve the sugar in the filtered liquid with a gentle heat, and add the spirit. The product should weigh 3 pounds 6 ounces, and should have the specific gravity 1.33.—*Br.*

This and all other syrups of acid fruit-juice should be prepared only in porcelain or well-enamelled iron vessels. The heating of the juice to the boiling-point has for its object the removal of the albumen.

The fruit syrups of the French Codex and of the German Pharmacopœia, with the exception of lemon syrup, are made with the fermented juice. (See Syrupus Rubi Idæi.)

Medical Uses.—In this country syrups made from currants, raspberries, and strawberries are as commonly used as mulberry syrup and mulberry wine are in England. Mulberry syrup has no therapeutic virtues which are not possessed by the other syrups mentioned.

SYRUPUS PAPAVERIS, *Br., P. G.*—Syrup of Poppies.

Syrupus capitum papaveris, Syrupus diacodii.—Sirop de pavot blanc, Fr.; *Beruhigungssaft*, G.

Preparation.—Take of Poppy-Capsules, dried, freed from the seeds, and coarsely powdered, 36 ounces; Rectified Spirit 16 fluidounces; Refined Sugar 4 pounds; boiling Distilled Water a sufficiency. Mix the poppy-capsules with 4 pints of the water and infuse for 24 hours, stirring them frequently; then pack them in a percolator, and, adding more of the water, allow the liquor slowly to pass until about 2 gallons have been collected or the poppies are exhausted. Evaporate the liquor by a water-bath, until it is reduced to 3 pints (Imperial). When quite cold, add the spirit, let the mixture stand for 12 hours, and filter. Distil off the spirit, evaporate the remaining liquor to 2 pints, and then add the sugar. The product should weigh 6½ pounds, and should have the specific gravity 1.330.—*Br.*

The concentrated infusion of poppy contains much mucilage, which is precipitated by the alcohol. This syrup is less liable to ferment than if prepared from an infusion not subjected to the treatment with alcohol and is nearly six times stronger in poppy-capsules than that of the P. G. The syrup was formerly often prepared from the hot infusion of poppy-capsules, St. John's bread, and liquorice-root. On account of the variable composition of poppy-capsules the French Codex directs this syrup to be prepared by dissolving 1 part of alcoholic extract of poppy in 3 parts of alcohol, and mixing with 96 parts of syrup. *Sirop diacode* is a solution of ½ grain, and *sirop d'opium* a solution of 2 grains, of extract of opium in 1000 grains of simple syrup; *syrupus opiatus* (P. G. 1872) contained 1 grain of the extract in the same amount of syrup.

Medical Uses.—The variable proportion of opium in poppy-capsules renders this preparation uncertain in its effects, and therefore capable of doing serious injury to young children, the class of persons it is intended for especially. It is far better to add a definite proportion of a liquid preparation of opium or of morphine to syrup of acacia, of marshmallow, or of wild-cherry if a weak anodyne or narcotic action is required. The *dose* of this syrup is stated to be ½ fluidrachm (Gm. 2) for young children.

SYRUPUS PICIS LIQUIDÆ, *U. S.*—Syrup of Tar.

Syrupus piceus.—Sirop de goudron, Fr.; *Theersyrup*, G.

Preparation.—Tar 6 parts (3 oz. av.); Cold Water 12 parts (6 oz. av. or 5¾ fluidounces); boiling Distilled Water 50 parts (25 oz. av. or 24 fluidounces); Sugar, in coarse powder, 60 parts (30 oz. av.); to make 100 parts (50 oz. av. or about 2¼ pints). Upon the tar, contained in a suitable vessel, pour the cold water, and stir the mixture frequently during 24 hours; then pour off the water and throw it away. Pour the boiling distilled water upon the residue, stir the mixture briskly for 15 minutes, and set it aside for 36 hours, stirring occasionally. Decant the solution and filter. Lastly, in 40 parts (20 oz. av. or 19¼ fluidounces) of the filtered solution dissolve the sugar by agitation, without heat.—*U. S.*

This formula is very similar to that of the French Codex of 1866. The tar is first treated with water for the purpose of removing most of the acetic acid present, and this infusion is rejected. The various soluble constituents of tar are then extracted by hot water, as directed above, or by one of the methods described on page 1182; in the tar-water thus obtained the sugar is dissolved by agitation or by percolation. Thus prepared, the syrup is of a yellowish color, has the odor of tar, a slightly bitter taste, and an acid reaction, and when rendered alkaline becomes brown.

Syrupus picis iodatus, *Sirop de goudron iodé*, is much employed in France, and contains $\frac{1}{10}$ per cent. of iodine. 1 grain of iodine dissolved in a little alcohol is added, with agitation, to 1000 grains of syrup of tar; the color of iodine will disappear in a few days, when the iodized syrup has about the same color as tar syrup.

Medical Uses.—It may be questioned whether the sugar in this preparation of tar-water does not impair the activity of the medicine, and partly so by retarding its absorption. The dose may be stated at from a tablespoonful to a wine-glassful (Gm. 16–64) according to the age of the patient and the tolerance of his stomach.

SYRUPUS PRUNI VIRGINIANÆ, *U. S.*—Syrup of Wild-Cherry.

Sirop d'écorce de cérisier, Fr.; *Wildkirschenrindensyrup*, G.

Preparation.—Wild-Cherry, in No. 20 powder, 12 parts (6 oz. av.); Sugar, in coarse powder, 60 parts (30 oz. av.); Glycerin 5 parts (2½ oz. av.); Water a sufficient quantity; to make 100 parts (50 oz. av. or about 2¼ pints). Moisten the wild-cherry thoroughly with water, and macerate for 24 hours in a close vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour water upon it until 35 parts (17½ oz. av. or about 16 fluidounces) of percolate are obtained. Dissolve the sugar in the liquid by agitation, without heat, add the glycerin, and strain.—*U. S.*

The treatment of wild-cherry bark with cold water results in the production of hydrocyanic acid and oil of bitter almond (see page 1248), which, together with the bitter and astringent principles, are contained in the syrup, which has a rich brownish-red color and a pleasant taste. A formula for this preparation was proposed by Procter and Turnpenny in 1842, and the substitution of glycerin for a portion of the sugar was suggested by C. Schnabel (1874) for the purpose of preventing fermentation. A still larger proportion of glycerin was recommended by W. H. Walling (1874).

Medical Uses.—Syrup of wild-cherry has no peculiar medicinal virtues, but is a most agreeable flavoring addition to mixtures. It is often added to such under the impression that it may aid in appeasing cough. The *dose* is a fluidrachm (Gm. 4) or more.

SYRUPUS RHAMNI.—Syrup of Buckthorn.

Syrupus rhamni catharticæ, s. Syr. spinæ cervinæ, s. Syr. domesticus, P. G.—*Sirop de nerprun*, Fr.; *Kreuzdornbeerensyrup*, G.

Preparation.—Take of Buckthorn-Juice 4 pints; Ginger, sliced, Pimento, bruised, each ¾ ounce; Refined Sugar 5 pounds or a sufficiency; Rectified Spirit 6 fluidounces. Evaporate the juice to 2½ pints (Imperial), add the ginger and pimento, digest at a gentle heat for 4 hours, and strain. When cold add the spirit; let the mixture stand for 2 days, then decant off the clear liquor, and in this dissolve the sugar with a gentle heat, so as to make the specific gravity 1.32.—*Br.*, 1867.

This syrup is made by the French and German Pharmacopœias with the fermented juice not concentrated by evaporation, and does not contain any aromatics.

Medical Uses.—In Europe syrup of buckthorn is generally used as a purgative for children in the *dose* of a teaspoonful (Gm. 4).

SYRUPUS RHEI, *U. S., Br., P. G.*—Syrup of Rhubarb.

Sirop de rhubarbe, Fr.; *Rhabarbersaft*, G.

Preparation.—Rhubarb, sliced, 90 parts (3¾ oz. av.); Cinnamon, bruised, 18 parts (¾ oz. av.); Carbonate of Potassium 6 parts (¼ oz. av.); Sugar, in coarse powder, 600 parts (25 oz. av.); Water a sufficient quantity; to make 1000 parts (41¾ oz. av. or about 30 fluidounces). Mix the rhubarb, cinnamon, and carbonate of potassium with 420 parts (17½ oz. av. or 16¾ fluidounces) of water, and macerate the mixture in a glass or porcelain vessel for 12 hours. Then strain and filter, adding through the dregs, if necessary, enough water to make the filtered liquid weigh 400 parts (16¾ oz. av.). Lastly, add the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

Take of rhubarb-root, in No. 20 powder, coriander-fruit, in No. 20 powder, each 2 ounces; refined sugar 24 ounces; rectified spirit 8 fluidounces; distilled water 24 fluidounces. Mix the rhubarb and coriander; pack them in a percolator; pass the spirit and water previously mixed slowly through them; evaporate the liquid that has thus passed until it is reduced to 14 fluidounces, and in this, after it has been filtered, dissolve the sugar with the aid of heat. The product should weigh nearly 2½ pounds.—*Br.*

The first formula is that of the German Pharmacopœia, with some modifications, the most important being the reduction of potassium carbonate from 9 to 6 parts, and the apparent strength of the syrup, 90 parts of rhubarb yielding 1000 parts (*U. S.*) and 1800 parts (*P. G.*) of finished syrup; the manipulation is alike in both cases, and involves considerable waste of material. Rhubarb yields to cold water about 40 per cent. of extractive matters, to alkaline liquids somewhat more; 90 parts of rhubarb therefore yield at least 36 parts of soluble matter, and, without taking into consideration the soluble matter yielded by the cinnamon, the actual weight of the solution is 420 (water) + 6 (potassium carbonate) + 36 (from rhubarb) = 462 parts. Of this at most 400 parts are obtained by expressing and washing, and the loss amounts to at least 62 parts or 13.4 per cent. It is, however, actually greater, since by adding water through the dregs (expression is not directed, but is indispensable) the solution is considerably diluted, instead of being simply displaced. The German Pharmacopœia directs for 90 parts of rhubarb 900 parts of water, and after expressing and filtering obtains 720 parts of liquid; the waste is proportionally greater.

The present syrup is of a deep brown-red color, and is transparent in thin layers; the presence of alkali renders it unfit for combination with various salts, which are precipitated thereby. The syrup of the Br. P. is of a deep-brown color and somewhat opaque, and of a similar appearance was the syrup of rhubarb as prepared by the U. S. P. 1870 by mixing 3 fluidounces of fluid extract of rhubarb with 29 fluidounces of simple syrup.

Medical Uses.—The simple syrup of rhubarb is seldom used, but it may be given as a purgative to infants in the *dose* of a fluidrachm (Gm. 4).

SYRUPUS RHEI AROMATICUS, *U. S.*—Aromatic Syrup of Rhubarb.

Spiced syrup of rhubarb, E.; *Sirop de rhubarbe aromatique*, Fr.; *Gewürzter Rhabarbersaft*, G.

Preparation.—Aromatic Tincture of Rhubarb 10 parts (2 oz. av.); Syrup 90 parts (18 oz. av.); to make 100 parts (20 oz. av. or about 15 fluidounces). Mix the aromatic tincture of rhubarb with the syrup.—*U. S.*

The aromatic tincture of rhubarb, which was formerly prepared to be at once mixed with the syrup, is now recognized as a distinct preparation. The syrup is of about the same strength as that of the former Pharmacopœia, which directed 1 part by measure of the tincture to 6 parts by measure of simple syrup; it has an agreeable odor, a spicy and bitterish but pleasant taste, and is somewhat opaque in appearance.

Medical Uses.—This preparation is in universal use as a purgative for children in *diarrhœa* attended with flatulence and colic. The *dose* is 1 fluidrachm (Gm. 4).

SYRUPUS RHŒADOS, *Br.*—Syrup of Red Poppy.

Sirop de coquelicot, de pavot rouge, Fr.; *Klatschrosensaft*, G.

Preparation.—Take of fresh Red Poppy-Petals 13 ounces; Refined Sugar 2¼ pounds; Distilled Water 1 pint (Imperial) or a sufficiency; Rectified Spirit 2½ fluidounces. Add the petals gradually to the water heated in a water-bath, frequently stirring, and afterward, the vessel being removed, infuse for 12 hours. Then press out the liquor, strain, add the sugar, and dissolve by means of heat. When nearly cold add the spirit and as much distilled water as may be necessary to make up for loss in the process, so that the product shall weigh 3 pounds 10 ounces. It should have the specific gravity 1.33.—*Br.*

The addition of alcohol to the finished syrup is designed to counteract its tendency to fermentation. The syrup is of a deep-red color.

Medical Uses.—The syrup of red poppy is an opiate preparation of uncertain strength, and, being only used for coloring mixtures, it appears to be superfluous. The *dose* is a fluidrachm (Gm. 4).

SYRUPUS ROSÆ, *U. S.*—Syrup of Rose.

Syrupus rosæ gallicæ, U. S. 1870, Br.; *Syrupus rosarum rubrarum.—Syrup of red rose*, E.; *Sirop de roses rouges*, Fr.; *Rosensyrup*, G.

Preparation.—Fluid Extract of Rose 10 parts (2 oz. av.); Syrup 90 parts (18 oz. av.); to make 100 parts (20 oz. av. or about 15 fluidounces). Mix them.—*U. S.*

Take of dried red rose petals 2 ounces; refined sugar 30 ounces; boiling distilled water 1 pint. Infuse the petals in the water for 2 hours; squeeze through calico, heat the liquor to the boiling point, and filter. Dissolve the sugar in the liquor by means of heat. The product should weigh 2 pounds 14 ounces, and should have the specific gravity 1.335.—*Br.*

The syrup is of a fine red color and has an agreeable somewhat astringent taste.

Medical Uses.—It is used almost exclusively for giving an agreeable color and flavor to other syrups and to mixtures. *Dose*, a fluidrachm (Gm. 4).

SYRUPUS RUBI, *U. S.*—Syrup of Rubus.

Syrup of blackberry-bark, E.; *Sirop de écorce de ronce*, Fr.; *Brombeerrindensyrup*, G.

Preparation.—Fluid Extract of Rubus 20 parts (4 oz. av.); Syrup 80 parts (16 oz. av.); to make 100 parts (20 oz. av. or about 1 pint). Mix them.—*U. S.*

This syrup has a deep reddish-brown color and a strongly astringent taste.

Medical Uses.—As a remedy for slight *diarrhœa* independent of irritants in the intestine and of inflammatory conditions of that organ syrup of blackberry-root is a convenient astringent. But the syrup is generally less appropriate than the decoction. Its *dose* is 1 or 2 fluidrachms (Gm. 4–8).

SYRUPUS RUBI IDÆI, *U. S.*, *P. G.*—Syrup of Raspberry.

Sirop de framboise, Fr.; *Himbeersaft*, G.

Preparation.—Fresh Ripe Raspberries any convenient quantity; Sugar a sufficient quantity. Reduce the raspberries to a pulp, and let it stand at rest for 3 days. Separate the juice by pressing, and set it aside until it has completely fermented and become clear, and then filter. To 40 parts of the filtered liquid add 60 parts of sugar, heat to boiling, avoiding the use of tinned vessels, and strain. Keep the syrup in well-stopped bottles in a cool and dark place.—*U. S.*

This formula has been taken from the P. G. 1872, and, if the temperature be kept low enough after bruising the raspberries, will yield good results; during the warm summer months, however, when fresh raspberries are procurable, acetic fermentation will set in. The new French Codex directs the fresh fruit to be expressed and the juice to be fermented at a temperature of 12° to 15° C. (54°–59° F.), fermentation to be arrested as soon as the liquid will readily pass through a filter; otherwise the flavor will be much impaired. The present P. G. gives the following directions: "Bruise the raspberries, set them aside, at about 20° C. (68° F.), in a covered vessel; stir frequently, and when a filtered portion of the juice may be mixed with half its bulk of alcohol without becoming turbid express and filter." Other fruit-juices are prepared in precisely the same manner. The juice of ripe raspberries ferments readily, and the fermentation is completed in a few hours or a day, according to the temperature. The formation of mould and acetic fermentation impair the flavor; the progress of fermentation should therefore be closely watched, and the expressed juice should be rapidly filtered and at once converted into syrup. Fruit-syrups contain 59.3 (*Br.*), 60 (*U. S.*), 63.7 (*F. Cod.*), and 65 (*P. G.*) per cent. of sugar.

Properties.—Raspberry syrup has a bright-red color, a very agreeable fruit odor, a pleasant acidulous taste, and a distinct acid reaction. When agitated with amylic alcohol, ether, or chloroform, these liquids are not colored. On being rendered alkaline the syrup becomes dark-blue or dingy-violet colored, and when treated with basic lead acetate a dingy-blue or blue-green precipitate is produced, the filtrate being colorless or nearly so When strongly acidulated with cold nitric acid the red color is not changed to yellow These reactions serve to distinguish raspberry syrup from imitations colored with aniline-red or with other coloring matters of vegetable origin.

Allied Preparations.—Syrupus cerasorum, *P. G.*—Cherry syrup, *E.;* Sirop de cerise, *Fr.;* Kirschsyrup, *G.*—The juice of black cherries is fermented in the presence of the bruised seeds, and further treated as stated above.

Syrupus cydoniæ (quince syrup), Syr. fragariæ (strawberry syrup), Syr. granati (pomegranate syrup), and others are prepared in a similar manner, the ripe fruits being used. (See also Syr. Mori and Syr. Rhamni).

Acetum rubi idæi.—Raspberry vinegar, *E.;* Vinaigre framboisé, *Fr.;* Himbeeressig, *G.*—Mix equal parts of syrup of raspberry and of vinegar.—*F. Cod.* Raspberry syrup 1 part, pure vinegar 2 parts.—*P. G.* 1872. Other fruit-vinegars may be made in the same manner.

Aqua rubi idæi.—Raspberry-water, *E.;* Eau de framboise, *Fr.;* Himbeerwasser, *G.*—Distil 2 parts of water from 1 part of the press-cake left on clarifying raspberry-juice as described above.—*P. G.* 1872. It has an agreeble fruit odor. *Strawberry-water* is made in the same manner; it is sometimes used as a cosmetic.

Medical Uses.—This syrup has no special medicinal virtues. It forms an agreeable flavoring addition to mixtures, and with water a pleasant drink in febrile affections.

SYRUPUS SARSAPARILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Sarsaparilla.

Syrupus sudorificus.—Sirop de salsepareille composé, Sirop sudorifique, Fr.; *Zusammengesetzter Sarsaparillsyrup*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 150 parts (12½ oz. av.); Guaiacum-Wood, in No. 30 powder, 20 parts (1¾ oz. av.); Pale Rose, in No. 30 powder, 12 parts (1 oz. av.); Glycyrrhiza, in No. 30 powder, 12 parts (1 oz. av.); Senna, in No. 30 powder, 12 parts (1 oz. av.); Sassafras, in No. 20 powder, 6 parts (½ oz. av.); Anise, in No. 20 powder, 6 parts (½ oz. av.); Gaultheria, in No. 20 powder, 6 parts (½ oz. av.); Sugar, in coarse powder, 600 parts (50 oz. av.); Diluted Alcohol, Water, each a sufficient quantity; to make 1000 parts (83⅓ oz. av. or about 60 fluidounces). Mix the solid ingredients, except the sugar, with 300 parts (25 oz. av. or 25⅞ fluidounces) of diluted alcohol, and macerate the mixture for 48 hours; then transfer it to a cylindrical percolator, pack it firmly, and gradually pour diluted alcohol upon it until 600 parts (50 oz. av. or about 3 pints) of tincture have been obtained. Evaporate this portion, by means of a water-bath, to 300 parts (25 oz. av. or about 1½ pints); add 100 parts (8⅓ oz. av.) of water, and filter, adding enough water through the filter to make the whole weigh 400 parts (33⅓ oz. av. or about 2 pints). Lastly, add the sugar, dissolve it by agitation without heat, and strain.

By careful percolation with diluted alcohol the medicinal principles of the drugs ordered in the above formula are thoroughly extracted, with the exception of the resin contained in guaiacum-wood, and are not injured if the alcohol of the tincture is evaporated at a heat not exceeding the temperature attainable by a water-bath. In the watery liquid now remaining the resinous matters which were dissolved by the alcohol are insoluble, and are removed by filtration; the filtrate therefore contains only the extractive matters of guaiacum-wood, but none, or only little, of its resin. The volatile oils taken up from the sassafras, anise, and gaultheria are partly volatilized during the evaporation; the heat should therefore be as low as possible in this operation, and the sugar should be dissolved in the filtered liquid by percolation, which, owing to frothing, is far preferable to agitation. The former Pharmacopœia did not use the aromatics ordered in the present formula for percolation, but in place thereof added to the warm syrup a small quantity of the volatile oils, amounting for each pint to about a drop of oil of anise and of sassafras and about ½ drop of oil of gaultheria. The syrup is of a dark-brown color, has an agreeable flavor, and leaves an acrid impression in the throat.

R. F. Fairthorne (1881) recommended the exhaustion of the powder without alcohol by what he termed "intermittent percolation," or alternate maceration and percolation. The material is macerated for a day with sufficient water only to obtain by percolation one-fourth of the total liquid needed, and this is repeated twice in the same manner; the drugs are now completely exhausted with cold water, the infusion concentrated by evaporation as much as necessary, and this liquid is added to the three portions previously obtained, which have in the mean time been mixed and kept in a cool place; the syrup is finally finished in the usual manner.

The syrup of the French Codex is made by hot infusion of sarsaparilla, borage-flowers, pale rose, senna, and anise; it is known as *sirop de Cuisinier.* Under the names of *sirop de Laffecteur* and *rob Boyveau-Laffecteur* a similar but more complex preparation has been in use in France; more than thirty drugs entered into its composition.

Medical Uses.—Compound syrup of sarsaparilla has been extensively used in the treatment of constitutional *syphilis*, but there is no evidence whatever to prove its efficiency when given alone. For this reason, probably, it is omitted from the British and German Pharmacopœias. It is a convenient vehicle for the administration of iodide of potassium. Corrosive sublimate, which is sometimes added to it, is converted by it into calomel. The *dose* is half a fluidounce (Gm. 16), diluted, several times a day.

SYRUPUS SCILLÆ, *U. S., Br.*—Syrup of Squill.

Syrupus aceti scillæ.—Sirop de scille, Fr.; *Meerzwiebelsyrup*, G.

Preparation.—Vinegar of Squill 40 parts (20 oz. av. or about 18½ fluidounces); Sugar, in coarse powder, 60 parts (30 oz. av.); Water a sufficient quantity; to make 100 parts (50 oz. or about 36 fluidounces). Heat the vinegar of squill to the boiling-point in a glass or porcelain vessel, and filter while hot, adding, through the filter, enough water to make the filtrate weigh 40 parts (20 oz. av.). Add the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

The formula now directs the removal of the albumen in the manner suggested in the preceding editions of this work, and a permanently clear syrup is thus obtained. The sugar may be dissolved with the aid of heat, but percolation is to be preferred. The use of metallic vessels should be avoided. The syrup of the Br. P. is much denser than the above; it is made from an Imperial pint (20 fluidounces) of the vinegar and 40 oz. av. of sugar, and has a specific gravity of about 1.345.

Medical Uses.—This syrup is an adequate representative of squill—at least in its action upon the bronchial mucous membrane. It is much used in the treatment of laryngeal and bronchial *catarrhs*, both for promoting the resolution of such affections, and in children, when used in appropriate doses, for producing emesis, and thereby expelling accumulated secretions from the air-passages. It is habitually associated with syrup of ipecacuanha or syrup of senega, according to the nature of the case. The *dose*, as an expectorant, is from half a fluidrachm to a drachm (Gm. 2–4), and in the latter quantity it is emetic when repeated at short intervals.

SYRUPUS SCILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Squill.

Sirop de scille composé, Fr.; *Zusammengesetzter Meerzwiebelsyrup*, G.

Preparation.—Squill, in No. 30 powder, 120 parts (4 oz. av.); Senega, in No. 30 powder, 120 parts (4 oz. av.); Tartrate of Antimony and Potassium 3 parts (44 grains); Sugar, in coarse powder, 1200 parts (40 oz. av.); Precipitated Phosphate of Calcium 9 parts (130 grains); Diluted Alcohol, Water, each a sufficient quantity; to make 2000 parts (66¾ oz. av. or about 3 pints). Mix the squill and senega, and, having moistened the mixture with 300 parts (10 oz. av. or 10⅜ fluidounces) of diluted alcohol, macerate for 1 hour; then transfer the mixture to a conical percolator, and gradually pour upon it diluted alcohol until 900 parts (30 oz. av. or about 30 fluidounces) of tincture are obtained. Boil this portion for a few minutes, and then evaporate it, by means of a water-bath, to 360 parts (12 oz. av. or about 11 fluidounces); having added 50 parts (5 oz. av. or 4¾ fluidounces) of boiling water, triturate the mixture with the precipitated phosphate of calcium; filter, and add, through the filter, enough warm water to make the whole weigh 750 parts (25 oz. av. or about 24 fluidounces). In this dissolve the sugar by agitation, without heat, and strain. Lastly, dissolve the tartrate of antimony and potassium in 47 parts (1½ fluidounces) of hot water, and mix the solution thoroughly with the remainder of the syrup.—*U. S.*

The present formula is nearly identical with that of the U. S. P. 1870, and differs mainly in the removal of the pectin compounds by the aid of an inert powder (as we suggested in the former edition of this work) and in dissolving the sugar without heat. Percolation with diluted alcohol exhausts squill and senega thoroughly. The boiling of the tincture is probably intended to remove any albumen which may have been taken up. After the evaporation of the alcohol the pectin compounds of the senega are sometimes separated in considerable quantity, so as to impede filtration. On the addition of a little alkali, or after trituration with magnesia, filtration proceeds more rapidly; but the alkali, if dissolved in sufficient quantity, will then cause a decomposition of the tartar emetic. Trituration with some inert and insoluble substance, like calcium phosphate, before filtration is therefore preferable. The tartar emetic is best dissolved in a small quantity of boiling water before it is mixed with the syrup. When carefully prepared the syrup will keep well. It has been stated that by dissolving the sugar in the cold filtrate fermentation is entirely prevented; the solution of the sugar is readily effected by percolation.

This syrup is known as *hive syrup* and *croup syrup*, and is an officinal substitute for *Coxe's hive syrup*, which was made by boiling the drugs in water and preserving the liquid by honey.

Medical Uses.—The union of squill, senega, and tartar emetic in this preparation renders it expectorant, diaphoretic, emetic, and, in full doses, purgative also. It was originally devised for the treatment of "croup," or "hives," whence its popular name, "hive syrup." It is not appropriate, however, for membranous croup, but only for the affection which is properly called *spasmodic laryngitis*, and which it relieves mainly by its nauseant, and therefore anti-spasmodic, action. Care must be taken in employing it not to allow its sedative operation to proceed too far. It may be prescribed in this affection in *doses* of from 10 to 30 drops (Gm. 0.60–2), repeated at intervals of ten minutes or until its nauseant or emetic operation is developed. In acute *bronchitis* with adequate secretion it should be administered in similar doses, but at longer intervals, so as to keep within the limits both of nausea and vomiting.

SYRUPUS SENEGÆ, *U. S., P. G.*—SYRUP OF SENEGA.

Sirop de polygala, Fr.; *Senegasyrup*, G.

Preparation.—Fluid Extract of Senega 160 parts (8 oz. av.); Water of Ammonia 4 parts (87½ grains or 1½ fluidrachms); Sugar, in coarse powder, 600 parts (30 oz. av.); Water, a sufficient quantity; to make 1000 parts (50 oz. av. or about 36 fluidounces). Mix the fluid extract with 250 parts (12½ oz. av. or 12 fluidounces) of water; add the water of ammonia, shake the mixture well, and let it stand for a few hours; then filter through paper, adding through the filter enough water to make the whole weigh 400 parts (20 oz. av. or about 18 fluidounces). To the filtered solution add the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

As formerly prepared from a tincture of senega, the separation of pectin compounds occasioned difficulty in filtration, which is now avoided by keeping the gelatinous matters in solution by the aid of ammonia, a portion of which is already contained in the pharmacopœial fluid extract. The syrup has a brown color and a decidedly acrid taste; it should be free from ammoniacal odor. 100 parts of syrup contain about 16 (*U. S.*), 4 (*P. G.*), or 2.5 (*F. Cod.*) parts, of senega.

Medical Uses.—The syrup of senega is a very useful medicine in subacute and chronic *bronchitis* and *laryngitis* in the *dose* of 1 or 2 fluidrachms (Gm. 4–8).

SYRUPUS SENNÆ, *U. S., Br., P. G.*—SYRUP OF SENNA.

Sirop de séné, Fr.; *Sennasyrup*, G.

Preparation.—Senna, bruised, 33 parts (16½ oz. av.); Sugar, in coarse powder, 60 parts (30 oz. av.); Alcohol 4 parts (2 oz. av. or 18½ fluidrachms); Oil of Coriander (8¾ grains or 10 minims), Water, each a sufficient quantity; to make 100 parts (50 oz. av. or about 36 fluidounces). Digest the senna in 160 parts (5 lbs. av. or 4¾ pints) of water, at a temperature not exceeding 50° C. (122° F.), for 24 hours; express and strain the liquid. Digest the mass with 70 parts (35 oz. av. or 33¾ fluidounces) of water at the same temperature for 6 hours, and again express and strain. Mix the strained liquids and evaporate the mixture to 30 parts (15 oz. av. or about 14 fluidounces). When cold add the alcohol, previously mixed with 1 per cent. of oil of coriander, and filter through paper, adding through the filter enough water to make the whole weigh 40 parts (20 oz. av. or about 18 fluidounces). Then add the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

This formula is modelled after that of the British Pharmacopœia; by a similar process 16 oz. av. of senna are made to yield 16 fluidounces of concentrated and filtered infusion, including 3 fluidounces of rectified spirit and 3 minims of oil of coriander, and in this liquid 24 ounces of sugar are dissolved. This syrup weighs 42 ounces, and its specific gravity is about 1.310.

Senna Syrup, *P. G.*, is only about one-fourth the strength of that of the U. S. P., and is flavored with fennel.

SYRUPUS SENNÆ CUM MANNA, *P. G.*, is made by mixing equal parts of syrup of senna and syrup of manna (see p. 958).

Medical Uses.—This is a mild and efficient cathartic for children in the *dose* of from 1 to 4 fluidrachms (Gm. 4–16).

SYRUPUS TOLUTANUS, *U. S., Br.*—SYRUP OF TOLU.

Syrop de baume de Tolu, Sirop balsamique, Fr.; *Tolubalsamsyrup*, G.

Preparation.—Balsam of Tolu 4 parts (2 oz. av.); Sugar, in coarse powder, 65 parts (32½ oz. av.); Distilled Water a sufficient quantity; to make 100 parts (50 oz. av. or about 36 fluidounces). Mix the sugar with 35 parts (17½ oz. av. or 16¾ fluidounces) of distilled water, add the balsam, and digest the whole in a covered vessel, at a temperature not exceeding 82° C. (180° F.), for 2 hours. When cold strain through a well-wetted muslin strainer, adding through the strainer enough water to make the syrup weigh 100 parts (50 oz. av.), and mix thoroughly.—*U. S.*

Take of balsam of Tolu 1¼ ounces; refined sugar 2 pounds; distilled water 1 pint or a sufficiency. Boil the balsam in the water for half an hour in a lightly-covered vessel, stirring occasionally. Then remove from the fire, and add distilled water, if necessary, so that the liquid shall measure 16 ounces. Filter the solution when cold, add the sugar, and dissolve with the aid of a steam or water-bath. The product should weigh 3 pounds, and should have the specific gravity 1.33.—*Br.*

The formula of the U. S. P. 1870 was objectionable on account of the use of magnesium carbonate for diffusing tincture of Tolu previous to treating it with water; the present formula yields a turbid syrup which cannot be obtained transparent by straining. The objection to the second formula is in the boiling, by which the tolene is volatilized. Digesting the Tolu balsam with water, as directed by the French Codex, is preferable, and yields a well-flavored, transparent syrup of a yellowish color. Using tincture of Tolu and manipulating as directed for syrup of ginger, an efficient but somewhat opaque syrup is obtained. The syrup is used in preparing Trochisci ammonii chlor. and Trochisci cubebæ, *U. S.*

SYRUPUS BALSAMI PERUVIANI, S. SYRUPUS BALSAMICUS. Digest 1 part of balsam of Peru in 11 parts of water; decant and filter when cold, and dissolve 18 parts of sugar in 10 parts of the filtrate.—*P. G.* 1872.

Medical Uses.—The medicinal virtues of this preparation are exceedingly feeble, if indeed it possess any. But its agreeable flavor renders it an eligible associate of other and less palatable syrups, especially such as are used in bronchial catarrhs. *Dose*, a fluidrachm (Gm. 4).

SYRUPUS ZINGIBERIS, *U. S., Br.*—SYRUP OF GINGER.

Sirop de gingembre, Fr.; *Ingwersyrup*, G.

Preparation.—Fluid Extract of Ginger 2 parts (1 oz. av.); Sugar, in coarse powder, 65 parts (32½ oz. av.); Water a sufficient quantity; to make 100 parts (50 oz. av. or about 36 fluidounces). Rub the fluid extract of ginger with 25 parts (12½ oz. av.) of sugar, and expose the mixture to a heat not exceeding 50° C. (140° F.) until all the alcohol has evaporated. Then mix the residue thoroughly, by agitation, with 35 parts (17½ oz. av. or 16¾ fluidounces) of water, and filter the liquid, adding through the filter enough water to make the whole weigh 60 parts (30 oz. av.). Finally, add the remainder of the sugar, dissolve it by agitation without heat, and strain.—*U. S.*

This formula accords with the suggestions made in previous editions of this work, and yields a syrup which, though not perfectly transparent, is not opaque, and contains the volatile oil as well as the pungent resin of ginger. In order to obtain a syrup of handsome appearance, the fluid extract must be well incorporated with, not merely poured upon, the sugar. The former Pharmacopœia used magnesium carbonate for diffusing the fluid extract preceding the treatment with water; a syrup was thus obtained which was transparent and had the odor of ginger, but contained magnesia in solution, and had but little pungency. The syrup of the Br. P. is milky; it is made by mixing strong tincture of ginger 6 fluidrachms with syrup 19 fluidounces.

Off. Prep.—Trochisci zingiberis, *U. S.*

Medical Uses.—It is chiefly employed as a flavoring ingredient of mixtures, but is most suitable as an addition to those which are intended to relieve *colic* by causing an expulsion of flatus. *Dose*, a fluidrachm or more (Gm. 4).

TABACUM, *U. S.*—TOBACCO.

Tabaci folia, Fr.; *Folia nicotianæ*, P. G.—*Leaf tobacco*, E.; *Nicotiane*, *Tabac*, Fr.; *Tabaksblätter*, G.

The commercial dried leaves of Nicotiana Tabacum, *Linné.* Steph. and Church, *Med. Bot.*, plate 37; Bentley and Trimen, *Med. Plants*, 191.

Nat. Ord.—Solanaceæ.

Origin.—The tobacco-plant is indigenous to tropical America, but the country which originally produced it cannot now be ascertained, since tobacco is now unknown in the wild state. The seeds were sent to Spain in 1518 by Fra Romano Pane, and reached France in 1560 from Lisbon through the French ambassador, Jean Nicot. The cultivation of tobacco was commenced in Holland in 1615, soon afterward in England, and about fifty years later in the Palatinate. About the same period, or a little earlier, it appears to have been introduced into China. At present tobacco is very extensively cultivated in most temperate and subtropical countries. During 1875 there were over 559,000 acres of land planted in the United States, yielding 367,000,000 pounds of tobacco. The annual production of tobacco in all countries has been estimated at about 3,000,000 tons.

N. Tabacum attains a height of 4 or 6 feet (1.2–1.8 M.), has a stout, viscidly hairy stem, shortly-stalked or sessile amplexicaul and alternate leaves, and terminal panicles of dull-pink or reddish flowers consisting of a tubular, bell-shaped, five-toothed calyx, a funnel-shaped corolla about 2 inches (5 Cm.) long, with a spreading five-lobed border and five stamens and a conical ovary. The capsule is about an inch (25 Mm.) long, opens by two valves, is two-celled, and contains a large number of minute, somewhat reniform, pale-brown seeds. Nicotiana macrophylla, *Lehmann*, Nic. fruticosa, *Linné*, Nic. petiolata, *Agardh*, and others are now regarded as varieties of the above species.

Nic. repanda, *Willdenow*, is cultivated in Cuba; Nic. persica, *Lindley*, yields the Shiraz or Persian tobacco; and Nic. rustica, *Linné*, is the species which is chiefly cultivated in Turkey and India. The last-named species is about 4 feet (1.2 M.) high, has oval or ovate entire leaves on petioles about 1½ inches (38 Mm.) long, and produces greenish-yellow flowers nearly an inch (25 Mm.) long. According to Thiselton Dyer, Latakia tobacco is prepared from the flowering panicles and capsules of N. Tabacum, and owes its peculiar flavor to the smoke of the wood of Pinus halepensis, *Aiton*, to which it is exposed.

Cultivation.—The plant requires a deep, rich soil, which must be annually well manured; the seeds are sown in beds, and when the young plants are 6 or 8 inches high they are transplanted to the tobacco-fields, and during their growth carefully freed from the larvæ of insects. The flowering tops and branches are broken off before the flowers expand, and when the leaves are fully matured, which takes place about the month of September, the plants are cut, allowed to wilt in the sun, and afterward cured by being hung up in a drying-house and exposed to the heat of a fire. The leaves at first become wet, or "sweat," and in the course of several weeks are dried, after which they are stripped from the stems, assorted, gathered up into small parcels, and then are packed into large boxes or hogsheads.

Description.—Tobacco-leaves are from 6 to 20 inches (15–50 Cm.) long and from 2 to 6 inches (5–15 Cm.) wide, oval or ovate-lanceolate, sometimes rather obovate in form, pointed and acute at the apex, and with an entire margin. In the fresh state they are rather thick, green, and covered with viscid hairs and with small sessile glands; after drying they are thinner, lighter or darker brown or mottled with different shades of brown, and friable. The leaves have a thick, prominent midrib, branching under acute angles into lateral veins, which are curved near the margin. The odor of tobacco is peculiar and heavy, and its taste disagreeable, bitter, and acrid.

Constituents.—Tobacco contains a large amount of salts, consisting of sulphates, nitrates, chlorides, phosphates, and malates of potassium, calcium, ammonium, and nicotine, and yields from 14 to 18.5 per cent. of ash. Larger amounts have been obtained, sometimes as much as 25 to 27 per cent.—a result which is probably due in some cases to dust adhering to the viscid glands, as was suggested by B. F. Creighton (1876). The other constituents of tobacco are albumen, resin, extractive, gum, citric acid (Goupil), nicotianin, and nicotine. *Nicotianin* was discovered by Hermbstädt on distilling tobacco with water; it separates from the distillate in the form of white foliaceous crystals, which have an odor resembling that of tobacco-smoke and a warm and bitterish aromatic taste (Posselt and Reimann, 1828). Landerer (1835) obtained nicotianin from the dried, but not from the fresh leaves. Barral (1845) stated that it contains 7.12 per cent. of nitrogen.

Nicotine or *nicotia* is the poisonous principle of tobacco, and was discovered by Posselt and Reimann (1828). It may be prepared by exhausting bruised tobacco with acidulated water, concentrating the infusion, adding an excess of potassa, and agitating with ether, which dissolves the alkaloid, and on the addition of powdered oxalic acid nicotine oxalate, which is insoluble in ether, is separated (Schloesing); or, the ether is evaporated, the liquid neutralized with oxalic acid, evaporated to dryness, and the residue exhausted with boiling alcohol, which dissolves oxalate of nicotine (Ortigosa). On evaporating the solution to a syrupy consistence and agitating it with potassa and ether, an ethereal liquid is obtained, which on fractional distillation yields the alkaloid. This is a colorless oily liquid, having at 15° C. (59° F.) the spec. grav. 1.0111, and remaining liquid at -10° C. (14° F.). It has an unpleasant, and when heated a pungent, acrid, tobacco-like odor, a burning taste, and a strongly alkaline reaction. Exposed to air and light, it rapidly acquires a brown color and is partly converted into a resinous compound. It boils near 250° C. (482° F.), but distils at a lower temperature, always leaving a residue.

Its composition is $C_{10}H_{14}N_2$ (mol. weight 162). It absorbs water from the air, dissolves readily in water, and is separated from this solution by caustic potassa. Alcohol and ether dissolve it in all proportions, and it yields with acids neutral and acid salts, of which the former crystallize with difficulty, and are mostly soluble in weak alcohol, but insoluble in ether. The alkaloid acquires a wine-red color with strong sulphuric acid, and on heating the mixture is charred. Chlorine gas colors it deep-red or red-brown. When heated with a little hydrochloric acid a violet color is produced, which on the further addition of nitric acid changes to yellowish-red. The double salts with mercuric and platinic chloride are sparingly soluble in cold water. Dried tobacco-leaves contain from 2 to 8, and occasionally as high as 11, per cent. of nicotine. The alkaloid is present in all parts of the green plant, as well as in the dried leaves, and, according to Kissling (1882), also in tobacco-smoke, which owes its toxic action mainly to this alkaloid. Instead of nicotine, H. Vohl and H. Eulenburg (1871), found chiefly *collodine*, with *pyridine*, *picoline*, and other bases of the same series (see page 1046), besides ammonia and traces of ethylamine; and, in passing the vapors through potassa solution, hydrocyanic, hydrosulphuric, acetic, formic, butyric, valerianic, carbolic, and probably other acids were retained.

Pharmaceutical Products.—Oleum tabaci, Oil of tobacco (*U. S.* 1870), is prepared by dry distillation of coarsely-powdered tobacco, and is a brown-black tar-like liquid of a strong and very peculiar empyreumatic odor. Unverdorben (1826) recognized in it the presence of an alkaloid, which on being boiled with diluted sulphuric acid yields, among other products, *odorine* or *picoline;* it is not unlikely that others of the ternary bases contained in animal oil (see page 1046) may likewise be present in this tarry product. Zeise (1843) demonstrated the presence of butyric acid, ammonia, paraffin, empyreumatic resin, and a pale-yellow oil of the formula $C_{11}H_{22}O_2$, which boils at 195° C. (383° F.). Melsens (1843) proved the presence of nicotine in the tarry matter separating in tobacco-pipes, and it is most likely present in the empyreumatic oil.

Unguentum tabaci, Tobacco ointment (*U. S.* 1870). The aqueous extract from ½ oz. av. of powdered tobacco is mixed with 8 oz. av. of lard.

Vinum tabaci, Wine of tobacco (*U. S.* 1870). Exhaust 120 grains of tobacco with 4 fluidounces of sherry wine.

Off. Prep.—Enema tabaci, *Br.*

History.—The use of tobacco by smoking cigars was practised by the natives of Cuba when that island was discovered in 1492, and pipe-smoking was then probably common among the aborigines of this continent, since it was observed in Canada in 1585 and in Florida in the seventeenth century. It was introduced into England in 1586. From these beginnings the use of tobacco spread over the whole world. In several countries of Europe the imposts upon it furnish the largest item of the national revenue, and it is there, as in this country, one of the most important articles of commerce.

Physiological Action.—*On Plants and Animals:* Tobacco is hostile to all forms of life. Plants confined in rooms where the fermentation of tobacco is conducted during the manufacture of snuff soon lose their foliage, and nearly all insects shun tobacco, whence its use to protect woollen fabrics from moths, etc. Herbivorous animals are not readily affected by it, but large doses even by the stomach are fatal to them. When its fumes are thrown into the lungs of animals or when its decoction is applied to their skin, its poisonous operation is speedily developed. In animals poisoned by the so-called "oil of tobacco" the blood is uncoagulated. From 2 to 5 grains of it given to dogs two or three times a day produced gradual but complete marasmus, partial paralysis of the hind legs, loss of venereal power with softening and shrivelling of the testicles, shedding of the hair, sloughing of the eyelids, and blindness. The gums were swollen, spongy, and bleeding, and the teeth became loose. The oil of tobacco, in the form in which it accumulates in the bowl of smoking-pipes, is a virulent poison even when applied to eruptions upon the skin. Its immediate effects are pallor, vertigo, faintness, nausea, vomiting, cold sweating, diarrhœa, and paralysis of the lower limbs. It is remarkable that there appears to be no fatal case of poisoning by this oil on record, except that of a child in whom the oil from a tobacco-pipe was applied to an ulcer on the lip.

Nicotine acts poisonously upon all animals. In horses its most striking influence is upon the pulse, which becomes less frequent, and continues to be so for many hours. In dogs it is fatal by arresting, after reducing, the action of the heart, and occasioning faintness, trembling, and vomiting. It neither irritates nor cauterizes the skin or the mucous membrane. In small doses it quickens, and in large doses checks, respiration, which is also accompanied by a hissing sound, attributed to a spasm of the laryngeal and bronchial muscles. It also retards and depresses the pulse when given in full doses. In frogs and snakes among its poisonous effects tetanic spasm is conspicuous, and in warm-blooded animals generally it excites alternate tonic and clonic spasms, followed by general relaxation and trembling. It has been shown by Lautenbach (*Phila. Med. Times*, x. 523) that nicotine acts with extreme rapidity and violence when thrown into the systemic veins, but very slowly, by comparison, and feebly, when injected into the arterial or the portal system. According to René, nicotine suspends the galvanic contractility of muscles, and causes a fibrillar trembling of these organs before it induces distinct spasms (*Amer. Jour. of Med. Sci.*, July, 1879, p. 247). The motor paralysis appears to affect the hinder legs chiefly. When the dose is very large its direct and immediate effects are extreme prostration and death. In some cases it appears to act as an anæsthetic, and in others to occasion pain. Primarily it dilates the pupil, but secondarily may contract it. Sometimes salivation and diuresis are abundant, and in non-lethal doses it is apt to cause vomiting and purging. From these statements it may be inferred that nicotine depresses the heart, quickens the respiration, and excites the muscular system, but its ultimate effect is general exhaustion.

After the death of animals by nicotine "the brain is empty of blood; the stomach is reddened in round spots, so raised and pile-like that they resemble patches of dark Utrecht velvet; the blood is preternaturally fluid; the lungs are pale as the lungs of a calf as we see them suspended in the shambles; while the heart is overburdened with blood, and, having little power left for its forcing action, is scarcely contracting, but is feebly trembling, as if, like a conscious thing, it knew equally its own responsibility and its own weakness" (Richardson).

On Man: The essential effects of tobacco are best illustrated by the action of nicotine employed experimentally. The following summary represents the effects of doses of nicotine varying from $\frac{1}{32}$ to $\frac{1}{16}$ grain, taken in water. The minutest doses occasion a burning sensation in the tongue, a hot, acrid feeling in the fauces, and a sense of rawness throughout the œsophagus. Salivation is abundant. Small doses produce a sense of heat in the stomach, chest, and head, and even in the fingers, with some excitement of the nervous system; larger ones cause heaviness, giddiness, torpor, sleepiness, indistinct vision, with sensitiveness of the eye to light, imperfect hearing, laborious and oppressed breathing, and dryness of the throat. In 40 minutes after the larger doses a sense of great debility is perceived, the head droops, the pulse-rate falls, the face grows pale, the features are relaxed, the limbs seem paralyzed, the hands and feet are cold, the coldness advances gradually toward the trunk, and faintness ends in loss of consciousness. The disorder of the digestive organs manifests itself by eructations, nausea, and even vomiting, the abdomen becomes distended, and an urgent desire is felt to go to stool; wind is discharged and urine voided copiously. The nervous system, after the debilitating influence of the poison has developed itself, shows its condition by muscular spasm, which begins with tremulousness of the extremities, and gradually involves the whole muscular system, including the respiratory muscles, so that the breathing is oppressed, gasping, and incomplete. This enumeration of effects is sufficient to prove that nicotine acts primarily upon the spinal and sympathetic nervous systems, and not upon the brain. It may cause death by direct paralysis of the heart, or more indirectly by paralysis of the respiratory muscles, producing asphyxia. The blood examined during life of a person under the full influence of tobacco presents a striking disaggregation of the red corpuscles, which are also less regularly circular than natural, and have jagged or crenated edges. As the poisonous operation passes off, however, the blood regains its normal characters. The action of tobacco itself is so nearly identical with that of nicotine as to render unnecessary a detailed account of it in this place. It, however, is mainly exhibited in muscular relaxation and collapse. In some cases "lethargy" and "insensibility" are mentioned, but the condition is not that of cerebral oppression so much as of cerebral exhaustion. Of other symptoms especially prominent in certain cases of tobacco-poisoning, either caused by a single excessive dose or by inordinate indulgence in smoking or chewing tobacco, may be mentioned: a rapid followed by a very slow pulse, hiccough, and cold perspiration, profuse diuresis, convulsions without loss of consciousness, sometimes cataleptic and sometimes hysterical, and great numbness as well as impaired motor power of the limbs and of the tongue (*e. g.* case in *Amer. Jour. of Med. Sci.*, Jan. 1882, p. 306).

The cases of serious illness produced by the emanations of tobacco, and by its application even to the unbroken skin, are innumerable, and many instances of fatal poisoning by tobacco are recorded, some of them being due to its having been swallowed purposely or accidentally, some to its use medicinally in an enema, and some to its application to eruptions on the skin. The fatal dose of tobacco internally, and generally by enema, has varied from the maximum of an ounce or two to a minimum of 15 grains. It was generally administered in decoction or infusion. Nicotine stands next to prussic acid in the rapidity and energy of its poisonous action, but the minimum fatal dose of it is unknown.

A detailed account of the evil effects of the habitually excessive use of tobacco by smoking, snuffing, or chewing would occupy more space than can be spared for the purpose in this work, but a condensed statement of the principal ones may not be omitted. (For full details see STILLÉ, *Therapeutics*, 4th ed., ii. 364 et seq.) It lessens the natural appetite, more or less impairs digestion, and induces constipation, while it irritates the mouth and throat, rendering it habitually congested and impairing the purity of the voice. It induces a constant sense of uneasiness and nervousness, with epigastric sinking or tension, palpitation ("irritable heart"), hypochondriasis, impaired memory, neuralgia, and frequent urination. Chewing and snuffing tend to cause gastralgia, but smoking causes neuralgia of the fifth pair. It renders the vision weak and uncertain, causing objects to appear nebulous, or creates muscæ volitantes and similar subjective perceptions. In numerous instances it is said to have produced amaurosis. But others decline to describe the effect by that word, employing rather "scotoma," or simple obscurity or indistinctness of vision. It usually disappears soon after the use of tobacco is abandoned (Nettleship, *St. Thomas's Hosp. Rep.*, ix. 51). Analogous derangements of hearing occur, with buzzing, ringing, etc. in the ears, and even hallucinations of this sense. Often there is a feeling of a rush of blood to the head, with vertigo and impairment of attention, so as to prevent continuous mental effort; the mind is also apt to be filled with crude and groundless fancies, leading to self-distrust and melancholy. The sleep is frequently restless and disturbed by distressing dreams. It impairs muscular power and co-ordination, probably both by interfering with nutrition and by exhausting nervous force, and usually keeps down the growth of muscle and the deposit of fat. Doubtless there are many persons who use tobacco in one or more forms who experience few or none of these evils, and whose constitutions seem proof against its mischievous effects; but to the greater number the habitual use of it is more injurious than useful, and it acts upon a certain number in almost all doses as a poison. Its poisonous action upon children and lads is far more intense and prolonged than upon adults.

Medical Uses.—Although the use of tobacco as an external remedy is no longer common, its efficacy is sufficiently well established in several diseases. It has been applied to the treatment of *scabies* in man, and long was used, and perhaps still is, for the same disease in domestic animals, but the risk of producing toxical symptoms when the skin is broken has probably led to its disuse. The same remark applies to other cutaneous eruptions. The bruised fresh leaves of the tobacco-plant have been found a local palliative in *urticaria*, *gout*, and *rheumatism*, and the fumes of tobacco have been applied with advantage in the last two disorders. Snuffing has been employed with success in the cure of *nasal polypus*, for the relief of chronic *ophthalmia* and catarrh of the *frontal sinuses*, and in tropical countries for destroying the *worms* which sometimes breed in the antrum highmorianum and the adjacent parts.

Internally, the smoke of tobacco inhaled is a palliative of nervous *cough* produced by tickling in the larynx or trachea, and has put an end to an attack of *spasmodic laryngitis* in the same manner as other nauseants and cardiac sedatives. A plaster made with strong snuff and tallow is a popular remedy in the same disorder, and has been applied successfully in *laryngismus stridulus*. Obstinate *hiccough* has been arrested by swallowing tobacco-smoke, and *dislocations* of the lower jaw and of various joints have been remedied while the patient was relaxed by tobacco-fumes.

The relaxing, nauseating, and purgative operation of tobacco has been successfully employed to overcome *obstruction of the bowel* by fecal accumulations. When the usual purgative agents have failed, tobacco cataplasms or enemas may be cautiously employed. It is not certain that *internal herniæ* and *intussusception* have not been relieved by this treatment, but the accurate diagnosis of intestinal obstructions is very difficult, and care must be taken not to exhaust the patient by heroic measures while a reasonable hope remains that nature will suffice for the cure. It is quite erroneous to suppose that these intestinal obstructions are overcome by relaxing muscular spasm; the only rational explanation of the utility of tobacco, and of various other medicines of the same class, is that by lowering the heart's action they tend to diminish the vascular congestion of the strangulated organ. In *lead colic*, in which tonic spasm probably does exist, tobacco may act as a true anti-spasmodic, but in this affection it is seldom used.

The powerful relaxing influence of tobacco led naturally to its use in the treatment of *tetanus*, and the list is long of the cases in which its infusion was given by enema. More recently nicotine was administered in this disease by the mouth or the rectum. It is, as might be expected, a surer remedy in the idiopathic than in the traumatic form of the disease. Tobacco has generally been prescribed in tetanus in an infusion made with 20 grains of the drug to $\frac{1}{2}$ pint of water (Gm. 1.30 in Gm. 250), and nicotine in the dose of a fraction of a drop, increased until its specific effects are developed. The same means as in tetanus have been employed in several cases of *strychnine-poisoning*. The power of tobacco-smoke to arrest or palliate paroxysms of *asthma* is well established. There is reason to believe that it is quite as efficient as lobelia, with which it is almost identical in operation. *Ascarides* of the rectum, and even *lumbricoid* worms, have been expelled after the injection into the rectum of tobacco-smoke or of tobacco infusion. This substance is alleged to be an antidote to poisoning by *mushrooms*, but upon insufficient grounds.

Administration.—Tobacco may be given as an emetic in the *dose* of 5 or 6 grains (Gm. 0.30), but it is rarely prescribed in this form. The infusion, wine, and ointment are no longer officinal. Fresh tobacco-leaves, which are sometimes used as a topical application, are much feebler in their action than the cured leaves, and those especially which have undergone fermentation in their manufacture. The dose of nicotine may be stated at from $\frac{1}{6}$ grain to 1 grain (Gm. 0.01–0.06), but some authorities recommend that the primary dose should not exceed $\frac{1}{60}$ grain (Gm. 0.001). For hypodermic injection a solution has been proposed containing the quantity of nicotine just mentioned in every 5 drops (Gm. 0.30). Of this solution the primary dose should not exceed the $\frac{1}{120}$ grain (Gm. 0.0005). Nicotine should never be used internally if either of the other preparations of tobacco can be procured.

TAMARINDUS, *U. S., Br.*—TAMARIND.

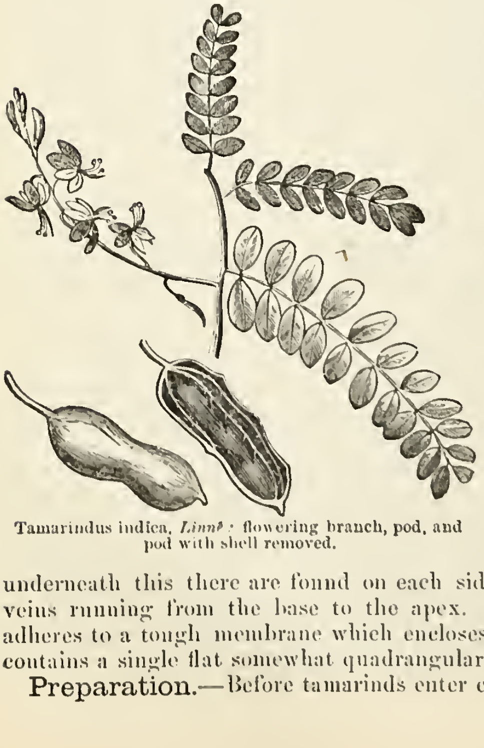
Pulpa tamarindorum cruda, s. Fructus tamarindorum, P. G.—*Tamarin, Pulpe de tamarin*, Fr.; *Tamarindenmus*, G.

The preserved fruit of Tamarindus indica, *Linné*, s. T. officinalis, *Hooker*. Woodville, *Med. Bot.*, pl. 166; Bentley and Trimen, *Med. Plants*, 92.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The tamarind tree attains a height of 60 to 80 feet (18–24 M.), is indigenous to India and throughout tropical Africa, and has been introduced into all tropical countries. It has alternate abruptly pinnate evergreen leaves, with from ten to eighteen pairs of oval-oblong, at the base unequal, veined leaflets, and produces few-flowered terminal and lateral racemes. The fragrant flowers have a four-lobed calyx, the upper lobe being broad and two-toothed; the corolla is white, afterward yellow, red-veined, and consists of three elliptical petals, which are longer than the calyx; occasionally two more petals, linear and minute, are present; the nine or ten stamens are monadelphous, but only three or four have anthers; the ovary is stalked and has a long style. The fruit is an indehiscent usually curved legume, about 6 inches (15 Cm.) long and nearly 1 inch (25 Mm.) broad. The West Indian tree bears a fruit which is only about three times longer than broad, and was formerly regarded as a distinct species, T. occidentalis, *Gaertner*. The fruit has a thin, fragile, pale-brownish shell (pericarp), and underneath this there are found on each side three tough fibrous somewhat branching veins running from the base to the apex. Next follows an acidulous pulp, and this adheres to a tough membrane which encloses from three to ten cavities, each of which contains a single flat somewhat quadrangular and polished brown seed.

FIG. 294.



Tamarindus indica, *Linné*: flowering branch, pod, and pod with shell removed.

Preparation.—Before tamarinds enter commerce the shell is removed, and the inner portion is in India pressed together into a mass to which sometimes sugar is added. In Upper Egypt it is formed into cakes which are dried in the sun, and in the West Indies hot syrup is poured over the pulpy mass. The fresh leaves and flowers have an acidulous taste, and are used in tropical countries for the preparation of cooling drinks.

Description.—As seen in our commerce, tamarinds form a reddish-brown soft mass in which the interior portion of the fruit is more or less broken. They have a fruit-like odor and an acidulous and sweet taste. *East Indian tamarinds* are tougher and darker in color and have a less sweet taste. *Egyptian tamarinds* appear in hard, flattish, circular cakes, about 6 inches (15 Cm.) in diameter, of a brown-black color externally, and frequently mouldy. The last two varieties are rarely met with in American commerce. On leaving the clean blade of an iron spatula for some time in contact with tamarinds, it should not become covered with a coating of copper.

Constituents.—Vauquelin ascertained tamarinds to contain sugar, tartaric, citric, and a little malic acid, pectin, and mucilaginous matter. The acids are mostly present as potassium compounds. Acetic acid has likewise been found in tamarinds; it probably results from the fermentation of the sugar. Tannin is not present, except in the testa of the seeds. C. Mueller (1882) found in East Indian tamarinds very little malic acid; citric acid varied between 6 and 4 per cent., tartaric acid between 5.3 and 8.8 per cent., potassium bitartrate between 4.7 and 6 per cent., the insoluble matter of the pulp between 12 and 20 per cent., and the seeds between 1.5 and 38 (average 13.9) per cent.

Pharmaceutical Uses.—Tamarinds are employed in the preparation of Confectio sennæ, *U. S.*, *Br.*, being freed from vegetable tissues by means of water and straining.

Pulpa tamarindorum depurata, *P. G.*, is made by softening East Indian tamarinds with sufficient boiling water, straining the mass through a hair sieve, evaporating the strained portion to the consistence of an extract, and incorporating with 5 parts of it 1 part of powdered sugar.

Conserva tamarindi, *F. Cod.* Tamarind-pulp 2 parts; powdered sugar 5 parts, water sufficient for 8 parts.

Tamar indien is a confection of senna flavored with anise and oil of lemon.

Medical Action and Uses.—Tamarinds are mentioned by the Arabian medical writers as antibilious and useful in correcting nausea, quenching thirst, and allaying febrile excitement, and also as being efficient in healing aphthous sores. They are still used for similar purposes, and especially to prepare a cooling drink in *febrile diseases*. They should be mixed with hot water, and the strained liquid allowed to cool. An ounce of tamarind-pulp boiled with a pint of milk produces a whey which also forms an agreeable drink in fevers. Although reputed to impair the purgative action of senna, they are habitually used along with that cathartic in magistral preparations, as well as in the officinal confection of senna.

TANACETUM, *U. S.*—Tansy.

Summitates tanaceti.—*Tanaisie*, *Herbe aux vers*, Fr.; *Rainfarn*, *Wurmkraut*, G.

The leaves and tops of Tanacetum vulgare, *Linné*, s. Chrysanthemum Tanacetum, *Karsch.*

Nat Ord.—Compositæ, Senecionideæ.

Origin and Description.—Tansy is a perennial herb indigenous to Europe and Central Asia and naturalized in many parts of North America, where it grows in old fields, along roadsides, and in the neighborhood of river-banks. The stout and fibrous many-headed root sends up a cluster of nearly simple stems which are 3 or 4 feet (.9–1.2 M.) high, roundish-angular, and frequently purplish at the base. The leaves are alternate, shortly petiolate or sessile, from 5 to 10 inches (12–25 Cm.) long and nearly half as wide, smooth, dark-green, dotted with oil-glands, bipinnately divided, and the segments rounded, incised, or coarsely serrate. The flowers are in a dense terminal corymb, have an imbricate involucre with numerous brown-margined scales, a convex naked receptacle, and numerous yellow florets, with the marginal ones pistillate and three-toothed, but not ligulate. The akenes are obovate, about five-ribbed, and terminate with a crown-like pappus. The plant commences to bloom in July, and should be collected while flowering; on drying the loss in weight is from 80 to 85 per cent. It has a strong, rather unpleasant odor, and an aromatic, pungent, and bitter taste. A variety, Tan. crispum, with twice-pinnatifid and curled leaves, is frequently cultivated, and is known as *double tansy*.

Constituents.—Among the ordinary constituents of tansy, Peschier and Frommherz found mucilage, sugar, albumen, fixed oil, resin, tannin, coloring matter, and malic acid, with which Peschier's *tanacetic acid* is probably identical. The bitter principle was isolated by Leroy (1845) by a process similar to that for digitalin. This *tanacetin* is described as being yellowish-white, granular, inodorous, fusible, soluble in ether, less freely soluble in alcohol, and sparingly soluble in water. Leppig (1882) gives for it the formula $C_{11}H_{16}O_4$, and found it to be present chiefly in the flowers; sulphuric acid colors it yellow, then brown, red-brown, and blood-red, the margin becoming blue. The most important constituent of tansy is its volatile oil, of which the fresh flowering herb yields ¼ to ⅓ per cent. of its weight. *Oil of tansy, Oleum tanaceti*, is an oxygenated oil of neutral or slightly acid reaction, varies in density between 0.92 and 0.95, and has either a yellow or green color. According to Geoffroy, the herb grown in dry places yields a green-colored volatile oil, but if grown in moist localities the oil is yellow. Oil of tansy has a camphoraceous aromatic odor and a bitterish pungent taste, deviates polarized light to the left, is readily soluble in alcohol, dissolves iodine without explosive action, and is readily oxidized on being heated with nitric acid. Bruylants (1877) found in it 1 per cent. of a terpene, $C_{10}H_{16}$, boiling near 160° C. (320° F.), and a small quantity of an acid and a neutral resin, while the greater portion consists of the aldehyd, $C_{10}H_{16}O$, mixed with about 20 per cent. of the alcohol, $C_{10}H_{18}O$.

Allied Plant.—TANACETUM BALSAMITA, *Linné*, s. Pyrethrum Tanacetum, *De Candolle*, Balsamita suaveolens, *Persoon*.—Costmary, *E.*; Balsamite, *Fr.*; Frauenminze, *G.*—This is a perennial herb of Southern Europe, with undivided serrate, oval-oblong, petiolate leaves, and discoid, yellow, hemispherical flower-heads in terminal corymbs. It has a strong aromatic odor and bitter taste, and is employed like tansy, and recognized as such by the French Codex.

Physiological Action.—*On Animals:* In some experiments 2 fluidrachms of oil of tansy given to a dog caused vomiting, salivation, dilated pupils, twitching of the muscles, followed by clonic convulsions and a cataleptic condition, from which the animal recovered. ½ fluidounce produced the same symptoms, from which, however, recovery took place, and then, on the same dose being repeated, a prolonged and fatal convulsion occurred, death being apparently due to asphyxia from paralysis of the respiratory muscles. On examination after death, the veins of the brain and spinal marrow were highly congested and a serous effusion existed in the pia mater. The lungs were engorged, and the heart empty on its left side, but its right cavities were distended with dark and liquid blood. The kidneys were congested and the bladder contracted (Van de Warker).

On Man: The author of the above experiments found that 10 minims of the oil of tansy taken by himself caused a sense of heat in the stomach, extending throughout the abdomen, flushing and fulness of the face and head, giddiness, and diuresis, lasting for many hours, the urine smelling strongly of tansy. Subsequently, a dose of 15 minims of the oil, repeated after 3 hours, induced similar effects, but the head symptoms were more marked and unpleasant and the diuresis was very copious. The pulse grew more frequent and less full, and the temperature was slightly raised.

In excessive and poisonous doses oil of tansy causes a sense of heat or burning in the œsophagus, stomach, and abdomen, with dizziness, numbness, and apparent paralysis, attended or followed by clonic convulsions, flushing or lividity of the face, dilated pupils, stertor, frothing at the mouth, and vomiting; hurried or laborious respiration, sometimes with stertor; the skin is usually moist and warm, the pulse somewhat increased in frequency; in fatal cases death is caused by coma and asphyxia. In a case of fatal poisoning by a decoction of the herb death took place by paralysis of the muscles of deglutition, respiration, and voluntary motion. Instead of these nervous symptoms, an infusion of tansy caused vomiting, purging, severe abdominal pain, and death in collapse, without previous impairment of intelligence (*Phila. Med. Times*, xi. 346). In another case it was attended with convulsions, and followed the taking of a teaspoonful of oil of tansy in an hour and a quarter. In a fatal case following a dose of 11 drachms of oil of tansy no congestion of the brain was found, but the heart was full of black blood and the lungs were shrunken and crepitous. The stomach was not inflamed (Jewett, *Boston Med. and Surg. Jour.*, March, 1880, p. 327).

The fatal poisonous dose of oil of tansy is undetermined; very grave symptoms have been produced by ½ fluidrachm (Gm. 2), and even by a dose of 15 or 20 drops (Gm. 1–1.30).

Medical Uses.—Tansy was used in the Middle Ages and subsequently as a remedy for *amenorrhœa*, *worms*, and *dropsy*, and, although it is no longer regarded as of equal potency with other medicines in these diseases, its efficacy cannot be reasonably questioned. Its tonic and stimulant virtues resemble those of absinth, but there can be little doubt that it causes a vascular congestion of the abdominal organs, increasing the secretion of urine and promoting the menstrual discharge. It is largely employed in domestic practice, especially in rural districts, to promote or restore *menstruation*, and sometimes with a criminal intention as an abortifacient, but, so far as appears, unsuccessfully. Its fruit is held by some to be as efficient as chenopodium in the destruction and expulsion of lumbricoid *worms*, and the bruised leaves have been applied to the abdomen for the same purpose. In this manner, and also in vinous and spirituous infusion, tansy has been in vogue as a topical application for *bruises*, *sprains*, *muscular rheumatism*, chronic *ulcers*, etc. Internally, it affords relief in flatulent *colic* and is not without efficacy in *hysterical* disorders.

The *dose* of the powder of the fruit of tansy is from 10 to 40 grains (Gm. 0.60–3), and of the flowers from 20 grains to 2 drachms (Gm. 1.30–8). An infusion may be prepared with from half an ounce to an ounce (Gm. 16–32) of the seeds, or with twice that quantity of the flowers (Gm. 32–64), in a pint (Gm. 500) of boiling water, and prescribed in doses of 1 or 2 fluidounces (Gm. 32–64). The oil may be given in doses of from 1 to 4 drops (Gm. 0.05–0.25) or more.

TARAXACUM, *U. S.*—TARAXACUM (DANDELION).

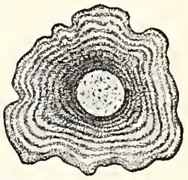
Taraxaci radix, Br.; *Radix taraxaci cum herba*, P. G.—*Dandelion-root*, E.; *Pissenlit*, *Dent de lion*, *Couronne de moine*, Fr.; *Löwenzahn*, *Pfaffenröhrchen*, G.

The root, gathered in the autumn, of Taraxacum Dens-leonis, *Desfontaines* (s. T. officinale, *Weber*, T. vulgare, *Schrank*, Leontodon Taraxacum, *Linné*). Woodville, *Med. Bot.*, plate 3; Bentley and Trimen, *Med. Plants*, 159.

Nat. Ord.—Compositæ, Cichoreæ.

Origin.—Dandelion is a perennial acaulescent herb, with a tuft of spreading short-stalked radical leaves, which are about 8 inches (20 Cm.) long, obovate-oblong, acute, and on the margin runcinately and coarsely serrate. The flower-heads are terminal upon the hollow scapes, about 1½ inches (38 Mm.) in diameter, and have an erect imbricate involucre and numerous ligulate, yellow, and five-toothed florets. The akene is compressed, obovate-oblong, and terminated by a silky-hairy, spreading pappus raised upon a long stalk. The plant grows in waste places, pastures, and on road-sides, and is met with in most countries of the northern hemisphere. Collected in spring and dried, the root loses from 80 to 85 per cent. in weight, but if collected in autumn the loss on drying ranges from 70 to 75 per cent.

Fig. 295.



Transverse section of Taraxacum-root.

Description.—The root is from 6 to 12 or 16 inches (15–30–40 Cm.) long, nearly cylindrical, ½ to 1 inch (12–25 Mm.) thick, crowned with several short thickish heads above and furnished with few branches below. Fresh, it is light yellowish-brown and fleshy; when dry, dark brown or blackish-brown, much wrinkled longitudinally; internally, it is white with a yellowish centre. It is inodorous and has a bitter taste. It is hygroscopic, and in damp weather rather flexible, but when dry breaks with a short fracture, showing the pale-yellow porous wood surrounded by a dark-brown cambium-line and a thick white bark, with concentric circles of milk-vessels of a brownish color, and separated by layers of thin-walled and axially elongated parenchyma. The meditullium has no medullary rays, and consists mainly of ducts varying in diameter and more or less interspersed with thin-walled, elongated cells.

After frost and early in the spring the root is sweet; during the spring and summer the milk-juice becomes thicker and the bitter taste increases; the root is therefore directed to be collected late in the autumn. The spring root yields a bitterish-sweet extract. Bentley regards the root collected about July as most efficient.

Constituents.—The bitter principle, *taraxacin*, was obtained by Polex (1839) in a crystalline state by treating the milk-juice with boiling water and evaporating. Kromayer (1864) found it necessary to leave the aqueous solution in contact with animal charcoal, from which afterward alcohol dissolved the bitter principle, requiring treatment with lead acetate and sulphuretted hydrogen to free it from coloring matter and other principles. Kromayer obtained taraxacin as an amorphous bitter mass. The milk-juice contains also *resin* and *taraxacerin*, $C_8H_{16}O$, which is insoluble in water, crystallizes from hot alcohol, and when in an alcoholic solution has an acrid taste. The dry root yields from 5 to 7 per cent. of ash.

Dandelion-root collected in autumn is rich in inulin. Dragendorff (1870) obtained from the root collected in October 24 per cent. of inulin and a little sugar, but when collected in March only 1.74 per cent. of inulin was found, and about 18 per cent. each of uncrystallizable sugar and *levulin*, the latter being intermediate between inulin and sugar in having the composition of inulin, but being of a sweet taste, soluble in cold water, and without influence on polarized light. Frickhinger (1840), Widemann, and others had obtained notable quantities of *mannit* from the concentrated juice of dandelion, but T. and H. Smith (1849) proved that this principle does not pre-exist, and that, on the contrary, it is a product resulting from fermentation.

The presence of fermentable sugar has been observed by most investigators, and Dragendorff's observations confirm the results previously obtained by Frickhinger, Widemann, and Overbrook, that the sugar predominates in the spring root, and inulin in the root collected in autumn. It seems to follow therefrom that the extract and other preparations made from the expressed juice or by treating the autumn root with cold water should be more efficacious and less loaded with inert matters (sugar, etc.) than those obtained from the spring root. Old extract of taraxacum sometimes contains granular crystals of calcium lactate (Ludwig, 1861); the lactic acid is probably produced from *inosit*, which, according to Marmé (1864), exists in the leaves and stalks of dandelion, but is not found in the root.

Substitutions.—Chicory-root is not unfrequently substituted for dandelion-root in the preparation of extract and fluid extract. While the roots of the two plants, notwithstanding their resemblance, may be distinguished from each other without difficulty (see page 450), no reliable tests are known by which their pharmaceutical preparations may be distinguished. It is therefore best for pharmacists to prepare them from the properly-selected drug.

Off. Prep.—Decoctum taraxaci, *Br.;* Extract. taraxaci, *U. S.*, *Br.;* Extr. taraxaci fluid., *U. S.;* Succus taraxaci, *Br.*

Medical History.—The first distinct mention of dandelion is by Arabian medical writers, who state it to be a very efficacious deobstruent and purifier of the blood. At the close of the last century it was greatly in vogue as a remedy for chronic affections of the liver and bowels, for renal calculus, some cutaneous diseases, etc. Its diuretic qualities are recognized in its popular names, pissenlit, lectiminga, etc.

Medical Action and Uses.—Rutherford and Vignal concluded from their experiments that taraxacum is a very feeble hepatic stimulant. It is employed now, as formerly, in cases of *hepatic congestion* due to or associated with *atonic dyspepsia* and *constipation*. It has been regarded as useful in pulmonary *consumption*—possibly, if at all, by its action upon the stomach and bowels, and indirectly upon the liver.

Dandelion is frequently administered in decoction, of which the *dose* is from 2 to 4 fluidounces (Gm. 64–128). It is apt to ferment. The extract is of little use. The fluid extract and the juice are probably its most active forms.

TAXUS.—Yew.

If commun, Fr.; *Eibe*, G.

Taxus baccata, *Linné.* Bentley and Trimen, *Med. Plants*, 253.

Nat. Ord.—Coniferæ.

Origin and Description.—The yew is an evergreen shrub, or more frequently a tree of very slow growth, but attaining a height of 30 or 40 feet (9–12 M.). It is indigenous to Asia from Siberia southward to the Himalaya Mountains, and westward to Syria, Northern Africa, and the greater part of Europe. It has been introduced as an ornamental tree into North America, and is naturalized to some extent. The tree has a red-brown bark, numerous and spreading (or in one variety fastigiate) branches, and closely placed, nearly sessile, and two-ranked or crowded leaves, which are linear, entire, flat, somewhat curved, acute, glossy-green above, pale-green beneath, and about 1 inch (25 Mm.) long. The fruit or berry consists of a globular-ovate, acutish or blunt, black-brown seed, surrounded by a fleshy cup-shaped scarlet-red arillus, which is open at the top, and at the base furnished with two or three rows of small scales. The young branches with the leaves attached and the fruit have been employed medicinally. The former have an unpleasant terebinthinaceous odor and a disagreeable bitter and acrid taste. The taste of the fleshy part of the berry is sweetish and not unpleasant, but the seed is bitter.

Constituents.—The leaves were examined by Peretti (1828) and Righini (1837), who, besides the common principles, found in them volatile oil, tannin, and an amorphous bitter principle. Lucas (1843) isolated the latter in the form of an amorphous bitter powder which is sparingly soluble in water, but freely soluble in dilute acids, in alcohol, and ether. The salts of this *taxine* are uncrystallizable, and are precipitated by tannin and by alkalies. Marmé (1876) obtained the alkaloid in a crystalline condition from the leaves and in small proportion from the seeds; besides the solvents mentioned before, it is soluble also in chloroform, benzol, and carbon bisulphide, is precipitated by all group reagents of the alkaloids except the chlorides of mercury, gold, and platinum and the platino-cyanide of potassium, and is colored purplish-red by sulphuric acid, but dissolves without coloration in other acids, and has poisonous properties. Amato and Capparelli prepared from the leaves a crystalline, nitrogenated, colorless compound, *milossin*, which is insoluble in water, and a volatile alkaloid which has a peculiar musty odor and is colored green by sulphuric acid and potassium chromate, the color changing to violet on warming. The air-dry leaves yield 5.5 per cent. of ash (Roth, 1876). The red coloring matter of the arillus is soluble in alcohol and ether, but insoluble in water.

Allied Plants.—The American yew, Taxus canadensis, *Willdenow*, is regarded by Gray as a low, straggling variety of the above species; its leaves are mucronate, and have a revolute or subrevolute margin. The yew of the Pacific coast, Taxus brevifolia, *Nuttall*, is a tree growing in Oregon to the height of 50 feet (15 M.), but is smaller in California. The Irish yew, T. hibernica, *Mack*, has a yellow fruit. T. nucifera, *Kämpfer*, indigenous to Japan, has a green fruit, the fleshy portion of which is astringent and pungent, while the seed is sweet and oily.

Physiological Action.—In his account of yew Pliny says that the berries, especially of Spanish yew, contain a mortal poison, and that wine-barrels made of its wood render their contents poisonous. He relates that in Arcadia the very shadow of the yew tree is fatal to those who sleep in it, and that arrows are rendered poisonous by its juice. Dioscorides states that the berries are poisonous to birds. The poisonous effects of the emanations of this tree have been mentioned by several later observers, who have put them to the test, and it is recorded that a girl who slept all night under a yew tree suffered from a copious miliary eruption, and for days remained in a half-delirious state. The poisonous portions of the plant are its foilage and the stony seed; the fleshy covering of the latter is innocuous.

On Animals: 15 grains of the alcoholic extract of the leaves given to rabbits occasioned hurried breathing and palpitation of the heart, followed by recovery, and double the dose produced the same effects, ending in sudden death. In other cases convulsions preceded the extinction of life, but it would appear that they are least apt to occur when the dose has been large. In several experiments with such doses the animal died quietly by syncope. So in certain cases horses poisoned by yew have died suddenly without any spasm or sign of pain. According to Borcher's (1876) experiments, taxine reduces the pulse- and respiration-rate and causes convulsions, with fatal asphyxia (Husemann). After death the evidences of gastro-intestinal inflammation have generally been slight, the heart was usually empty, the kidneys strongly congested, and the blood less coagulated than usual.

On Man: The effects which are produced by yew on man vary materially in different cases, and, in general, the larger the dose of the poison the less definite and various are the symptoms. When they are fully developed they comprise irritation of the stomach and bowels, with vomiting, and sometimes purging, difficult urination, pallor, giddiness, prostration, coldness, spasm, or partial paralysis, irregular and feeble action of the heart, and death by coma or by syncope. The latter mode of death occurs most frequently when the dose of the poison is very large, and then the phenomena of nervous irritation and exhaustion and the gastric disturbance may be very trifling, the patient dying by rapid asthenia or by absolute syncope. In the case of a young woman who took the leaves of yew as an abortive, death occurred without convulsion, and her countenance was as natural as in sleep. In another case eleven persons partook of a decoction of yew; some of them were seized with giddiness, confusion of sight, pain in the head, nausea, and vomiting, and then fell asleep; but two of them died within an hour without pain or convulsion. The fatal dose varies greatly; a decoction of from 2 to 5 ounces has destroyed life. The lesions found after death in man produced by this poison are the same as those already mentioned as occurring in animals.

Medical Uses.—A jelly prepared from the berries of yew has been employed in the treatment of chronic catarrh of the *bronchia* and the *urinary passages*, and the leaves have been recommended in *scurvy*, *epilepsy*, and other spasmodic affections, and been used by the vulgar as an *emmenagogue*, and especially as an abortive. The efficiency of yew in these conditions is far from proven, and among the numerous cases in which it has been employed to provoke abortion several have resulted fatally to the mother, but in none was the fœtus expelled. The leaves have been prescribed in doses of from 1 to 5 grains (Gm. 0.06–0.30), or in a decoction or infusion made with from 8 to 16 grains in 4 ounces of water (Gm. 0.50–1 in Gm. 120).

In *poisoning* by this substance the stomach should be speedily evacuated, after which milk may be given in small quantities to allay the irritation, and alcoholic liquids in stimulant doses.

TEPHROSIA.—Goat's Rue.

Turkey pea, *Hoary pea*, *Devil's shoestring*, E.; *Tephrosie*, Fr., G.

Tephrosia (Galega, *Linné*) virginiana, *Persoon*. Meehan, *Native Flowers*, i. 81.
Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin and Description.—This species is an herbaceous perennial growing in sandy soil in Canada and the United States westward to the Mississippi. Its root is many-headed and divided into several nearly horizontal branches, which are about ½ inch (12 Mm.) in diameter, 1 to 2 feet (30–60 Cm.) long, somewhat beset with fibres, rather tough and flexible, externally brown-gray and internally whitish. The stems are about 2 feet (60 Cm.) high, nearly simple, more or less woolly, and have numerous alternate, oddly-pinnate leaves, with about ten pairs of oblong, mucronate, shortly-stalked, straight-veined, and silky-villous, pale-green leaflets. The flowers are in terminal and axillary racemes, white, rose-colored, and red, and produce a curved silky legume.

The root, and occasionally the herb, have been employed; the root is without odor and has a bitterish and somewhat acrid taste.

Constituents.—The principles to which the properties of goat's rue may be due are unknown.

Allied Plants.—Tephrosia appolinea, *De Candolle.* The leaflets have occasionally been used as a substitute for, or for the adulteration of, senna-leaves (see p. 1366).

T. toxicaria, *Persoon*, is indigenous to Africa and naturalized in tropical America. It has deep-red flowers and a poisonous root.

T. purpurea and T. spinosa, *Persoon*, indigenous to India, have bitter roots, which are employed for their tonic properties.

T. leptostachya, *De Candolle*, is a native of Senegambia. Its root and leaves are regarded as possessing purgative properties.

Medical Action and Uses.—The root as well as the leaves of the native tephrosia are said to be laxative, tonic, and *vermifuge*. For the last-named purpose a decoction of the root has been used. It may be prepared by boiling an ounce of the plant in a pint (Gm. 32 in Gm. 500) of water, to the reduction of one-half. *Dose*, 1 or 2 tablespoonfuls (Gm. 16–32). It has also been reported to be useful in the treatment of *typhoid fever*, but as it was not given alone, its value in this disease cannot be estimated.

TEREBINTHINA, *U. S., P. G.*—Turpentine.

Thus americanum, Br.; *Terebinthina communis.*—*Crude turpentine*, E.; *Térébenthine commune*, Fr.; *Gemeiner Terpentin*, G.

The concrete (semi-fluid, *P. G.*) oleoresin obtained from Pinus australis and other species of Pinus. Bentley and Trimen, *Med. Plants*, 256–259.

TEREBINTHINA CANADENSIS, *U. S., Br.*—Canada Turpentine.

Balsamum canadense.—*Canada balsam*, *Balsam of fir*, E.; *Térébenthine du Canada*, *Baume de Canada*, Fr.; *Canadischer Terpentin*, G.

The liquid oleoresin obtained from Abies (Pinus, *Linné*, s. Picea, *Loud*) balsamea, *Marshall.* Michaux, *N. Amer. Sylva*, iii. t. 150; Bentley and Trimen, *Med. Plants*, 263.
Nat. Ord.—Coniferæ.

Origin.—The different species of pine and fir form resin-ducts in the bark or wood, in which liquid oleoresins secrete. Most of these oleoresins exude to some extent spontaneously, but the various turpentines of commerce are obtained by wounding the trees. Many species secrete the oleoresin in such small quantities that it is not collected. The turpentines recognized in the U. S. and British Pharmacopœias are furnished by the following species:

Pinus australis, *Michaux*, s. P. palustris, *Miller*. This is the *broom pine* or *swamp pine* of the United States, where it is very abundant from Southern Virginia to Florida, not extending more than about 100 miles from the coast. Its leaves are 10 to 15 inches (25–38 Cm.) long, crowded near the ends of the branches, and in tufts of threes, surrounded by long, ragged sheaths. The cones are nearly cylindrical, about as long as the leaves, and have the scales furnished with a short spine. This species yields nearly all the turpentine and rosin in the United States.

Pinus Tæda, *Linné*, grows in barren, sandy soil near the coast from Virginia to Florida, and is known as *loblolly* or *old-field pine*. The leaves are 8 or 10 inches (20–25 Cm.) long, in fascicles of threes, and surrounded by elongated, subentire sheaths. The cones are ovate-oblong, about one-half the size of the leaves, and have the scales tipped with a stout inflexed spine.

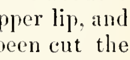
Abies balsamea, *Marshall*, is the *balsam fir* or *balm-of-Gilead fir* of Canada and the Northern United States. It attains a height of about 50 feet (15 M.), has numerous solitary leaves, which are about $\frac{4}{5}$ inch (2 Cm.) long, linear, flat, obtuse, and glaucous-silvery beneath, and produces cylindrical bluish cones 3 or 4 inches (7–10 Cm.) long and with scales tipped by a short spine.

Abies Fraseri, *Pursh*, resembles the last species, but has the cones only about 2 inches (5 Cm.) in length, and the upper part of their sharp-pointed scales much projecting and recurved. It grows from New England to North Carolina, principally in the mountains, and may be used for collecting *balsam of fir*.

Collection.—Common Turpentine. In the United States turpentine is chiefly obtained in North Carolina, and more recently it has been procured from South Carolina and Georgia. During the autumn and winter the pine trees are *boxed*, one to four excavations being made, by means of an axe, through the bark into the sapwood, commencing about 6 or 8 inches (15–20 Cm.) above the roots. The bottom of these *boxes* is about 5 inches (12 Cm.) below the lower and 8 or 10 inches (20–25 Cm.) below the upper lip, and their capacity varies from 4 to 8 pints. A few days after the boxes have been cut the bark is removed above the box to the height of about 3 feet, and some of the wood is scraped off or *hacked*, the hacks being made in the shape of the letter L. The oleoresin or *crude* begins to flow about the middle of March, runs best during July and August, and slackens again in September and October. The boxes are from time to time emptied by means of a peculiarly-constructed spoon or ladle, called turpentine-dipper, and the turpentine is at once transferred into rudely-constructed barrels, and usually used for distilling the oil. The trees are slightly scraped every eight or ten days, and the scraping or hacking is continued until finally ladders have to be employed. The flow of the first year is the best, called *virgin dip*, and yields about 6 gallons of oil per barrel and the so-called "window-glass rosin." *Yellow dip* is the exudation of the second and subsequent years, yields about 4 gallons of oil per barrel, and furnishes the medium grades of rosin. The turpentine which hardens upon the tree is termed *scrapings*, yields about 2 gallons of oil per barrel, and leaves a very dark-colored nearly black rosin. (See I. Zacharias, *Amer. Jour. Phar.*, 1877, 543, and Dr. T. F. Wood, *New Remedies*, 1880, 289.)

Canada Turpentine is largely collected in the province of Quebec, Canada, the balsam-gatherers, with their whole families, encamping in the woods for two months each year. The turpentine is secreted in vesicles formed in the bark, each of which requires to be pierced by the sharp-pointed iron tube attached to a can, when the balsam flows into the vessel. The average yield of each tree is about 8 ounces, and a man with the aid of two children may gather about 1 gallon during the day. The trees require two or three years' rest before they are tapped again, and the yield is then always less than the first time. The largest crop ever gathered in the Laurentine Mountains of Quebec in one year was 5000 gallons. (See Wm. Saunders, *Proceedings Amer. Phar. Assoc.*, 1877, p. 337.)

Fig. 296.



Instrument for collecting balsam of fir.

Description.—Turpentine is a yellowish, or brownish-yellow, viscid liquid, which, when it exudes, is transparent, but soon becomes opaque from a crystalline deposit, is rendered thinner and clear by a moderate heat, and has an agreeable terebinthinate odor and a pungent, bitterish, and acrid taste. In this condition turpentine is recognized by the pharmacopœias of continental Europe, but in the United States and in Great Britain the oleoresin which has concreted on the trees is officinal, and is generally kept under the name of *white turpentine*, and in England is known as *common frankincense*. It is identical with the granular sediment deposited from liquid turpentine, and is found in irregular yellowish-white, more or less tough masses, which contain fragments of bark and wood, are brittle in the cold, breaking with a crummy fracture, and are more tenacious, or even semi-liquid, in warm weather. It contains from 12 to 16 per cent. of volatile oil, on the loss of which by exposure it becomes firm and friable.

Canada Turpentine is a yellowish or faintly greenish, perfectly transparent, and occasionally somewhat fluorescent, viscid liquid, having a similar but more agreeable odor and taste than the preceding. On exposure it acquires a slightly darker tint and dries into a transparent, pale-yellow mass. It is completely soluble in chloroform, benzol, ether, and warm amylic alcohol, but incompletely in bisulphide of carbon, glacial acetic acid, acetone, and absolute alcohol (*Pharmacographia*).

Substitutions.—Common turpentine is not liable to adulterations, but a fictitious Canada turpentine has occasionally been sold under the name of *Oregon balsam of fir*, which was made by dissolving rosin in oil of turpentine and flavoring the solution by the addition of a little oil of wormwood. A liquid pale-yellow turpentine may be procured by puncturing the vesicles of the bark of Abies (Pinus, *Douglas*) Menziesii, *Lindley*, the *balsam pine* of the Pacific coast. The sample in our possession slowly deposited white granular matter, and became rather opaque and solid.

Other Turpentines.—European Turpentine closely resembles American turpentine, and is obtained in Russia from Pinus sylvestris, *Linné;* in Germany, from the same species and from P. rotundata, *Link;* in Austria, from P. Laricio, *Poiret;* and in South-western Europe, from P. Pinaster, *Solander*, s. P. maritima, *Poiret* (Bentley and Trimen, *Med. Plants*, 256, 257). The turpentine is secreted in the sap-wood, and is obtained in a manner similar to that in which the American turpentine is procured. The concrete French or *Bordeaux turpentine* is known in European commerce as *gallipot*, and resembles white turpentine.

Strassburg Turpentine, *Terebinthina argentoratensis*, is procured, like Canada balsam, which it resembles, by puncturing the vesicles of the bark of Abies (Pinus, *Lamarck*) pectinata, *De Candolle*, s. Pinus Picea, *Linné*, P. Abies, *Duroi*, Abies alba, *Miller*, A. excelsa, *Link* (Silver fir, *E.;* Sapin, *Fr.;* Weisstanne, Edeltanne, *G.* Bentley and Trimen, *Med. Plants*, 262). It is collected in the Vosges, and has an agreeable odor, somewhat resembling that of lemon.

Venice Turpentine, *Terebinthina laricina, s. laricis, s. veneta*, is procured in Tyrol and Switzerland from Larix europæa, *De Candolle* (L. decidua, *Miller*, Pinus Larix, *Linné*) (Bentley and Trimen, *Med. Plants*, 260). (See Laricis Cortex.) The oleoresin is secreted in the heart-wood, and is obtained by boring a hole into the trunk to the centre and dipping the liquid out as it accumulates. It is a nearly transparent or slightly opaque and somewhat fluorescent thick liquid, of a terebinthinate odor, a bitter and aromatic taste, and a yellowish or greenish-yellow color. It is freely soluble in alcohol, amyl alcohol, acetone, and glacial acetic acid, and does not become hard when mixed with magnesia. The article usually sold here under this name is an artificial product. 59,366 pounds of Venice turpentine were imported in 1878; the average is about 48,000 pounds.

Hungarian Turpentine, *Balsamum hungaricum*, exudes from Pinus Pumilio, *Hænke*, after cutting off the tops of the branches in the spring. It is thin, transparent, yellowish, and has an aromatic odor and warm taste.

Constituents.—All turpentines consist of a volatile oil having the composition $C_{10}H_{16}$ (see Oleum Terebinthinæ) and of resin, which is left behind on distilling the oil, and then constitutes rosin. (See Resina.) The transparent turpentines, according to Maly, are solutions of *abietic anhydride* in the volatile oil, and on exposure to a moist atmosphere gradually become turbid and opaque from the crystallization of *abietic acid*. But the resin contained in those turpentines which do not become opaque on exposure must necessarily be different. Hot water agitated with turpentine acquires an acid reaction from the presence of formic, and probably also of succinic, acid, and the alcoholic solution of turpentine has a strong acid reaction.

Other Products of Pines.—Turiones (Gemmæ) Pini.—Pine-shoots, *E.:* Bourgeons de pin (sapin), *Fr.:* Fichtensprossen, *G.*—The young shoots of P. sylvestris, collected when about 2 inches (5 Cm.) long, are glutinous from an oleoresinous exudation, and have an agreeable terebinthinate odor and a bitter, resinous, and rather acrid taste.

Oleum pini foliorum.—Pine-leaf oil, Fir-wool oil, *E.:* Essence de feuilles de pin, *Fr.:* Kiefernadelöl, Waldwollöl, *G.*—The leaves of the different species of pine by pounding are converted into a fibrous substance known as *Fichtenwolle* (*fir-wool*), and when distilled with water yield a volatile oil which differs from the volatile oil obtained from the resin of the same species. It is of a green-yellow color, is limpid, has an agreeable terebinthinate and somewhat lavender-like odor, and is soluble in about seven times its volume of alcohol sp. gr. .838. The volatile oil is recognized as Oleum Pini sylvestris, *Br.*

Oleum templinum is distilled from the shoots of Pinus Pumilio, and is known in Germany as

Krummholzöl and *Latschenöl.* It is colorless or yellowish-green, and of an agreeable somewhat terebinthinate odor. The volatile oils of Pinus sabiniana, *Douglas*, and of other species of pine indigenous to California resemble these products.

Allied Oleoresins.—Terebinthina chia, s. Cypria, *Chian turpentine*, is the turpentine of ancient authors. It is obtained from incisions made in the bark of Pistacia Terebinthus, *Linné* (nat. ord. Anacardiaceæ; Bentley and Trimen, *Med. Plants*, 69). This species is a small tree found in the basin of the Mediterranean and eastward in Asia. The oleoresin is greenish-yellow or brownish, transparent, has a terebinthinate and somewhat fennel-like odor and a mild bitterish taste, and hardens to a transparent resin.

Balsamum gileadense (see p. 1009).

Caranna is a soft oleoresin of a greenish-brown or brownish-green color coming from Central and South America, and probably obtained from Icica Caranna, *Kunth*, and other trees of the nat. ord. Burseraceæ. It has an agreeable balsamic odor and a bitterish taste.

Tacamahaca is the product of Elaphrium tomentosum, *Jacquin*, and probably of several South American trees (nat. ord. Burseraceæ). It is in brown or yellowish translucent pieces, of an aromatic odor, and breaking with a smooth and glossy fracture. The exudations of Calophyllum Tacamahaca, *Willdenow*, and Cal. inophyllum, *Linné* (nat. ord. Guttiferæ), indigenous to India and the islands of the Indian Ocean, have been used under the same name. Their odor bears a resemblance to lavender and fenugreek. The seeds of the last-named species contain from 50 to 60 per cent. of fixed oil, known in Indian commerce as *bitter oil* or *weandee;* it is butyraceous, green, aromatic, and is in great repute for rheumatic complaints.

Anime. South American anime is probably derived from some species of the nat. ord. Burseraceæ, though it has been referred to Hymenæa Courbaril, *Linné* (nat. ord. Leguminosæ). It is in yellowish-white or brownish, rather opaque pieces, which soften between the teeth and have an odor resembling that of olibanum. East Indian anime is reddish and yellowish, friable, of a waxy lustre, and has a somewhat fennel-like odor.

Pharmaceutical Products.—Tinctura pini composita.—Compound tincture of pine-shoots, *E.;* Teinture de sapin composée, *Fr.;* Holztinktur, *G.*—Macerate for 8 days young pine-shoots 3 parts, guaiac-wood 2 parts, sassafras-root and juniper-berries, each 1 part, in alcohol (sp. gr. .892) 36 parts; express and filter.—*P. G.* 1872.

Syrup of Pine-Shoots, *E.;* Sirop de bourgeons de pin, *Fr.*—Macerate for 12 hours 100 parts of young pine-shoots with an equal weight of alcohol; add 1000 parts of hot water, digest for 6 hours, express, filter, and dissolve 180 parts of sugar in every 100 parts of the filtrate.—*F. Cod.*

Off. Prep.—Of *turpentine:* Empl. galbani comp., *U. S.;* Empl. picis, *Br.* Of *Canada turpentine:* Charta cantharidis (epispastica), Collodium flexile, *U. S.*, *Br.;* Emplastrum ferri, *U. S.*

Medical Uses.—Turpentine is seldom or never used in medicine, as its virtues depend entirely upon its volatile oil (see Ol. Terebinthinæ), which is separately employed. In ancient times it was prescribed chiefly as a stimulant in *amenorrhœa*, as a diuretic, as a remedy for catarrhal affections of the *urino-genital* organs and of the *lungs*, and in *ulceration of the bowels*, *hæmorrhoids*, and *rheumatism.* Externally, it was applied in the treatment of *itch* and of numerous chronic *diseases of the skin*, and its vapor, at a high temperature, as a bath in *chronic rheumatism.* The *dose* of turpentine may be stated at from 20 to 60 grains (Gm. 1.30–4).

Under the name of Canada balsam, balsam of fir, and even under the deceptive title of balm of Gilead, Canada turpentine has been used, especially in the treatment of chronic *bronchitis*, as well as for the purposes to which other turpentines are applied. It is destitute of the special qualities of the true balsams, since it does not contain benzoic acid.

The resin of tacamahaca was formerly used in fumigations for *rheumatism* and in plasters for that affection, *sprains*, and other local disorders requiring stimulation or mechanical support. It was also given internally, associated with amber, cloves, nutmeg, etc.

Chian turpentine was introduced as a remedy for *uterine cancer* in 1880 by Prof. Clay of Birmingham, Eng. It was given internally, and in a maximum dose of 25 grains. Its effects were thus described: "It appears to act upon the periphery of the growth with great vigor, causing the speedy disappearance of what is usually termed the cancerous infiltration. . . . . It appears to dissolve the cancer-cells, ... and the firmer structures gradually gain a comparatively normal condition. . . . . It is a most efficient anodyne" (*Lancet*, Mar. 27 and Oct. 2, 1880). On the other hand, Dr. Henry Morris (*Lancet*, Dec. 4, 1880) declared that the drug did not exercise a favorable influence over a single symptom of cancer, and that as a cure it was utterly valueless. To the latter opinion all experts in the matter have rallied.

TEUCRIUM.—GERMANDER.

Herba mari veri.—Herb mastich, Cat thyme, E.; *Germandrée maritime*, Fr.; *Gamander, Katzengamander, Amberkraut*, G.

Teucrium Marum, *Linné.*
Nat. Ord.—Labiatæ, Ajugoideæ.

Description.—Of the numerous species of the genus Teucrium which are occasionally employed in medicine, nearly all are indigenous to Europe. The genus is characterized by its flowers, which have the lower lip elongated and the upper lip short and deeply divided, the four stamens projecting from the cleft. All are aromatic and more or less bitter. The above-named species is shrubby, about 10 inches (30 Cm.) high, and much branched. The leaves are about ⅓ inch (8 Mm.) long, petiolate, oval or lanceovate, with the margin entire and revolute, and whitish tomentose beneath. The rose-red flowers are single in the axils of the bracts, forming a one-sided, spike-like raceme. The odor is strongly camphoraceous, the taste pungent and bitter.

Allied Plants.—TEUCRIUM CANADENSE, *Linné.*—Woodsage, *E.*—It is downy or hairy, of a grayish-green color, and about 2 feet (60 Cm.) high. The leaves are about 2 inches (5 Cm.) long, short-stalked, lance-ovate, rounded at the base and serrate on the margin. The pale-purple flowers are in whorls of about six, and form a terminal spike.

T. SCORDIUM, *Linné;* Herba scordii.—Water germander, *E.;* Germandrée aquatique, *Fr.;* Lachenknoblauch, *G.*—It is about 12 inches (30 Cm.) high, has sessile, lance-oblong, serrate, and soft hairy leaves about 1½ inches (38 Mm.) long, and rose-colored flowers in whorls of two to four. In the fresh state it has an alliaceous odor.

T. POLIUM, *Linné.*—Polymountain, *E.;* Polium, *Fr.;* Bergpoley, *G.*—The leaves are ½ inch (12 Mm.) long, tomentose, sessile, lance-linear, obtuse, crenate, and strongly revolute on the margin. The flowers are white. The allied T. montanum, *Linné*, has yellowish flowers.

T. CHAMÆDRYS, *Linné.*—Petit-chêne, *Fr.*—It is low, suffruticose, and branching. The leaves are about an inch (25 Mm.) long, petiolate, hairy, ovate or obovate, obtuse, cuneate at base, and crenately serrate. The flowers are purplish-red.

AJUGA (TEUCRIUM, *Linné*) CHAMÆPITYS, *Schreber.*—Ground pine, *E.;* Ivette, *Fr.;* Günsel, Feldcypresse, *G.*—A small hairy annual with axillary flowers, having the yellow corolla dotted with purple; the lower-leaves are lanceolate, the upper ones three-cleft with linear lobes; the odor is rosemary-like.

AJUGA (TEUCRIUM, *Linné*) IVA, *Schreber.*—French ground pine, *E.;* Ivette musquée, *Fr.;* Bisamgünsel, *G.*—It resembles the preceding, but has linear, somewhat toothed, woolly leaves, red flowers, and a musk-like odor. This and the preceding two species are officinal in the French Codex.

AJUGA REPTANS and A. PYRAMIDALIS, *Linné*, are small perennials with obovate crenate radical leaves and blue flowers, are slightly aromatic and somewhat bitter, and are known in Europe as *bugle* and *mountain bugle.*

Constituents.—These species owe their virtues to volatile oil, to a small quantity of bitter principle, and to tannin.

Medical Action and Uses.—The numerous species of Teucrium appear to possess similar qualities in different degrees, and among them T. marum, or germander, has enjoyed the greatest reputation. It is described as tonic, stimulant, diaphoretic, diuretic, and emmenagogue, and has been used in *scrofula*, *chlorosis*, chronic *bronchitis*, *leucorrhœa*, *amenorrhœa*, *dropsy*, *chronic gout*, etc.—in a word, in various affections requiring a stimulant and tonic treatment. A snuff made from its powder has been employed to cure *nasal polypi.* Teucrium is administered in powder in the dose of 30 or 40 grains (Gm. 2–2.30), or in an infusion made with from half an ounce to an ounce in a pint (Gm. 16–32 in Gm. 500) of water.

THAPSIA.—THAPSIA.

Thapsie, Faux fenouil, Fr.; *Thapsie*, G.

Thapsia garganica, *Linné.*
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin and Description.—This plant is a perennial herb of Northern Africa and Southern Europe, and has a smooth, thick, and hollow stem; smooth, shining, twice or thrice-pinnate leaves, with large sheaths and lance-linear, acute, often two- or three-lobed leaflets; and pale-yellow flowers in large compound umbels. The root is usually employed. It is about 2 feet (60 Cm.) long, about 2 inches (5 Cm.) thick, gradually tapering, somewhat branched, brownish-gray externally and internally whitish. When fresh it contains a white acrid juice. It is nearly inodorous and has a biting, acrid taste.

The closely-allied Th. Sylphium, *Viviani*, of Northern Africa, is, like the Narthex Sylphium, *Oersted*, regarded as a mere variety of the preceding plant, which is by some believed to be identical with the Sylphium cyrenaicum of the ancients.

Constituents.—The acrid properties are due to a resin which is neutral and free from nitrogen, crystallizes in needles, and is soluble in hot alcohol, in ether, and in carbon bisulphide. Canzoneri (1883) found in the resinous extract also an octoic acid, $C_8H_{16}O_2$, closely related to caprylic acid, and *thapsic acid*, $C_{16}H_{30}O_4$, which is scaly, melts near 124° C. (255° F.), and is nearly insoluble in water, benzol, and carbon bisulphide.

Pharmaceutical Uses.—Resina thapsiæ. Exhaust the bark of the root with alcohol and evaporate to a soft extract.—*F. Cod.*

Thapsia Plaster contains 7 per cent. of the resin, combined with yellow wax, colophony, and turpentine.—*F. Cod.*

Medical Action and Uses.—Galen, Dioscorides, and the Arabians agree in describing the powdered root and juice of this plant as being irritating to the skin, and, when taken internally, as emetic and purgative. The juice and ointments and plasters prepared with it were used as stimulants and counter-irritants for the relief of rheumatic and other local pains and to lessen dyspnœa. About 1868 some attempts were made to revive its use in the form of the resin extracted from the root. Applied in a plaster, the skin became inflamed, with intolerable itching, and a copious vesicular eruption ensued. If the application was not prolonged, this eruption speedily dried up, but in the contrary case the vesicles became confluent, broke, and exposed an ulcerated and suppurating surface, which on healing left scars resembling those of small-pox. On delicate skins its operation was extremely severe. It is stated that the men employed in preparing extract of thapsia on a large scale were affected with fever and swelling of the hands and face, and from time to time were obliged to suspend their work. A case is also related in which the application of a plaster of thapsia resin to the chest was followed in about 12 hours by severe strangury and violent itching about the genitals and anus. In the Therapeutical Society of Paris all the leading members of that body condemned thapsia plasters as unnecessary, and as sometimes dangerous (*Bull. et Mém. Soc. thér.*, Avr. 1882, p. 101). It does not appear that its therapeutic operation differs in any wise from that of other counter-irritants, such as croton oil, euphorbium, mezereon, and tartar emetic, but it may be added to the number of such agents for occasional use. The resin may be mixed with diachylon in the form of a plaster, or ordinary adhesive plaster may be coated with an alcoholic solution of the resin and applied to the skin.

THEA.—Tea.

Thé, Fr.; *Thee*, G.

The leaves of Thea chinensis, *Sims* (Camellia Thea, *Link*, C. theifera, *Griffith*). Bentley and Trimen, *Med. Plants*, 34.

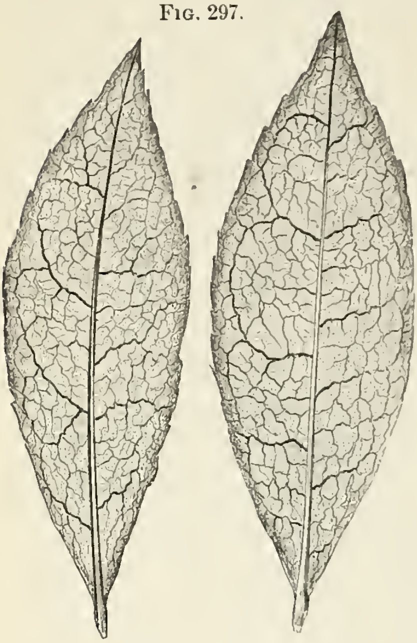
Nat. Ord.—Ternstrœmiaceæ (Camelliaceæ).

Origin.—Tea is obtained from a shrub which is indigenous to China and probably to other parts of Southern and South-eastern Asia, and has been cultivated in India, China, and Japan from a very early period. The varieties produced by long cultivation were formerly regarded as distinct species, and described as Thea Bohea, T. viridis, T. stricta, etc. The plant has been successfully introduced in several parts of the United States. It bears white axillary flowers and roundish-triangular, three-celled, and three-seeded capsules. The seeds are subglobular, somewhat flattened, of the size of a cherry-stone, glossy-brown, yellow at the hilum, and have a brittle testa, a short radicle, and unequal thick plano-convex cotyledons.

Preparation.—After the leaves have been gathered they are either rapidly dried, when they change to a dull-green color (*green tea*), or they are allowed to wilt, and are subsequently kept for some time in heaps, when they acquire a dark color (*black tea*). Both varieties are subjected to various manipulations, such as rolling upon a table, heating over a fire, etc., and are sometimes flavored by being left in contact with the flowers of the orange, fragrant olive, jessamin, and others. Hyson, Young Hyson, Gunpowder, and Imperial are some of the best-known brands of green tea, and Souchong, Oolong, and Pekoe are black teas.

Description.—Tea is met with in commerce in the form of little cylinders or rolls, into which the leaves have been twisted during the manipulation of rolling, and in some varieties these leaves have again been formed into balls of different sizes. Tea-leaves after having been softened in water and unfolded are found to be from 1 to 3 inches (25–75 Mm.) long, varying between oblong-ovate and oblanceolate in shape, short-stalked, pointed at both ends or blunt, sometimes emarginate at the apex and irregularly toothed at the margin. They have a prominent midrib, the lateral branches of which are curved upward near the margin. Tea has an agreeable odor, which varies, however, in the different varieties; its taste is pleasantly astringent and bitterish. The green color is not unfrequently heightened or imparted to tea by a mixture of Prussian blue and gypsum.

Fig. 297.



Tea-leaves: natural size.

Constituents.—Tea contains 1 to 2, or sometimes 4, per cent. of *theine*, which was discovered by Oudry (1827), and by Mulder and Jobst (1838) proved to be identical with caffeine (see page 342). It may be obtained by sublimation on carefully heating powdered tea-leaves, or, according to Cazeneuve and Caillot (1877), by macerating in a water-bath and drying a mixture of 1 part of cut tea-leaves, 4 of water, and 1 of slaked lime; the residue is exhausted with chloroform; this is distilled off, and the greenish mass treated with boiling water; the solution is passed through a moist filter, and on cooling and concentrating yields the alkaloid. Mulder obtained from tea between 13 and 18 per cent. of tannin, which, according to Peligot, is peculiar, and, according to Stenhouse, differs from gallo-tannic acid and is accompanied by a little gallic acid. Rochleder (1848), on the contrary, found a small quantity of tannin identical with that of nutgalls, and a smaller proportion of *boheic acid*, $C_{14}H_{20}O_{12}$, which is amorphous, deliquescent, freely soluble in water and alcohol, and is colored brown, but not precipitated, by ferric chloride. Peligot found tea-leaves to contain pectin. Mulder obtained about 3 per cent. of albumen, 2 to nearly 4 per cent. of wax and resin, aside from the chlorophyll, and between 0.6 and 1 per cent. of volatile oil, which necessarily must vary with the variety of tea yielding it; it is of a lemon-yellow color, has a strong aromatic odor and taste, and congeals readily. Tea yields between 4 and 6 per cent. of ash, about two-thirds of which is soluble in water; but on extracting tea-leaves with water, one-half to three-fourths or more of the mineral constituents enter the infusion. The ash contains from 38 to 48 per cent. of potassa and from 11 to 26 per cent. of phosphoric acid. The nitrogen of the leaves varies between 4 and 7 per cent. R. Weyrich (1872) found it impossible to determine chemically the value of tea; the best results were obtained from determining the phosphoric acid, which was always present in largest proportion in the best qualities, but varies greatly in the different varieties, green tea yielding 11.6 to 13.3 per cent., black tea 13.1 to 17.3 per cent., yellow tea 18.5 to 25 per cent., etc.

By expression tea-seeds yield about 35 per cent. of comestible oil, which resembles olive oil, is of a yellow color, has the spec. grav. .927, becomes turbid below 5° C. (41° F.), and congeals at about —60° C. (21° F.); it consists of olein and stearin.

Allied Plants.—THEA (CAMELLIA, *Linné*) JAPONICA, *Baillon*, s. Thea Camellia, *Hoffmann*. The seeds of this well-known ornamental shrub are regarded as poisonous in Japan. Katzuyama (1878) isolated from them tannin, acrid soft fixed oil, and *camellin*, which is nearly insoluble in cold water and ether, is freely soluble in water, turns yellow by alkalies, and red by sulphuric acid containing nitric acid, and appears to be a glucoside.

CAMELLIA OLEIFERA, *Abel* (Thea oleosa, *Loureiro*), and CAM. DRUPIFERA, *Loureiro*. The seeds, like tea-seeds, yield bland fixed oils, that of the last species having an agreeable odor.

Physiological Action.—*On Animals:* Long ago Lettsom proved that the fragrant and volatile substance which may be distilled from an infusion of tea was capable of paralyzing the hinder limbs of a frog, and even of causing the death of the animal when introduced into a wound in its abdomen. In 1868, Leven (*Amer. Jour. of Med. Sci.*, July, 1868, p. 260) experimented upon frogs with theine and caffeine, and concluded that to these animals the former was the less powerful poison of the two, since twice as much of it as of caffeine was required to produce the same effects. Yet it excited convulsive movements in the animals' limbs, which caffeine did not. In other respects the physiological actions of the two alkaloids were identical. They both seemed to directly excite the heart and the respiratory movements, and to increase arterial tension. They both appeared to stimulate the brain and the spinal marrow, but not to arrest the functions of either. The tetanic convulsions were attributed by Leven to excitation of the spinal cord. Both appeared to abolish muscular contractility, but the heart continued to beat after general death. The experiments of Dr. A. Bennett, on the other hand, which were made upon frogs, mice, rabbits, and cats, led him to conclude that theine and caffeine are identical throughout the whole range of their action, and he especially made no distinction between the convulsifying operations of the two alkaloids. According to this experimenter, theine in small doses produces cerebral excitement, not succeeded by coma, and partial loss of sensibility, and in large doses occasions cerebral excitement, paralysis of sensibility, tetanic spasm, convulsions, and death. Further, it does not cause muscular paralysis, but at first it produces contraction, and afterward dilatation, of the capillaries and small blood-vessels, with stasis of the blood in them (*Edinb. Med. Jour.*, xix. 323).

On Man: The most familiar effect of tea is its power of inducing a cheerfulness of disposition and a lively flow of ideas, without that tendency to mental and physical torpor which follows the exhilaration caused by alcohol. The familiar line of Cowper, "The cups that cheer, but not inebriate," describes its usual mode of action. There can be no doubt that, like its congeners, tea diminishes the need of food even while it quickens the activity of the nervous system. In this way, probably, it has become the favorite drink of women, whose sedentary lives impede the activity of tissue-waste, without lessening the craving peculiar to their sex for lively conversation. Tea imparts to them the mental activity which their ordinary occupations restrain. It also tends to banish the drowsiness which their monotonous labor induces. Many men have been great tea-drinkers, but they were chiefly of the class addicted to prolonged mental labor, particularly at night; and they found in it not only the power of resisting sleep, but often the inspiration of bright ideas. It is evident that these effects, which are notorious and familiar, must be attributed to the direct stimulation of the brain, and by no means to the restriction of tissue-change, which is too often regarded as the prime, and indeed the sole, effect of tea. The latter is, undoubtedly, a real result of tea-drinking, but it is not that for which tea is so universally employed. It has been alleged that persons employed in tasting tea for commercial purposes are liable to lose their health and grow morbidly nervous, their bowels become constipated, and the urine and the proportion of urea in it suffer diminution (Morton, *Monthly Abstract*, Jan. 1880, p. 54). It is affirmed as positively, on the other hand, that none of these alleged effects occur, so far as relates to derangement of the nervous system and the general health (Dana, *Medical Record*, xvii. 85).

In comparing the physiological effects of theine and caffeine upon the excretions, it has been found by some experimenters that the former does not affect the elimination of carbonic acid, while the latter diminishes it, as well as the discharge of urea, uric acid, and water, in a larger proportions than theine. Caffeine also is said to increase the watery constituent of the urine, while theine diminishes it. However this may be, it is a matter of familiar observation that the effects of tea and coffee upon the system are by no means identical; for while coffee causes wakefulness as well as tea, in the former case it is rather a pleasing insomnia, not unlike that occasioned by small doses of opium, tranquil for the most part, and filled with pleasing reveries; while tea, on the other hand, induces in one who endeavors in vain to sleep after its use a state of tension of the nervous system which is in the highest degree distressing. Upon almost every one coffee acts as a stimulant which is more or less cordial, flushing the face and rendering the pulse fuller, but such effects never follow the use of tea as direct consequences. It is seldom that a single indulgence in strong coffee induces that nervous agitation and tremulousness and impaired muscular power which are ordinary effects of strong tea; and, unless we are greatly mistaken, gastralgia and other neuralgic affections are much more frequent among tea-drinkers than coffee-drinkers. It is very true that some of these apparent differences may be explained by the fact that tea is generally taken with only a small modicum of cream or milk, while coffee is as commonly used with a large proportion of one or both Indeed, in France, where coffee is the universal breakfast drink, it is always mixed with a great excess of milk, and it is used pure chiefly after dinner, when the presence of food in the stomach retards its absorption and modifies it action. It is, however, customary for those who have mental or bodily work to perform before breakfast to take a cup of "black coffee" immediately on leaving bed.

It has been already objected that theine and caffeine do not fully represent the sources from which they are respectively obtained. The identity of these alkaloids in their physiological action does not imply a similar identity in tea and coffee. As little should we be entitled to infer that all alcoholic drinks produce identical effects because they all contain alcohol as their chief constituent. It is just as certain that tea and coffee differ in their action upon the human system as that Rhenish or Bordeaux wine acts very differently from whiskey or brandy, although in all of these liquors the common cause of their effects is alcohol. Moreover, not only are theine and caffeine physiologically identical, but so are guaranine, cocoaine, and theobromine with them and with one another; and yet the operations of guarana, coca, and theobroma are different from one another, and from those of tea and coffee, in important particulars. It is unquestionably a fact of the highest possible interest that all of these vegetable products, which are used by different and remote nations, should contain identical proximate principles; but while we thus are led to admire the universality of physiological laws, we should not lose sight of the peculiarities which distinguish these important articles of human food from one another.

Medical Uses.—When tea was introduced into Europe by the Dutch about the middle of the seventeenth century, it became the subject of extravagant eulogy, and was declared to be a remedy for all bodily ills and a sure means of prolonging life. Among the virtues attributed to it were these: that it cured headache and difficulty of breathing, prevented stone and gravel and the lassitude and laborious digestion of heavy eaters, dispelled distressing dreams, quickened the memory, and overcame drowsiness, so that, as one of its early historians phrases it, "whole nights might be spent in study without hurt to the body." An exaggeration of its virtues in a different manner is perhaps chargeable upon a late writer on dietetics, when he intimates that the substitution of tea and coffee for malt and distilled liquors at ordinary meals has tended to limit the vice of drunkenness and promote that "diffusion of mental industry and mental acquirements which constitutes the most striking physiological phenomenon of the condition of the European races of mankind at the present day." But as, in point of fact, drunkenness is more prevalent now than in any former generation, it may quite as rationally be questioned whether the mental activity, over-stimulated by tea and coffee, has not instinctively sought a counter-poison in alcohol.

Among the Chinese, we are told, tea is held to be "cooling, peptic, exhilarating, stimulating, both laxative and astringent, diuretic, emmenagogue, and, in large concentrated doses, emetic. It is applied in a wash to the eyes, ulcers, and wounds of all kinds, but its excessive use as a drink renders people thin, anæmic, and weak-sighted. Tea is taken by Chinese scholars and laborers to stave off the cravings of hunger until a convenient season arrives." The Chinese also prescribe tea, acidulated with vinegar, in *diarrhœa*, and give it as an antidote to the poisonous action of *tartar emetic* and *corrosive sublimate*. The small proportion of tannic acid contained in tea renders it too feeble a remedy in such cases if stronger ones can be procured, but its stimulant and exhilarant action adapts it to be used as an antidote to *poisoning by opium*. A cup of hot tea is a familiar domestic remedy for the relief of nausea and oppression after too full a meal, to produce diaphoresis at the commencement of slight attacks of *muscular rheumatism*, *pulmonary catarrh*, or *sore throat*, and to banish the sense of fatigue and muscular soreness produced by excessive exertion, particularly when it is seasoned with some alcohol. It is one of the best remedies for *nervous headache*, and when cold or acidulated with lemon-juice is a most refreshing drink in midsummer heats which produce excessive perspiration. It moderates also the copious *sweats* of hectic conditions. A strong infusion of green tea has been used by injection in *gonorrhœa*, *leucorrhœa*, and *gleet*, and as a wash in *conjunctivitis*, as a gargle in *sore throat*, etc. In China it is often used for certain of these purposes as a fine powder mixed with water, or in decoction rather than in infusion; and doubtless in these forms its operation is more energetic.

THEOBROMA.—Cacao.

Semen (s. Fabæ) cacao.—Cacao, Fèves du Mexique, Fr.; *Kakaobohnen*, G.

The seeds of Theobroma Cacao, *Linné.* Bentley and Trimen, *Med. Plants*, 38.
Nat. Ord.—Sterculiaceæ, Buettnerieæ.

Origin.—The cacao (often incorrectly called *cocoa*) or *chocolate tree* is indigenous to Brazil and other parts of tropical America northward to Mexico, and is largely cultivated throughout the tropics. It is about 40 feet (12 M.) high, has alternate, oblong-lanceolate or lance-ovate, acute, and entire leaves, and produces pale-pink, five-petalled flowers in clusters from the axils of old leaf-scars. The fruit is about 6 inches (15 Cm.) long, pear-shaped, with an elongated nipple-shaped apex, ten-furrowed and while unripe five-celled, and contains numerous seeds imbedded in a sweet pulpy mass.

Preparation.—Cacao-seeds are prepared for use by removing them from the fruit and simply drying them, in which case they retain their astringent and bitter taste; or they are subjected to a sweating process by enclosing them in a box or burying them in the ground for two or three days, whereby they lose much of their astringency and bitterness, and change in color; the best cured cacao is kept in heaps covered with plantain or other green leaves, for about a week before it is finally dried. The seeds of Th. bicolor, *Humboldt*, Th. guayanensis, *Willdenow*, Th. sylvestre, *Martius*, Th. ovatifolium, *Sessé*, and other species are stated to be collected, prepared, and mixed with the seeds of the cacao; but, according to Karsten, these uncultivated species do not furnish any commercial cacao. The seeds of Herrania albiflora, *Goudot*, and several other species appear to have the properties of cacao, and are used like the latter in the mountain-districts of South America under the name of *cacao cimarrona*, but they are only of about the size of a pea and do not enter commerce. The consumption of cacao-seeds in South America and South-western Europe has been estimated at over 100,000,000 pounds annually.

Description.—The seeds are $\frac{3}{5}$ to 1 inch (15–25 Mm.) long, ovate or oblong, somewhat flattened, and vary in color, according to the manner in which they have been prepared, from brown-red to brown or grayish-brown. A prominent raphe runs along one edge of the seed from one end to the other, uniting the hilum and chalaza, and is divided at the latter into many branching nerves. The testa is thin, papery, and fragile. The embryo has the shape of the seed, and consists of a small conical radicle and two large oily cotyledons, which are strongly ribbed upon their face, and by the projecting folds of the inner seed-coat are divided from the back into numerous small irregular lobes, so that they readily break into many angular pieces. The odor of cacao-seeds is slight, but on warming is agreeably aromatic; their taste is oily, aromatic, and bitterish.

Constituents.—The quantitative analyses by Lampadius, Tuchen (1857), and A. Mitscherlich (1859) vary greatly in their results. Lampadius found the seeds to yield about 12 per cent. of husks or shells and about 88 per cent. of kernels, and the latter to contain about 53 per cent. of fat. Mitscherlich obtained from the seeds nearly 50 per cent. of fat, 14 to 18 per cent. of starch, 13 to 18 per cent. of proteids, 1.2 to 1.5 per cent. of theobromine, 3.5 per cent. of ash, and 0.6 per cent. of sugar. Tuchen found also about 3 per cent. of gluten, and isolated between 4.5 and 6.6 per cent. of *cacao-red.* The latter is soluble in water and alcohol, precipitated by acetate of lead, and is generated in the seeds during the sweating process; it appears to be combined with a proteid, and when pure has a carmine-red color, does not change the color of litmus, and is insoluble in litmus and fixed oils. *Oil of theobroma* is described on page 1094. The odorous principle of cacao appears to be somewhat volatile, but has not been isolated. *Theobromine*, $C_7H_8N_4O_2$ (molecular weight 180), was discovered by Woskresensky (1841), and was found by Bley (1842) to be present also in small proportion in cacao-shells. The alkaloid is obtained from the infusion of cacao by precipitating it with acetate of lead, removing the excess of lead by sulphuretted hydrogen, evaporating and exhausting the residue with boiling alcohol, from which the alkaloid separates in minute colorless or white bitter crystals which are sparingly soluble in cold water, alcohol, and ether, and require for solution 55 parts of boiling water, 47 parts of boiling alcohol, and 600 parts of boiling ether. The alkaloid sublimes without decomposition at 290° C. (554° F.), and has a neutral reaction, but yields with acids crystallizable salts which are decomposed by water. Strecker converted theobromine into caffeine by heating the silver compound of the former with methyl iodide to 100° C. (212° F.). From Trojanowsky's researches (1875), it appears that the ash of the kernel is usually a little below 3 per cent., and should not materially exceed that amount; starch was found to vary between 2.23 and 6.65 per cent., the fat from 39.3 to 52.05 per cent., and the theobromine from 1.205 to 4.652 per cent., while the shells alone yielded from 0.866 to 4.540 per cent. of the alkaloid.

Uses.—Cacao-seeds are employed for preparing butter of cacao (p. 1094) by expressing them between heated iron plates. The press-cake, ground either by itself or with starchy substances, is sold as *cocoa.* The seeds, ground together, while warm with about their own weight of sugar, constitute *chocolate.* This is usually flavored with about ½ per cent. of cinnamon or other aromatics, and occasionally various amylaceous or mucilaginous substances are added to it.

The following formulas are taken from the French Codex, the last two from F. Cod. 1866:

CHOCOLATA SIMPLICIOR.—Simple chocolate, *E.;* Chocolat de santé, *Fr.*—3000 parts each of Caraccas and Marañon cacao are well cleaned, torrefied, deprived of the shells, and the remaining kernels reduced in a heated mortar to a paste, which is well mixed with 5000 parts of sugar and 30 parts of powdered cinnamon, and transferred to a hot slab, where it is worked with a roller until uniformly mixed; the mass is now transferred to sheet-tin moulds, the surfaces rendered smooth by beating, and, after cooling, the cakes are wrapped in tin-foil.

CHOCOLATA CUM FERRO.—Iron chocolate, *E.;* Chocolat ferrugiueux, *Fr.*—Mix 10 parts of ferric oxide with 990 parts of simple chocolate.

CHOCOLATA CUM VANILLA. Vanilla 4 parts; sugar 36 parts; chocolate without cinnamon 1000 parts.

CHOCOLATA CUM CETRARIA.—Iceland moss chocolate, *E.;* Chocolat au lichen d'Islande, *Fr.*—Mix 100 parts of saccharated powdered Iceland moss jelly (see page 419) with 1000 parts of simple chocolate.

CHOCOLATA CUM SALEP.—Salep chocolate, *E.;* Chocolat au salep, *Fr.*—Incorporate 30 parts of powdered salep with 1000 parts of simple chocolate.

Preparations analogous to the latter are made by substituting powdered tapioca, sago, or arrowroot for the salep, and the aromatics are often varied by replacing the cinnamon wholly or in part with powdered cloves, mace, nutmeg, cardamom, or vanilla sugar. Chocolate has also been medicated by incorporating with 1000 parts of simple chocolate 30 parts of powdered catechu, or 60 parts of guarana or powdered cinchona, or 100 parts of calcined magnesia, etc. Chocolate has been proposed as a pleasant vehicle in the preparation of lozenges containing santonin, etc.

Medical Action and Uses.—The dietetic uses of chocolate do not require any detailed notice in this place. Prepared with water or milk, it is employed as a substitute for coffee in Southern Europe, South America, Mexico, and the West Indies, and to a less degree in other civilized countries. It is difficult to discern in it, when thus used, any of the stimulating qualities which belong to the theobromine it contains. It is to be preferred to the other agents mentioned when a nutritive rather than an excitant operation is desired; and hence it is familiarly employed during convalescence from acute diseases, and as a substitute for tea or coffee in the diet of persons whose nervous system is liable to be deranged by them. Chocolate prepared with milk, and seasoned by the addition of a modicum of coffee, is less stimulating than the latter and more palatable than chocolate alone.

The physiological action of theobromine has been investigated by Mitscherlich. 15 grains of it dissolved in water and administered hypodermically to rabbits occasioned grinding of the teeth, slowing of the respiration even to a third or a fourth of the normal rate, reduction of the temperature, increased frequency and diminished force of the pulse, and convulsions of spinal origin. When the poison was more slowly absorbed the animals lost their muscular power gradually. There was no diuresis nor any thirst or loss of appetite. Occasionally there was retching or vomiting. In frogs the lungs and bladder were distended. Death appeared to be due to paralysis of the vagus or spinal cord, and, when the poison was rapidly absorbed, spinal convulsions hastened the end. When it occurred promptly, there was long-continued irritability of the voluntary muscles and persistence of the peristaltic movements of the intestine; when the poisoning took place more gradually, the heart and voluntary muscles lost their irritability; the ventricles were contracted; the auricles, the great veins, the small vessels in every part of the body, especially in the mucous and serous membranes, the brain, liver, and kidneys, were strongly congested; and extravasations of blood were frequently found in the mucous and peritoneal coats of the bladder, and more rarely in the stomach and duodenum. The blood had a dark-red color, which became lighter on exposure to the air. Mitscherlich concluded that theobromine is poisonous in the same manner as caffeine, but that it is poisonous and fatal in much smaller doses, and also that it is absorbed from the stomach as well as from the subcutaneous connective tissue.

Theobromine does not appear to have been used therapeutically, but the identity of its action with that of theine and caffeine renders it probable that it may be substituted for them in appropriate cases, but in smaller doses.

THERIACA, *Br.*—TREACLE.

Syrupus fuscus, U. S. 1870; *Sacchari fœx*, *Syrupus communis*, *s. hollandicus.*—*Molasses*, E.; *Mélasse*, *Pyromel*, Fr.; *Melasse*, *Brauner Syrup*, G.

The uncrystallized residue of the refining of sugar.—*Br.*

Origin and Properties.—The manner in which molasses is obtained is described on page 1321. That variety procured in the preparation of raw sugar is in the United States usually designated as *West India molasses*, while that drained from refined sugar is known as *sugar-house molasses.* Both kinds closely resemble each other, except that the former is of a lighter color and has a different somewhat empyreumatic flavor. Molasses is a brown, thick, fermentable, uncrystallizable syrup of a very sweet taste and having a specific gravity of about 1.40. It contains about 75 per cent. of solid matter, of which from 5 to 7 per cent. are salts. The molasses of beet-root sugar, according to Landolt (1868), contains 56 to 64 per cent. of sugar and about 20 per cent. of oxalate, tartrate, and malate of potassium.

Medical Uses.—Molasses—or treacle, as it is called in England—is rather a food than a medicine. Apart from its pharmaceutical uses, it is seldom employed medicinally except as an ingredient of the common domestic enema, which consists usually of a pint of warm water to which a wine-glassful or more of molasses and a heaped tablespoonful of salt have been added. It is also a popular remedy for superficial *burns*, which it protects as well as oil.

THUJA, *U. S.*—THUJA (ARBOR VITÆ).

Thuya, *Arbre de vie*, Fr.; *Lebensbaum*, G.

The small branches of Thuja occidentalis, *Linné.*

Nat. Ord.—Coniferæ.

Origin.—The arbor vitæ, also called *white cedar*, is a tree with spreading branches, attaining under favorable circumstances a height of 50 feet (15 M.). It grows in cedar swamps in Canada and the northern section of the United States, and is met with southward along the Alleghanies and westward to Wisconsin. It has been introduced into Europe as an ornamental tree.

Description.—The branchlets are dark-green and rather glossy above, dull pale-green beneath, two-edged, and flat from the appressed scale-like leaves, which are placed in four rows, closely imbricate, ⅛ to ⅙ inch (3–4 Mm.) long, rhombic-ovate, obtusely pointed, and bear upon the back near the apex an elevated roundish gland; the leaves forming the edges of the branchlets are folded in the centre, compressed, boat-shaped, when young with a small gland beneath the apex, the older ones glandless. The odor is strongly balsamic and the taste pungently aromatic, camphoraceous, and bitter.

The allied Thuja orientalis, *Linné*, which is indigenous to Asia, is sometimes cultivated as an ornamental tree. It is distinguished from the preceding by the erect branches and by the absence of glands and the grooved back of the leaves. The Western species, Thuja gigantea, *Nuttall*, grows from Northern California northward, and attains a height of 120 feet (36 M.).

Constituents.—The volatile *oil of arbor vitæ* was examined by Bonastre (1825) and Schweizer (1844). Hübschmann (1846) obtained about 1 per cent. of the weight of the branchlets. The volatile oil is colorless or greenish-yellow, has the density 0.925, and is a mixture of two oxygenated oils boiling near 195° and 205° C. (383° and 400° F.); it is readily soluble in alcohol, and when treated with potassa or with sulphuric acid acquires a black color. Kawalier (1854–58) obtained from arbor vitæ, in addition to the volatile oil, a gelatinous compound, sugar, two resins, tannin, pinipicrin, and thujin. *Pinipicrin*, $C_{22}H_{36}O_{11}$, was discovered by Kawalier (1853) in the leaves and bark of Pinus sylvestris. It is a yellow bitter powder which becomes soft at 55° C. (131° F.), fuses to a transparent liquid at 100° C. (212° F.), is not precipitated by lead salts, dissolves in water, alcohol, and spirit of ether, is insoluble in pure ether, and when boiled with diluted acids is split into sugar and *ericinol.* *Thujin*, $C_{20}H_{22}O_{12}$, crystallizes in small lemon-yellow tables, has an astringent taste, dissolves readily in alcohol and hot water, acquires with alkalies a deep-yellow and red-brown and with ferric chloride a dark-green color, and is precipitated by acetate and subacetate of lead. When heated with dilute hydrochloric acid it is converted into sugar and *thujigenin*, $C_{14}H_{12}O_7$, and *thujetin*, $C_{14}H_{14}O_8$, both of which are almost insoluble in cold water, and when in alcoholic solution acquire a handsome blue-green color with ammonia. Thujin, boiled with hydrate of barium, yields sugar and *thujetic acid*, $C_{28}H_{22}O_{13}$, which is insoluble in water. These compounds are probably related to *quercitrin* and its derivatives.

Pharmaceutical Preparation.—Tinctura thujæ, Tincture of arbor vitæ. 5 parts of the fresh small branches of arbor vitæ are bruised, and macerated with 6 parts of alcohol for 8 days; the liquid is expressed and filtered.—*P. G.* 1872. The tincture is of a greenish-yellow color.

Medical Action and Uses.—Arbor vitæ somewhat resembles savine in its qualities, and particularly by irritating the skin when the fresh leaves or an ointment made from them is applied to it. Like savine, it has been found useful in repressing the fungous granulations of *ulcers*, in removing *warts*, and in an ointment as a palliative of chronic *rheumatism*. Some have even gone so far as to atttribute to it the cure of *cancerous* ulcers both of external parts and of the uterus. The published reports, however, rather denote cases of simple ulcers aggravated by improper applications as those which have been benefited by this medicine. Internally, it has been given with alleged benefit in *amenorrhœa* and *pulmonary catarrh*, and for destroying *worms*. For these several purposes the distilled oil has been found efficient. Boerhaave used a distilled water of the leaves in *dropsy*. A fluid extract and a saturated tincture have been given in *doses* of a fluidrachm (Gm. 4) several times a day, and applied topically on compresses and to the uterus on a tampon. An ointment made with the leaves or with the volatile oil has been used in rheumatism.

THUS AMERICANA, *Br.*—Common Frankincense.

The concrete turpentine of Pinus Tæda, *Linné*. (See Terebinthina.)

Medical Uses.—This turpentine may be used for the various purposes to which other turpentines are adapted. In England it forms a constituent of the officinal pitch plaster, under the name of common frankincense.

THYMOL, *U. S., Br., F. Cod.*—Thymol.

Thymolum, P. G.; *Acidum thymicum.*—*Thymol*, E., Fr., G.; *Thymic acid*, E.; *Acide thymique*, Fr.; *Thymiansäure*, G.

Formula $C_{10}H_{13}HO$. Molecular weight 150.

Origin.—Thymol is present in the volatile oils of Thymus vulgaris, *Linné*, Monarda punctata, *Linné*, and Ptychotis Ajowan, *De Candolle*, and very likely in other volatile oils of the natural orders Labiatæ and Umbelliferæ.

Preparation.—Oil of thyme is subjected to fractional distillation. That portion which distils at a temperature above 200° C. (392° F.) is separately collected, and is agitated with solution of soda, the solution of thymol sodium separated from the thymene, and the thymol liberated by hydrochloric acid; after it has crystallized it is pressed between bibulous paper and recrystallized from alcohol. This is Lallemand's process (1853), which may be modified so as to distil off only the hydrocarbons at a temperature not exceeding 180° C. (356° F.), and treating the residue in the still with soda solution as stated. By a similar process thymol is obtained from the volatile oils of Monarda and of Ptychotis.

Properties.—Thymol crystallizes in thin, colorless, rhombic scales or is seen in commerce in large translucent crystals of the spec. grav. 1.028. It melts between 50° and 52° C. (122°–125.6° F.) (*U. S., P. G.*) to a colorless liquid lighter than water, retains its fluid condition often for a long time, and boils near 230° C. (446° F.). It has an aromatic thyme-like odor and a warm, pungent but scarcely caustic taste. It dissolves sparingly in water, requiring at 15° C. 1100 (*P. G.*) or 1200 (*U. S.*) parts for solution, but is soluble in half its weight of alcohol, ether, and chloroform, in 2 parts of soda solution sp. gr. 1.16, and freely in benzol, benzin, carbon disulphide, glacial acetic acid, and fixed and volatile oils. It forms with soda a crystallizable and readily soluble compound, and does not change the color of solution of ferric chloride. Symes (1879) ascertained that on being triturated with one-half to ten times its weight of camphor a colorless syrupy liquid is obtained, but it does not liquefy with chloral hydrate. According to Gerrard, the strongest aqueous solution of thymol available is 1 in 1000, and a solution of 4 grains of it in a fluidounce of alcohol is miscible with water without becoming turbid; 3 grains of thymol are dissolved by 1 grain of caustic soda and 1¼ grains of caustic potassa. Solid fats, when heated, are excellent solvents of thymol. A solution of 1 part of thymol in 100 parts of warm glycerin remains clear. Thymol is also soluble in 4 parts of cold sulphuric acid; the solution has a yellowish color, and on being gently heated becomes rose-red. On pouring this solution into 10 volumes of water, digesting the mixture with an excess of lead carbonate, and filtering, the liquid becomes violet-blue on the addition of ferric chloride. This reaction is due to *sulphothymolic acid*, $C_{10}H_{14}SO_4$, discovered by Lallemand (1853). Hammarsten and Robert (1881) give the following as the most delicate test by which one-millionth of thymol may still be detected: Mix the liquid with one-half of its volume of glacial acetic acid, then with at least an equal volume of sulphuric acid, and warm gently, when a bright reddish-violet color is produced which is not destroyed by boiling. According to Hirschsohn (1881), a solution of thymol in 60,000 parts of water is rendered turbid by bromine-water, but, according to Hammarsten, the precipitate is not crystalline like tribromophenol.

Composition.—Thymol is the phenol of cymene, and its composition is shown by the formula $C_6H_3.C_3H_7.CH_3.OH$. Widman (1882) has succeeded in preparing it synthetically from cuminol (see page 524) by converting this into nitrocuminol, acting upon this with phosphorus pentachloride, when nitrocymylene chloride, $C_{10}H_{11}(NO_2)Cl_2$, is formed, and treating this with nascent hydrogen, first at a low temperature, afterward with the aid of heat, to obtain cymidin, $C_{10}H_{13}.NH_2$. A dilute solution of cymidin sulphate is treated with potassium nitrite and finally distilled, when thymol is obtained, having the melting-point 44° C. (111.2° F.), which is the same as found by Lallemand and Stenhouse for thymol from the oils of thyme and of ptychotis. Widman prepared nitrosothymol from artificial thymol; the product from both fused between 160° and 162° C. (320°–323.6° F.).

Tests.—Thymol should be volatilized by the heat of a water-bath without leaving any residue (inorganic and non-volatile organic compounds). Its saturated aqueous solution should have a neutral reaction, and should not acquire a darker color on the addition of a drop of test solution of ferric chloride (carbolic acid, various phenols, etc.).

Action and Uses.—These have been considered under OLEUM THYMI.

TILIA.—LINDEN.

Flores tiliæ, P. G.—*Linden-flowers*, E.; *Fleurs de tilleul*, Fr.; *Lindenblüthen*, G.

The inflorescence of different species of Tilia.

Nat. Ord.—Tiliaceæ.

Origin.—The different species of linden, which are also known as *lime tree*, *whitewood*, and *bass-wood*, are stately trees from 40 to 100 feet (12–30 M.) high, and have a soft white wood, a fibrous bark, and alternate petiolate, heart-shaped, serrate leaves, frequently with a more or less oblique base. The wood yields a very light charcoal.

TILIA ULMIFOLIA, *Scopoli* (T. parvifolia, *Ehrhart*, T. microphylla, *Ventenat*). The leaves are pale-green on the lower surface and pubescent in the angles of the veins, otherwise smooth; the cymes are about seven-flowered.

TILIA PLATYPHYLLOS, *Scopoli* (T. grandifolia, *Ehrhart*, T. pauciflora, *Hayne*). The leaves are larger and softly pubescent beneath; the cymes are about three-flowered. This, with the preceding species, constitutes Tilia europæa, *Linné*, and is occasionally cultivated as an ornamental tree.

TILIA AMERICANA, *Linné*. It has thickish and smooth (T. glabra, *Ventenat*) or underneath softly pubescent and frequently thin (T. pubescens, *Aiton*) leaves; the cymes are mostly many-flowered. The smooth form grows in Canada and the United States, the pubescent variety from Maryland southward.

TILIA HETEROPHYLLA, *Ventenat* (T. alba, *Michaux*, T. laxiflora, *Pursh*). It is found from the mountains of Pennsylvania along the Ohio and Mississippi and southward, and has the leaves bright-green and smooth above and silvery-whitened beneath. It resembles the South European Tilia argentea, *Desfontaines*, which, however, has the leaves on shorter petioles.

Description.—Linden-flowers grow in axillary cymes, and have the peduncle partly united to the midrib of a leaf-like, linear, or oblong-lanceolate greenish-yellow bract. The flowers of each cyme vary in the different species from three to about thirty in number, and have a five-parted calyx and five whitish or yellowish, lanceolate or oblong, usually notched petals. The numerous stamens are hypogynous, slightly united in the first two species by the base of their filaments into about five groups, or in the other species with the base of a petal-like scale placed opposite each petal. The ovary is five-celled, has a style with a five-lobed stigma, and produces a globular, nut-like, one-celled capsule containing one or two seeds. Linden-flowers have an agreeable and (when dry) feeble odor and a sweetish and mucilaginous taste. American linden-flowers and their bracts are larger than the European, and the petals have a somewhat horn-like appearance.

Constituents.—From the analyses made by Marggraf, Brossat, Buchner, Siller, Winckler, and others, it appears that linden-flowers contain mucilaginous or pectinaceous principles, sugar, a little tannin, fat, malates and other salts. The odorous principle is a colorless or yellowish, sweetish, light, and fragrant volatile oil, which is readily soluble in alcohol and dissolves iodine without giving off vapors. Herberger and Winckler obtained between $\frac{1}{20}$ and $\frac{1}{10}$ per cent.

Pharmaceutical Preparation.—Aqua tiliæ, Linden-flower water. Distil 1 part of linden-flowers and sufficient water until 4 parts (10 parts, *P. G.* 1872) of distillate are obtained.—*F. Cod.*

Allied Plants.—Corchorus capsularis, C. olitorius, *Linné*, and several other species are annual herbs of India, where they are cultivated for their bast-fibres, which are known in commerce as *gunny* and *jute;* the fibre yields from 1 to 2 per cent. of ash. The second species is also employed as a potherb.

Medical Uses.—On the continent of Europe linden-flowers, buds, and leaves are among the most generally used of domestic remedies, in the form of an infusion, to palliate *painful indigestion*, *nervousness*, *nervous headache*, and even mild forms of *hysteria.* For these purposes it is taken either cold or warm, according to circumstances, but in the latter way to dissipate commencing *catarrhs of the respiratory passages* and *diarrhœa* occasioned by cold. The flowers are also used in warm general baths to allay nervous irritability, or a strong infusion of them is administered by enema for similar purposes. The American species is probably quite as operative as the European, and both depend for whatever virtues they possess upon their combined lenitive and stimulant qualities. The agreeable smell and taste of the infusion render it acceptable to the sick and appropriate as a vehicle for more active medicines. The infusion is usually made with from 30 to 60 grains of the flowers to a pint (Gm. 2–4 to Gm. 500) of water.

TINCTURÆ.—Tinctures.

Teintures, Alcoolés, Fr.; *Tinkturen*, G.

Tinctures are solutions of medicinal non-volatile or only partially volatile substances in liquids other than water and glycerin. Solutions of volatile substances in water are known as *medicated waters*, and similar solutions in alcohol as *spirits.* The menstrua employed in the preparation of tinctures are alcohols of different strengths, spirit of ether or spirit of nitrous ether, and aromatic spirit of ammonia or ammoniated alcohol. According to the menstruum employed, tinctures are distinguished as *ammoniated, ethereal*, and *alcoholic*, and that class of tinctures in the preparation of which diluted alcohol or a still weaker spirit has been used is sometimes designated as *hydro-alcoholic.* By far the greatest number of tinctures are made with an alcoholic menstruum. The employment of spirit of nitrous ether in tinctures is confined to a few unofficinal preparations.

Alcoholic Menstruum.—Most tinctures of the United States Pharmacopœia are prepared with diluted alcohol, of the British Pharmacopœia with proof spirit, and of the French and German Pharmacopœias with alcohol of about 60 per cent., or of specific gravities 0.912 and 0.894. While it is desirable to keep the alcoholic strength of tinctures as low as possible, it is evidently improbable that one and the same menstruum should be equally well adapted for the preservation of liquid preparations of drugs having the most varied composition; and that improvements in this respect are needed is shown by the unsightly deposits occurring in some and the change into gelatinous masses observed in other tinctures. In most cases these obvious changes are prevented by the employment of a stronger alcoholic menstruum.

Strength.—The British Pharmacopœia prepares tinctures in such a manner that 1 Imperial pint (20 fluidounces) represents 2½ oz. av. of the drug, or 1 part of the drug is used for 8 measured parts of the finished tincture; the U. S. P. 1870 recognized a similar proportion—1 troyounce of drug to 8 fluidounces of tincture. There are, however, numerous important exceptions to this rule, and notably among tinctures of narcotic and other powerful drugs. The present U. S. P. directs tinctures, like all other liquid preparations (fluid extracts excepted), to be prepared by weight; and in making this change of manipulation the previous strength of the tinctures has been preserved as nearly as possible. The French and German Pharmacopœias prepare their tinctures almost without exception in such a manner that 1 part of the drug is represented by about 5 or 10 parts (by weight) of the tincture, either 5 or 10 parts of the menstruum being used for extracting 1 part of the drug by maceration. Prepared in this manner, the actual weight of the tincture is equal to that of the menstruum and of the soluble matter combined, so that the strength is only approximately as 1 in 5 or 10.

It is to be regretted that the tinctures of the different pharmacopœias, or at least those prepared from potent drugs, are not of the same composition, as will be seen from the following table, in which no account is taken of the difference in the density of the menstruum:

100 parts of tincture of—	Represent parts of the active drug—				100 parts of tincture of—	Represent parts of the active drug—			
	By weight.			By measure.		By weight.			By measure.
	U.S. P.	F. Cod.	P.G.	Br. P.		U.S. P.	F. Cod.	P.G.	Br. P.
Aconitum (leaves)	...	20			Hyoscyamus	15	20	...	12.5
" (root)	40	20	10	12.5	Iodine	8	7.7	9.1	2.5
Aloes	10	20	20	2.5	Kino	10	20	...	10
Arnica (flowers)	20	20	10		Krameria	20	20	20	12.5
" (root)	10	...	...	5	Lobelia	20	20	10	12.5
Asafetida	20	20	20	12.5	Moschus	10	10	2	
Belladonna	15	20	...	5	Myrrha	20	20	20	12.5
Calumba	10	20	...	12.5	Nux vomica	20	20	10	10
Cannabis ind. (herb)	20	20			Opium	10	13	10	7.5
" (extract)	...	...	5	5	Physostigma	10	20		
Cantharides	5	10	10	1.25	Pyrethrum	20	20	...	20
Capsicum	5	...	10	3.75	Quassia	10	20	...	3.75
Catechu (* with cinnamon)	*12	20	20	*12.5	Rheum	12	20	...	10
Cinchona	20	20	20	20	Scilla.	15	20	20	12.5
Colchicum (seed)	15	20	10	12.5	Stramonium (* leaves)	10	*20	...	12.5
Conium (fruit)	15	...	...	12.5	Valeriana.	20	20	20	12.5
" (leaves)	...	20			Veratrum album	...	20	10	
Digitalis	15	20	10	12.5	" viride	50	...	...	20
Galla	20	20	20	12.5	Zingiber	20	20	20	12.5
Gentiana (* compound)	*8	20	20	*7.5					

Preparation.—Tinctures of resins, oleoresins, balsams, and of most gum-resins and extractive drugs are best prepared by maceration. Nearly all other drugs are conveniently extracted by percolation, which process is fully described on pages 606, etc., and if the process is properly conducted the drug will be practically exhausted long before the requisite amount of tincture has been obtained. The chief objections that can be raised against this process are, that the manipulation must vary with the nature of the drug, and that a certain amount of alcohol will be retained in the powder. The former is of no weight with the pharmacist, who recognizes his duty of intimately acquainting himself with the characteristics and peculiarities of each drug passing through his hands; and the second objection will be of little moment if weaker menstrua are gradually and judiciously employed, as indicated on page 608. In the formulas which follow the "parts" directed by the Pharmacopœia have been rendered in convenient weights, and the approximate measure has been given for each preparation. This measure necessarily varies somewhat with the temperature and with the amount of solid matter taken up from the drug; but it serves a convenient purpose in indicating when the percolate has nearly attained the desired weight, thus avoiding frequent weighings. The tare of the receiving vessel is accurately taken and marked on the paper indicating the approximate measure to be obtained, after which percolation may proceed and be finished with little trouble.

The British Pharmacopœia avoids the second objection by expressing the contents of the percolator as soon as the requisite quantity of menstruum has been used. In most of its formulas the preparation of a pint (Imperial) of tincture is directed, and the following explains the manipulations which have been adopted: Macerate the material for 48 hours in 15 fluidounces of the menstruum in a closed vessel, agitating occasionally; then transfer to a percolator and when the fluid ceases to pass continue the percolation with the remaining 5 ounces of menstruum. Afterward subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient menstruum to make 1 pint.

The German Pharmacopœia prepares all tinctures by maceration. The drugs, either coarsely powdered or cut into thin slices, and the menstruum are introduced into a bottle, which should be only partly filled, so as to permit the frequent agitation of the contents; after macerating in a shady place at about 15° C. (59° F.) for a week, the liquid is decanted and the residue subjected to pressure; the liquids thus obtained are mixed, set aside for a day or two. and then filtered, care being taken to prevent the evaporation of alcohol. The liquid which remains absorbed in the drug is not replaced.

The French Codex directs its tinctures to be made by maceration or by displacement. For the latter process the directions are similar to those of the United States Pharmacopœia, except that the powder is ordered to be of medium fineness and is not moistened previously to its introduction into the percolator.

ETHEREAL TINCTURES—Éthérolés, *F. Cod.*—are not recognized by the U. S. P., and only one has been admitted by the Br. P. (lobelia) and by the P. G. (valeriana), both using spirit of ether for the menstruum. For eight ethereal tinctures of the French Codex a menstruum containing more ether is used; it is designated Ether à 0.758, and is prepared by mixing 3 parts of alcohol with 7 parts of ether spec. grav. .724. These tinctures are prepared by maceration or displacement, provision being made to prevent evaporation of the ether.

Preservation.—All tinctures should be perfect solutions, and to retain them entirely transparent the evaporation of the volatile portions should be prevented. Tinctures are best kept in well-stoppered bottles, in a room where the temperature is not subject to great variations, and where they are not exposed to the direct sunlight. The size of the bottles should be adapted to the quantities of the tincture that are likely to be used within a reasonable length of time.

TINCTURÆ HERBARUM RECENTIUM, *U. S.*—TINCTURES OF FRESH HERBS.

Alcoolaturæ, F. Cod.—*Alcoolatures*, Fr.; *Tinkturen von frischen Pflanzen*, G.

Tinctures made from fresh herbs were, to some extent, prepared more than two hundred years ago, but were more prominently introduced by Hahnemann, and are extensively employed in homœopathic practice. They have attracted more or less attention in Europe since about 1817, when Schrader (*Buchner's Repertorium*, iii. 20) made a number of investigations, and recommended such tinctures prepared from the fresh juice and twice its weight of alcohol. A similar method was subsequently advocated by Béral and by Deschamps, while Soubeiran suggested the use of the fresh plants and their maceration with strong alcohol in definite proportions. This method was adopted in the French Codex of 1866, and has been retained in that of 1884. Tinctures made from fresh herbs have been admitted in the new U. S. Pharmacopœia, which, however, gives only a general formula.

Preparation.—"These tinctures, when not otherwise directed, are to be prepared by the following formula: Take of the fresh herb, bruised or crushed, 50 parts; alcohol 100 parts. Macerate the herb with the alcohol for fourteen days; then express the liquid and filter."—*U. S.*

This is essentially the formula for preparing the third class of tinctures of the Homœopathic Pharmacopœia. The French Codex directs equal parts of the fresh drug and of 90 per cent. alcohol, the maceration to be continued for ten days; in this manner alcoolatures are prepared from aconite-leaves and root, arnica-flowers, belladonna-leaves and root, bryony, colchicum-flowers and root, conium-leaves, digitalis-leaves, drosera (entire plant), eucalyptus-leaves, hyoscyamus-leaves, pulsatilla (flowering herb), spilanthes-flowers, and stramonium-leaves.

It is evident that these preparations must vary in strength at least to the same extent as juices (see p. 1452), and that they are of doubtful utility, except perhaps for such drugs which, like the leaves of Rhus Toxicodendron, owe their virtues to very volatile uncombined principles.

TINCTURA ACONITI, *U. S., Br., P. G.*—Tincture of Aconite.

Tinctura aconiti radicis, U. S. P. 1870.—*Tincture of aconite-root*, E.; *Teinture de racine d'aconit*, Fr.; *Eisenhuttinktur*, G.

Preparation.—Aconite, in No. 60 powder, 400 parts (12 oz. av.); Tartaric Acid 4 parts (52½ grains); Alcohol a sufficient quantity; to make 1000 parts (30 oz. av.). Moisten the powder with 200 parts (6 oz. av. or 7 fluidounces) of alcohol in which the tartaric acid has previously been dissolved, and macerate for 24 hours; then pack it firmly in a cylindrical glass percolator, and gradually pour alcohol upon it until 1000 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

Aconite-root 2½ oz. av., alcohol (sp. gr. .838) sufficient to make 1 Imperial pint (20 fluidounces).—*Br.*

Aconite-root 20 parts, alcohol (sp. gr. .912) 100 parts.—*F. Cod.*

Aconite-root 10 parts, alcohol (sp. gr. .894) 100 parts.—*P. G.*

There is no obvious necessity for the use of tartaric acid in the first formula, but the selection of efficient root and its careful percolation are of the utmost importance. The tincture is of a yellowish-brown color, and on the addition of water becomes milky from the precipitation of resin. Formerly *tincture of aconite-leaves* (2 troyounces to 1 pint of diluted alcohol) was officinal; it was much weaker than the present tincture, and could be given in larger doses.

Medical Uses.—Tincture of aconite is the best form for the administration of this powerful medicine. The *dose* is from 1 to 5 minims (Gm. 0.06–030).

TINCTURA ALOES, *U. S., Br., P. G.*—Tincture of Aloes.

Teinture d'aloès, Fr.; *Aloetinktur*, G.

Preparation.—Purified Aloes, in moderately fine powder, 10 parts (1 oz. av.); Extract of Glycyrrhiza, in moderately fine powder, 10 parts (1 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (10 oz. av.). Mix the powders with 80 parts (8 oz. av. or 8¼ fluidounces) of diluted alcohol, and macerate the mixture for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough diluted alcohol to make the tincture weigh 100 parts (10 oz. av. or about 10 fluidounces).—*U. S.*

The formulas of other pharmacopœias require—Socotrine aloes ½ ounce, extract of liquorice 1½ ounces (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Aloes 1 part, alcohol (sp. gr. .912) 5 parts.—*F. Cod.* Aloes 1 part, alcohol (sp. gr. .832) 5 parts. —*P. G.*

The tincture has a dark blackish-brown color and a very bitter taste.

Medical Uses.—This preparation is rarely used as a purgative, for which purpose not less than half an ounce (Gm. 16) of it would be necessary. As a laxative 1 or 2 fluidrachms (Gm. 4–8) may be taken after food. It has been applied topically as a dressing for indolent *ulcers*, *excoriations*, *bed-sores*, *fissures*, and *cutaneous eruptions*. It enters into various preparations of old repute for their virtues in such affections—*e. g.* Turlington's balsam, Friars' balsam, etc.—and has more recently been employed for similar purposes with glycerin, by evaporating from 4 to 8 parts of the tincture of aloes, and then gradually adding 30 parts of glycerin.

TINCTURA ALOES ET MYRRHÆ, *U. S.*—Tincture of Aloes and Myrrh.

Elixir proprietatis Paracelsi.—*Elixir de propriété*, Fr.; *Aloëelixir*, G.

Preparation.—Purified Aloes, in moderately fine powder, 10 parts (1 oz. av.); Myrrh, in moderately fine powder, 10 parts (1 oz. av.); Alcohol a sufficient quantity; to make 100 parts (10 oz. av.). Mix the powders with 80 parts (8 oz. av. or 8½ fluidounces) of alcohol, and macerate the mixture for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (10 oz. av. or about 10 fluidounces).—*U. S.*

This preparation has been dropped from the other pharmacopœias; that of the P. G. 1872 was four-fifths of the above strength and contained also 4 per cent. of saffron and 8 per cent. of diluted sulphuric acid sp. gr. 1.115.

The color of this tincture is deep reddish-brown; if prepared with saffron it is of a rich orange-brown. It is precipitated by water.

In this connection should be mentioned the following preparation, which has long enjoyed considerable reputation on the continent of Europe:

Tinctura aloes composita, *P. G.*; Elixir ad longam vitam, Elixir suecicum.—Compound tincture of aloes, Swedish bitters, *E.*; Élixir de longue vie, Elixir suédois, *Fr.*; Lebenselixir, *G.*—Aloes 6 parts, and gentian, rhubarb, zedoary, and saffron, each 1 part, are macerated for a week with 200 parts of alcohol sp. gr. .894; the tincture is expressed and filtered.—*P. G.* The formula of the French Codex reduces the aloes to 4 parts, the other ingredients to ½ part, and adds ½ part each of agaric and of confection of opium.

Medical Uses.—As a purgative capable of especially stimulating the pelvic organs this preparation has been employed under the name of *Elixir proprietatis* ever since it was invented by Paracelsus, and also as peculiarly fitting for *constipation* in females when associated with *amenorrhœa* or irregular menstruation. But this state is commonly a result of general atony, and can only be radically cured by remedies addressed to the general system. The *dose* is from 1 to 2 fluidrachms (Gm. 4–8).

TINCTURA ARNICÆ FLORUM, *U. S.*—TINCTURE OF ARNICA-FLOWERS.

Tinctura arnicæ, U. S. P. 1870, P. G.—*Teinture de fleur d'arnica*, Fr.; *Arnikatinktur*, G.

Preparation.—Arnica-Flowers, in No. 20 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 40 parts (12 oz. av. or 12½ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Arnica-flowers 20 parts, alcohol (sp. grav. .912) 100 parts.—*F. Cod.*

Arnica-flowers 10 parts, alcohol (sp. grav. .894) 100 parts.—*P. G.*

The first formula yields a yellowish-brown tincture of a darker tint than the other two and that of the U. S. P. 1870, a less alcoholic menstruum being now employed, which extracts more of the extractive matter, but probably less of the resinous and oily constituents. The present tincture becomes less opalescent with water than one prepared with a stronger alcoholic menstruum.

Medical Uses.—In Germany tincture of arnica is universally employed as the sovereign domestic remedy for *wounds*, *bruises*, and all manner of *local pains*, which it benefits quite as much through the alcohol as through the essential oil that it contains. It is applied diluted with water as a lotion or upon compresses; it is not often prescribed internally, but may be given in *doses* of from 10 to 60 drops (Gm. 0.60–4).

TINCTURA ARNICÆ RADICIS, *U. S.*—TINCTURE OF ARNICA-ROOT.

Tinctura arnicæ, Br.; *Teinture de racine d'arnica*, Fr.; *Arnikawurzeltinktur*, G.

Preparation.—Arnica-Root, in No. 40 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Arnica-root 1 oz. av., alcohol (sp. gr. .838) sufficient to make 1 Imperial pint (20 fluidounces).—*Br.*

The first formula yields a darker-colored tincture than the second, due not merely to the larger amount of drug used, but on account of the reduced alcoholic strength of the menstruum, which is the same as that used for the fluid extract.

Action and Uses.—The German Pharmacopœia does not contain any tincture of arnica-root, and it is difficult to understand why the American should be so encumbered. The *dose* may be stated as about the same as that of the tincture of the flowers.

TINCTURA ASAFŒTIDÆ, *U. S.*, *Br.*—TINCTURE OF ASAFETIDA.

Tinctura asæ fœtidæ, P. G.—*Teinture d'asafœtida*, Fr.; *Asanttinktur*, G.

Preparation.—Asafetida, bruised, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Mix the asafetida with 80 parts (24 oz. av. or 28 fluidounces) of alcohol, and macerate for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (30 oz. av. or about 33 fluidounces).—*U. S.*

The proportions of other pharmacopœias are—Asafœtida 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Asafœtida 1 part, alcohol 5 parts.—*F. Cod.*, *P. G.*

The tincture is about one-third stronger than that of the U. S. P. 1870, and nearly agrees with those of the French and German Pharmacopœias. It has a yellowish brown-red color and is rendered milky on the addition of water.

Off. Prep.—Mistura magnesiæ et asafœtida, *U. S.*

TINCTURA ÆTHEREA ASÆFŒTIDÆ. Asafetida 2 parts, ether 7 parts, alcohol 3 parts. —*F. Cod.*

Medical Uses.—Owing to its repulsive taste, tincture of asafetida is seldom given by the mouth, although the *dose* is commonly stated to be from 30 minims to a fluidrachm (Gm. 2–4). It is more convenient and useful in an enema, with water alone, or with other appropriate adjuncts, for the relief of intestinal *flatulence* and for obtaining the influence of the drug in *hysterical* attacks. From ½ to 1 fluidounce (Gm. 16–32) may be used in this manner.

TINCTURA AURANTII AMARI, *U. S.*—TINCTURE OF BITTER ORANGE-PEEL.

Tinctura aurantii, U. S. 1870, Br.—*Tincture of orange-peel*, E.; *Teinture d'orange amère*, Fr.; *Pomeranzentinktur*, G.

Preparation.—Bitter Orange-Peel, in No. 30 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it moderately in a conical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Other pharmacopœias direct: Bitter orange-peel 2 ounces (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Bitter orange-peel 1 part; macerate with 5 parts of alcohol spec. grav. .863.—*F. Cod.* (spec. grav. .894, *P. G.*).

The tincture has a yellowish-brown color, and is about one-fourth stronger than that of the U. S. P. 1870.

Off. Prep.—Mistura ferri aromatica, Syrupus aurantii, Tinct. quiniæ, *Br.*

Medical Uses.—Tincture of bitter orange-peel is employed almost exclusively as a flavoring ingredient in mixtures. The *dose* is 1 to 2 fluidrachms (Gm. 4–8).

TINCTURA AURANTII DULCIS, *U. S.*—TINCTURE OF SWEET ORANGE-PEEL.

Teinture d'orange douce, Fr.; *Apfelsinentinktur*, G.

Preparation.—Sweet Orange-Peel, recently separated from the fresh fruit and deprived of the inner white layer, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Mix the orange-peel, previously cut into small pieces, with 80 parts (24 oz. av. or 28 fluidounces) of alcohol, and macerate for 24 hours; then pack it moderately in a conical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

By careful grating the yellow rind of fresh oranges is easily removed, and at once obtained in a suitable condition for preparing the tincture, which has a yellow color and a very agreeable odor.

TINCTURA AURANTII RECENTIS, *Br.*—TINCTURE OF FRESH ORANGE-PEEL.

Preparation.—Take of Bitter Orange, Rectified Spirit, each a sufficiency. Carefully cut from the orange the colored part of the rind in thin slices, and macerate 6 ounces of this in 18 fl. oz. of the spirit for a week, with frequent agitation. Then pour off the liquid, press the dregs, mix the liquid products, and filter; finally, add sufficient spirit to make 1 pint (Imperial).—*Br.*

Medical Uses.—The tincture of fresh orange-peel contains a larger proportion of the volatile oil and has a more agreeable flavor than that made from the dry rind of the bitter orange. The *dose* is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA BELLADONNÆ, *U. S., Br.*—TINCTURE OF BELLADONNA.

Teinture de belladone, Fr.; *Belladonnatinktur*, G.

Preparation.—Belladonna-Leaves, in No. 60 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

The proportions directed by other pharmacopœias are—Belladonna-leaves 1 ounce (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Belladonna-leaves 1 part, alcohol (sp. gr. .912) 5 parts.—*F. Cod.*

This tincture differs very little in strength from that of the U. S. P. 1870. The color is greenish-brown or brown-green, according to the strength of the alcohol.

TINCTURA ÆTHEREA BELLADONNÆ. Belladonna-leaves 2 parts, ether 7 parts, alcohol 3 parts.—*F. Cod.*

Medical Uses.—The *dose* of this tincture is about 7 minims, representing 1 grain of the leaves (Gm. 0.50).

TINCTURA BENZOINI, *U. S.*—TINCTURE OF BENZOIN.

Tinctura benzoës, P. G.—*Teinture de benjoin*, Fr.; *Benzoëtinktur*, G.

Preparation.—Benzoin, in moderately coarse powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av). Mix the powder with 80 parts (24 oz. av. or 28 fluidounces) of alcohol, and macerate for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (30 oz. av. or about 32 fluidounces).—*U. S.*

Macerate benzoin 1 part in alcohol 5 parts.—*F. Cod., P. G.*

The tincture is brownish-red, and yields with water a milky mixture having an acid reaction.

LAC VIRGINIS—Virgin's milk, *E.;* Lait virginal, *Fr.;* Jungfernmilch, *G.*—is a cosmetic preparation consisting of tincture of benzoin 1 part and rose-water from 20 to 100 parts.

Medical Uses.—The tincture of benzoin was formerly in more general use than at present, both internally and externally. By the former method it was employed in chronic mucous profluvia of the *bronchial* and *urinary organs*, and even in chronic *diarrhœa* and *dysentery;* in the same cases, in short, for which copaiba has more recently been recommended. As a local application by means of the atomizer it may sometimes be administered with benefit in chronic *laryngeal* and *bronchial catarrh*. Externally, it is useful both as a stimulant and a protective for *ulcers*, and even for slight fresh *wounds*. But it is more applicable to irritable and indolent sores, as *bed-sores*, ulcers tending to gangrene, *sore nipples*, *chapped hands* and *lips*, and to slight lesions of the same sort about the *anus*. Mixed with water or rose-water, it may be used to remove *freckles* and slight papular and other *eruptions*, as well as to preserve the freshness and suppleness of the skin. It is the medicinal ingredient of the usual forms of court plaster, and too often renders this preparation irritating rather than healing. The *dose* of tincture of benzoin is from 30 minims to a fluidrachm (Gm. 2–4).

TINCTURA BENZOINI COMPOSITA, *U. S., Br.*—COMPOUND TINCTURE OF BENZOIN.

Tinctura balsamica, F. Cod.; *Balsamum commendatoris*, *Elixir traumaticum.*—*Teinture balsamique*, *Baume du commandeur de Permes*, F.; *Persischer Wundbalsam*, G.

Preparation.—Benzoin, in coarse powder, 12 parts (3 oz. av.); Purified Aloes, in coarse powder, 2 parts (½ oz. av.); Storax 8 parts (2 oz. av.); Balsam of Tolu 4 parts (1 oz. av.); Alcohol a sufficient quantity; to make 100 parts (25 oz. av.). Mix the benzoin, aloes, storax, and balsam of Tolu with 75 parts (18¾ oz. av. or 22 fluidounces) of alcohol, and macerate the mixture for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (25 oz. av. or about 26 fluidounces).—*U. S.*

Take of benzoin, in coarse powder, 2 ounces; prepared storax 1½ ounces; balsam of Tolu ½ ounce (av.); Socotrine aloes 160 grains; rectified spirit sufficient for 1 pint (Imperial). Macerate for 7 days and filter.—*Br.*

St. Johnswort 2 parts; angelica-root, myrrh, olibanum and aloes, of each 1 part; balsam of Tolu and benzoin, of each 6 parts; alcohol (spec. grav. .863) 72 parts.—*F. Cod.* The older pharmacopœias had still more complicated formulas.

The tincture is intended to take the place of numerous preparations formerly employed, as *Wade's, Vervain's, Saint Victor's, Jesuits', Friars', Turlington's, Persian,* and *Swedish balsam.* It is of a deep red-brown color, and yields with water a reddish-white opaque mixture having an acid reaction.

Medical Uses.—The uses of the compound tincture are essentially the same as those of the simple tincture of benzoin, but the former is in most cases the more efficient of the two. Especially is this true of its use in affections of the air-passages and lesions of the skin. For such ailments it was for centuries in high repute under various names, as Friars' balsam, Turlington's balsam, etc., until it was displaced by the influence of doctrinal principles in therapeutics. Those who considered the cure of disease of more consequence than the justification of a doctrine adhered to its use, and the medicine survived the theory. It it needless to particularize all the cases in which this preparation may be beneficially used; they are, as already stated, those mentioned under the head of the simple tincture. The *dose* is from 30 minims to a fluidrachm (Gm. 2–4).

The compound is far more efficient than the simple tincture as an application to the various ulcerative lesions mentioned in the article upon that preparation, and especially to *bed-sores.* After cleansing and drying the sore it should be thoroughly covered with the tincture, over which should be laid two thicknesses of fresh cotton wadding extending far beyond the sore, and the whole supported by a broad bandage. The application is for a short time painful, but it should be removed at intervals of two or more days, care being taken at each dressing to remove any dead tissue that is loose (Woodman).

TINCTURA BRYONIÆ, *U. S.*—Tincture of Bryonia.

Teinture de bryone blanche, Fr.; *Zaunrübentinktur,* G.

Preparation.—Bryonia, recently dried and in No. 40 powder, 10 parts (3 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3½ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

This tincture is not recognized by the other pharmacopœias; it has a brown-yellow color, is destitute of any characteristic odor, and has a somewhat bitter taste. Since bryony does not grow in North America, it will be difficult to comply with the pharmacopœial directions of using the "recently-dried" root. The bitter principle, bryonin, is soluble in water; hence diluted alcohol would seem to be an equally effective menstruum.

Action and Uses.—This drastic purgative may be prescribed in *doses* of from 15 to 60 drops (Gm. 1–4).

TINCTURA BUCHU, *Br.*—Tincture of Buchu.

Teinture de buchu, Fr.; *Buchutinktur,* G.

Preparation.—Take of Buchu-Leaves, in No. 20 powder, 2½ ounces (av.); Proof Spirit 1 pint (Imperial). Prepare the tincture by maceration, as described under Tincturæ.—*Br.* Buchu 1 part, alcohol (sp. gr. .836) 5 parts.—*F. Cod.*

The first tincture has a greenish-brown, the second a brownish-green, color; both have the odor and taste of the drug.

Medical Uses.—A medicine intended to allay irritated conditions of the urinary passages should seldom be prepared with alcohol, or if it is so it should be administered in a large proportion of water. The convenience of dispensing buchu under certain circumstances may justify this preparation, but on purely therapeutical grounds it is ineligible. The *dose* of the tincture is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CALENDULÆ, *U. S.*—Tincture of Calendula.

Tincture of marigold, E.; *Teinture de souci,* Fr.; *Calendulatinktur,* G.

Preparation.—Calendula, in No. 20 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 40 parts

(12 oz. av. or 12½ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 30 fluidounces) of tincture are obtained.—*U. S.*

This, like Tinctura bryoniæ, is a newly-introduced preparation, which is not recognized by other pharmacopœias. It should be remembered that the Pharmacopœia defines calendula to be the fresh flowering herb, and that two cultivated species of Tagetes are likewise popularly known as marigold (see page 357). The intention seems to be that calendula, freshly gathered, should be at once dried, powdered, and converted into tincture.

Action and Uses.—Considering the deobstruent virtues attributed to calendula, alcohol does not appear to be an appropriate vehicle for its administration. The tincture, however, is convenient for topical application.

TINCTURA CALUMBÆ, *U. S., Br.*—TINCTURE OF CALUMBA.

Tinctura colombo.—*Teinture de colombo*, Fr.; *Kolombotinktur*, G.

Preparation.—Calumba, in No. 20 powder, 10 parts (3 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 3 parts (18 oz. av. or 21 fluidounces) of alcohol to 2 parts (12 oz. av. or 11½ fluidounces) of water, and, having moistened the powder with 10 parts (3 oz. av. or 3¼ fluidounces) of the mixture, macerate for 24 hours; then pack it in a cylindrical percolator, and gradually pour menstruum upon it until 100 parts (30 oz. or about 32 fluidounces) of tincture are obtained.—*U. S.*

Columbo 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Colombo 1 part, alcohol (sp. grav. .912) 5 parts.—*F. Cod.*

The alcoholic strength of the menstruum has been very properly increased, and is now slightly above that of the French Codex. The tincture has a brown-yellow color, and is much less prone to unsightly precipitation than that of the former Pharmacopœia, which was made with diluted alcohol.

Medical Uses.—This tincture possesses all the virtues of calumba, and may be given for the same purposes as that medicine. It is chiefly employed as a stomachic tonic during convalescence from acute diseases and in *feeble states of digestion* from other causes. It may also be added to bitter infusions where a special stimulant action is desired. The *dose* is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CANNABIS INDICÆ, *U. S., Br., P. G.*—TINCTURE OF INDIAN CANNABIS.

Tinctura cannabis, U. S. 1870.—*Tincture of hemp* (*Indian hemp*), E.; *Teinture de chanvre de l'Inde*, Fr.; *Indischhanftinktur*, G.

Preparation.—Indian Cannabis, in No. 40 powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 7 fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 35 fluidounces) of tincture are obtained.—*U. S.*

The tincture of the French Codex is apparently of the same strength, but is made with alcohol spec. grav. .912, which is too weak a menstruum. It is to be regretted that the present formula must be regarded as the reverse of an improvement. Good Indian cannabis yields about 12½ per cent. of alcoholic extract; the tincture will therefore contain about 2½ per cent. of extract, or about 150 grains in the pint. The Pharmacopœia of 1870 ordered 360 grains of extract to the pint. The British and German Pharmacopœias direct this tincture to be made from the extract, and both preparations are practically of the same strength, and double that of the U. S. P.

Extract of Indian hemp 1 oz. av., rectified spirit 1 pint.—*Br.*

Extract of Indian hemp 1 part, alcohol (sp. grav. .832) 19 parts.—*P. G.*

Medical Uses.—The tincture of Indian hemp may be employed for the same purposes as the extract of that plant, but is ineligible on account of the precipitation of its resin by water. The primary *dose* is about 20 minims (Gm. 1.30).

TINCTURA CANTHARIDIS, *U. S., Br., F. Cod.*—TINCTURE OF CANTHARIDES.

Tinctura cantharidum, P. G.—*Teinture de cantharides*, Fr.; *Spanischfliegentinktur*, G.

Preparation.—Cantharides, in No. 60 powder, 5 parts (1½ oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 3 parts of alcohol, and pack it firmly in a cylindrical percolator; then gradually pour alcohol upon it until 100 parts (30 oz. av. or about 35 fluidounces) of tincture are obtained. —*U. S.*

The proportions directed by other pharmacopœias are—Cantharides ¼ oz. av., proof spirit 1 pint (Imperial).—*Br.* Cantharides 1 part, alcohol 10 parts.—*F. Cod.*, *P. G.*

The tincture has the burning taste and the peculiar odor of cantharides. Made with alcohol, it is of a greenish-yellow color; but diluted alcohol dissolves the dark extractive matter and yields a brown-yellow tincture. The tincture of the U. S. P. 1870 was made with diluted alcohol, and represented in the fluidounce 15 grains (the present one 18.7 grains) of cantharides.

Medical Uses.—This preparation is convenient for use in the comparatively rare cases in which cantharides are internally administered. It may be prescribed in doses of from 10 to 20 drops (Gm. 0.60–1.20) and upward until vesical irritation is produced. Tincture of cantharides should be administered largely diluted in a mucilaginous vehicle. The external uses of this preparation include numerous cases in which a more prolonged and sustained irritation, amounting sometimes to rubefaction, is required than can be obtained by more immediate irritants. Although sometimes applied in liniments to the whole surface of the body, it is manifestly less appropriate to such a purpose than stimulants which act more promptly and for a shorter time; its proper use is as a substitutive stimulant in local *torpor*, *congestions*, *inflammations*, and *pains*, in *neuralgia* of certain nerves, *alopecia*, *frost-bite*, *fistulous ulcers*, etc. The following liniment is used in alopecia: ℞. Cologne-water f℥j; Tincture of Cantharides fʒiss; Tinctures of Rosemary and Lavender, each 10 drops. The scalp should be gently rubbed every day with this lotion, applied on a sponge or piece of flannel.

TINCTURA CAPSICI, *U. S., Br., P. G.*—TINCTURE OF CAPSICUM.

Teinture de piment des jardins, Fr.; *Spanischpfeffertinktur*, G.

Preparation.—Capsicum, in No. 30 powder, 5 parts (1½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 19 parts (28½ oz. av. or 33⅜ fluidounces) of alcohol to 1 part (1½ oz. av. or 11½ fluidrachms) of water, and, having moistened the powder with 3 parts of the mixture, pack it firmly in a cylindrical percolator; then gradually pour menstruum upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

Other pharmacopœias direct—Capsicum ¾ ounce (av.), rectified spirit sufficient for 1 pint (Imperial).—*Br.* Capsicum 1 part, alcohol 10 parts.—*P. G.*

The tincture has a light reddish-orange color and the fiery taste of capsicum. Made according to the U. S. P. 1870, diluted alcohol was used, and a fluidounce of it contained 15 grains (the present tincture 19 grains) of capsicum; the color of the latter is somewhat lighter.

Medical Uses.—This tincture can be used for most of the purposes for which capsicum has been recommended, and especially as an addition to gargles, rubefacient liniments, and mixtures intended to stimulate the stomach exhausted by alcoholic excesses. It may be prescribed in *doses* of 1 or 2 fluidrachms (Gm. 4–8), appropriately diluted.

TINCTURA CARDAMOMI, *U. S.*—TINCTURE OF CARDAMOM.

Teinture de cardamome, Fr.; *Kardamomentinktur*, G.

Preparation.—Cardamom, in No. 30 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 4⅝ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

It is of a brown-yellow color, and has the aromatic odor and spicy taste of cardamom.

Medical Uses.—The simple is much less used than the compound tincture of cardamom. It may, however, be prescribed as a carminative in the *dose* of 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CARDAMOMI COMPOSITA, *U. S., Br.*—Compound Tincture of Cardamom.

Teinture de cardamome composée, Fr.; *Zusammengesetzte Kardamomentinktur*, G.

Preparation.—Cardamom 20 parts (1 oz. av.); Cinnamon 20 parts (1 oz. av.); Caraway 10 parts (½ oz. av.); Cochineal 5 parts (¼ oz. av.); Glycerin 60 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 1000 parts (50 oz. av. or about 50 fluidounces). Mix the cardamom, cinnamon, caraway, and cochineal, and reduce them to a moderately coarse (No. 40) powder. Having moistened the powder with 25 parts (1¼ fluidounces) of diluted alcohol, pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 940 parts (47 oz. av. or about 47½ fluidounces) of tincture are obtained; then add the glycerin, and mix them.—*U. S.*

Cardamom-seeds, freed from the pericarps, and caraway-fruit, each ¼ ounce; raisins, freed from their seeds, 2 ounces; cinnamon-bark ½ ounce (av.); cochineal 55 grains; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Both tinctures have a red color, due to cochineal, and are of an agreeable aromatic odor and taste.

Off. Prep.—Decoct. aloes comp., Mist. ferri arom., Mist. sennæ comp., Tinct. chloroformi comp., *Br.*

Medical Uses.—This tincture, on account of its brilliant color and carminative properties, is, when mixed with sweetened hot water, a favorite remedy for flatulent *colic*. It is a customary addition to mixtures intended to relieve similar affections. The *dose* is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CASCARILLÆ, *Br.*—Tincture of Cascarilla.

Teinture de cascarille, Fr.; *Kaskarilltinktur*, G.

Preparation.—Take of Cascarilla-Bark 2½ oz. av.; proof spirit 1 pint (Imperial). Macerate and finish the tincture by the process described under Tincturæ.—*Br.* Cascarilla 1 part, alcohol (sp. grav. .863) 5 parts.—*F. Cod.*

The tincture has a reddish-brown color.

Medical Uses.—Although not generally used in this country, it is not unworthy of being employed in cases requiring a tonic and stimulant operation. It is especially useful in *dyspeptic* gastro-intestinal derangements due to atony, and is beneficially associated in these affections and others with compound tincture of cinchona. The *dose* is from ½ to 2 fluidrachms (Gm. 2–8).

TINCTURA CASTOREI, *F. Cod., P. G.*—Tincture of Castor.

Teinture de castoreum, Fr.; *Bibergeiltinktur*, G.

Preparation.—Take of Castor, in coarse powder, 1 oz. av.; Rectified Spirit 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.*, 1867.

Macerate 1 part of castor in 10 parts of alcohol (sp. grav. .863).—*F. Cod.* (sp. grav. .832, *P. G.*).

The tincture has a deep reddish-brown color, is rendered opalescent by water, and with a larger quantity of water becomes milky, of a dingy brownish-white color, deposits red-brown resinous matter, and on standing becomes nearly colorless and almost transparent; on the addition of excess of ammonia the resin remains undissolved (see page 400).

Tinctura ætherea castorei. Castor 1 part, ether (sp. gr. .724) 7 parts, alcohol 3 parts.—*F. Cod.*

Medical Uses.—Tincture of castor is seldom employed, but in the obligatory variation of medicines used in the treatment of *hysterical disorders* it may occasionally find its place, particularly in enemas. The latter method is peculiarly appropriate when an hysterical attack occurs about the *menstrual period*, with symptoms of utero-ovarian irritation and flatulent distension of the bowels. The ataxic state of *low fevers* may be treated in the same manner, but with less prospect of doing good than by the use of asafetida, valerian, opium, or simply alcohol. *Dose*, from ½ to 2 fluidrachms (Gm. 2–8).

TINCTURA CATECHU COMPOSITA, *U. S.*—COMPOUND TINCTURE OF CATECHU.

Tinctura catechu, U. S. 1870, Br., P. G.—*Teinture de cachou*, Fr.; *Katechutinktur*, G.

Preparation.—Catechu, in No. 40 powder, 12 parts (3 oz. av.); Cinnamon, in No. 40 powder, 8 parts (2 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (25 oz. av.). Mix the powders, and, having moistened the mixture with 15 parts (3¾ oz. av. or 3⅝ fluidounces) of diluted alcohol, macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (25 oz. av. or about 25 fluidounces) of tincture are obtained.—*U. S.*

The formulas of other pharmacopœias direct: Pale catechu 2½ oz. av., cinnamon-bark 1 ounce av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Catechu 1 part, alcohol (sp. grav. .912 or .894) 5 parts.—*F. Cod.*, *P. G.*

The tincture has a dark red-brown color, a strongly astringent taste, and an acid reaction; it does not become milky on the addition of water, produces with ferric salts green-black precipitates, and when heated with potassium bichromate becomes brownish-red.

Medical Uses.—Compound tincture of catechu is used internally chiefly for the purpose of diminishing *diarrhœa.* When the latter affection is acute, the tincture is generally administered in chalk mixture; when chronic, it is often given with port wine. Externally, it is useful as a dressing for indolent *ulcers* of soft tissues, and particularly of the *nipples* and *anus.* Diluted with water, it may be injected into the *rectum* or *vagina* in chronic *fluxes* of those organs. The *dose* is from 30 minims to 2 fluidrachms (Gm. 2–8).

TINCTURA CHIRATÆ, *U. S., Br.*—TINCTURE OF CHIRATA.

Tincture of chiretta, E.; *Teinture de chirette*, Fr.; *Chirettatinktur*, G.

Preparation.—Chirata, in No. 40 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Chiretta, cut small and bruised, 2½ oz. av.; proof spirit 1 pint (Imperial). Prepare the tincture by the process described under TINCTURÆ.—*Br.*

Medical Uses.—The medicinal qualities of this preparation are closely analogous to those of columbo. It is but little used in this country. *Dose*, from 30 minims to 2 fluidrachms (Gm. 2–8).

TINCTURA CHLOROFORMI COMPOSITA, *Br.*—COMPOUND TINCTURE OF CHLOROFORM.

Preparation.—Take of Chloroform 2 fluidounces; Rectified Spirit 8 fluidounces; Compound Tincture of Cardamom 10 fluidounces. Mix.—*Br.*

TINCTURA CHLOROFORMI ET MORPHINÆ, *Br.* Dissolve morphine hydrochlorate 8 grains, and oil of peppermint 4 minims, in rectified spirit 1 fluidounce, and add chloroform 1 fluidounce and ether 2 fluidrachms. Mix liquid extract of liquorice and treacle each 1 fluidounce with syrup 3 fluidounces, add this to the above solution; then add diluted hydrocyanic acid ½ fluidounce, and sufficient syrup to make 8 fluidounces.—*Br.* (See also CHLORODYNE, p. 440.)

Medical Uses.—This preparation is convenient for administering chloroform as a liquid internally. The *dose* is from 20 to 40 minims (Gm. 1.30–2.60). It is chiefly used for allaying flatulent, biliary, and renal *colics*, but has also been employed in *delirium tremens* and in *mania-à-potu.* (For remarks on CHLORODYNE, see p. 446.)

TINCTURA CIMICIFUGÆ, *U. S., Br.*—TINCTURE OF CIMICIFUGA.

Tincture of black snakeroot, E.; *Teinture d'actée à grappes*, Fr.; *Cimicifugatinktur*, G.

Preparation.—Cimicifuga, in No. 60 powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 5¼ fl. oz.) of alcohol, macerate for 24 hours, pack firmly in a cylindrical percolator, and with alcohol obtain 100 parts (30 oz. av. or about 34 fl. oz.) of tincture.—*U. S.*

Cimicifuga in No. 40 powder 2½ oz.; proof spirit sufficient for 20 fl. oz.—*Br.*

Medical Uses.—The tincture of cimicifuga seems to be an unnecessary medicine, since the fluid extract contains all the virtues of the drug in a smaller quantity of alcohol. *Dose,* from 1 to 2 or 3 fluidrachms (Gm. 4–12).

TINCTURA CINCHONÆ, *U. S., Br.*—Tincture of Cinchona.

Tinctura cinchonæ flavæ, F. Cod.; *Tinctura chinæ*, P. G.—*Tincture of yellow cinchona*, E.; *Teinture de quinquinia jaune*, Fr.; *Chinatinktur*, G.

Preparation.—Yellow Cinchona, in No. 60 powder, 20 parts (6 oz. av.); Glycerin 10 parts (3 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix the glycerin with 65 parts (19½ oz. av. or 22⅞ fluidounces) of alcohol and 25 parts (7½ oz. av. or 7¼ fluidounces) of water, and, having moistened the powder with 20 parts (6 oz. av.) of the mixture, macerate for 24 hours; then pack it firmly in a cylindrical glass percolator, and gradually pour on the remainder of the mixture. When the liquid has disappeared from the surface gradually pour on more of the mixture of alcohol and water, using the same proportions as before, and continue the percolation until 100 parts (30 oz. av. or about 32 fluidounces) of tincture are obtained.—*U. S.*

Other pharmacopœias employ—Red cinchona 4 ounces av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Yellow cinchona 1 part, alcohol (sp. grav. .912) 5 parts—*F. Cod.* Cinchona containing 3½ per cent. of alkaloids 1 part, alcohol (sp. grav. 0.894) 5 parts.—*P. G.*

The tincture has a red-brown color, and, if not sufficiently strong in alcohol, deposits a sediment of cinchonic red containing kinates of the alkaloids. Mr. A. B. Taylor (1865) found a menstruum composed of 2 measures of alcohol and 1 measure each of water and glycerin capable of preventing this precipitation for several months. The present U. S. P. uses alcohol and water nearly in the same proportion as before, and adds a small quantity of glycerin, equal to about one-fifteenth of the measure of the menstruum.

Medical Uses.—Tincture of cinchona is seldom given alone, but is generally used as an addition to tonic mixtures, infusions, etc., and especially for modifying the taste of solutions of quinia. But for these and all other purposes the compound tincture is preferable. *Dose,* 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CINCHONÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Cinchona.

Tinctura chinæ composita, P. G.; *Huxham's tincture of bark*, E.; *Teinture de quinquina composée, Elixir fébrifuge d'Huxam*, Fr.; *Zusammengesetzte Chinatinktur*, G.

Preparation.—Red Cinchona 10 parts (2½ oz. av.); Bitter Orange-Peel 8 parts (2 oz. av.); Serpentaria 2 parts (¼ oz. av.); Glycerin 10 parts (2½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (25 oz. av.). Mix the glycerin with 80 parts (20 oz. av. or 23½ fluidounces) of alcohol and 10 parts (2½ oz. av. or 2⅜ fluidounces) of water. Having mixed the cinchona, orange-peel, and serpentaria, reduce them to a fine (No. 60) powder. Moisten the powder with 20 parts (5 oz. av.) of the menstruum, and macerate for 24 hours; then pack it firmly in a cylindrical glass percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour upon it enough of a mixture of alcohol and water, using the same proportions as before, and continue the percolation until 100 parts (25 oz. av. or about 27 fluidounces) of tincture are obtained.—*U. S.*

Red cinchona 2 oz. av.; bitter orange-peel 1 oz. av.; serpentary-root ½ oz. av.; saffron 55 grains; cochineal 28 grains; proof spirit sufficient to obtain 1 pint (Imperial). —*Br.*

The tincture of the German Pharmacopœia is also known as *Elixir roborans Whyttii*, and is composed of cinchona 6 parts, orange-peel and gentian-root, each 2 parts, Chinese cinnamon 1 part, alcohol (spec. grav. .894) 50 parts.

The first formula directs a menstruum containing nearly one-fourth more alcohol than is ordered for the simple tincture of cinchona; the strength of the latter appears to be ample also for the compound tincture. The preparation has a deep red-brown color, an aromatic odor, and a bitter and astringent taste.

Medical Uses.—The one disease—or morbid condition, rather—in which this preparation of cinchona is superior to all others is the *typhoid state*, whatever may be the original affection during which it is developed. In doing good the cinchona is aided by the serpentaria and alcohol of the compound, if not, as was once believed, by the saffron also (*Br. P.*). It should be given in small and repeated *doses* of from 1 to 2 fluidrachms (Gm. 4–8), with 3 or 4 parts of water.

TINCTURA CINNAMOMI, *U. S., Br., F. Cod., P. G.*—TINCTURE OF CINNAMON.

Teinture de cannelle, Fr.; *Zimmttinktur*, G.

Preparation.—Cinnamon, in No. 40 powder, 10 parts (3 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 3 parts (18 oz. av. or 21 fluidounces) of alcohol to 2 parts (12 oz. av. or 11½ fluidounces) of water, and, having moistened the powder with 5 parts (1½ oz. av. or 1⅝ fluidounces) of menstruum, pack it in a conical percolator, and gradually pour menstruum upon it until 100 parts (30 oz. av. or about 32 fluidounces) of tincture are obtained.—*U. S.*

Ceylon cinnamon 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Ceylon cinnamon 1 part, alcohol (sp. grav. .863) 5 parts.—*F. Cod.* Chinese cinnamon 1 part, alcohol (sp. grav. 0.894) 5 parts.—*P. G.*

The tincture has a red-brown color and a sweetish, warmly aromatic, and somewhat astringent taste. It sometimes gelatinizes when the menstruum becomes too weak in alcohol.

Medical Uses.—The agreeable taste and slight astringency of this preparation render it a suitable addition to mixtures intended to check recent diarrhœa. It may be added to lime-water to control *nausea* and *vomiting*. *Dose*, ½ to 2 fluidrachms (Gm. 2–8).

TINCTURA COCCI, *Br.*—TINCTURE OF COCHINEAL.

Teinture de cochenille, Fr.; *Cochenilletinktur*, G.

Preparation.—Take of Cochineal, in powder, 2½ oz. av.; Proof Spirit 1 pint (Imperial). Macerate for 7 days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make 1 pint.—*Br.* Cochineal 1 part, alcohol (spec. grav. .863) 10 parts.—*F. Cod.*

This tincture has a deep-red color, which is affected by reagents, as described on page 479.

Medical Uses.—It is used exclusively for coloring tinctures, ointments, and mixtures.

TINCTURA COLCHICI, *U. S., P. G.*—TINCTURE OF COLCHICUM.

Tinctura colchici seminum, Br.—*Tincture of colchicum-seeds*, E.; *Teinture de colchique*, Fr.; *Zeitlosentinktur*, G.

Preparation.—Colchicum-Seed, in No. 30 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 4⅝ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it moderately in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained. —*U. S.*

Colchicum-seed 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Colchicum-seed 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.* Colchicum-seed 1 part, alcohol (sp. grav. .894) 10 parts.—*P. G.*

That unbroken colchicum-seeds may be completely deprived of colchicine by digestion has been mentioned on page 483; but all the pharmacopœias direct the seeds to be bruised or powdered. The tincture is of a brownish-yellow color, has a bitter taste, and becomes opalescent with water.

Medical Uses.—This tincture possesses the proper virtues of colchicum, and may be used as well as the wine. The difference of alcoholic strength between it and the wine can make no perceptible difference in the effects of such doses as are employed in practice. The *dose* is from 10 to 30 minims (Gm. 0.60–2).

TINCTURA CONII, *U. S., Br.*—TINCTURE OF CONIUM.

Teinture de ciguë, Fr.; *Schierlingstinktur*, G.

Preparation.—Conium, in No. 30 powder, 150 parts (4½ oz. av.); Diluted Hydrochloric Acid 4 parts (52 grains or minims); Diluted Alcohol a sufficient quantity; to make 1000 parts (30 oz. av.). Moisten the powder with 45 parts (1⅜ oz. av. or 9½ fluid-drachms) of diluted alcohol, previously mixed with the diluted hydrochloric acid, and macerate for 24 hours; then pack it moderately in a conical glass percolator, and gradually pour diluted alcohol upon it until 1000 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

This tincture is now very properly prepared from the full-grown but still green fruit, which, in our opinion, should be bruised and exhausted by maceration, so as to prevent the volatilization of a portion of the alkaloid. For reducing conium-fruit to powder it should be dried at as low a temperature as possible. The acid is added to the menstruum with the view of fixing the alkaloid.

The British Pharmacopœia likewise directs the fruit, in the nearly ripe state, 2½ oz. av. being used with sufficient proof spirit to obtain 1 Imperial pint. The tincture of the French Codex is made from the leaves 1 part and alcohol (sp. grav. .912) 5 parts. It has the peculiar nauseous odor and taste of the drug.

Medical Uses.—Tincture of conium cannot be regarded as an eligible preparation, inasmuch as the quantity of it capable of producing definite effects contains sufficient alcohol to counteract the sedative action of the conium. It is supplanted by the juice of conium. *Dose*, from 20 to 60 minims (Gm. 1.30–4).

TINCTURA CROCI, *U. S., Br., P. G.*—TINCTURE OF SAFFRON.

Teinture de safran, Fr.; *Safrantinktur*, G.

Preparation.—Saffron 10 parts (1 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (10 oz. av.). Moisten the saffron with 10 parts (1 oz. av. or 8¼ fluid-drachms) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (10 oz. av. or about 10¼ fluidounces) of tincture are obtained.—*U. S.*

Saffron 1 oz. av.; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Saffron 1 part. Macerate with 10 parts of alcohol (sp. grav. .863, *F. Cod.*) (sp. gr. .894, *P. G.*) for 10 days; express, and filter.—*F. Cod.*, *P. G.*

The tincture is of a rich orange-yellow color, and has the odor and taste of saffron.

Medical Uses.—Tincture of saffron is rarely given alone internally. It is chiefly employed to impart a pleasing color to mixtures. *Dose*, 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA CUBEBÆ, *U. S., Br.*—TINCTURE OF CUBEB.

Teinture de cubèbe, Fr.; *Kubebentinktur*, G.

Preparation.—Cubeb, in No. 30 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Powdered cubebs 2½ oz. av., proof spirit sufficient to obtain 1 pint (Imperial).—*Br.*
Powdered cubebs 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.*

The tincture has a brownish color. It is too weak in alcohol for dissolving much of the volatile oil or resin contained in good cubebs; both these constituents are present in the French tincture, which becomes milky with water.

Medical Uses.—Tincture of cubeb is chiefly of use in *gleet*, but sometimes also as a carminative. The *dose* is from ½ to 2 fluidrachms (Gm. 2–8).

TINCTURA DIGITALIS, *U. S., Br.*—TINCTURE OF DIGITALIS.

Teinture de digitale, Fr.; *Fingerhuttinktur*, G.

Preparation.—Digitalis, recently dried and in No. 60 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 4⅝ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Digitalis 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Digitalis 1 part, alcohol (sp. grav. .912) 5 parts.—*F. Cod.* Dried digitalis-leaves 1 part, alcohol (sp. grav. .894) 10 parts.—*P. G.*

Digitalis not growing wild in North America, and the cultivated plant being of doubtful medicinal value, it will be difficult to comply with the directions to use recently-dried leaves only. The tests given on p. 545 are valuable for determining the quality of digitalis; namely, the infusion made with 30 parts of water should become distinctly turbid with a solution of tannin, and the infusion with 10 parts of water should not yield a precipitate with ferric chloride. The tincture has a brown-green color, the peculiar odor of the leaves, and a bitter taste.

TINCTURA DIGITALIS ÆTHEREA. Bruised digitalis 1 part, ether (sp. grav. .758) 5 parts.—*F. Cod.* It is of a dark-green color.

Medical Uses.—The special virtues of digitalis are possessed by this preparation, which is more used than any other to obtain the action of the drug upon the heart. Its convenience, rather than its superiority to the infusion, has probably led to this custom. Friction of the abdomen and of other parts of the body with tincture of digitalis has sometimes been followed by diuresis in dropsy. *Dose*, from 10 to 20 minims (Gm. 0.60–1.20) three times a day. Great care should be taken in obtaining a new parcel of the medicine to learn whether it be of the same strength as that previously used.

TINCTURA ERGOTÆ, *Br.*—TINCTURE OF ERGOT.

Tinctura secalis cornuti.—*Teinture de seigle ergoté*, Fr.; *Mutterkorntinktur*, G.

Preparation.—Take of Ergot, finely comminuted, 5 oz. av.; Proof Spirit 1 pint (Imperial). Prepare the tincture by the process described under TINCTURÆ.—*Br.*

The tincture has a red-brown color and the odor and taste of ergot.

Medical Uses.—The stimulant action of the alcohol in this preparation probably renders it less eligible than the wine or the fluid extract of ergot. The *dose* is from 10 minims to a fluidrachm (Gm. 0.60–4).

TINCTURA FERRI ACETATIS, *U. S.*, *Br.*—TINCTURE OF ACETATE OF IRON.

Tinctura ferri acetici ætherea, P. G.—*Tincture of ferric acetate*, E.; *Teinture d'acétate de fer*, Fr.; *Eisenacetattinktur*, G.

Preparation.—Solution of Acetate of Iron 50 parts (5 oz. av. or 4⅛ fluidounces); Alcohol 30 parts (3 oz. av. or 3½ fluidounces); Acetic Ether 20 parts (2 oz. av. or about 17¼ fluidrachms); to make 100 parts (10 oz. av.). Mix the alcohol and acetic ether, and gradually add the solution of acetate of iron, taking care that the mixture remains cool. Keep the tincture in glass-stoppered bottles in a cool and dark place.—*U. S.*

Solution of ferric acetate 80 parts, alcohol 12 parts, acetic ether 8 parts.—*P. G.*

Take of strong solution of acetate of iron 5 fluidounces; acetic acid 1 fluidounce; rectified spirit 5 fluidounces; distilled water 9 fluidounces. Mix, and then add sufficient distilled water to make 20 fluidounces. Preserve in a stoppered bottle.—*Br.*

On mixing solutions of ferric sulphate and potassium acetate the mixture assumes a dark blood-red color from the formation of ferric acetate; $Fe_2 3SO_4 + 6KC_2H_3O_2$ yields $Fe_2 6C_2H_3O_2 + 3K_2SO_4$. The sulphate of potassium which is produced at the same time, being insoluble in alcohol, is precipitated, and the filtrate will be an alcoholic solution of normal ferric acetate. This process of double decomposition has been abandoned in the present British Pharmacopœia for a tincture which contains an excess of acetic acid, while that of the U. S. P. contains normal ferric acetate, and that of the P. G. a more basic salt (see p. 899); the last two authorities order also the addition of acetic ether. The solution of ferric acetate, *Br.* (see. p. 899), is of the same strength as the tincture, but contains less free acetic acid.

Properties.—This tincture is "a clear, dark reddish-brown liquid, transparent in thin layers, having the odor of acetic ether, an acidulous and astringent taste, and a slightly acid reaction. Sp. gr. about 0.950 (1.044–1.046, *P. G.*). It is miscible in all proportions with water, without becoming turbid."—*U. S.*, *P. G.* For reasons stated on page 899 the tincture must be kept in the dark and in a cool place.

A weak tincture or solution of ferric acetate is largely used as a *wood-stain.* Woods containing tannin are thereby colored black, resembling ebony. To produce the same imitation with wood which is free from tannin, this is first soaked in a solution of extract of logwood before it is treated with ferric acetate.

Tests.—The diluted tinctures, after being precipitated by an excess of ammonia, yield a filtrate which should not be precipitated by sulphuretted hydrogen (zinc, copper), barium chloride (sulphate), or, after having been acidulated with nitric acid, by nitrate of silver (chloride); and on being evaporated and ignited should not leave any fixed residue (alkalies, earths).

"20 Gm. of the tincture carefully evaporated and, after addition of a few drops of nitric acid, ignited, should yield a residue weighing 1.12 Gm."—*U. S.* 10 Gm. of the solution are required to leave 1.13 Gm. of ferric oxide. (See also tests on p. 900.)

Medical Uses.—This preparation is reputed by English authorities to be not only an excellent chalybeate for general purposes, but also one of the best of the *styptic* ferruginous preparations for internal administration. It should be given largely diluted with water and taken in small and repeated doses. The *dose* is from 5 to 30 minims (Gm. 0.20–2). The acetic-æthereal tincture is convenient in hysterical anæmic cases, but only as an occasional substitute for the more actively reconstituent preparations of iron.

TINCTURA FERRI CHLORIDI, *U. S.*—TINCTURE OF CHLORIDE OF IRON.

Tinctura ferri perchloridi, Br.; *Tinctura ferri sesquichloridi.—Tincture of perchloride of iron, Tincture of ferric chloride*, E.; *Teinture de perchlorure de fer*, Fr.; *Eisenchloridtinktur*, G.

Preparation.—Solution of Chloride of Iron 35 parts (8¾ oz. av. or 6 fluidounces); Alcohol 65 parts (16¼ oz. av. or 19 fluidounces); to make 100 parts (25 oz. av. or nearly 25 fluidounces). Mix the solution with the alcohol, and let it stand in a closely-covered vessel at least three months; then transfer it to glass-stoppered bottles.—*U. S.*

Mix strong solution of perchloride of iron 5 fluidounces with rectified spirit 5 fluidounces and distilled water 10 fluidounces.—*Br.*

The two tinctures are practically alike, except that the first contains free hydrochloric acid, and when it is kept on hand for some time, as now directed by the Pharmacopœia, previous to dispensing it, acquires an ethereal odor from the formation of various compounds, resulting from the action upon the alcohol of the free acid, and probably also of the ferric chloride, the latter being reduced to ferrous chloride more particularly on exposing the tincture to the light. Notwithstanding this gradual reduction is well known, the U. S. P. requires the tincture, on the addition of freshly-prepared test solution of potassium ferricyanide, to acquire merely a greenish-brown color without a trace of blue; which is simply an impossibility, the tincture being even not directed to be kept in the dark, which would at least lessen, though not entirely prevent, the reducing action. The present Br. P. has reduced the alcohol to ⅓ the former strength.

Tincture of ferric chloride is perfectly transparent, and has a brown-yellow or bright brownish color, an agreeable ethereal odor, a strongly astringent, ferruginous taste, and an acid reaction. Its specific gravity is .988 (*U. S.*). The tincture behaves to alkalies, potassium ferrocyanide, and silver nitrate like the solution (see page 901). Dr. Robert Battey and Mr. J. C. Wharton (1870) occasionally observed the tincture to deposit white crystals of sulphate of calcium, which were probably derived from impurity in the acid.

Tests.—Impurities like nitric acid, sulphate of copper, zinc, alkalies, and ferric oxychloride are detected in the same manner as stated for the salt and the solution (see pp. 676 and 901). In testing for oxychloride the Pharmacopœia directs 8 parts of the tincture to be diluted with 100 parts of distilled water before boiling. "10 Gm. of the tincture, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 0.652 Gm."—*U. S.*

Off. Prep.—Mistura ferri et ammonii acetatis, *U. S.*

TINCTURA FERRI CHLORATI ÆTHEREA, *P. G.*, s. Tinctura tonico-nervina Bestuscheffii, s. Liquor anodynus martiatus, s. Spiritus ferri chlorati æthereus. 1 part of solution of ferric chloride spec. grav. 1.282 (containing 19.9 per cent. Fe_2Cl_6) is mixed with alcohol 7 parts and ether 2 parts, the mixture exposed to the sunlight until colorless, and afterward kept in partially filled bottles in a shady place until it has acquired a yellow color. During the bleaching process the ferric is reduced to ferrous chloride, chloride of ethyl and a little aldehyd being generated through the influence of the nascent chlorine. On exposure to the air the salt is partly oxidized to ferric oxychloride. This is known as *Bestuscheff's tincture.* It has a warm and ferruginous taste, is precipitated black by ammonia, white by silver nitrate, and blue by both ferrocyanide and ferricyanide of potassium, and contains 1 per cent. of iron. 10 Ccm. of this tincture, after being agitated with an equal volume of the solution of potassium acetate, should separate on standing 3 Ccm. of ethereal liquid.

TASTELESS TINCTURE OF IRON, introduced by M. Creuse (1873), has the ferruginous taste modified by an alkali citrate, the compound formed being analogous in color and taste to the pharmacopœial phosphate and pyrophosphate of iron (see pp. 691 and 693). For 1 fluidounce of the tincture about 130 grains of citric acid neutralized by an alkali, or about 200 grains of potassium citrate, are required, and one-half the alcohol ordered by the Pharmacopœia should be replaced by water.

Physiological Action.—Tincture of chloride of iron is, of all ferruginous compounds except the solutions of the chloride and of the persulphate, the one that exerts the most powerful local action as a styptic, and indeed as a caustic, upon delicate tissues. Even when largely diluted it constringes the mouth and fauces. A diuretic action is attributed to it, which is probably due to the ether which it contains. It is very apt to attack the teeth unless properly diluted and taken through a tube. One or two cases are reported of strangury caused by its external application.

Medical Uses.—Like the solution of chloride of iron, this preparation may be used as a local styptic, but it is less efficient than the former. It is better suited for internal administration in all cases of passive *hæmorrhage*, and especially in that from the uterus. It is eminently serviceable when hæmorrhage depends upon imperfect coagulability of the blood, associated with a lax condition of the solids and general debility. For these reasons, doubtless, it is very efficient in *purpura hæmorrhagica.* It is probably the best preparation that can be employed in chronic *albuminuria*, although the utility of other ferruginous preparations in the same affection proves that they do not act by their astringency as much as by their reconstituent power in the blood. Indeed, the form in which the tincture is ordinarily given in renal disorders, "Basham's mixture," no longer holds iron as a chloride, but as an acetate. Possibly, the free acids of this preparation act as diuretics. The formula for this solution is as follows: ℞. Tr. ferri chloridi fʒss; Acid. acetic. dil. f℥j; Liq. ammoniæ acet. f℥ivss; Tr. aurant. cort. f℥iss; Glycerinæ fʒss.—M. S. A tablespoonful, largely diluted, two or three times a day. The tincture of the chloride is the best form in which iron can be given in *diabetes.*

In various chronic mucous fluxes, including *leucorrhœa*, *blenorrhœa*, *bronchorrhœa*, *diarrhœa*, and also in passive *sweats*, this preparation is often of essential service, both by its constringing action and its reconstituent operation. It is scarcely less efficient in *vesical catarrh*, especially when it is associated with paralysis of the bladder. Doubtless the double action just indicated renders it an efficient remedy for *seminal losses* due to an excessive or unnatural stimulation of the genital organs. To its astringency must probably be ascribed its remarkable efficacy in *idiopathic erysipelas* and its alleged utility in other forms of the same affection. In regard to the first-named disease, the virtues of the medicine are incontestable whenever it is administered in sufficient doses—*i. e.* of 20 to 30 drops (Gm. 1.30–2) every two hours, both night and day. In many cases of traumatic erysipelas its utility is equally well established. Applied topically and undiluted, it is said to prevent the spreading of the eruption (Hopadze, *Med. Record*, xix. 364), but this statement may not apply to the idiopathic affection. In *puerperal fever*, an affection which stands in the closest relationship to erysipelas, the power of this medicine has been unequivocally demonstrated (Bell, *Edinburgh Med. Jour.*, xxvi. 50, 74). In *diphtheria* this tincture is one of the most efficient topical applications to the parts on which the exudation is seated, and its internal administration in appropriate doses, such as from 5 to 15 drops (Gm. 0.30–1) every half hour or hour, has produced better results than any other medicine. When thus administered the special topical use of the medicine may be dispensed with (*Boston Med. and Surg. Jour.*, July, 1881, p. 58). As an application to *chilblains* it is sometimes used. It has also been employed, in large and repeated doses, in acute articular *rheumatism*, but, while the results show that it is tolerated in most instances, and appears to be beneficial in a small proportion of mild cases, yet the proportion of cardiac complications occurring during its administration seems to have been unusually large.

This tincture may be applied in the same manner as the solution of chloride of iron for arresting *hæmorrhage*, whether external or internal. It may be inhaled as an atomized solution in cases of pulmonary hæmorrhage. For the latter purpose a solution of 1 part of the tincture to 10 parts of water may be used.

The *dose* of this medicine is from 10 to 30 drops (Gm. 0.60–2), largely diluted with water.

TINCTURA GALLÆ, *U. S., Br.*—Tincture of Nutgall.

Tinctura gallarum, P. G.—*Tincture of galls*, E.; *Teinture de noix de galle*, Fr.; *Galläpfeltinktur*, G.

Preparation.—Nutgall, in No. 40 powder, 20 parts (6 oz. av.); Glycerin 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Mix the glycerin with 90 parts (27 oz. av. or 28 fluidounces) of diluted alcohol, and, having moistened the powder with 10 parts of the mixture, pack it in a conical glass percolator; then gradually pour upon it, first, the remainder of the mixture, and afterward diluted alcohol, until 100 parts (30 oz. av. or about 29 fluidounces) of tincture are obtained. —*U. S.*

Nutgall 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Macerate nutgall 1 part with 5 parts of alcohol spec. grav. .912 (*F. Cod.*), (sp. grav. .894, *P. G.*).

Nutgall yields over 60 per cent., or 20 parts yield at least 12 parts, of extract; the menstruum of the first formula weighing 100 parts, about one-eighth of it, containing ⅜ oz. of glycerin, must remain in the powder. The addition of glycerin is intended to retard the formation of gallic acid, which is deposited if the tincture be long kept. The tincture has a yellowish-brown color, a strongly astringent taste, and an acid reaction, and yields blue-black precipitates with ferric salts.

Medical Uses.—Tincture of nutgall is seldom given internally, but is sometimes used, diluted with water, as a lotion in relaxed conditions of the *mouth* and *fauces*, of the *rectum*, and of the *vagina*. *Dose*, from 30 minims to 2 fluidrachms (Gm. 2–8).

TINCTURA GELSEMII, *U. S., Br.*—Tincture of Gelsemium.

Teinture de gelsemium, Fr.; *Gelsemiumtinktur*, G.

Preparation.—Gelsemium, in No. 60 powder, 15 parts (4½ oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3½ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 35 fluidounces) of tincture are obtained.—*U. S.*

The tincture is of a brown-yellow color, becomes milky with water, and has the aromatic odor and bitter taste of the drug. A somewhat weaker alcohol would be equally well adapted, but alcohol spec. grav. .912, which is ordered by the French Codex for preparing *extract of gelsemium*, appears to be too aqueous for conveniently exhausting all the desirable principles. The *Br. P.* orders gelsemium 2½ ounces, proof spirit 20 fluidounces.

Medical Uses.—This preparation represents all the virtues and all the dangers of gelsemium. It may be prescribed in *doses* of 10 minims (Gm. 0.60), and gradually increased.

TINCTURA GENTIANÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Gentian.

Preparation.—Gentian 8 parts (4 oz. av.); Bitter Orange-Peel 4 parts (2 oz. av.); Cardamom 2 parts (1 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (50 oz. av.). Mix the gentian, orange-peel, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Moisten the powder with 10 parts (5 oz. av. or 5¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (50 oz. av. or about 51 fluidounces) of tincture are obtained.—*U. S.*

The British Pharmacopœia prepares 1 pint (Imperial) of tincture from gentian 1½ ounces, bitter orange-peel ¾ ounce, and ¼ ounce (av.) of cardamom-seeds deprived of the pericarps, using sufficient proof spirit.

The principal change in the first formula is the direction to powder the drugs together to prevent the loss of the volatile oil remaining in the dried aromatics. The tincture has a brown-yellow color, an agreeable aromatic odor, and a bitter taste. It acquires with ferric salts a dark black-brown color.

Allied Tinctures.—Tinctura gentianæ alkalina.—Teinture de gentiane alcaline (stomachique), Elixir amer de Peyrilhe, *F. Cod.*—Gentian 10 parts, crystallized sodium carbonate 3 parts, alcohol (sp. grav. .912) 300 parts.

Tinctura gentianæ.—Tincture of gentian, *E.;* Teinture de gentiane, *Fr.;* Enziantinktur, *G.*—Macerate gentian 1 part in 5 parts of alcohol spec. grav. .912 (*F. Cod.*), (sp. gr. .894, *P. G.*).

Medical Uses.—This tincture is a very agreeable bitter and an efficient stomachic in cases of *feeble digestion.* It is especially adapted to improve the tone of the stomach exhausted by the abuse of alcoholic drinks. The *dose* is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA GUAIACI, *U. S.*—Tincture of Guaiac.

Teinture de résine de gayac, Fr.; *Guajaktinktur,* G.

Preparation.—Guaiac, in coarse powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Mix the powder with 80 parts (24 oz. av. or 28⅛ fluidounces) of alcohol, and macerate for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (30 oz. av. or about 32 fluidounces).—*U. S.*

Since guaiac resin dissolves completely in alcohol with the exception of the impurities, the tincture is conveniently made by maceration. The formula directs the original weight to be made up, irrespective of the amount of insoluble impurities, by washing the filter with alcohol. The tincture has been dismissed from the German Pharmacopœia; that of the French Codex (1 part resin to 5 parts alcohol sp. gr. .863) is weaker. The tincture has a dark brownish-red color, is precipitated by water, and is colored green or blue by ferric chloride and other agents.

Allied Tincture.—Tinctura guaiaci ligni.—Tincture of guaiacum-wood, *E.:* Teinture de gayac, *Fr.*—Macerate for 10 days guaiacum-wood 10 parts in alcohol (spec. grav. .912) 50 parts; express and filter.—*Fr. Cod.*

Medical Uses.—The tincture may be used in most of the cases to which other preparations of guaiacum are adapted, but especially in chronic fibrous *rheumatism* and in scanty or painful *menstruation.* It has been especially recommended in *tonsillitis.* The ammoniated tincture is in general to be preferred, and may be used as a *gargle* in the proportion of a fluidrachm to 2 fluidounces of water. Both tinctures, being decomposed by water, should be administered internally in mucilage or syrup. *Dose,* 1 or 2 fluidrachms (Gm. 4–8) several times a day.

TINCTURA GUAIACI AMMONIATA, *U. S., Br.*—Ammoniated Tincture of Guaiac.

Teinture de gayac ammoniacale, Fr.; *Ammoniakalische Guajaktinktur,* G.

Preparation.—Guaiac, in coarse powder, 20 parts (4 oz. av.); Aromatic Spirit of Ammonia a sufficient quantity; to make 100 parts (20 oz. av.). Mix the powder with 80 parts (16 oz. av. or 17½ fluidounces) of aromatic spirit of ammonia, and macerate for 7 days in a closed vessel; then filter through paper, adding, through the filter, aromatic spirit of ammonia until 100 parts (20 oz. av. or about 20 fluidounces) of tincture are obtained.—*U. S.*

Guaiacum resin in powder 4 oz. av., aromatic spirit of ammonia sufficient for 1 pint (Imperial).—*Br.*

The two formulas yield practically identical tinctures, which resemble tincture of guaiac in appearance, but have an ammoniacal odor and taste.

Allied Tincture.—Dewees's Tincture of Guaiacum. Digest for a few days powdered guaiacum resin 4 ounces, carbonate of sodium or potassium 90 grains, powdered pimento 1 ounce, in diluted alcohol 1 pint. Add spirit of ammonia, if required, in the proportion of 1 or 2 drachms to each 4 fluidounces of the tincture.

Medical Uses.—The uses of this preparation are the same as those of the simple tincture. It may be applied locally in *tonsillitis* by means of a brush. The ammonia it contains may possibly promote the curative effects of the resin. At all events, the ammoniated tincture is generally preferred. *Dose,* 1 or 2 fluidrachms (Gm. 4–8).

Dewees claimed that in idiopathic *amenorrhœa* of long standing he had for more than forty years almost daily used the preparation which bears his name, without its having failed in any case proper for its use. He prescribed a teaspoonful of it three times a day in a wine-glassful of milk or white wine.

TINCTURA HUMULI, *U. S.*—Tincture of Hops.

Tinctura lupuli, Br.; *Teinture de houblon*, Fr.; *Hopfentinktur*, G.

Preparation.—Hops, well dried and in No. 20 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 40 parts (12 oz. av. or 12½ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. or about 31 fluidounces) of tincture are obtained.—*U. S.*

The British tincture of hop is about one-third weaker and is made from 2½ ounces av. of hop, with sufficient proof spirit to obtain 1 pint (Imperial).

Hops should not be dried by artificial heat; when air-dry, they may be conveniently reduced to powder by grinding them together with some clean sand in an ordinary drug-mill; when unground, they are unsuited for percolation, and so bulky that in preparing the tincture by maceration most of the liquid is absorbed, necessitating the frequent agitation of the mixture and afterward its forcible expression. The tincture is of a yellowish-brown color, and has the odor and bitter taste of hop, though in less degree than the tincture of lupulin, which has been dismissed from the present Pharmacopœia (see p. 939).

Medical Uses.—The proportion of hops or of lupulin in the average dose of this tincture is too small to produce much effect beyond that of the alcohol it contains. A draught of malt liquor would generally be preferable. The *dose* is from 1 to 3 fluidrachms (Gm. 4–12).

TINCTURA HYDRASTIS, *U. S.*—Tincture of Hydrastis.

Teinture de hydrastis, Fr.; *Hydrastistinktur*, G.

Preparation.—Hydrastis, in No. 60 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 4⅝ fluidounces) of diluted alchol, and macerate for 24 hours; then pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

This is a new tincture, which has a brown-yellow color and bitter taste. A menstruum stronger in alcohol would render the tincture more permanent.

Medical Uses.—Probably this tincture fully represents hydrastis. Its dose is yet to be determined, but provisionally may be stated at a fluidrachm (Gm. 4).

TINCTURA HYOSCYAMI, *U. S.*, *Br.*—Tincture of Hyoscyamus.

Teinture de jusquiame, Fr.; *Bilsenkrauttinktur*, G.

Preparation.—Hyoscyamus, recently dried and in No. 60 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 4⅝ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 30 fluidounces) of tincture are obtained. —*U. S.*

Hyoscyamus-leaves, in coarse powder, 2½ oz. av., proof spirit sufficient for 1 Imperial pint.—*Br.* Hyoscyamus 1 part, alcohol (sp. grav. .912) 5 parts.—*P. Cod.*

The tincture is greenish-brown, and has the narcotic odor of the leaves and a bitter taste.

Medical Uses.—The tincture is generally believed to contain all the virtues of hyoscyamus, and is directed to be given in the *dose* of a fluidrachm (Gm. 4). But, according to Mr. Boulter's experiments (*St. Bartholomew's Reports*, xv. 224), the tinctures of the leaves and seeds are practically quite useless, although they occasion some dilatation of the pupils and render the pulse weak, irregular, and intermittent. The tincture of the root, on the other hand, in doses of from ½ to 2 fluidrachms, produced dryness of the mouth and fauces, with thirst, flushed face, cracked lips, and sometimes delirium.

TINCTURA IGNATIÆ, *U. S.*—Tincture of Ignatia.

Teinture de fève de Saint Ignace, Fr.; *Ignazbohnentinktur*, G.

Preparation.—Ignatia, in No. 60 powder, 10 parts (3 oz. av.); Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 8 parts (32 oz.

av. or 37½ fluidounces) of alcohol to 1 part (4 oz. av. or 3⅞ fluidounces) of water. Moisten the powder with 10 parts (3 oz. av. or 3⅜ fluidounces) of the menstruum, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until the ignatia is exhausted. Reserve the first 90 parts (27 oz. av.) of the percolate; evaporate the remainder to 10 parts (3 oz. av.) and mix with the reserved portion. Of this tincture take any convenient number of parts, and by means of a water-bath evaporate it to dryness. Weigh the resulting extract, and from its weight calculate the quantity of extract contained in the 100 parts of tincture obtained; then dissolve the dried extract in the remainder of the tincture, and add enough of the above menstruum to make the product weigh so many parts that each 100 parts of tincture shall contain 1 part of dry extract. Lastly, mix thoroughly and filter through paper. Tincture of ignatia thus prepared represents about 10 parts (3 oz. av.) of ignatia in 100 parts (30 oz. av. or about 34 fluidounces).—*U. S.*

The object of this process is to have the tincture always approximately of uniform strength; to secure this result it is absolutely necessary to closely adhere to the alcoholic strength of the menstruum, since variation therein is accompanied by variation in the amount of extract, though not in that of the alkaloids. If extract of ignatia is on hand which has been prepared with alcohol of the strength indicated, the tincture may be made by dissolving 1 part (or 40 grains) of it in 99 parts (or 9 oz. av. = 10¼ fluidounces) of the menstruum. (For further remarks on standardizing this tincture see TINCTURA NUCIS VOMICÆ.)

Medical Uses.—Like the tincture of nux vomica, this preparation is chiefly used to reinforce other bitter tonics or to represent the minutest doses of the alkaloids it contains. *Dose*, 5 to 20 minims (Gm. 0.30–1.20).

TINCTURA IODI, *U. S., Br., F. Cod., P. G.*—TINCTURE OF IODINE.

Tinctura iodinii, U. S. 1870.—*Teinture d'iode*, Fr.; *Jodtinktur*, G.

Preparation.—Iodine 8 parts (½ oz. av.); Alcohol 92 parts (5¾ oz. av. or 6¾ fluidounces); to make 100 parts (6¼ oz. av. or about 7 fluidounces). Dissolve the iodine in the alcohol.—*U. S.*

Iodine ½ oz. av., iodide of potassium ½ oz. av., rectified spirit 1 pint (Imperial).—*Br.* Iodine 1 part, alcohol (spec. grav. .833) 12 parts, *F. Cod.* (10 parts, *P. G.*).

The tincture has a deep brown-red color and the odor of iodine, evaporates completely without leaving any fixed residue (that of Br. P. leaves KI), and yields a precipitate of iodine on being mixed with water. The iodine gradually reacts with the alcohol at ordinary temperatures, and more rapidly at a somewhat elevated temperature, resulting in the formation of hydriodic acid and other compounds, which prevent the precipitation by water of some of the iodine. According to Guibourt, after the tincture has been kept on hand for about eighteen months it is scarcely rendered turbid by water. The tincture should therefore be made in moderate quantities only, or, according to Castelhaz (1882), may be preserved of proper strength by the addition of one-half of 1 per cent. of potassium iodate, which salt is insoluble in alcohol and regenerates iodine from the hydriodic acid formed; at the same time, however, a corresponding quantity of iodate is converted into iodide; $KIO_3 + 6HI$ yield $3I_2 + KI + 3H_2O$. According to Pavesi (1883), chloral hydate dissolves in tincture of iodine without decomposition, and renders it miscible with water without precipitation. The tincture should be kept in well-stopped bottles to prevent the evaporation of alcohol.

Tests.—"6.33 Gm. of the tincture, mixed with a solution of 2 Gm. of iodide of potassium in 25 Ccm. of water and a little gelatinized starch, should require for complete decoloration 40 Ccm. of the volumetric solution of hyposulphite of sodium."—*U. S.* This test indicates 8 per cent. of free iodine, and is perfectly correct for the freshly-prepared tincture, but entirely too rigorous for that which has been kept on hand for some time. The same test has been adopted by the P. G.; but, while the freshly-made tincture contains 9.09 per cent. of free iodine, the tincture is regarded as being of good quality if the iodine has been reduced to 8.78 per cent. The French Codex directs the tincture to be recently made, without further indicating the limit of time.

Off. Prep.—Vapor iodi, *Br.*

Allied Tinctures.—TINCTURA IODI DECOLORATA. Digest 10 parts each of iodine, hyposulphite of sodium, and water until solution has been effected; then add 16 parts of ammoniated alcohol and 75 parts of alcohol. After setting the mixture aside for two or three days it becomes colorless and is ready for use.—P. G. 1872. It has a somewhat ethereal and feebly ammoniacal odor, and contains *iodide of ammonium, iodide of ethyl* (C_2H_5I), and *hydriodate of triethylamine* ($C_6H_{15}NHI$); the latter compound is gradually converted into iodide of ethyl and triethylamine. In addition to these compounds the tincture contains also a little iodide and sulphate of sodium, which are not present if the tincture is made as originally proposed (1869) by Dr. C. O. Curtman (iodine 10 drachms, alcohol 13 fluidounces, stronger ammonia-water 3 fluidounces). In the latter case, however, about 27 days are required for effecting complete decoloration.

Tinctura iodinii composita, Compound Tincture of Iodine. Dissolve iodine 240 grains and iodide of potassium 480 grains in alcohol 1 pint.—*U. S.* 1870. This tincture resembles the simple tincture of iodine in appearance, but differs from it in being miscible with water without causing precipitation. The British *Tinctura iodi* likewise contains potassium iodide, but in insufficient quantity to prevent its precipitation by water, at least when recently made.

Medical Uses.—They are set forth at length under Iodum. This preparation is unsuited for internal administration, since the addition of water precipitates its iodine. The compound tincture, which is no longer officinal, is to be preferred for this purpose. The *dose* of the simple tincture is from 5 to 15 drops (Gm. 0.30–1). It may be given largely diluted with water properly flavored.

Decolorized tincture of iodine is, as above pointed out, no longer a tincture of iodine, and is practically of no more value as a local discutient than a solution of iodide of sodium or ammonium in water.

The compound tincture (1870) is not precipitated by water, and is also more permanent than the simple tincture, as well as less irritating and more absorbable. It is greatly to be preferred for internal use. The *dose* is from 10 to 30 drops (Gm. 0.60–2), largely diluted with water or some mild liquid.

TINCTURA IPECACUANHÆ ET OPII, *U. S.*—Tincture of Ipecacuanha and Opium.

Preparation.—Deodorized Tincture of Opium 100 parts (10 oz. av.); Fluid Extract of Ipecac 10 parts (1 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (10 oz. av.). Evaporate the deodorized tincture of opium on a water-bath until it weighs 85 parts (8½ oz. av.). When it has become cold add to it the fluid extract of ipecac; filter the mixture and pass enough diluted alcohol through the filter to make the tincture weigh 100 parts (10 oz. av. or about 10 fluidounces).—*U. S.*

This tincture has been admitted into the Pharmacopœia to take the place of similar preparations which have been used to some extent under the designation of *tincture of Dover's powder.*

Medical Uses.—The virtues of this new preparation, which is apparently intended to present Dover's powder in a liquid form, are not very evident. If, as generally has been supposed, the gradual solution and absorption of the opium and ipecac in that preparation has much to do with its diaphoretic operation, then in the liquid form the object is less likely to be attained. And it is difficult to understand why an extemporaneous mixture of deodorized tincture of opium and wine of ipecac would not have answered the same purpose as this new officinal formula.

TINCTURA JALAPÆ, *Br.*—Tincture of Jalap.

Teinture de jalap, Fr.; *Jalapentinktur*, G.

Preparation.—Macerate and displace coarsely-powdered jalap 2½ oz. av. with sufficient proof spirit to obtain 1 pint (Imperial).—*Br.*

Jalap 1 part, alcohol (sp. grav. .912) 5 parts.—*F. Cod.*

Medical Uses.—This tincture is seldom used except as an addition to other purgative liquids. The *dose* is from ½ fluidrachm to 2 fluidrachms (Gm. 2–8).

TINCTURA KINO, *U. S., Br.*—Tincture of Kino.

Teinture de kino, Fr.; *Kinotinktur*, G.

Preparation.—Kino 10 parts (1 oz. av.); Glycerin 15 parts (1½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (10 oz. av.). Mix the glycerin with 60 parts (6 oz. av. or 7 fluidounces) of alcohol, and 15 parts (1½ oz. av. or 11½ fluidrachms) of water. Rub the kino in a mortar, adding gradually 30 parts (3 oz. av.) of this menstruum until a smooth paste is made; transfer this to a bottle, add the remainder of the menstruum, and macerate for 24 hours, occasionally shaking the bottle; then filter through paper, adding, through the filter, enough of a mixture of alcohol and water, made in the proportion of 4 parts (5 fluidrachms) of alcohol and 1 part (1 fluidrachm) of water, to make the tincture weigh 100 parts (10 oz. av. or about 10 fluidounces). Keep the tincture in well-stopped bottles.—*U. S.*

Kino in coarse powder 2 ounces; glycerin 3 fluidounces; distilled water 5 fluidounces; rectified spirit 12 fluidounces. Macerate for 7 days in a closed vessel, with occasional agitation; filter and add sufficient alcohol to make 1 pint (Imperial).—*Br.* Macerate for 10 days kino 1 part with alcohol (sp. grav. .913) 5 parts, and filter.—*F. Cod.*

Tincture of kino is conveniently prepared by maceration, and has a dark brown-red color. Made with alcohol and properly preserved, it will remain limpid, but if made with diluted alcohol it will gradually lose its astringency and become gelatinous. According to P. P. Fox (1877), this may be prevented, without increasing the alcoholic strength, by replacing one-half of the water with an equal measure of glycerin—a fact noticed by Haselden as early as 1860; and this is substantially the process adopted by the present U. S. Pharmacopœia. The employment of magnesia, logwood, and other foreign substances with the same end in view is objectionable and unnecessary. The origin of kino, and probably also its age, may influence the tendency to gelatinize.

Medical Uses.—This tincture is used for most of the internal purposes of kino in the *dose* of 1 or 2 fluidrachms (Gm. 4–8). When made according to the formula of 1870, it tended to gelatinize in watery mixtures. The presence of glycerin in the present tincture is supposed to remedy that defect, but perhaps at the expense of the astringency of the preparation.

TINCTURA KRAMERIÆ, *U. S., Br.*—TINCTURE OF KRAMERIA.

Tinctura ratanhiæ, P. G.—*Tincture of rhatany*, E.; *Teinture de ratanhia*, Fr.; *Ratanhatinktur*, G.

Preparation.—Krameria, in No. 40 powder, 20 parts (6 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Rhatany 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Macerate rhatany 1 part in 5 parts of alcohol sp. grav. .912, *F. Cod.* (sp. grav. .894, *P. G.*).

This tincture has a brown-red color and a strongly astringent taste. After having been kept in partly-filled bottles it deposits rhatany-red, and occasionally gelatinizes. It is therefore best prepared in small quantities.

Medical Uses.—This is the form in which rhatany is perhaps more frequently used than any other astringent in the treatment of subacute *diarrhœa*. For this purpose it is usually added to the chalk mixture. Diluted with water, it forms a very useful mouthwash when the *gums* are spongy. It has also been reputed serviceable in atonic *menorrhagia* and in other forms of passive *hæmorrhage*. The *dose* is 1 or 2 fluidrachms (Gm 4–8).

TINCTURA LARICIS, *Br.*—TINCTURE OF LARCH.

Teinture d'écorce de mélèze, Fr.; *Lärchenrindentinktur*, G.

Preparation.—Take of Larch-Bark, in No. 40 powder, 2½ oz. av.; Rectified Spirit 1 pint. Prepare 1 pint (Imperial) of tincture by the formula given under TINCTURÆ. —*Br.*

This tincture has a red-brown color, and should be carefully preserved like other astringent tinctures.

Medical Uses.—Tincture of larch-bark is not employed in this country. It has been used in England as a remedy for passive *hæmorrhages*, *purpura*, and *chronic bronchitis*. The *dose* is from 20 to 30 minims (Gm. 1.30–2).

TINCTURA LAVANDULÆ COMPOSITA, *U. S., Br.*—COMPOUND TINCTURE OF LAVENDER.

Spiritus lavandulæ compositus, U. S. 1870.—*Compound spirit of lavender*, *Lavender drops*, E.; *Teinture de lavande composée*, Fr.; *Zusammengesetzte Lavendeltinktur*, G.

Preparation.—Oil of Lavender 8 parts (½ oz. av. or 4⅓ fluidrachms); Oil of Rosemary 2 parts (⅛ oz. av. or 65 minims); Cinnamon, in coarse powder, 18 parts (1⅛ oz.

av.); Cloves 4 parts (¼ oz. av.); Nutmeg 10 parts (⅝ oz. av. = 274 grains); Red Saunders, in coarse powder, 8 parts (½ oz. av.); Alcohol 680 parts (42½ oz. av. or 49¾ fluidounces); Water 270 parts (16⅞ oz. av. or 16¼ fluidounces); Diluted Alcohol a sufficient quantity; to make 1000 parts (62½ oz. av.). Dissolve the oils in the alcohol and add the water. Crush the nutmeg in a mortar, mix it with the cinnamon, cloves, and red saunders, and reduce the mixture by grinding to a coarse (No. 20) powder. Moisten the mixture with a sufficient quantity of the alcoholic solution of the oils, pack it firmly in a cylindrical percolator, gradually pour upon it the remainder of the alcoholic solution, and afterward sufficient diluted alcohol, until 100 parts (62½ oz. av. or about 4¼ pints) of tincture are obtained.—*U. S.*

Take of oil of lavender 1½ fluidrachms; oil of rosemary 10 minims; cinnamon-bark, bruised, nutmeg, bruised, each 150 grains; red sandal-wood 300 grains; rectified spirit 2 pints (Imperial). Macerate the cinnamon, nutmeg, and red sandal-wood in the spirit for 7 days in a closed vessel, with occasional agitation; then strain and press, dissolve the oils in the strained tincture, filter, and add sufficient rectified spirit to make 2 pints.—*Br.*

The tincture of the first formula is stronger in volatile oils and aromatics than that made by the second formula. Both have a red color, form opalescent mixtures with water, and, if prepared from good materials, have an agreeable odor and a strong but pleasant aromatic taste.

Off. Prep.—Liquor potassii arsenitis (Liq. arsenicalis), *U. S.*, *Br.*

Medical Action and Uses.—Of the numerous ingredients in this popular and useful compound, oil of lavender, except by its disproportionate quantity, is one of the least active and efficient. It is universally employed in this country as a domestic cordial remedy for *nausea*, *flatulent colic*, and gastric distress after food. It is most conveniently administered on a lump of sugar or in a little hot and sweetened water. The *dose* is from half a fluidrachm to a fluidrachm (Gm. 2–4).

TINCTURA LIMONIS, *Br.*—TINCTURE OF LEMON-PEEL.

Teinture de zeste de citron (*limon*), Fr.; *Citronenschalentinktur*, G.

Preparation.—Take of Fresh Lemon-Peel, sliced thin, 2½ oz. av.; Proof Spirit 1 pint. Macerate for 7 days in a closed vessel, with occasional agitation; strain, press, and filter; then add sufficient proof spirit to make 1 pint (Imperial).—*Br.*

Medical Uses.—Tincture of lemon-peel is used for flavoring mixtures, etc. *Dose*, a fluidrachm (Gm. 4).

TINCTURA LOBELIÆ, *U. S.*, *Br.*, *P. G.*—TINCTURE OF LOBELIA.

Teinture de lobélie enflée, Fr.; *Lobeliatinktur*, G.

Preparation.—Lobelia, in No. 40 powder, 20 parts (6 oz.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Lobelia 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Lobelia 1 part, alcohol (spec. grav. .912) 5 parts.—*F. Cod.* Lobelia 1 part, alcohol (spec. grav. 0.894) 10 parts.—*P. G.*

The tincture is of a green-brown color and has a somewhat heavy odor and a bitter and acrid taste.

Medical Uses.—Lobelia is most frequently prescribed under the form of this tincture. Its *dose* as an expectorant is from 10 minims to a fluidrachm (Gm. 0.60–4). In asthmatic attacks 1 or 2 fluidrachms (Gm. 4–8) should be administered every half hour or hour.

TINCTURA LOBELIÆ ÆTHEREA, *Br.*—ETHEREAL TINCTURE OF LOBELIA.

Preparation.—Take of Lobelia, in coarse powder, 2½ oz. av.; Spirit of Ether 1 pint. Macerate for 7 days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient spirit of ether to make 1 pint (Imperial).—*Br.*

It is of a brownish-green color.

Medical Uses.—This preparation is perhaps more efficient than the simple tincture in *asthma*. The *dose* is from 10 to 30 minims (Gm. 0.60–2).

TINCTURA MATICO, *U. S.*—Tincture of Matico.

Teinture de matico, Fr.; *Maticotinktur*, G.

Preparation.—Matico, in No. 40 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the matico with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

This tincture has been newly admitted into the Pharmacopœia. It is about one-tenth the strength of the fluid extract, and, being made with a weaker alcohol, is of a greenish-brown color. The following formula yields a brown-green tincture: Matico 1 part, alcohol (spec. grav. .863) 5 parts.—*F. Cod.*

Medical Uses.—In nearly all the affections in which matico is used alcohol is contraindicated, and hence it would seem that the already officinal fluid extract of matico was sufficient without a tincture. Of the new preparation the dose may be stated at 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA MOSCHI, *U. S., P. G.*—Tincture of Musk.

Teinture de musc, Fr.; *Moschustinktur*, G.

Preparation.—Musk 10 parts (1 oz. av.); Alcohol 45 parts (4½ oz. av. or 5¼ fluidounces); Water 45 parts (4½ oz. av. or 4⅜ fluidounces); Diluted Alcohol a sufficient quantity; to make 100 parts (10 oz. av.). Rub the musk in a mortar first with a little of the water, until a smooth mixture is made, and then with the remainder of the water. Transfer the whole to a bottle, add the alcohol, and macerate the mixture for 7 days, occasionally shaking the bottle. Then filter through paper, adding, through the filter, enough diluted alcohol to make the tincture weigh 100 parts (10 oz. av. or about 10 fluidounces).—*U. S.*

Musk 10 parts, alcohol (spec. grav. .863) 100 parts.—*F. Cod.* Musk 2 parts, water and alcohol (spec. grav. .894), of each 50 parts.—*P. G.*

The manipulation described above is the same as directed by the German Pharmacopœia, but the strength of the alcohol and the proportion of musk differ considerably. Strong alcohol gives a light-brown tincture, which becomes slightly opalescent with water; but weak alcohol yields a dark reddish-brown tincture, which has a strong musk odor and remains clear on the addition of water.

Medical Uses.—This preparation will be found convenient for the rare occasions in which musk is used medicinally. The alcoholic menstruum promotes its action. Every 10 minims of the tincture contains about 1 grain of musk. *Dose*, about 1 fluidrachm (Gm. 4).

TINCTURA MYRRHÆ, *U. S., Br., P. G.*—Tincture of Myrrh.

Teinture de myrrhe, Fr.; *Myrrhentinktur*, G.

Preparation.—Myrrh, in moderately coarse powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Mix the powder with 80 parts (24 oz. av. or 28 fluidounces) of alcohol, and macerate for 7 days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (30 oz. av. or about 34 fluidounces).—*U. S.*

Myrrh 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Myrrh 1 part, alcohol spec. grav. .863 (*F. Cod.*) (or .832, *P. G.*) 5 parts.

The tincture is of a brownish-yellow or reddish-yellow color, has the balsamic odor of myrrh and a bitter aromatic taste, and yields a precipitate of resin on the addition of water. E. B. Shuttleworth (1871) suggested the utilization of the gum left on preparing the tincture for making a mucilage, by dissolving it in boiling water, straining, and allowing to settle. The adhesive properties are increased by the addition of a small quantity of molasses.

Medical Uses.—Tincture of myrrh is seldom used internally, but it may be prescribed in *doses* of from 30 minims to a fluidrachm (Gm. 2–4). It is chiefly used as a stimulant, astringent, and protective agent in the treatment of *aphthæ*, *spongy gums*, *relaxed uvula*, aphthous affections of the *vagina*, etc. In these cases it is generally diluted with water, which precipitates its resin. Campardon (1879) reports that "*whooping cough* yields easily and promptly to tincture of myrrh administered in 'wine of cinchona.'" He prescribes it in doses of 10 drops or of 5 drops every hour, according to the age of the patient, and asserts that in every one of numerous cases it destroyed the spasmodic element of the cough in a few days (*Bull. de thérap.*, xcv. 193).

TINCTURA NUCIS VOMICÆ, *U. S., Br.*—TINCTURE OF NUX VOMICA.

Tinctura strychni, P. G.—*Teinture de noix vomique*, Fr.; *Krähenaugentinktur*, G.

Preparation.—Nux Vomica, in No. 40 powder, 20 parts (6 oz. av.); Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 8 parts (32 oz. av. or 37½ fluidounces) of alcohol to 1 part (4 oz. av. or 3⅞ fluidounces) of water. Moisten the powder with 20 parts (6 oz. av. or 6¾ fluidounces) of the menstruum, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until the nux vomica is exhausted. Reserve the first 90 parts (27 oz. av. or about 30 fluidounces) of the percolate; evaporate the remainder to 10 parts (3 oz. av.) and mix with the reserved portion. Of this tincture take any convenient number of parts, and by means of a water-bath evaporate to dryness; weigh the resulting extract, and from its weight calculate the quantity of dry extract contained in the 100 parts of tincture; then dissolve the dried extract in the remainder of the tincture, and add enough of the above menstruum to make the product weigh so many parts that each 100 parts of tincture shall contain 2 parts of dry extract. Lastly, mix thoroughly and filter through paper. Tincture of nux vomica thus prepared represents about 20 parts (6 oz. av.) of nux vomica in 100 parts (30 oz. av. or about 34 fluidounces).—*U. S.*

Dissolve extract of nux vomica, 133 grains, in distilled water 4 fluidounces and rectified spirit sufficient for 20 fluidounces.—*Br.* This formula has been adopted in accordance with the investigations of Dunstan and Short, noticed below.

Rasped nux vomica 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.* Nux vomica 1 part, alcohol (sp. gr. 0.894) 10 parts.—*P. G.*

TINCTURA STRYCHNI ÆTHEREA. Coarsely-powdered nux vomica 1 part, spirit of ether 10 parts. Macerate for 8 days, express, and filter.—*P. G.* 1872.

These tinctures have a yellowish color and a very bitter taste, and become opalescent when mixed with water. A few drops of the tincture, evaporated to dryness, leave a brownish-yellow residue, which is colored yellowish-red by nitric acid. The tough nature of the drug necessitates its prolonged maceration or digestion with the menstruum, and the firm packing in case the tincture is prepared by percolation. R. Rother (1883) noticed that the horny matter of nux vomica is speedily softened by sodium chloride, without becoming in the least mucilaginous, and proposes the addition of ¾ oz. of the salt for 8 oz. of the drug; a portion of the salt may be mixed with the powder, and the remainder dissolved in the water before the alcohol is added. G. W. Kennedy (1870) observed the separation of crystals of strychnine from a tincture which had been prepared with nux vomica, yielding an aqueous infusion of an alkaline reaction.

The first formula is an attempt at standardizing this important tincture, the strength being adjusted by the amount of extract, as is also directed for tincture of ignatia. We have stated elsewhere (p. 651) that the percentage of extract obtained from the drug varies considerably with the alcoholic strength of the menstruum, strong alcohol yielding less and weak alcohol more extract from the same sample of nux vomica. The tincture should therefore never be prepared from the extract unless the latter has been made in strict conformity with the Pharmacopæia—*i. e.* with the same menstruum directed for the tincture. ½ oz. av. of such extract dissolved in 24½ oz. av. or 27⅝ fluidounces of alcohol spec. grav. .846 will yield the pharmacopœial tincture.

The percentage of alkaloids contained in nux vomica is not constant (see p. 1024), and even the relative amount of strychnine and brucine varies in different specimens. Investigations made by W. R. Dunstan and F. W. Short (1883–84) show that it is perfectly feasible to obtain pharmaceutical preparations of nux vomica containing a definite amount of total alkaloids, and they propose an extract which should contain 15 per cent. of these alkaloids, and a tincture containing 1 grain of alkaloids in 1 Imperial fluidounce. Accepting the standard extract, 500 grains of the tincture (*U. S. P.*), containing 10 grains of extract, should contain 1.5 grains of alkaloids, and may be assayed by Dunstan and Short's process as follows: Evaporate the tincture over a water-bath almost to dryness; dissolve the residue in 2 fluidrachms of chloroform and ½ fluidounce of dilute sulphuric acid, mixed with an equal bulk of water; when the liquids have separated draw off the chloroform, add to the acid liquid ammonia in excess and ½ fluidounce of chloroform; well agitate, gently warm, transfer the clear chloroform to a weighed dish, evaporate, dry at 100° C. (212° F.) for one hour, allow to cool, and weigh.

Medical Uses.—This is a very convenient form for the exhibition of nux vomica, especially in small doses, although it is of uncertain strength. It is particularly adapted for use in *atonic dyspepsia*. *Dose*, from 5 to 20 minims (Gm. 0.30–130).

TINCTURA OPII, *U. S., Br.*—TINCTURE OF OPIUM.

Tinctura opii simplex, P.G.—*Tinctura extracti opii*, Fr. Cod.; *Tinctura thebaica, Tinctura meconii.*—*Laudanum*, E.; *Teinture d'extrait d'opium, Teinture thébaïque*, Fr.; *Einfache Opiumtinktur*, G.

Preparation.—Powdered Opium 10 parts (4 oz. av.); Water 40 parts (16 oz. av. or 15⅜ fluidounces); Alcohol 40 parts (16 oz. av. or 19¾ fluidounces); Diluted Alcohol a sufficient quantity; to make 100 parts (40 oz. av.). Rub the opium in a mortar with the water, previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and macerate for 12 hours; then add the alcohol, mix thoroughly, and transfer the whole to a conical percolator. Return to the percolator the first portion of percolate until it becomes clear, and when the liquid ceases to drop gradually pour on diluted alcohol, continuing the percolation, until 100 parts (40 oz. av. or about 40 fluidounces) of tincture are obtained.—*U. S.*

Take of opium, in coarse powder, 1½ oz. av., proof spirit 1 pint. Macerate for 7 days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient proof spirit to make 1 pint (Imperial). It contains the soluble matter of 33 grains of opium nearly, or about 3.3 grains of morphine in 1 fluidounce.—*Br.*

Powdered opium 1 part, alcohol sp. grav. 0.894 and distilled water, each 5 parts.—*P. G.* Extract of opium 10 parts, alcohol (sp. gr. 0.912) 120 parts.—*F. Cod.*

Each fluidrachm (U. S. measure) of these tinctures represents 4.3 grains (*Br.*), 5.5 grains (*U. S.* against 4.7 grains, *U. S.* 1870), and 5.3 grains (*P. G.*) of dry opium, and 4 grains (*F. Cod.*) of extract of opium. Calculating 60 per cent. as the yield of extract from dry opium, 1 grain of powdered opium is represented by 9 minims (*F. P.*), 11.3 minims (*P. G.*), 11 minims (*U. S.* against 12.8 minims, *U. S.* 1870), and 14 minims (*Br.*), U. S. measure, of these tinctures. The powdered or dry opium used is directed to contain of morphine 12 to 16 per cent. (*U. S.*), about 10 per cent. (at least 6 to 8 per cent. for crude opium, *Br.*), at least 10 to 12 per cent. (*F. Cod.*), 10 per cent. (*P. G.*).

With due care, opium is readily exhausted by weak alcohol, about 60 per cent. of its constituents being soluble in that menstruum. To ensure uniformity of strength in this important preparation, the opium employed in making it should be well dried, of full morphine strength, and sufficiently long macerated or digested in the menstruum to be completely disintegrated at least a day before it is transferred to a percolator or filter. The residue after drying should yield nothing to water, and dilute acids should dissolve from it only minute quantities of alkaloid compounds. The color of the tincture is deep reddish-brown. It has the narcotic odor and bitter taste of opium, and should be preserved in well-stopped bottles to prevent evaporation of the alcohol.

The term *laudanum* is still recognized by several European pharmacopœias as a synonym for opium. In connection with various epithets (antihystericum, diureticum, etc.) it was formerly employed to designate numerous solid compound preparations of opium, while the stronger liquid opiates were called *laudanum liquidum*, and distinguished by other epithets—tincture of opium, for instance, as *laudanum liquidum simplex*. However, in the United States and Great Britain the tincture is popularly known as laudanum.

Off. Prep.—Enema opii, Linimentum opii, *Br.;* Mistura magnesiæ et asafœtidæ, *U. S.*

Allied Tinctures.—TINCTURA OPII ACETATA, *U. S.* 1870. Dry powdered opium 2 troyounces, distilled vinegar 12 fluidounces, alcohol ½ pint; macerate for a week, express, and filter. The yield is about 20 fluidounces, and 10 minims contain 1 grain of opium. This tincture is now rarely used.

TINCTURA OPII MURIATICA. Macerate for 2 weeks powdered opium 1 ounce, hydrochloric acid 1 ounce, and distilled water 20 ounces; filter (Nichol). This is half the strength of laudanum and contains no alcohol.

Medical Uses.—The simple tincture of opium—or laudanum, as it is distinctively called—possesses most of the good and evil qualities of pure opium. Of the latter the most conspicuous is its tendency to nauseate. This operation is supposed to depend upon the narcotine which it contains, and which is removed in the process for making the deodorized tincture. The latter is therefore preferable for internal administration, but laudanum forms a convenient addition to liniments, poultices, and other external anodyne applications. It should be remembered that by being kept in imperfectly stoppered vials it becomes relatively stronger by the evaporation of its alcohol. The *dose* for an adult is about 25 drops or 13 minims (Gm. 1), equivalent to about 1 grain of opium.

TINCTURA OPII AMMONIATA, *Br.*—AMMONIATED TINCTURE OF OPIUM.

Teinture d'opium ammoniacale, Fr.; *Ammoniakalische Opiumtinktur*, G.

Preparation.—Take of Opium in coarse powder, 100 grains; Saffron, cut small, Benzoic Acid, each 180 grains; Oil of Anise 1 fluidrachm; Strong Solution of Ammonia 4 fluidounces; Rectified Spirit 16 fluidounces. Macerate for 7 days in a well-closed vessel, with occasional agitation; then strain, press, filter, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.*

This is a slight modification of the formula formerly recognized by the Edinburgh Pharmacopœia. The preparation was known as *elixir paregoricum scoticum*, and in Scotland employed as paregoric elixir. It contains the opium alkaloids in a free state, dissolved by the aid of alcohol and of an excess of ammonia. 90 minims of it represent very nearly 1 grain of opium.

Medical Uses.—This preparation, sometimes called Scotch paregoric, is composed of nearly the same ingredients as ordinary paregoric, except that in it ammonia takes the place of the camphor in that preparation. The *dose* is from half a fluidrachm to a fluidrachm (Gm. 2–4).

TINCTURA OPII CAMPHORATA, *U. S.*—CAMPHORATED TINCTURE OF OPIUM.

Tinctura camphoræ composita, Br.; *Tinctura extracti opii camphorata*, F. Cod.; *Tinctura opii benzoica*, P. G.; *Elixir paregoricum.—Paregoric elixir*, E.; *Elixir parégorique*, *Teinture d'opium camphrée*, Fr.; *Benzoësäurehaltige Opiumtinktur*, G.

Preparation.—Powdered Opium 4 parts (44 grains); Benzoic Acid 4 parts (44 grains); Camphor 4 parts (44 grains); Oil of Anise 4 parts (44 grains or 47 minims); Glycerin 40 parts (440 grains or 1 oz. av.); Diluted Alcohol a sufficient quantity: to make 1000 parts (11,000 grains = 25⅛ oz. av.). Add 900 parts (9900 grains = 22⅝ oz. av. or 23½ fluidounces) of diluted alcohol to the other ingredients, contained in a suitable vessel, and macerate for 7 days, frequently stirring; then filter through paper in a well-covered funnel, and pass enough diluted alcohol through the filter to make the product weigh 1000 parts (25⅛ oz. av. or about 25½ fluidounces).—*U. S.*

Opium, in coarse powder, benzoic acid, each 40 grains; camphor 30 grains; oil of anise ½ fluidrachm; proof spirit 1 pint (Imperial).—*Br.* Extract of opium, benzoic acid, oil of anise, each 3 parts; camphor 2 parts; alcohol (sp. gr. .912) 650 parts.—*F. Cod.* Powdered opium and oil of anise, each 1 part; benzoic acid 4 parts; camphor 2 parts; alcohol (sp. gr. 0.894) 192 parts.—*P. G.*

1 grain of opium is represented in 273 (*U. S.*), 256 (*U. S.* 1870), and 230 (*Br.*) minims (U. S. measure), and in 250 (*U. S.*), 200 (*P. G.*), and 132 (*F. Cod.*) grains of the tincture. This tincture has a brownish-yellow color, an anise-like and camphoraceous odor, a sweetish, pungently aromatic, and slightly bitter taste, and an acid reaction; on the addition of water it turns milky. It is an ingredient in Mistura glycyrrhizæ comp., *U. S.*

Allied Preparations.—The following formulas were adopted by the Philadelphia College of Pharmacy (1833) for the nostrums named:

BATEMAN'S PECTORAL DROPS. Digest for 24 hours rasped red saunders 2 troyounces in 4 gallons of diluted alcohol; filter, and add powdered opium, catechu, and camphor, each 2 troyounces, oil of anise 4 fluidrachms. Digest for 10 days and filter. It is of the same opium strength as paregoric.

GODFREY'S CORDIAL. Dissolve carbonate of potassium 2¼ troyounces in water 26 pints; add sugar-house molasses 16 pints; heat the mixture over a gentle fire until it simmers; remove the scum; add tincture of opium 1½ pints, alcohol 2 pints, and oil of sassafras 4 fluidrachms, previously mixed together. Each fluidounce represents nearly 1¼ grains of opium.

Medical Uses.—Camphorated tincture of opium is in common use to relieve *abdom-*

inal pains produced by flatus or by irritability of the stomach or bowels, and for allaying *cough* when there is no active inflammation of the respiratory organs. The *dose* for an adult is 1 or 2 fluidrachms (Gm. 4–8), and for an infant from 5 to 20 drops (Gm. 0.30–1.30). It is usually administered in sweetened water.

TINCTURA OPII DEODORATA, *U. S.*—DEODORIZED TINCTURE OF OPIUM.

Preparation.—Powdered Opium 10 parts (4 oz. av.); Ether 20 parts (8 oz. av. or 10¼ fluidounces); Alcohol 20 parts (8 oz. av. or 9⅞ fluidounces); Water a sufficient quantity; to make 100 parts (40 oz. av.). Rub the opium in a mortar with 40 parts (16 oz. av. or 15⅜ fluidounces) of water, gradually added, until thoroughly softened, and macerate for 12 hours; then express, and repeat the operation twice, using the same quantity of water each time. Mix the expressed liquids, evaporate the mixture to 10 parts (4 oz. av. or about 3 fluidounces), and when it has cooled shake it repeatedly with the ether in a bottle. When the ethereal solution has separated by standing, pour it off, and evaporate the remaining liquid until all traces of ether have disappeared. Mix the residue with 50 parts (20 oz. av. or 19¼ fluidounces) of water, and filter the mixture through paper. When the liquid has ceased to pass add enough water, through the filter, to make the filtered liquid weigh 80 parts (32 oz. av. or about 29½ fluidounces). Lastly, add the alcohol, and mix them.—*U. S.*

The process differs but little from that of 1870, except that the infusion of opium is concentrated to a nearly syrupy consistence before it is agitated with ether, whereby narcotine and the odorous principle, together with a little coloring matter, are removed. The remaining aqueous liquid is freed from ether by heat, properly diluted with water, filtered, and preserved by the addition of alcohol. T. G. Davis (1877) proposed to shorten the process by boiling the opium with 3 portions of water, each time for half an hour, expressing, evaporating to 4 fluidounces, mixing with an equal bulk of alcohol, filtering from the gummy precipitate, washing the filter with alcohol, evaporating to 4 fluidounces, and then finishing the product as directed by the Pharmacopœia.

This tincture is of the same opium strength (by weight) as laudanum, but rather lighter in color, and, being made with a more aqueous menstruum, is heavier, so that 10.5 minims represent 1 grain of opium. It is nearly identical with *denarcotized tincture of opium*, and takes the place of several preparations which were at one time introduced as *elixirs* of opium.

Off. Prep.—Tinctura ipecacuanhæ et opii, *U. S.*

Allied Preparations.—LIQUOR OPII COMPOSITUS. Opium is exhausted with water, the infusion concentrated, precipitated by alcohol, the clear liquid evaporated to a small bulk equal in weight to that of opium, and agitated with ether. The aqueous liquid, freed from the ether, is diluted with 1 part of its own weight of water, filtered, mixed with 1 part of stronger alcohol, and diluted with water to 5 parts. A portion of this is assayed, and the whole liquid is then mixed with the remaining ingredients in such proportions that 30 Ccm. or 1 fluidounce shall contain 6 grains of morphine, 1 Ccm. of chloroform, 2 Ccm. of acetic ether, and 13 Ccm. of stronger alcohol, the remaining liquid being water. As originally suggested by Dr. Squibb, this preparation contained 4 grains of morphine in the fluidounce, but after the appearance of the new Pharmacopœia this amount was increased to 6 grains. (For details see *Amer. Jour. Phar.*, 1870, p. 47.)

BATTLEY'S SEDATIVE DROPS. 3 ounces of extract of opium are dissolved in 30 ounces of hot water, and the solution filtered and mixed with 6 ounces of alcohol. This preparation is about 50 per cent. stronger than those above described.

Medical Uses.—The nauseating effects of laudanum are supposed not to be produced by this preparation, which is of the same strength. It may be given in the *dose* of 15 minims (Gm. 1) or 25 drops.

TINCTURA PHYSOSTIGMATIS, *U. S.*—TINCTURE OF PHYSOSTIGMA.

Teinture de fève du Calabar, Fr.; *Kalabarbohnentinktur*, G.

Preparation.—Physostigma, in No. 40 powder, 10 parts (3 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3½ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 35 fluidounces) of tincture are obtained.—*U. S.*

Physostigma 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.*

In view of the fact that physostigmine and its salts when in solution are readily altered by the influence of light and air (see pp. 1149 and 1152), it is doubtful whether the tincture is a sufficiently stable preparation; it is advisable, therefore, to make it only in small quantities as needed; and since the amount of matter soluble in strong alcohol is quite small (see p. 654), the tincture may very properly be made by maceration. 38 grains of powdered physostigma and 374 grains (or 1 fluidounce) of alcohol should be used, and after sufficient maceration the liquid should be filtered from the dregs without adding more alcohol.

Medical Uses.—This preparation fully represents physostigma. Its commencing *dose* may be stated at 10 minims (Gm. 0.60).

TINCTURA PYRETHRI, *U. S., Br.*—TINCTURE OF PYRETHRUM.

Tincture of pellitory, E.; *Teinture de pyrèthre*, Fr.; *Bertramwurzeltinktur*, G.

Preparation.—Pyrethrum, in No. 40 powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 15 parts (4½ oz. av. or 5¼ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

Powdered pellitory 4 oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Pellitory 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.*

It has a brownish-yellow color and a very acrid taste, and on the addition of water becomes opalescent and milky.

Medical Uses.—Tincture of pellitory is not given internally, but is a convenient substitute for the root of the plant as an application to painful cavities in *carious teeth* and as a local stimulant in *paralysis* of the *tongue*, *velum palati*, and *pharynx*.

TINCTURA QUASSIÆ, *U. S., Br.*—TINCTURE OF QUASSIA.

Teinture de quassie amère, Fr.; *Quassiatinktur*, G.

Preparation.—Quassia, in No. 40 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Quassia-wood, in chips, ¾ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Quassia 1 part, alcohol (sp. gr. .912) 5 parts.—*F. Cod.*

The tincture has a light brownish-yellow color and a persistently bitter taste, and is not colored black by ferric salts.

Medical Uses.—It is occasionally employed during convalescence from low fevers and other exhausting acute diseases, as well as in various atonic *dyspeptic conditions* of gastric origin; but it is less frequently prescribed alone than as an addition to the infusion of quassia or of other bitter tonics or associated with their tinctures. The average *dose* is about 1 fluidrachm (Gm. 4). It is sometimes given in enema to destroy rectal *ascarides*.

TINCTURA QUININÆ, *Br.*—TINCTURE OF QUININE.

Preparation.—Take of Hydrochlorate of Quinine 160 grains; Tincture of Orange-Peel 1 pint (Imperial). Dissolve the hydrochlorate of quinine in the tincture with the aid of a gentle heat; then allow the solution to remain for 3 days in a closed vessel, shaking it occasionally, and then filter.—*Br.*

Medical Uses.—This preparation might very properly have been left to magistral prescription. Each fluidrachm (Gm. 4) contains 1 grain of hydrochlorate of quinine.

TINCTURA QUININÆ AMMONIATA, *Br.*—AMMONIATED TINCTURE OF QUININE.

Preparation.—Take of Sulphate of Quinia 160 grains; Solution of Ammonia 2½ fluidounces (Imperial); Proof Spirit 17½ fluidounces. Dissolve the sulphate of quinia in the spirit with a gentle heat, and add the solution of ammonia.—*Br.*

Medical Uses.—This association of quinine and ammonia is supposed to be indicated in *neuralgia* and other *nervous affections* due to a want of nervous energy. The *dose* is from ½ to 1 fluidrachm (Gm. 2–4).

TINCTURA RHEI, *U. S., Br.*—TINCTURE OF RHUBARB.

Teinture de rhubarbe, Fr.; *Rhabarbertinktur*, G.

Preparation.—Rhubarb 12 parts (3 oz. av.); Cardamom 2 parts (½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (25 oz. av.). Mix the rhubarb and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (25 oz. av. or about 25 fluidounces) of tincture are obtained. —*U. S.*

Rhubarb, in coarse powder, 2 oz. av.; cardamom-seeds, freed from the pericarps and bruised, coriander-fruit, bruised, saffron, each ¼ oz. av.; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Rhubarb 1 part and alcohol (sp. gr. .912) 5 parts.—*F. Cod.*

The tincture is of a deep reddish-brown color, has the odor and taste of rhubarb, becomes turbid with water, and on standing deposits orange-yellow granular crystals, consisting mainly of chrysophanic acid. The use of a stronger alcohol or the addition of glycerin to the menstruum will only partly prevent this precipitation.

Allied Tinctures.—TINCTURA RHEI AQUOSA, *P. G.* Take of rhubarb, cut into thin pieces, 100 parts; powdered borax, carbonate of potassium, each 10 parts; add boiling distilled water 900 parts, and after 15 minutes alcohol 90 parts; macerate for 1 hour, express slightly, and to 850 parts of liquid add cinnamon-water 150 parts.

TINCTURA RHEI ET ABSINTHII; Tinct. absinthii composita, *F. Cod.*—Elixir stomachique de Stoughton, *Fr.*—Rhubarb, gentian, wormwood, germander, and bitter orange-peel, of each 5 parts; aloes and cascarilla, each 1 part; alcohol (sp. gr. .912) 200 parts.—*F. Cod.* Numerous other formulas for *Stoughton's bitters* have been in use, rhubarb, gentian, and orange-peel being the principal ingredients.

TINCTURA RHEI ET ALOES, s. *Elixir sacrum.* Rhubarb, bruised, 10 drachms, aloes 6 drachms, cardamom 4 drachms, diluted alcohol 2 pints. Macerate for 14 days, express, and filter.—*U. S.* 1850.

TINCTURA RHEI ET GENTIANÆ, s. *Tinct. rhei amara.* Rhubarb, bruised, 2 troyounces, gentian, bruised, 4 drachms, diluted alcohol 2 pints. Proceed as above.—*U. S.* 1850.

TINCTURA RHEI ET SENNÆ. Rhubarb 1 troyounce, senna 120 grains, coriander, fennel, each 60 grains, liquorice 30 grains, raisins, deprived of their seeds, 6 troyounces, diluted alcohol 3 pints. Macerate for 7 days, express, and filter through paper.—*U. S.* 1870. This tincture is known as *Warner's gout cordial* and has a reddish-brown color.

Medical Uses.—Tincture of rhubarb is used to qualify the action of saline purgatives and in *gouty* or other feeble states of the system requiring a stimulant as well as a laxative medicine. Its *dose* is from ½ to 1 fluidounce (Gm. 16–32) as a purgative. As a stomachic it may be given in the dose of about a fluidrachm (Gm. 4).

TINCTURA RHEI AROMATICA, *U. S.*—AROMATIC TINCTURE OF RHUBARB.

Teinture de rhubarbe aromatique, Fr.; *Aromatische Rhabarbertinktur*, G.

Preparation.—Rhubarb 20 parts (5 oz. av.); Cinnamon 4 parts (1 oz. av.); Cloves 4 parts (1 oz. av.); Nutmeg 2 parts (½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (25 oz. av.). Mix the rhubarb, cinnamon, cloves, and nutmeg, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 15 parts (3¾ oz. av. or 3⅞ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (25 oz. av. or about 24 fluidounces) of tincture are obtained. —*U. S.*

This tincture is for the first time recognized as a distinct preparation, it having formerly been made only for preparing spiced syrup of rhubarb (see p. 480). It has a dark red-brown color, a pleasant aromatic odor, and a spicy and bitter taste; on keeping it deposits some chrysophanic acid and other principles of rhubarb; on the addition of water it becomes turbid.

Off. Prep.—Syrupus rhei aromaticus, *U. S.*

Medical Uses.—This new officinal seems to have been intended only for the preparation of the aromatic syrup of rhubarb. It may, however, be added to the number of purgative tinctures which are used in gouty and enfeebled states of the system, such as the tinctures of aloes and myrrh or of rhubarb and senna (1870), and indeed may be appropriately administered along with them. *Dose*, 2 to 4 fluidrachms (Gm. 8–16).

TINCTURA RHEI DULCIS, *U. S.*—SWEET TINCTURE OF RHUBARB.

Teinture de rhubarbe douce, Fr.; *Süsse Rhabarbertinktur*, G.

Preparation.—Rhubarb 8 parts (2 oz. av.); Glycyrrhiza 4 parts (1 oz. av.); Anise 4 parts (1 oz. av.); Cardamom 1 part (¼ oz. av.); Diluted Alcohol a sufficient quantity, to make 100 parts (25 oz. av.). Mix the rhubarb, glycyrrhiza, anise, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with 15 parts (3¾ oz. av. or 3⅞ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (25 oz. av. or about 25 fluidounces) of tincture are obtained. —*U. S.*

This tincture has been in use for a number of years, and was admitted into the Pharmacopœia of 1880. It resembles tincture of rhubarb in appearance, but is one-third weaker in rhubarb, the bitter taste of which is somewhat modified by the other ingredients.

Medical Uses.—From the small proportion of rhubarb in this preparation it may be surmised that it was intended for infantile disorders. But as the aromatic tincture or the aromatic syrup can readily be employed in doses appropriate to such cases, the need of the new officinal is not apparent. The *dose* may be stated at 2 or 3 fluidrachms (Gm. 8–12).

TINCTURA SABINÆ, *Br.*—TINCTURE OF SAVIN.

Teinture de sabine, Fr.; *Sadebaumtinktur*, G.

Preparation.—Take of Savin Tops, dried and coarsely powdered, 2½ oz. av.; Proof Spirit 1 pint. Prepare the tincture according to the formula given under TINCTURÆ. —*Br.*

Proof spirit appears to be hardly strong enough for dissolving the volatile oil and resin contained in savin. The tincture has a brown-green color.

Medical Uses.—Tincture of savin may be employed internally in all cases in which that mode of administering savin is appropriate. *Dose*, from 20 minims to a fluidrachm (Gm. 1.30–4).

TINCTURA SANGUINARIÆ, *U. S.*—TINCTURE OF BLOODROOT.

Teinture de sanguinaire, Fr.; *Blutwurzeltinktur*, G.

Preparation.—Sanguinaria, in No. 60 powder, 15 parts (4½ oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 2 parts (20 oz. av. or 23½ fluidounces) of alcohol to 1 part (10 oz. av. or 9⅝ fluidounces) of water. Moisten the powder with 10 parts (3 oz. av. or 3¼ fluidounces) of the mixture, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until 100 parts (30 oz. av. or about 32 fluidounces) of tincture are obtained.—*U. S.*

In alcoholic and in medicinal strength this tincture corresponds nearly with that of the preceding Pharmacopœia. It has a rich brownish-red color and the bitter and acrid taste of bloodroot.

Medical Uses.—This tincture contains all the virtues of bloodroot. It may be given in *doses* of from 30 to 60 minims (Gm. 2–4) as an "alterative" and expectorant, and as an emetic in doses of from 1 to 4 fluidrachms (Gm. 4–16).

TINCTURA SAPONIS VIRIDIS, *U. S.*—TINCTURE OF GREEN SOAP.

Spiritus saponis kalinus Hebra, Linimentum saponis viridis.—Teinture de savon vert, Fr.; *Hebra's Seifenspiritus*, G.

Preparation.—Green Soap 65 parts (16¼ oz. av.); Oil of Lavender 2 parts (½ oz. av. or 4⅜ fluidrachms); Alcohol a sufficient quantity; to make 100 parts (25 oz. av.). Mix the soap and oil of lavender with 33 parts (8¼ oz. av. or 9⅝ fluidounces) of alcohol, and macerate the mixture until the soap is dissolved; then filter through paper, adding alcohol, through the filter, until 100 parts (25 oz. av.) of tincture are obtained. —*U. S.*

This preparation was introduced by Prof. Hebra; its name should be changed to Linimentum.

Medical Uses.—This solution of green soap is more convenient than the soap itself, because its smell is not offensive and because it is free from the gritty particles often contained in the soap. It is used chiefly in the treatment of *psoriasis*, *lichen*, *eczema*, and *prurigo*.

TINCTURA SCILLÆ, *U. S., Br., P. G.*—Tincture of Squill.

Teinture de scille, Fr.; *Meerzwiebeltinktur*, G.

Preparation.—Squill, in No. 30 powder, 15 parts (4½ oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6¼ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it moderately in a conical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 30 fluidounces) of tincture are obtained.—*U. S.*

Squill 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Squill 1 part, alcohol (sp. gr. .912, *F. Cod.*) (sp. gr. .894, *P. G.*) 5 parts.

The tincture is of a light-yellow color and has the nauseous bitter taste of squill.

Allied Tincture.—Tinctura scillæ kalina. Macerate for a week squill 8 parts and caustic potassa 1 part in alcohol (sp. gr. 0.894) 50 parts; express, and filter. It has a brownish color.—*P. G.* 1872.

Medical Uses.—Tincture of squill is perhaps better adapted than squill in substance for the treatment of *dropsy*. It is generally associated with other medicines, as in the following efficient formula: ℞. Tincture of digitalis f℥ij–f℥iij; tincture of squill f℥ss; compound spirit of juniper f℥ij; sherry wine f℥x; acetate of potassium ℥j. M.—S. A tablespoonful, largely diluted, three times a day. Tincture of squill is said to have produced diuresis when applied to the skin with friction. The *dose* is from 10 to 20 minims (Gm. 0.60–1.30).

TINCTURA SENEGÆ, *Br.*—Tincture of Senega.

Teinture de polygala de Virginie, Fr.; *Senegatinktur*, G.

Preparation.—Take of Senega-Root, in coarse powder, 2½ oz. av.; Proof Spirit 1 pint (Imperial). Proceed according to the directions given under Tincturæ.—*Br.* Senega 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.*

The tincture has a yellowish-brown color and the acrid taste of senega.

Medical Uses.—This preparation is probably less efficient than the syrup of senega in affections of the air-passages, and than the fluid extract as a stimulant of the uterine functions. The alcohol it contains renders it peculiarly unsuitable in the former, and probably impairs its virtues in the latter case, while it tends to produce a local irritant action upon the stomach. Its *dose* is from 30 minims to 2 fluidrachms (Gm. 2–8).

TINCTURA SENNÆ, *Br.*—Tincture of Senna.

Elixir salutis.—Teinture de séné aromatique, Elixir de salut, Fr.; *Sennatinktur*, G.

Preparation.—Take of Senna, broken small, 2½ oz. av.; Raisins, freed from seeds, 2 ounces; Caraway-Fruit, bruised, Coriander-Fruit, bruised, each ½ ounce; Proof Spirit 1 pint. Prepare 1 pint (Imperial) of tincture according to the formula given under Tincturæ.—*Br.*

Senna 1 part, alcohol (sp. gr. .912) 5 parts.—*F. Cod.*

It is used in preparing Mistura sennæ comp., *Br.* The formulas of old pharmacopœias directed rhubarb or jalap in addition to the senna.

Medical Uses.—It is convenient as an addition to cathartic infusions, and particularly to the compound infusion of senna, or "black draught," or along with the tincture of rhubarb in cases that require a stimulating purge, especially in persons of a gouty habit. The *dose* is from 1 to 3 or 4 fluidrachms (Gm. 4–16).

TINCTURA SERPENTARIÆ, *U. S., Br.*—Tincture of Serpentaria.

Teinture de serpentaire, Fr.; *Schlangenwurzeltinktur*, G.

Preparation.—Serpentaria, in No. 40 powder, 10 parts (3 oz. av.); Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅜ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Serpentaria 2½ oz. av., proof spirit sufficient to make 1 pint (Imperial).—*Br.*

The tincture has a brownish-yellow color and the camphoraceous odor and taste of the drug.

Medical Uses.—In the low forms of febrile disease for which serpentaria is employed the tincture is the most appropriate form of administering it. It may be associated advantageously in such cases with the compound tincture of cinchona. *Dose*, 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA STRAMONII, *U. S., Br.*—TINCTURE OF STRAMONIUM.

Teinture de semences de stramoine, Fr.; *Stechapfelsamentinktur*, G.

Preparation.—Stramonium-Seed, in No. 40 powder, 10 parts (3 oz. av.): Diluted Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3⅛ fluidounces) of diluted alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 100 parts (30 oz. av. or about 31 fluidounces) of tincture are obtained.—*U. S.*

Stramonium-seeds 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.*

The tincture has a brownish-yellow color and becomes opalescent with water. The tincture of the first formula is about one-fifth weaker than that of the second formula, and about one-third weaker than that of the U. S. P. 1870. Teinture de stramoine (*F. Cod.*) is made from stramonium-leaves 1 part and alcohol (sp. gr. .912) 5 parts.

Medical Uses.—Although less frequently used than other preparations of stramonium, the tincture is probably one of the best, whether for internal administration or as a topical anodyne. It would seem appropriate for inhalation, when atomized, in cases of *spasmodic asthma*, and it has been used with marked advantage for the relief of *dysmenorrhœa.* It may also be given internally for the relief of *neuralgia*, and used locally for that affection and for *muscular rheumatism* in anodyne liniments. Even in subacute and chronic *articular rheumatism* it may be employed in the same way with advantage. The average *dose* of the tincture is 15 minims (Gm. 1).

TINCTURA SUMBUL, *Br.*—TINCTURE OF SUMBUL.

Teinture de sumbul, Fr.; *Sumbultinktur*, G.

Preparation.—Sumbul, in No. 30 powder, 10 parts (3 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 10 parts (3 oz. av. or 3½ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

Sumbul 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.*

Both these tinctures possess the peculiar musk-like odor in a marked degree. The menstruum of the Br. P. 1867 was too weak for exhausting the root; alcohol of about 70 or 75 per cent. appears to be well adapted for this purpose.

Medical Uses.—This tincture probably possesses all the virtues of sumbul. Its *dose* is from 10 to 30 minims (Gm. 0.60–2).

TINCTURA TOLUTANA, *U. S., Br.*—TINCTURE OF TOLU.

Teinture de baume de Tolu, Fr.; *Tolubalsamtinktur*, G.

Preparation.—Balsam of Tolu 10 parts (3 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Add the balsam of Tolu to 90 parts (27 oz. av. or 31⅝ fluidounces) of alcohol, and macerate until dissolved; then filter through paper, adding, through the filter, enough alcohol to make the tincture weigh 100 parts (30 oz. av. or about 33 fluidounces).—*U. S.*

Balsam of Tolu 2½ oz. av., rectified spirit sufficient to make 1 pint (Imperial).—*Br.* Balsam of Tolu 1 part, alcohol (sp. gr. .863) 5 parts.—*F. Cod.*

The tincture has a yellowish color, and becomes milky on the addition of water.

Off. Prep.—Trochisci acidi tannici, Troch. morphiæ, Troch. morphiæ et ipecacuanhæ, Troch. opii, *Br.*

Medical Uses.—This preparation is used for little else than to flavor cough mixtures; it is ineligible even for that purpose, since it is decomposed by water. Its flavor, however, remains after the removal of its resin, and in this manner the agreeable officinal syrup is formed. *Dose*, 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA VALERIANÆ, *U. S., Br., P. G.*—TINCTURE OF VALERIAN.

Teinture de valériane, Fr.; *Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder, 20 parts (6 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 2 parts (20 oz. av. or 23½ fluidounces) of alcohol to 1 part (10 oz. av. or 9⅝ fluidounces) of water. Moisten the powder with 15 parts (4½ oz. av. or 5 fluidounces) of the mixture, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 32 fluidounces) of tincture are obtained.—*U. S.*

Valerian 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Valerian 1 part, alcohol (sp. gr. .912, *F. Cod.*) (sp. gr. 894, *P. G.*) 5 parts.

The alcoholic and medicinal strength of the U. S. P has been altered, so that the tincture is practically identical with those of the French and German Pharmacopœias. The tincture is of a brown or reddish-brown color, varying somewhat with the variety of valerian employed, and has the odor and taste of the drug in a marked degree. On the addition of water it becomes opalescent and turbid.

Allied Tincture.—TINCTURA VALERIANÆ ÆTHEREA. Valerian 1 part, spirit of ether 5 parts. —*P. G.* Valerian 2 parts, ether (sp. gr. .724) 7 parts, alcohol 3 parts.—*F. Cod.* It is of a yellow or brownish-yellow color, and becomes opalescent and turbid on the addition of water.

Medical Uses.—The tincture is much less frequently employed than the other preparations of valerian, although in certain cases it is more efficacious—those, namely, in which a prompt and efficient operation is required. Such cases are the *typhoid state* with predominance of ataxic phenomena and *delirium tremens*. On the other hand, in purely nervous disorders, especially of an hysterical kind, it is far less eligible than the infusion, the oil, the ammoniated tincture, or even the fluid extract of valerian. The *dose* is 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA VALERIANÆ AMMONIATA, *U. S., Br.*—AMMONIATED TINCTURE OF VALERIAN.

Teinture de valériane ammoniacale, Fr.; *Ammoniakalische Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder, 20 parts (6 oz. av.); Aromatic Spirit of Ammonia a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the powder with 20 parts (6 oz. av. or 6½ fluidounces) of aromatic spirit of ammonia, and macerate for 24 hours in a closed vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour aromatic spirit of ammonia upon it until 100 parts (30 oz. av. or about 32 fluidounces) of tincture are obtained.—*U. S.*

Valerian 2½ oz. av., aromatic spirit of ammonia sufficient for 1 pint (Imperial).—*Br.*

The tincture is of a brown color, with the odor and taste of valerian and of ammonia.

Medical Uses.—This preparation may be employed in all the disorders in which the simple tincture is eligible, but it is perhaps best adapted to cases of a purely nervous description, in which its use need not be prolonged. It may be given in *doses* of from 30 to 60 or more minims (Gm. 2–4) in sweetened water or mucilage, but never in milk. A non-officinal preparation, the elixir of valerianate of ammonia, operates in the same manner, but much less energetically. Both are suited to cases of *nervous headache* and of general nervousness with *insomnia* produced by exhaustion of mind or body. *Dose* of the tincture, 1 or 2 fluidrachms (Gm. 4–8).

TINCTURA VANILLÆ, *U. S.*—TINCTURE OF VANILLA.

Teinture de vanille, Fr.; *Vanilletinktur*, G.

Preparation.—Vanilla, cut into small pieces and bruised, 10 parts (3 oz. av.); Sugar, in coarse powder, 20 parts (6 oz. av.); Alcohol, Water, each a sufficient quantity; to make 100 parts (30 oz. av.). Mix alcohol and water in the proportion of 2 parts (16 oz. av. or 18¾ fluidounces) of alcohol to 1 part (8 oz. av. or 7⅝ fluidounces) of water; macerate the vanilla in 50 parts (15 oz. av. or 16¼ fluidounces) of this mixture for 12 hours, then drain off the liquid and set it aside. Transfer the vanilla to a mortar, beat it with the sugar into a uniform powder, then pack it in a percolator, and pour upon it the reserved liquid; when this has disappeared from the surface gradually pour on menstruum, and continue the percolation until 100 parts (30 oz. av. or about 30 fluidounces) of tincture are obtained.—*U. S.*

Vanilla, cut, 1 part, alcohol (sp. grav. .863) 10 parts.—*F. Cod.*

The first formula agrees in the main with that for *essence* or *fluid extract of vanilla*, given in previous editions of this work; but the strength has been increased about 50 per cent., the commercial essence being usually made from 1 ounce of vanilla to 1 pint of tincture. Maceration of the cut vanilla with a portion of the menstruum previous to beating the former with sugar into powder we regard as an improvement of the manipulation heretofore recommended.

Tincture of vanilla is used only as a flavoring agent.

TINCTURA VERATRI VIRIDIS, *U. S., Br.*—Tincture of Veratrum Viride.

Tincture of green (American) hellebore, E.; *Teinture de vératre vert*, Fr.; *Grün-Nieswurztinktur*, G.

Preparation.—Veratrum Viride, in No. 60 powder, 50 parts (10 oz. av.); Alcohol a sufficient quantity; to make 100 parts (20 oz. av.). Moisten the powder with 15 parts (3 oz. av. or 3½ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (20 oz. av. or about 22 fluidounces) of tincture are obtained.—*U. S.*

Veratrum viride 4 oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.*

This tincture is now between 10 and 12 per cent. weaker than that of the U. S. P. 1870, but still about two and a half times the strength of that of the Br. P. It is of a deep red-brown color, has a bitter and acrid taste, and becomes opalescent and turbid on the addition of water. The present English title is to be preferred to the older one, as not likely to lead to confounding this preparation with the tincture of Helleborus viridis, which is employed in some parts of Europe.

Allied Tinctures.—Veratrum viride not being recognized by the French and German Pharmacopœias, these authorities have adopted a tincture from the closely-allied Veratrum album:

Tinctura veratri, *P. G.*—Teinture d'hellébore blanc (vératre blanc), *Fr.*—White veratrum 1 part, alcohol (sp. grav. .863) 5 parts.—*F. Cod.* White veratrum 1 part, alcohol (sp. grav. .894) 10 parts.—*P. G.*

Medical Uses.—The American is more than twice as strong as the British tincture, and may be given to adults in *doses* of 6 or 8 drops (Gm. 0.40–0.50) every three hours, and cautiously increased until nausea is felt or the pulse begins to fall. The dose of the British tincture is from "5 to 20 minims" (Gm. 0.30–1.30). It may be remarked here, as was implied in the account given of green American hellebore itself, that while some of our native physicians exalt this medicine to the rank of a panacea, others condemn its use altogether as scientifically illogical and practically dangerous. Among the latter we desire to be reckoned.

TINCTURA ZINGIBERIS, *U. S., Br., P. G.*—Tincture of Ginger.

Teinture de gingembre, Fr.; *Ingwertinktur*, G.

Preparation.—Ginger, in No. 40 powder, 20 parts (6 oz. av.); Alcohol a sufficient quantity; to make 100 parts (30 oz. av.). Moisten the ginger with 5 parts (1½ oz. av. or 1¾ fluidounces) of alcohol, and macerate for 24 hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 100 parts (30 oz. av. or about 34 fluidounces) of tincture are obtained.—*U. S.*

Ginger 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Ginger 1 part; alcohol (sp. gr. .863, *F. Cod.*) (sp. grav. 0.894, *P. G.*) 5 parts. The tincture is brownish-yellow or reddish, has the aromatic odor and hot taste of ginger, and is rendered milky by water. Diluted alcohol yields a turbid tincture.

Allied Tincture.—Tinctura zingiberis fortior, *Br.*—Strong tincture of ginger, *E.*—Take of ginger, in fine powder, 10 ounces, rectified spirit a sufficiency. Pack the ginger tightly in a percolator, and pour over it carefully ½ pint of the spirit. At the expiration of 2 hours add more spirit, and let it percolate slowly until 1 pint (Imperial) of tincture has been collected. —*Br.*

This has about one-half the strength of the fluid extract of ginger.

Off. Prep.—Pilulæ scammonii comp., Syrup. zingiberis, *Br.;* Trochisci zingiberis, *U. S.*

Medical Uses.—These tinctures suffice for nearly all the purposes to which ginger can be applied, either internally or externally, and especially to parts slightly affected with muscular *rheumatism*, and to the abdomen in cases of *nausea* or colic, and internally the weaker tincture may be given for flatulent *colic*, *dysmenorrhœa*, etc. The British strong tincture is twice as strong as the American tincture, but neither is as strong as the fluid extract. The latter tincture may be prescribed in *doses* of from 10 to 60 minims (Gm. 0.60–4), the former in the dose of from 5 to 30 minims (Gm. 0.30–2).

TORMENTILLA.—Tormentil.

Rhizoma tormentillæ, P. G.—*Tormentille*, Fr.; *Tormentillwurzel*, G.

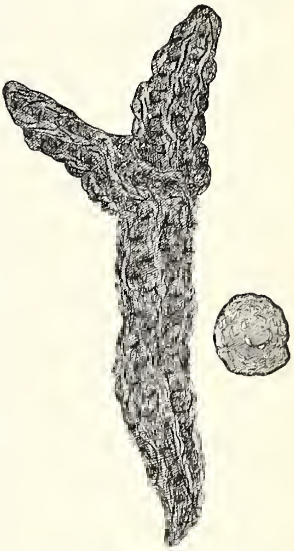
The rhizome of Potentilla Tormentilla, Schrank (P. sylvestris, *Necker*, P. erecta, *Karsten*, Tormentilla erecta, *Linné*, T. officinalis, *Curtis*). Bentley and Trimen, *Med. Plants*, 101.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The tormentil-plant grows in open woodlands and grassy places throughout Europe and Northern Asia, and flowers from May to August. It resembles our cinquefoil, but has numerous ascending or weak stems, with trifoliate and frequently opposite, sessile upper leaves, and long-peduncled yellow tetramerous flowers.

Description.—Tormentil attains a length of 3 inches (75 Mm.), but as usually seen is about 2 inches (5 Cm.) long, about ½ inch (12 Mm.) thick, irregularly cylindrical or obconical, occasionally branched, and has the surface covered with numerous roundish protuberances, and between these with depressions from which remnants of thin wiry rootlets project. The rhizome has externally a dark-grayish, red-brown color, is hard, breaks with a nearly smooth somewhat resinous fracture, is internally light or deeper brownish-red, and consists of a thin bark, of a large pith, and of one or two circles of small yellowish wood-wedges separated by broad medullary rays. In the fresh state tormentil has a faint rose-like odor, but after drying, by which process it diminishes nearly 70 per cent in weight, it is inodorous and has a strongly astringent taste.

Fig. 298.



Tormentilla: root and transverse section.

Constituents.—Meissner (1822) obtained from tormentil 17.5 per cent. of tannin, 18 per cent. of *tormentil-red*, soluble in alcohol and ether, not in water, and smaller quantities of wax, resin, mucilage, etc. Scheele has proved the presence of oxalate of calcium. Bowman (1869) estimated the amount of tannin with gelatin at between 24 and 30 per cent. Rembold (1867) corroborated the previous observations of Grischow and Baldman concerning the presence of a small quantity of *ellagic acid;* found the *tormentil-red* to be probably identical with the allied red compound of rhatany and horse-chestnut, since with potassium hydrate it yields protocatechuic acid and phloroglucin; established the presence of notable quanties of *kinovic acid*, $C_{24}H_{38}O_4$, and obtained the *tormentil-tannic acid* of the composition $C_{26}H_{22}O_{11}$. The tannin is precipitated by gelatin, gives with ferric chloride a blue-green reaction, and yields tormentil-red, but no sugar, on being boiled with dilute sulphuric acid.

Medical Action and Uses.—This drug is almost obsolete even in Europe, and is hardly known in this country. It is a pure and powerful astringent, which can be used, like tannic acid and the plants that contain it, for constringing relaxed tissues, diminishing *fluxes*, arresting passive *hæmorrhages*, etc. The *dose* of the powder is 5 grains (Gm. 0.30) or more. A decoction or infusion is prepared with from 1 to 4 drachms of it in half a pint (Gm. 4–16 in Gm. 250) of water, which may be taken in tablespoonful doses or applied topically.

TRAGACANTHA, *U. S., Br., P. G.*—TRAGACANTH.

Gummi tragacantha.—*Gomme adragante*, Fr.; *Traganth*, G.

The gummy exudation from Astragalus gummifer, *Labillardière*, and from other species of Astragalus. Bentley and Trimen, *Med. Plants*, 73.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus Astragalus comprises numerous herbaceous, suffruticose, and shrubby species, and is characterized by its flowers having ten stamens, nine of which are united into a bundle, and by having the lower suture of their legumes inflexed so as to make the fruit apparently two-celled. The subgenus Tragacantha has the stipules united with the permanent petioles, which become thorny. According to Boissier and Haussknecht, the principal species yielding tragacanth are Astragalus adscendens, *Bois. et Haussk.*, A. brachycalyx, *Fischer*, A. microcephalus, *Willdenow*, A. pycnocladus, *Bois. et Haussk.*, A. stromatodes, *Bunge*, A. kurdicus, *Bois.*, A. cylleneus, *Bois. et Heldreich* (probably a variety of A. Parnassi, *Boissier*); also, A. verus, *Olivier*, and A. creticus, *Lamarck*. All are low shrubs, indigenous to a portion of the territory lying between Eastern Persia and Greece.

The secretion of tragacanth is due to a transformation of the cell-walls, with their incrusting layers, of the pith and medullary rays contained in the stem and older branches, as was first observed by Hugo von Mohl (1857), whose observations were corroborated by Wigand (1861). The altered tissue is confined in the plant between the wood-wedges with considerable tension, and oozes out with some force on breaking a branch or making an incision.

Collection.—Tragacanth exudes spontaneously either from fissures or from punctures and longitudinal incisions made into the stem and older branches. From such incisions flake tragacanth is obtained, while the spontaneously exuding gum often forms irregularly globular or somewhat conical pieces. The rapidity with which the gum exudes chiefly determines the shape in which it ultimately hardens, and the time which elapses before it is sufficiently hard for collection influences the color of the product, which is white if congealed rapidly, and more or less yellowish and brown if hardened slowly. Tragacanth enters commerce from the ports of Asia Minor and from the Persian Gulf.

Properties.—Tragacanth consists of different layers, either laid upon one another and spirally twisted, or confluent into tear-like masses, or extended into curved, narrow, or broad bands, varying in width between ¼ inch and 1 inch (6 and 25 Mm.), and sometimes 4 or 5 inches (10–13 Cm.) long. These bands are rarely made up of a single layer, but usually are marked with several parallel ridges, indicating the various strata, which are united into broader and thicker laminæ. This form of tragacanth is known as *flake tragacanth* or *leaf gum*, and is the more valuable the whiter and more translucent it is. Smyrna tragacanth is mostly in rather broad and thick flakes, which are yellowish or of a brownish tint, and often prominently ridged. Thin, ribbon-like, and white flakes are produced in Kurdistan and Persia, but are sometimes distinguished in commerce as Syrian tragacanth. Another variety is *vermiform tragacanth*, also called *vermicelli*. It consists of very narrow, variously coiled, and contorted string-like pieces, the different coils of which are most frequently confluent. *Common tragacanth*, or *sorts*, in Europe known as *traganton*, is the product obtained by spontaneous exudation, forming subglobular, conical, or variously shaped tear-like pieces, with the surface rounded and more or less irregular, and usually of a brownish or brown color, and rather waxy in appearance; but it shows the stratification described above, and, like the white and thin bands, encloses starch.

Tragacanth is hard, tough, difficult to powder, inodorous, and tasteless, insoluble in alcohol and ether, and forms with 50 parts of water a thick, jelly-like mucilage. When diffused in a much larger quantity of water it forms a ropy liquid which may be passed through a filter, leaving behind an insoluble residue, which in contact with iodine acquires a blue color from the presence of starch. The mucilage acquires a yellow color on the addition of caustic soda, and the solution of tragacanth yields clear mixtures with borax, ferric chloride, and sodium silicate, is precipitated by alcohol, thickened by cold lead acetate and subacetate, and precipitated by these salts on heating (Flückiger).

Composition.—The soluble gum is not identical with arabin, though its solution is precipitated by alcohol and ammonium oxalate. The insoluble gum is known as *bassorin*, *traganthin*, *adraganthin*. It is soluble in hydrochloric acid and in ammonia, and is stated to have the composition $C_{12}H_{20}O_{10}$. According to Giraud (1876), tragacanth consists essentially of *pectose* or a closely-allied principle, which on being digested with water is gradually converted into a soluble compound, *pectin*, which is precipitated by alcohol. He regards it as very improbable that tragacanth should originate from a transformation of cellulose, since this body is ordinarily converted into dextrin and sugar, which compounds are not met with in tragacanth. According to this author, the average composition of tragacanth is 20 per cent. water, 60 per cent. pectin compound, 8 to 10 per cent. soluble gum, 3 per cent. cellulose, 2 or 3 per cent. starch, 3 per cent. of mineral constituents, and a trace of nitrogenous matter. By drying, tragacanth loses about 15 per cent. of moisture; the ash contains over half its weight of calcium carbonate.

Allied Gums.—CHERRY GUM. The different species of cherry and plum trees frequently yield gummy exudations which harden to irregular nodulous masses, are of a more or less brown color, translucent, and dissolve imperfectly in water. According to Guérin, the insoluble portion of this gum is not identical with bassorin.

BASSORA OF KUTERA GUM is a Persian product of unknown origin, and is met with in yellowish or brownish, semi-transparent, and tasteless masses, which swell considerably with water. It is used in Smyrna for adulterating the cheaper varieties of tragacanth, and is then usually broken into smaller pieces of about the same size as the tragacanth. Such broken pieces are angular, and are said to be sometimes artificially whitened with white lead. This fraud may be readily detected by treating the gum with cold dilute nitric acid, when the presence of lead in the solution may be established without difficulty.

CASHEW GUM, *Gomme acajou*, is an exudation of Anacardium occidentale (see page 201), is brown-yellow, translucent, somewhat iridescent, and partly soluble in water. (See also HOG GUM, page 10.)

Other Species of Astragalus.—A. BAETICUS, *Linné*. An herbaceous annual of the basin of the Mediterranean. Its brownish-yellow, angular, subcubical seeds have been used as a substitute for coffee; they were examined by Trommsdorff (1824).

A. EXSCAPUS, *Linné*. This perennial is indigenous to the mountainous parts of Southern and Central Europe. Its root is mucilaginous, somewhat astringent and bitter, and was formerly used as a diuretic. Examined by Fleurot (1833), no peculiar active principle was found.

A. GLYCYPHYLLOS, *Linné*. The leaves and seeds of this perennial, indigenous to Europe and Northern Asia, have an unpleasant sweet taste and are used as diuretics.

A. CROTALARIÆ, *Gray*. This is a Californian plant, known as *loco-weed* and *rattle-weed*, and is reported to be poisonous to horses and cattle.

A. MOLLISSIMUS, *Torrey*. It is indigenous to North America west of the Mississippi from Nebraska to Western Texas, and is said to be poisonous to horses; the leaflets are densely covered with a glossy, soft, white or yellowish pubescence.

Off. Prep.—Confectio opii, *Br.*; Mucilago tragacanthæ, *U. S.*, *Br.*; Pulv. opii comp., Pulv. tragacanthæ comp., *Br.*; Trochisci, *U. S.*

Medical Action and Uses.—Tragacanth is demulcent and nutritious. It was apparently unknown to the Greek physicians until the fourth or fifth century, and was then used to allay *cough* and *hoarseness* and promote *expectoration*, and, in a word, for all the affections in which gum-arabic has been employed. Its difficult solubility renders it less eligible than the latter gum in most instances. On the other hand, the greater tenaciousness of its mucilage fits it to be a better protective in some local affections, such as *burns*.

A. mollissimus has been studied by Dr. Isaac Ott, who summarizes its effects as follows: It lessens the irritability of the motor nerves and of the sensory ganglia of the central nervous system; has a spinal tetanic action; reduces the action of, and then arrests, the heart; salivates; ultimately it diminishes arterial tension, and dilates the pupil (*Phila. Med. Times* xii. 892).

TRILLIUM.—BETHROOT.

Birthroot, Wakerobin.—*Trillium*, Fr., G.

The rhizome of Trillium erectum, *Linné*.

Nat. Ord.—Liliaceæ.

Origin.—Bethroot is generally stated to be obtained from Trillium pendulum, which is now regarded as a white flowering variety of Tr. erectum, but the drug as met with in the market is evidently derived from different plants, and it is not unlikely that in different localities bethroot is collected from such species of Trillium as may be most abundant. All the species have a simple stem, mostly about a foot (30 Cm.) high, bearing at its apex a single hexandrous flower, and beneath it a whorl of three leaves, which are reticulate-palmately veined and usually broadly ovate or rhomboid in shape. The fruit is a triangular-ovate, three-celled, and many-seeded dark purple or red berry. The different species grow in moist thickets and shady woods in various parts of the United States and Canada. Two of the species have the dark-purple flower sessile between the leaves—namely, Tr. sessile, *Linné*, with erect petals and sessile leaves, and Tr. recurvatum, *Beck*, with recurved petals and stalked leaves. Two species have white flowers on erect peduncles and petiolate leaves—namely, Tr. nivale, *Riddell*, with the leaves and petals obtuse, and Tr. erythrocarpum, *Michaux*, with pointed leaves and petals, and the latter striped with purple near the base. Tr. cernuum, *Linné*, and Tr. stylosum, *Nuttall*, have white or rose-colored flowers on peduncles which are deflexed under the leaves, the last-named species being distinguished by the partly-united styles. Tr. erectum, *Linné*, bears a nodding and finally deflexed flower, with dark-purple spreading petals, or in the variety album (Tr. pendulum, *Muhlenberg*) with greenish-white or yellowish petals. The variety declinatum has a horizontal peduncle and white or pink-colored petals. Tr. grandiflorum, *Salisbury*, has a large white or rose-colored suberect flower.

Description.—Bethroot is a subglobular, oblong, or nearly obconical and oblique rhizome, which is truncate at the lower end and terminates above with a short tuft of sheathing leaf-bases. The rhizome is 1 or 1½ inches (25–38 Mm.) long, ½ to ¾ inch (12–18 Mm.) in diameter, slightly flattened, finely but distinctly annulate, and, particularly in the upper portion, beset with circular rows of straw-colored or pale-brownish rootlets or with the short remnants of the same. Bethroot is externally of a yellowish orange-brown color, internally whitish or more frequently yellowish or light-brown, and upon transverse section is seen to be composed of rather spongy parenchyma and of small scattered fibro-vascular bundles, which are circular, elongated, or irregularly curved, and more numerous toward the circumference than near the centre. It is inodorous or nearly so, and has a sweetish, astringent, afterward bitter and acrid taste.

Constituents.—On moistening a section of bethroot with solution of iodine the tissue assumes a uniform blue color, with the exception of the wood-bundles, proving the presence of starch in the parenchyma. From an investigation by Prof. E. S. Wayne (1856), it appears that on evaporating the tincture and diluting with water fatty and resinous matter, and perhaps a little volatile oil, are separated, and that from the aqueous liquid tannin and coloring matter are precipitated by acetate and subacetate of lead, while the acrid principle remains in solution. On removing the excess of lead by sulphuric acid and filtering, the acrid principle, or probably a decomposition-product of it, is deposited as a gelatinous mass, soluble in alcohol, but insoluble in water, and producing with it on agitation a permanent foam. The principle deserves further investigation.

Medical Action and Uses.—This is one of the plants used as a medicine by the American aborigines. Its acrid principle causes it to irritate the mouth and throat when chewed, and increase the flow of saliva. It is reputed to be astringent, tonic, and alterative, and to have a special action upon the uterine system, controlling *menorrhagia* and quickening the uterine contractions during *parturition* For the latter reason it received the name of "birthwort." In large doses the root is alleged to be emetic, and the bruised herb has been applied with supposed advantage to unhealthy *ulcers* and to *tumors*. Trillium erectum appears to be the most active species. The *dose* of its dried and powdered root is stated at 1 drachm (Gm. 4).

TRIMETHYLAMINA.—TRIMETHYLAMINE.

Triméthylamine, Fr.; *Trimethylamin*, G.
Formula $(CH_3)_3N$. Molecular weight 59.

Origin and Preparation.—This compound, frequently incorrectly called *propylamine*, with which it is isomeric, has been obtained from ergot (*secaline*), from the leaves of Beta vulgaris and Chenopodium Vulvaria, from the flowers of Arnica montana, Pyrus communis, Sorbus aucuparia, and Cratægus oxyacantha, and from cod-liver oil, bone oil, and guano. It is also produced on heating codeine with potassa, but may be economically obtained from herring-pickle, which contains this alkaloid in considerable quantity and owes to it its peculiar odor. A mixture of herring-pickle and lime is subjected to distillation, the alkaline distillate is neutralized with hydrochloric acid and evaporated, and the saline residue is treated with absolute alcohol, which leaves ammonium chloride undissolved. The alcoholic solution is evaporated, the residue redissolved in a little water, and again carefully distilled with lime. If the vapors are first passed through an empty bottle before they are condensed by means of ice or conducted into water, several less volatile alkaloids are separated in the bottle. Large quantities of trimethylamine are now obtained from the residues left in the preparation of sugar from beets.

Properties.—In its pure state trimethylamine is a colorless, thin, and strongly alkaline liquid having a strong ammoniacal odor modified by the peculiar odor of herring-pickle, and boiling at 9.8° C. (49.6° F.). At ordinary temperatures it is a colorless, inflammable gas. It is readily soluble in water and alcohol, and an aqueous solution of it has been sold as *propylamine.* The chloroplatinate of trimethylamine is soluble in alcohol and water, crystallizes in well-defined orange-colored octahedrons, and contains 37.21 per cent. of platinum. More characteristic, particularly in the presence of methylamine and allied bases, is the double salt with gold, which is very sparingly soluble in cold water and has the composition $N(CH_3)_3HCl.AuCl_3$ (Hesse, 1857, 1883).

HYDROCHLORATE OF TRIMETHYLAMINE is obtained on neutralizing the alkaloid with hydrochloric acid and evaporating. It crystallizes in white or colorless prisms, is nearly inodorous, has a saline pungent taste, is very deliquescent on exposure, and dissolves freely in water and alcohol.

Allied Compounds.—AMYLAMINA, $C_5H_{11}H_2N$, is a colorless liquid, having a penetrating ammoniacal odor, and the density 0.7503 at 18° C., and boiling at 95° C. (203° F.). The hydrochlorate crystallizes in octahedrons, is freely soluble in water and alcohol, and is insoluble in ether.

PROPYLAMINA, $C_3H_7H_2N$, is a colorless, strongly refracting, inflammable liquid of an ammoniacal odor, boiling at 50° C. (122° F.), and yielding with platinic chloride a double salt, which crystallizes in orange-yellow clinorhombic plates.

METHYLAMINA, $(CH_3)H_2N$, and DIMETHYLAMINA, $(CH_3)_2HN$, are colorless inflammable gases of an ammoniacal odor, very soluble in water, and condensing to colorless liquids, the former at − 18° C. (0.4° F.), the latter below 8° C. (46.4° F.).

NEURINA, CHOLINA, $C_5H_{15}NO_2$, is present in bile to a small extent, and is obtained by boiling bile with caustic baryta, and in a similar manner from brain, yelk of egg (see VITELLUS), and mustard-seed (*sinkaline,* see p. 1373); it has also been prepared synthetically. It is a colorless, syrupy, non-volatile liquid of a strongly alkaline reaction, very hygroscopic, combining readily with carbonic acid gas, and soluble in alcohol or water in all proportions; on heating it gives off trimethylamine, and on boiling its aqueous solution the same alkaloid is given off and ethylene-glycol produced. On treating its hydriodate with silver oxide, the anhydrous base, $C_5H_{13}NO$, is separated. By careful oxidation *betaine,* $C_5H_{11}NO_2$ (see p. 939), is produced. Neurine has been used in diphtheritis, and has also been called *amanitine* (see p. 716), which has the same composition, but on oxidation yields *muscarine.*

Physiological Action.—*On Animals:* When from 20 to 30 grains of trimethylamine were injected under a rabbit's skin in the course of an hour, there occurred trembling with convulsive succussion, agitation, increased excito-motor action, with hyperæsthesia and quickened cardiac and respiratory movements. These phenomena were fellowed by a period of depression or collapse and a degree of motor paresis, with death by asphyxia. In frogs the same phenomena essentially were produced, and the heart-beats fell from 64 or 68 at the commencement of the experiment to 34, 20, and 12, and finally were suspended. Doses of from 30 to 50 grains introduced into a dog's stomach excited immediate vomiting. Smaller and repeated doses occasioned anxiety, distress, immobility, general muscular tremor, accelerated action of the heart, distaste for food, and marked emaciation; bloody urine was voided at the end of six days, charged with biliary and coloring matters, and there were increased reflex excitability and hyperæsthesia. In the rabbits killed by this substance discoloration, gangrene, and emphysema were found at the point of hypodermic injection. The lungs were congested and spots of subpleural ecchymosis existed. The heart contained large black clots in both cavities. The kidneys were congested, and the bladder was filled with non-albuminous urine of an ammoniacal odor. Husemann, however, in his experiments on rabbits, observed neither bloody urine nor congestion of the lungs or kidneys (*Arch. f. exper. Pathol. u. Pharm.,* vi. 55). Other experimenters (Dujardin-Beaumetz) state that as much as 75 grains of muriate of trimethylamine may be administered subcutaneously to rabbits without occasioning toxical phenomena, and that when they perished their death seemed always to be due to the caustic action of the salt upon the tissues. This observer attributes the depression and collapse of the animals to the pain produced by this caustic action. But his judgment seems untenable. The mode of death in animals killed by this substance, given hypodermically or by the stomach, and especially the persistence of the heart's beats after the suspension of respiration, appear to prove that it does not act directly as a heart-poison, but indirectly, through the spinal marrow, first upon the respiratory muscles, and then upon the heart. In many experiments the excitability of the heart persisted for quite ten minutes after general death.

On Man: Applied to the sound skin, trimethylamine is negative in its action unless friction is employed, in which case it causes redness very much as ammonia does. Upon the mucous membrane it acts as a strong irritant, causing a lively sense of burning, with redness, and if allowed to continue its action it produces superficial ulceration. Its taste is ammoniacal and saline, and if taken in a large dose and undiluted it occasions a burning sensation in the throat, œsophagus, and stomach. Propylamine and muriate of trimethylamine agree in their effects; 30 or 40 grains of the former or 10 grains of the latter will reduce the pulse about ten beats in the minute, and under the influence of the muriate the temperature may fall 1° or 2° F. In febrile rheumatism the decline of the pulse-rate and temperature is more decided. But the medicine causes neither diaphoresis, diuresis, colic, nor diarrhœa.

Medical Uses.—The disease in connection with which trimethylamine was first brought into notice, and the only one in which its importance as a medicine was recognized, is *articular rheumatism*. It does not appear what motives first led to its use in the treatment of this affection by Awenarius of St. Petersburg, who between 1854 and 1856 treated by its means more than two hundred and fifty rheumatic patients, and affirmed that it dissipated the pain of the acute disease from one day to another. Isolated statements attributing to it a similar efficacy were made in France previous to 1864; but in 1870, Lagrange confirmed them, and in 1873, Dujardin-Beaumetz gave the history of seven cases of acute articular rheumatism which were cured in a very short time by trimethylamine. The improvement in general was rapid, and sometimes great relief was experienced within twelve hours, the pain first and then the swelling subsiding, as well as the fever. Further experience led him to conclude that of all the remedies hitherto used in the treatment of acute articular rheumatism, muriate of trimethylamine appeared to be the most efficient. A number of physicians in France have sustained this conclusion by their own experience; a few have published a similar judgment in England, and also in Germany. The less favorable accounts of some others are attributed to their having made use of ill-prepared and inert preparations of the medicine or of those which did not contain a due proportion of the active ingredient. As will be observed, this history of the virtues of trimethylamine in rheumatism has a striking analogy with that of salicylic acid and its salts in the same disease; the same mode of action is attributed to the two medicines, and the same extraordinary curative powers are ascribed to both. The newer remedy has, however, so entirely supplanted the older that hardly any trace of the latter can be found in medical literature since 1879.

Weiss has reported that this medicine is very efficient in the treatment of *chorea*, moderating the spasmodic movements greatly, even when it did not suspend them, when it was given to the extent of 15 or 20 grains (Gm. 1–1.30) a day.

The *dose* of trimethylamine is from 2 to 6 minims (Gm. 0.10–0.40) every three or four hours. Its extremely offensive taste and smell render necessary its administration in syrup flavored with mint, or anise, or some other aromatic water. To obviate this difficulty, the substitution of the chloride of trimethylamine, which has no smell and only a faint taste, has been proposed. Dr. J. L. Tyson has reported favorably of its use in doses of 2 grains every two hours (*Phila. Med. Times*, ix. 374). It is generally given in doses of 2 or 3 grains (Gm. 0.10–0.20), dissolved in a syrup and repeated at similar intervals, so that not less than 15 grains (Gm. 1) shall be taken during the day.

TRIOSTEUM.—Fever-Root.

Feverwort, *Horse-gentian*, *Bastard ipecac*, *Tinker's weed*, E.; *Racine de trioste*, Fr.; *Dreisteinwurzel*, G.

The root of Triosteum perfoliatum, *Linné*.

Nat. Ord.—Caprifoliaceæ.

Origin.—This perennial herb is indigenous to the United States, grows in woodlands, and flowers in June. The stem is from 2 to 4 feet (0.6–1.2 M.) high, soft-hairy, and has opposite spatulate-ovate and entire leaves, which are about 4 inches (10 Cm.) long, abruptly narrowed below and connate at the base. The flowers are in axillary clusters, and have a five-lobed brown-purple corolla, about ½ inch (12 Mm.) long. The ripe fruit is orange-colored, drupaceous, and contains three hard nutlets. All parts of the plant have a bitter taste, but only the rhizome and roots are employed. The more slender and rougher Tr. angustifolium, *Linné*, which grows chiefly in the Western and Southern United States, is said to have similar properties.

Description.—The rhizome is horizontal, from 6 to 12 inches (15–30 Cm.) long, knotty-cylindrical, about ¾ inch (18 Mm.) thick, somewhat branched, and on the upper side bears numerous cup-shaped scars of the over-ground stems about ¼ inch (6 Mm.)

in diameter. The numerous spreading rootlets are inserted mainly on the lower side of the rhizome, and are at their base $\frac{1}{4}$ to $\frac{3}{8}$ inch (6–9 Mm.) thick, and 5 to 10 inches (12–25 Cm.) long. Both the rhizome and roots are slightly wrinkled longitudinally, externally of a yellowish-brown color, internally white, and contain a hard, slightly bitter wood, with delicate medullary rays. The bark of the rhizome is thin, that of the roots rather thick, and has a bitter somewhat nauseous taste. Fresh fever-root has a slight disagreeable odor, which is dissipated on drying.

Constituents.—On moistening a transverse section of the roots with solution of iodine a deep-blue color is imparted to the medullary rays and the cambium-layer, but the bark acquires only a slight blue tinge. Fever-root has not been subjected to analysis; its bitter principle is dissolved both by water and alcohol.

Medical Uses.—A decoction of this plant is said to have been used by some of the American aborigines in the treatment of *fevers* and *female obstructions.* The fresh root, in the dose of from 20 to 30 grains (Gm. 1.30–2), and the extract in the dose of 10 or 15 grains (Gm. 0.60–1), purge actively after the manner of jalap. The bark of the root is said to be emetic.

TRITICUM, *U. S.*—TRITICUM.

Rhizoma graminis, P. G.; *Radix graminis.—Couch-grass, Quick-grass, Quickens, Quitch.* E.; *Chiendent officinal, Petit chiendent*, Fr.; *Queckenwurzel, Grasswurzel*, G.

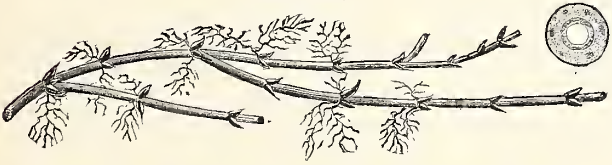
The rhizome of Triticum (Agropyrum, *Beauvais*) repens, *Linné*, collected in the spring and deprived of the rootlets.

Nat. Ord.—Graminaceæ.

Origin.—Couch-grass is a troublesome perennial weed growing along roadsides and in cultivated grounds throughout the northern hemisphere. The plant has a long, jointed, whitish rhizome, with a tuft of fibrous rootlets at each joint. The culm is about 2 or sometimes 4 feet (0.6–1.2 M.) high, and has compressed spikes 3 or 4 inches (7–10 Cm.) long, and four- to eight-flowered spikelets. The florets are variable, mostly awnless, and either pointed or rather obtuse.

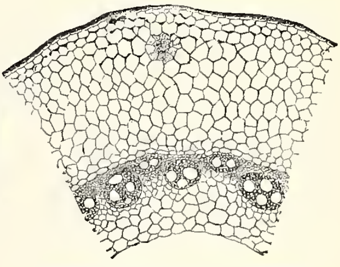
Description.—Couch-grass root is met with in the market cut into short sections, about $\frac{1}{5}$ to $\frac{2}{5}$ inch (5–10 Mm.) in length, about $\frac{1}{12}$ inch (2 Mm.) in diameter, of a straw-yellow color, smooth, hollow in the centre, inodorous, and of a sweet taste. The transverse section shows the central cavity surrounded by a narrow layer of delicate parenchyma, projecting somewhat into the equally narrow circle of fibro-vascular bundles, which is separated by the nucleus-sheath from the broad outer layer of parenchyma containing about six or eight isolated, distant fibro-vascular bundles in a loose circle.

FIG. 299.



Triticum repens: rhizome; transverse section, magnified 3 diam.

FIG. 300.



Section through portion of rhizome, magnified 65 diam.

Constituents.—The latest analysis of couch-grass root is by Ludwig and H. Müller (1872, 1873), who obtained from it malates, a nitrogenous principle which is readily darkened by heat, fruit-sugar (2.4 to 3.3 per cent.), levulose, and a right-rotating sugar which is not identical with cane-sugar. A peculiar gum-like principle, *triticin*, was isolated, which resembles inulin in its optical behavior, and, like this, may be converted into levulose. It is obtained by exhausting the rhizome with water, neutralizing with baryta, concentrating, precipitating with subacetate of lead, removing the excess of lead, treating with animal charcoal, neutralizing the filtrate, again concentrating, and precipitating by alcohol (Reidemeister 1880). Triticin is amorphous and transparent in thin layers or forms a white powder; it is inodorous, tasteless, very hygroscopic, in damp air deliquescent, insoluble in ether and absolute alcohol, and is oxidized by nitric acid to oxalic acid. Mannit, which was stated by Berzelius (1837) and Völker (1846) to be present in the rhizome, has not been obtained by later investigators; but the extract of couch-grass root may contain calcium lactate, and possibly also mannit, as products resulting from fermentation. Couch-grass root yields about 4.5 per cent. of ash, which is rich in silica.

Allied Drugs.—Sorghum-Fruit is $\frac{1}{8}$ or $\frac{1}{6}$ inch (3–4 Mm.) long, nearly as wide, broadly oval, somewhat flattened, brownish-yellow, and somewhat granular externally, or covered with the glossy dark-purple paleæ; internally white and mealy; inodorous and of a farinaceous and sweetish taste.

Off. Prep.—Extractum tritici fluidum, *U. S.*

Medical Action and Uses.—Couch-grass was employed by the ancients as a vulnerary and for the relief of dysury. They also believed that it removed stone, or at least *gravel*, from the bladder. In modern times it has been very generally regarded as emollient, antiphlogistic, and diuretic. Its infusion is a common medicinal drink in European hospitals and private life, and is regarded as adapted to relieve thirst, allay fever, and promote urination. It was formerly employed as a popular diet-drink to "purify the blood" in the spring season, and doubtless assisted in purging, through the kidneys, the accumulated organic detritus of a long winter. It was also thought to be very efficient in relieving congestions of the liver and portal circulation with *jaundice* arising under analogous circumstances, and in a less degree chronic *bronchitis*, *skin diseases*, *gout*, etc. It was even alleged to be capable of curing gastric cancer and removing biliary calculi. In truth, it possesses no special medicinal virtues beyond being, when given in infusion, an agreeable drink, which, owing to the sugar it contains, tends to increase the urinary secretion, and thereby palliate irritations of the *urinary passages*. It is best administered in a decoction prepared with from 2 to 4 ounces of the plant in 2 pints of water (Gm. 64–128 in Gm. 1000), and reduced one-half by boiling. The officinal fluid extract may be used for the same purposes if largely diluted.

Sorghum vulgare or broom-corn seeds are said to have been in common use as a remedy for disorders of the bladder by the plantation negroes of Maryland and Virginia. They made a decoction by boiling 2 ounces of the seed in a quart of water until reduced to a pint. It has been found useful as a palliative in several cases of *cystitis* by Dr. Garnett (*Amer. Jour. of Med. Sci.*, July, 1881, p. 165).

TRITURATIONES, *U. S.*—Triturations.

Triturations, Fr.; *Triturationen*, G.

This term has been used in homœopathic pharmacy in the same sense in which it has been adopted by the U. S. Pharmacopœia—namely, for powders, prepared by trituration, of a medicinal substance with a definite quantity of milk-sugar. In homœopathy this is done with the view of developing the medicinal power, and two proportions are used, termed the centesimal and the decimal scales; 1 part of the substance being triturated with 99 parts or with 9 parts of the milk-sugar, gradually added.

Preparation.—The directions for preparing these powders are very similar to those followed in homœopathic dispensing, except that the length of time for mixing and triturating has been omitted.

"Triturations are to be prepared by the following formula: Take of the substance 10 parts, sugar of milk, in moderately fine powder, 90 parts; to make 100 parts. Weigh the substance and sugar of milk separately; then place the substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal bulk of sugar of milk, mix well by means of a spatula, and triturate them thoroughly together. Add fresh portions of the sugar of milk from time to time until the whole is added, and continue the trituration until the substance is intimately mixed with the sugar of milk, and finely comminuted."—*U. S.*

Medical Uses.—The utility of this new title is open to very grave doubts on moral as well as therapeutical grounds. It encourages the prevalent habit, as erroneous scientifically as it is practically misleading, that the doses of medicines are fixed quantities. Sugar of milk is undoubtedly susceptible of minuter division by trituration than cane-sugar, but its use is a practical detail that may very well be left to the physician and the pharmaceutist, and modified according to circumstances.

TRITURATIO ELATERINI, *U. S.*—TRITURATION OF ELATERIN.

Trituration d'élatérine, Fr.; *Elaterintrituration*, G.

Preparation.—Elaterin 10 parts, Sugar of Milk 90 parts; to make 100 parts. Mix them thoroughly by trituration.—*U. S.*

Medical Uses.—The average *dose* of elaterin being $\frac{1}{16}$ grain (Gm. 0.004), and the proportion of the drug in the trituration being one-tenth, it follows that the dose of the latter should be about $\frac{5}{8}$ grain (Gm. 0.05).

TROCHISCI, *U. S., Br., P. G.*—TROCHES.

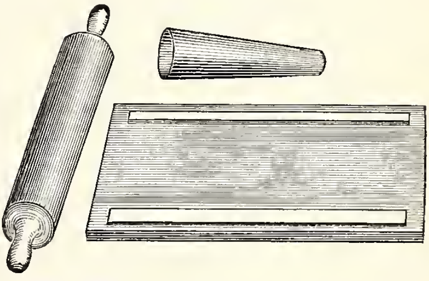
Tabellæ, F. Cod.—*Lozenges*, E.; *Tablettes*, *Pastilles*, F.; *Pastillen*, *Zeltchen*, G.

Troches are mixtures of medicinal substances with sugar or extract of liquorice, formed by the aid of mucilage into stiff, pasty masses, and divided into flat circular, oblong, rectangular, or stellate pieces, usually weighing about 10 or 20 grains. A cylindrical shape has been adopted for a few of the officinal lozenges. The French Codex makes a distinction between tablettes and pastilles, and applies the former term to the preparations just defined, and restricts the term *pastilles* to the sugar drops described below.

Preparation.—The dry ingredients are separately reduced to fine powders and thoroughly mixed in a mortar or by sifting. Volatile oils, tinctures, and similar liquids should now be intimately incorporated with the powder, and the whole beaten into a rather firm mass by the addition of mucilage of tragacanth or of acacia. The mass is then rolled out into sheets of suitable thickness and cut into the requisite number of pieces by a punch. A hard and smooth board or a polished marble slab, dusted over with finely-powdered sugar, is well adapted for this purpose; and in order to keep the mass at a somewhat elevated temperature while being rolled out the roller is sometimes made of iron or glass and hollow in the interior, so that it may be filled with water of any desired temperature. When lozenges are ordered on extemporaneous prescriptions, the mass is usually rolled out into a square, rectangular, or rhombic cake, and then divided by means of a ruler and knife into the requisite number of pieces, all having the same size and shape. After lozenges have been cut they are spread out on a sieve or other surface and exposed to a current of warm air until they are sufficiently dry.

The amount of powdered tragacanth necessary for imparting the requisite adhesiveness varies with the nature of the ingredients; 1 part of it is sufficient for 100 parts, and even more, of sugar and similar powders if, after the addition of water, the mass is well beaten. A much larger proportion of tragacanth renders the lozenges, after some time, very hard and slowly soluble. If mucilage of acacia is employed instead of tragacanth, the lozenges become somewhat translucent, and a similar effect is produced by employing the white of eggs as the adhesive material. Some manufacturers employ a machine with movable dies for cutting lozenges of any desired shape, and for stamping them at the same time with the name of the principal ingredient. A simple instrument for cutting lozenges with a tubular punch has been described by A. D. Marcy in *New Remedies*, 1882, p. 34. Lozenge-boards, adjustable for different sizes, are described by F. L. Slocum and F. E. Harrison in *Amer. Jour. Pharmacy*, 1879, p. 589, and 1880, p. 254.

FIG. 301.



Board, Roller, and Punch for making Lozenges.

If the lozenges are to be made of a cylindrical shape, the mass is rolled out into thin cylinders, in a manner similar to that of making pills, and then cut into shorter pieces having the requisite weight. The mass should be sufficiently firm not to flatten on drying, and the rolling-board, instead of being dusted with sugar, is greased with a little olive oil, to prevent the mass from adhering to it. (For a description and sketch of an apparatus by F. C. Hill, suitable for making such lozenges, see *Amer. Jour. Phar.*, 1874, p. 402.)

The general directions of the French Codex for the preparation of tablettes agree with the description given above. But for some years past *compressed tablettes* have been in use, prepared in a manner similar to that in which compressed pills are made (see p. 1166); and this form has been adopted by the German Pharmacopœia, which gives the following general directions: "For preparing *sugar pastilles*, the whole amount of the medicinal substance is intimately mixed with sufficient powdered sugar to make each lozenge weigh 1 Gm.; alcohol (sp. gr. .994) is now carefully added to produce a damp powder, which by compression will form a coherent mass; from this powder the requisite number of lozenges are made. For *chocolate pastilles* a mass is made by melting together, with the aid of a steam-bath, equal weights of cacao and sugar, and a sufficient weight of medicinal substance is added, so as to form lozenges weighing 1 Gm.; the somewhat cooled mass is then divided into the requisite number of lozenges."

The French Codex likewise directs the tablettes to weigh 1 Gm., and permits some kinds to be variously flavored, for which purpose to every 1000 Gm. of mass may be added 1 Gm. of volatile oil of anise, lemon, or peppermint or 10 Gm. of tincture of vanilla; and in case the flavor of rose or orange-flower be desired, the distilled aromatic water is used in the place of water for preparing the mucilage employed in rendering the mass plastic.

PASTILLI (ROTULÆ) SACCHARI.—Sugar lozenges, Sugar drops, *E.;* Pastilles, Orbicules, *Fr.;* Zuckerplätzchen, *G.*—This form of lozenges is usually made by the confectioner, and the medication merely is left to the pharmacist. The lozenges are prepared by mixing, in a pan having a suitable lip, some granulated sugar with a sufficient quantity of water to form a pasty mixture; this is heated carefully to prevent empyreuma, until it begins to boil. An additional quantity of sugar is then stirred in to give the requisite consistence; 100 parts of sugar require about 12 to 15 parts of water. The semi-liquid mass is now poured out upon cold, polished sheet iron in such a manner that each drop is kept separate, when, on touching the iron plate, it will congeal into a flattish hemispherical body. The peppermint drops of the French Codex are made in this manner, ½ per cent. of oil of peppermint being incorporated with the sugar and 12½ per cent. of water; this mixture is heated in small portions and dropped in the manner stated. *Chocolate drops* are made by a similar process. The term *trochisques*, formerly used in France for such lozenges, is now usually applied to the little cones obtained in drying elutriated powders (see p. 517).

ROTULÆ MENTHÆ PIPERITÆ, *P. G.*—Peppermint drops, *E.;* Pastilles de menthe à la goutte, *Fr.;* Pfefferminzkuchen, *G.*—Dissolve 1 part of oil of peppermint in 2 parts of alcohol; add the solution to 200 parts of sugar drops in a bottle, and well agitate, so as to impregnate them uniformly with the liquid; afterward expose to the air for a few minutes, and when the alcohol has evaporated keep in a stoppered bottle. By substituting other volatile oils for the oil of peppermint, lozenges of any desired flavor may be obtained.

Most of the lozenges of the British Pharmacopœia vary but slightly from 1 Gm. (15.43 grains) in weight, but the majority of the troches of the U. S. Pharmacopœia weigh between 10½ and 12¼ grains, or between .68 and .80 Gm., while troches of cubeb weigh 6⅔ grains (.44 Gm.), and troches of potassium chlorate 25 grains (1.63 Gm.).

In addition to the troches described below, the following have been admitted by the French Codex, of which we give the title and the weight of medicinal ingredient in each: Tablettes de baume de Tolu, .05 Gm.; T. de borate de soude, .10 Gm.; T. de calomel, .05 Gm.; T. de charbon, .50 Gm.; T. de gomme, .01 Gm.; T. de guimauve, .01 Gm.; T. de kermès, .01 Gm.; T. de lichen (made with one-third saccharure, p. 419); T. de manne, .20 Gm.; and T. de soufre, .10 Gm.

TROCHISCI ACIDI TANNICI, *U. S., Br.*—TROCHES OF TANNIC ACID.

Tablettes (Pastilles) de tannin, Fr.; *Tanninpastillen*, G.

Preparation.—Tannic Acid 100 grains (6.50 Gm.); Sugar, in fine powder, 1000 grains (65 Gm.); Tragacanth, in fine powder, 25 grains (1.60 Gm.); Orange-Flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

Tannic acid 360 grains; tincture of Tolu ½ fluidounce; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce; prepare 720 lozenges.—*Br.*

TROCHISCI ACIDI BENZOICI, *Br.*, are made like the preceding from 360 grains of benzoic acid, but omitting tincture of tolu.

Medical Uses.—Tannic acid troches are suitable in relaxed states of the mucous membrane of the mouth, throat, and larynx to allay *cough* produced by irritation of these parts. They may also be used in mild cases of *diarrhœa* after a preliminary evacuation of the bowels.

TROCHISCI AMMONII CHLORIDI, *U. S.*—TROCHES OF CHLORIDE OF AMMONIUM.

Tablettes (Pastilles) de sel ammoniac, Fr.; *Salmiakpastillen*, G.

Preparation.—Chloride of Ammonium, in fine powder, 200 grains (13 Gm.); Sugar, in fine powder, 1000 grains (65 Gm.); Tragacanth, in fine powder, 25 grains (1.60 Gm.); Syrup of Tolu a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with syrup of Tolu form a mass, to be divided into 100 troches.—*U. S.*

Medical Uses.—These lozenges may be used to palliate subacute and chronic inflammations of the *throat* and *air-passages*, but they are less efficient than the inhalations recommended elsewhere. Their objectionable taste would have been palliated and their curative action improved by substituting extract of liquorice for a portion of the sugar they contain.

TROCHISCI BISMUTHI, *Br.*—BISMUTH LOZENGES.

Tabellæ cum subnitrate bismuthico, F. Cod.—*Tablettes (Pastilles) de sous-nitrate de bismuth*, Fr.; *Wismuthpastillen*, G.

Preparation.—Take of Subnitrate of Bismuth 1440 grains; Carbonate of Magnesia 4 oz. av.; Precipitated Carbonate of Lime 6 ounces; Refined Sugar 29 ounces; Gum-Acacia, in powder, 1 ounce; Mucilage of Gum-Acacia 2 fluidounces; Rose-Water a sufficiency. Mix the dry ingredients, then add the mucilage, and form the whole into a proper mass with rose-water. Divide the mass into 720 lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains 2 grains of subnitrate of bismuth.—*Br.*

The corresponding lozenges of the French Codex contain 0.10 Gm. (1.5 grain) of the subnitrate, but no magnesia or calcium carbonate.

Medical Uses.—This form of administering bismuth is very unprofitable, since bismuth does not act except mechanically and by diffusion.

TROCHISCI CATECHU, *U. S., Br.*—TROCHES OF CATECHU.

Tabellæ cum catechu, F. Cod.—*Catechu lozenges*, E.; *Tablettes (Pastilles) de cachou*, Fr.; *Katechupastillen*, G.

Preparation.—Catechu, in fine powder, 100 grains (6.50 Gm.); Sugar, in fine powder, 1000 grains (65 Gm.); Tragacanth, in fine powder, 25 grains (1.60 Gm.); Orange-Flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

Pale catechu, in powder, 720 grains; refined sugar, in powder, 25 oz. av.; acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water a sufficiency; prepare 720 lozenges.—*Br.* Each lozenge contains 1 grain, *U. S.*, *Br.* (0.10 Gm. = 1.5 grain *F. Cod.*) of catechu.

Medical Uses.—These troches, each containing 1 grain of catechu, are serviceable in the cases mentioned under troches of tannic acid. They are generally employed to obviate the *hoarseness* or huskiness of the voice due to prolonged speaking or to slight *pharyngeal* or *laryngeal catarrh*.

TROCHISCI CRETÆ, *U. S.*—TROCHES OF CHALK.

Tablettes (Pastilles) de craie lavée, Fr.; *Kreidepastillen*, G.

Preparation.—Prepared Chalk 400 grains (26 Gm.); Acacia, in fine powder, 100 grains (6.50 Gm.); Nutmeg, in fine powder, 15 grains (1 Gm.); Sugar, in fine powder, 600 grains (39 Gm.); to make 100 troches. Rub them together until they are thoroughly mixed; then with water form a mass, to be divided into 100 troches.—*U. S.*

The nutmeg, freshly grated, should be rubbed into a uniform powder with a portion of the sugar. Each lozenge contains 4 grains (.26 Gm.) of prepared chalk.

Medical Uses.—Troches of chalk may be used to correct *acidity* of the stomach and a slight tendency to *diarrhœa.*

TROCHISCI CUBEBÆ, *U. S.*—TROCHES OF CUBEB.

Pastilles de cubèbe, Fr.; *Kubebenpastillen*, G.

Preparation.—Oleoresin of Cubeb 50 grains (3.25 Gm.); Oil of Sassafras 15 grains (1 Gm.); Extract of Glycyrrhiza, in fine powder, 400 grains (26 Gm.); Acacia, in fine powder, 200 grains (13 Gm.); Syrup of Tolu a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil and incorporate them with the mixture. Lastly, with syrup of Tolu form a mass, to be divided into 100 troches.—*U. S.*

This is a modification of the formula for *Spitta's lozenges*, from which it differs essentially in the substitution of oleoresin for powdered cubebs. The lozenges are usually made of a cylindrical shape, and each contains ½ grain of oleoresin of cubeb.

Medical Uses.—These troches are chiefly used in cases of subacute and chronic inflammation of the *pharynx* and *larynx*, especially when those parts are covered with viscid mucus.

TROCHISCI FERRI, *U. S.*—TROCHES OF IRON.

Trochisci ferri subcarbonatis, U. S. 1870; *Tablettes (Pastilles) de l'hydrate de fer*, Fr.; *Ferrihydrat-Pastillen*, G.

Preparation.—Hydrated Oxide of Iron, dried at a temperature not exceeding 80° C. (176° F.), 500 grains (32.50 Gm.); Vanilla, cut into slices, 10 grains (0.65 Gm.); Sugar, in fine powder, 1500 grains (97.50 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the vanilla first with a portion of the sugar to a uniform powder, and afterward with the oxide of iron and the remainder of the sugar, until they are thoroughly mixed. Then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

Each lozenge contains 5 grains of ferric hydrate. The French Codex recognizes three lozenges made with soluble salts of iron—namely, Tablettes de lactate de fer, T. de citrate de fer ammoniacal, and T. de tartrate de fer ammoniacal.—*F. Cod.* These are flavored with vanilla, and each lozenge contains .05 Gm. (¾ grain) of the salt.

Medical Uses.—Hydrated oxide of iron in troches is only a little less objectionable than the reduced iron troches of the British Pharmacopœia. Both deserve to be classed among pharmaceutical and medical superfluities. We may repeat concerning troches of iron what was said of troches of the subcarbonate of iron in a former edition of this work: they are convenient for administering to "refractory children, who may be tempted by their agreeable flavor to take them." Each troche contains 5 grains (Gm. 0.30) of hydrated oxide of iron.

TROCHISCI FERRI REDACTI, *Br.*—REDUCED IRON LOZENGES.

Tablettes (Pastilles) de fer, Tablettes chalybées, Fr.; *Eisenpastillen*, G.

Preparation.—Take of Reduced Iron 720 grains; Refined Sugar, in powder, 25 oz. av.; Gum-Acacia, in powder, 1 oz. av.; Mucilage of Gum-Acacia, 2 fluidounces; Distilled Water 1 fluidounce or a sufficiency. Mix the iron, sugar, and gum, and add the mucilage and water to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains 1 grain of reduced iron.—*Br.*

Medical Uses.—It is not easy to discern the merits of this preparation. Reduced iron can be serviceable only when it is acidulated by the gastric acids, and that action is better secured by administering it in powder.

TROCHISCI GLYCYRRHIZÆ ET OPII, *U. S.*—TROCHES OF GLYCYRRHIZA (LIQUORICE) AND OPIUM.

Trochisci opii, Br.—*Opium lozenges*, E.: *Pastilles d'opium, P. de réglisse opiacées*, Fr.; *Opiumpastillen*, G.

Preparation.—Extract of Glycyrrhiza, in fine powder, 200 grains (13 Gm.); Extract of Opium, in fine powder, 5 grains (0.32 Gm.); Acacia, in fine powder, 200 grains (13

Gm.); Sugar, in fine powder, 300 grains (19.50 Gm.); Oil of Anise 3 grains (0.20 Gm.); to make 100 troches. Rub the powders together until they are thoroughly mixed; then add the oil of anise, and incorporate it with the mixture. Lastly, with water form a mass, to be divided into 100 troches.—*U. S.*

Extract of opium 72 grains, tincture of Tolu $\frac{1}{2}$ fluidounce; refined sugar, in powder, 16 oz. av.; gum-acacia, in powder, 2 oz. av.; extract of liquorice 6 oz. av.; distilled water a sufficiency; prepare 720 lozenges.—*Br.*

The lozenge of the first formula (*U. S.*) contains $\frac{1}{20}$, and that of the second formula (*Br.*) $\frac{1}{10}$, grain of extract of opium. The lozenges of the United States Pharmacopœia are much used under the name of *Wistar's cough lozenges*, and are prepared of a cylindrical shape. Formerly, they were made with opium instead of the extract of opium, and some manufacturers substitute for opium an equivalent quantity of morphine. Lozenges of the same shape and composition, but with the omission of opium or morphine, have been introduced as *liquorice lozenges*, and are similar to the *Trochisci bechici nigri*, which are still used to some extent in Europe, and usually contain a small quantity of orris-root and balsam of Tolu.

Medical Uses.—This popular medicine is well adapted for use in *bronchitis* and *laryngitis* attended with harassing cough, but without marked febrile reaction. Its efficiency is greatly increased in the more acute forms of the affections mentioned by the addition of a minute proportion of tartar emetic, not exceeding the fortieth of a grain, or of half a grain of ipecacuanha, to each troche. On an average, one troche may be taken every three hours, but in general it is better to use the third of a troche every hour.

TROCHISCI IPECACUANHÆ, *U. S., Br.*—Troches of Ipecac.

Tabellæ cum ipecacuanha, F. Cod.—*Ipecacuanha lozenges*, E.; *Tablettes (Pastilles) d'ipécacuanha*, Fr.; *Brechwurzelpastillen*, G.

Preparation.—Ipecac., in fine powder, 25 grains (1.60 Gm.); Tragacanth, in fine powder, 25 grains (1.60 Gm.); Sugar, in fine powder, 1000 grains (65 Gm.); Syrup of Orange a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with syrup of orange form a mass, to be divided into 100 troches.—*U. S.*

Ipecacuanha, in powder, 180 grains; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce or a sufficiency; prepare 720 lozenges.—*Br.*

Each lozenge contains $\frac{1}{4}$ grain (.016 Gm.) *U. S.*, *Br.*, .01 Gm. ($\frac{1}{7}$ grain) *F. Cod.*, of ipecacuanha.

Medical Uses.—Ipecacuanha troches are useful in *laryngeal* and *bronchial inflammation* before secretion has been established. One troche, containing a quarter of a grain of ipecacuanha, may be taken every half hour until the dryness of the air-passages abates or the stomach begins to be nauseated. On the other hand, they are often very serviceable in *humid asthma*, or that asthmatic affection which is met with in cases of pulmonary emphysema complicated with obstructive disease of the heart, especially as they may conveniently be carried about by the patient and used in anticipation of a paroxysm.

TROCHISCI KRAMERIÆ, *U. S.*—Troches of Krameria.

Tablettes (Pastilles) de ratanhia, Fr.; *Ratanhapastillen*, G.

Preparation.—Extract of Krameria 100 grains (6.50 Gm.); Sugar, in fine powder, 1000 grains (65 Gm.); Tragacanth, in fine powder, 25 grains (1.60 Gm.); Orange-Flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

Medical Uses.—Krameria troches may be used for the same purposes as tannic acid or catechu troches—*i. e.* for constringing the mucous membrane of the mouth, fauces, larynx, and digestive canal.

TROCHISCI MAGNESIÆ, *U. S.*—Troches of Magnesia.

Tablettes (Pastilles) absorbantes, Fr.; *Magnesiapastillen*, G.

Preparation.—Magnesia 300 grains (19.50 Gm.); Nutmeg, in fine powder, 15 grains (1 Gm.); Sugar, in fine powder, 900 grains (58.50 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the magnesia and the powder together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

The freshly-grated nutmeg should be rubbed into a uniform powder with a portion of the sugar.

Tabellæ cum carbonate magnesico—Tablettes (Pastilles) de magnésie, *F. Cod.*—contain .20 Gm. (3 grains) of magnesium carbonate.

Medical Uses.—The proportion of magnesia in these troches is too small, and that of sugar too large, to render them efficient antacid medicines, which they are generally supposed to be. Each troche, weighing 12 grains, contains about 3 grains (Gm. 0.20) of magnesia.

TROCHISCI MENTHÆ PIPERITÆ, *U. S.*—Troches of Peppermint.

Tabellæ cum oleo volatile menthæ piperitæ, F. Cod.—*Tablettes de menthe, Pastilles de menthe anglaises*, Fr.; *Pfefferminzpastillen*, G.

Preparation.—Oil of Peppermint 15 grains (1 Gm.); Sugar, in fine powder, 1200 grains (78 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the oil of peppermint and the sugar together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

These lozenges, made according to the French Codex, contain 1 per cent. of the volatile oil. (See also Pastilli Sacchari and Rotulæ Menthæ Piperitæ, under the general heading Trochisci.)

Medical Uses.—Peppermint troches are employed to relieve *flatulence* and *colic* and to prevent *sea-sickness* and other forms of *nausea.* They are apt to excite gastric pain when too freely used.

TROCHISCI MORPHINÆ, *Br.*—Morphine Lozenges.

Pastilles de morphine, Fr.; *Morphinpastillen*, G.

Preparation.—Take of Hydrochlorate of Morphine 20 grains; Tincture of Tolu ½ fluidounce; Refined Sugar, in powder, 24 oz. av.; Gum-Acacia, in powder, 1 oz. av.; Mucilage of Gum-Acacia a sufficiency; Distilled Water ½ fluidounce. Dissolve the hydrochlorate of morphia in the water; add this solution to the tincture of Tolu, previously mixed with 2 ounces of the mucilage; then add the gum and sugar, previously mixed, and more mucilage if necessary to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat.—*Br.*

Medical Uses.—Each of these lozenges contains about $\frac{1}{36}$ grain (Gm. 0.0018) of hydrochlorate of morphine. They are chiefly used to allay *laryngeal* and *bronchial irritation.*

TROCHISCI MORPHINÆ ET IPECACUANHÆ, *U. S., Br.*—Troches of Morphine and Ipecac.

Morphia and ipecacuanha lozenges, E.; *Tablettes (Pastilles) de morphine et d'ipécacuanha*, Fr.; *Morphinpastillen mit Brechwurzel*, G.

Preparation.—Sulphate of Morphine 5 grains (0.32 Gm.); Ipecac, in fine powder, 16 grains (1 Gm.); Sugar, in fine powder, 2000 grains (130 Gm.); Oil of Gaultheria 2 grains (0.13 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 200 troches. Rub the powders together until they are thoroughly mixed; then add the oil of gaultheria, and incorporate it with the mixture. Lastly, with mucilage of tragacanth form a mass, to be divided into 200 troches.—*U. S.*

Hydrochlorate of morphia 20 grains; ipecacuanha, in fine powder, 60 grains; tincture of Tolu ½ fluidounce; refined sugar, in powder, 24 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia a sufficiency; distilled water ½ fluidounce; prepare 720 lozenges.—*Br.*

Medical Uses.—Each of these troches contains about $\frac{1}{40}$ grain of sulphate or hydrochlorate of morphine (Gm. 0.0016) and $\frac{1}{12}$ grain (Gm. 0.005) of ipecacuanha. They allay *cough* and promote expectoration.

TROCHISCI POTASSII CHLORATIS, *U. S., Br.*—TROCHES OF CHLORATE OF POTASSIUM.

Tabellæ cum chlorate potassico, F. Cod.—*Tablettes (Pastilles) de chlorate de potasse*, Fr.; *Kaliumchlorat-Pastillen*, G.

Preparation.—Chlorate of Potassium, in fine powder, 500 grains (32.50 Gm.); Sugar, in fine powder, 1900 grains (124 Gm.); Tragacanth, in fine powder, 100 grains (6.50 Gm.); Spirit of Lemon 10 grains (0.65 Gm.). Mix the sugar with the tragacanth and the spirit of lemon by trituration in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula mix with it the chlorate of potassium, being careful to avoid trituration and pressure, to prevent the mixture from igniting or exploding. Lastly, with water form a mass, to be divided into 100 troches.—*U. S.*

Take of chlorate of potash, in powder, 3600 grains; refined sugar, in powder, 25 ounces; gum-acacia, in powder, 1 ounce; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce or a sufficiency. Mix the powders, and add the mucilage and water to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat.—*Br.*

By both the above formulas lozenges are obtained containing 5 grains of potassium chlorate; those of the French Codex contain only 0.10 Gm. (1.5 grains) of the same salt.

Medical Uses.—Chlorate of potassium troches may be used in the treatment of *aphthæ* and other forms of *ulcer* of the mouth and throat, but they are much less efficient than solutions of the chlorate.

TROCHISCI SODII BICARBONATIS, *U. S., Br.*—TROCHES OF BICARBONATE OF SODIUM.

Tabellæ cum bicarbonate sodico, F. Cod.—*Bicarbonate of soda lozenges*, E.; *Tablettes (Pastilles) de bicarbonate de soude, P. de Vichy, P. digestives*, Fr.; *Natronpastillen*, G.

Preparation.—Bicarbonate of Sodium 300 grains (19.50 Gm.); Sugar, in fine powder, 900 grains (58.50 Gm.); Nutmeg, in fine powder, 15 grains (1 Gm.); Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the bicarbonate of sodium with the powders until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

Bicarbonate of soda 3600 grains; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce; prepare 720 lozenges.—*Br.*

The freshly-grated nutmeg should be rubbed with a portion of the sugar to a uniform powder, and afterward thoroughly mixed with the remaining powders. In France these lozenges are variously flavored, either with the volatile oil of anise, lemon, or peppermint, with the distilled water of orange-flowers or rose, or with tincture of vanilla. As directed by the different pharmacopœias, the lozenges contain 5 grains (.33 Gm.) *Br.*, 3 grains (.20 Gm.) *U. S.*, and 0.025 Gm. ($\frac{3}{8}$ grain) *F. Cod.*, of bicarbonate of sodium.

Medical Uses.—Troches of bicarbonate of sodium are convenient and useful in cases of habitual *acidity* of the stomach. The utility of the nutmeg they contain is not apparent.

TROCHISCI SODII SANTONINATIS, *U. S.*—TROCHES OF SANTONINATE OF SODIUM.

Tablettes (Pastilles) de santonate de soude, Fr.; *Santoninnatronpastillen*, G.

Preparation.—Santoninate of Sodium, in fine powder, 100 grains (6.50 Gm.); Sugar, in fine powder, 2000 grains (130 Gm.); Tragacanth, in fine powder, 50 grains (3.25 Gm.); Orange-Flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches. Troches of santoninate of sodium should be kept in dark, amber-colored vials.—*U. S.*

These troches have been introduced, on account of the greater solubility of the sodium compound, to take the place of santonin lozenges (see page 1339).

Medical Uses.—Each troche contains about 1 grain (Gm. 0.06) of santoninate of sodium. One may be given every three or four hours until three or four are taken or until the sight begins to be affected, when a purgative dose of castor oil should be administered. They are employed chiefly for the destruction of *lumbricoid worms* and rectal *ascarides*. It is almost certain that these troches will be found less efficient than the santonin troches they have displaced. Their very solubility must tend to prevent their reaching the intestinal parasites they are used to expel.

TROCHISCI ZINGIBERIS, *U. S.*—Troches of Ginger.

Tablettes (Pastilles) de gingembre, Fr.; *Ingwerpastillen*, G.

Preparation.—Tincture of Ginger 200 grains (13 Gm.); Tragacanth, in fine powder, 50 grains (3.25 Gm.); Sugar, in fine powder, 2000 grains (130 Gm.); Syrup of Ginger a sufficient quantity; to make 100 troches. Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder; to this add the tragacanth and mix thoroughly. Lastly, with syrup of ginger form a mass, to be divided into 100 troches.—*U. S.*

Medical Uses.—Troches of ginger are used to relieve flatulent *colic* and quicken laborious digestion.

TUSSILAGO.—Coltsfoot.

Folia farfaræ, s. tussilaginis, P. G.—*Tussilage, Pas d'âne*, Fr.; *Huflattig, Rosshuf*, G.

Tussilago Farfara, *Linné*.

Nat. Ord.—Compositæ, Eupatorieæ.

Origin and Description.—Coltsfoot is a perennial herb which is indigenous to Europe and Northern Asia, has been naturalized in the United States from New England to Pennsylvania, and grows in damp clayey soil and along ditches and brooks. All parts of the plant have been used, but the leaves and flower-heads have been generally employed, and the former have been admitted into the German, the latter into the French, Pharmacopœia. The *rhizome* is creeping, 12 to 18 inches (30–45 Cm.) long, branching, about ⅛ inch (3 Mm.) thick, with joints about 2 inches (5 Cm.) long, radiating on the nodes, and of a grayish-white or pale-brownish color. It is fragile when dry, has a thick whitish bark, yellowish porous wood-wedges, and a prominent pith, is inodorous, and has a mucilaginous, bitterish, and astringent taste. The *leaves* appear after the flowers, and are radical, long-petiolate, about 4 inches (10 Cm.) long and broad, roundish heart-shaped, angular-toothed, dark-green and smooth above, and white tomentose beneath. They are rather fleshy while fresh, and fragile after drying. The *flower-heads* are smaller than those of dandelion, make their appearance in early spring upon scaly scapes, and have a cylindrical involucre of lance-linear scales in a single row, numerous yellow narrowly-ligulate pistillate ray-florets in several rows, and about twenty tubular staminate disk-florets. The pappus is long, silky-hairy, and white. The dried flowers and leaves are inodorous and have a mucilaginous, bitterish, and somewhat astringent taste.

The rhizome of Asarum canadense is known in some parts of the United States as *coltsfoot-root*.

Constituents.—All parts of coltsfoot contain *mucilage*, a *bitter principle* which has not been isolated, and *tannin*, producing a dark-green precipitate with ferric salts.

Medical Action and Uses.—Coltsfoot was anciently renowned in pulmonary affections, and for their relief the smoke of its burning root was inhaled through a funnel; even in modern times it was smoked in pipes for the same purpose by the peasantry of Sweden and Germany. It is demulcent and tonic through its mucilaginous and bitter constituents, and has been compared in its action to Iceland moss. It has been widely used in the treatment of chronic *bronchitis* and for various *scrofulous* affections, both internally and locally. It may be administered in decoction or infusion made with an ounce of the dried leaves and flowers to a pint (Gm. 32 to Gm. 500) of water. The expressed juice is also employed.

ULMUS, *U. S.*—Elm (Slippery Elm).

Ulmi cortex, Cortex ulmi interior.—*Elm-bark*, E.; *Orme fauve, Orme champêtre*, Fr.; *Ulmenrinde, Rüsterrinde*, G.

The inner bark of Ulmus fulva, *Michaux* (*U. S., F. Cod.*), of Ulmus campestris, *Linné* (*F. Cod.*). Bentley and Trimen, *Med. Plants*, 232, 233.

Nat. Ord.—Urticaceæ, Ulmeæ.

Origin.—The elms are trees with alternate, oblique, and slightly heart-shaped, serrate, and straight-veined leaves, and with lateral clusters of small polygamous flowers, having a bell-shaped four- to nine-lobed perianth, the same number of stamens, and two nearly sessile styles. The fruit is a one-celled and one-seeded samara, surrounded with a membranous wing, which is notched or cleft at the apex. The American officinal elm, known as *slippery elm*, *red elm*, or *moose elm*, is a small or medium-sized tree, which is usually about 30, and occasionally 60, feet (9–18 M.) high, with a diameter of 1 or 2 feet (30–60 Cm.), and with a reddish wood. The leaves are 4 to 8 inches (10–20 Cm.) long, elliptic-oblong, pointed and very rough above; the flowers are reddish pubescent, precede the leaves, and have the perianth six- to nine-cleft; the samara is orbicular and not ciliate. The tree grows in woods and rich soil from Canada westward to Lake Superior and Nebraska, and southward to near the Gulf of Mexico, but is most abundant in the Western States. The *white elm*, Ulmus americana, *Linné*, is taller, 60 to 80 feet (18–24 M.) high, bears an oval, on the margin densely ciliate samara, and is a favorite shade tree in New England.

Ulmus alata, *Michaux*, the winged elm, grows in the Southern United States, where it is known as *wahoo* (see also p. 596). The wood is fine-grained and heavy, and the bark, which on the branches has prominent corky wings, is used for making ropes.

The European officinal elm is probably a native of Western Asia and Eastern Europe, but now is naturalized or cultivated throughout the greater portion of Asia, Europe, and Northern Africa. It has likewise been introduced in some parts of New England. Its leaves are only about 2½ inches (6 Cm.) long, oval or obovate, and acute or somewhat pointed; the flowers are mostly pentamerous, and the samara is roundish-obovate, smooth, and has the seed placed near the apical notch. The European *black elm*, Ulmus effusa, *Willdenow*, which has larger ovate or elliptical leaves and roundish-elliptic ciliate fruits, likewise furnishes some elm-bark.

Description.—SLIPPERY-ELM BARK is met with in commerce in flat pieces, consisting of the liber only, the corky layer being removed before drying, and usually several feet long and 4 or 6 inches (10–15 Cm.) broad. It is about ⅛ inch (3 Mm.) thick, is externally of a very light-cinnamon color or pale brownish-white, smooth, occasionally with small fragments of the corky layer adhering, and upon the inner surface grayish-white, finely ridged longitudinally, and usually more or less woolly from some detached bast-fibres. The bark breaks, or rather tears, readily in a longitudinal direction, the fragments adhering together with the wavy bast-fibres. It breaks with some difficulty in a transverse direction with a fibrous and mealy fracture, and when cut transversely the bast-fibres are seen arranged in tangential rows, imbedded in a loose parenchyma, and dissected by numerous fine medullary rays, giving to the transverse section a delicately checkered appearance. Slippery-elm bark has a slight but distinct odor, resembling that of fenugreek, and a mucilaginous, insipid taste. It is also met with as a coarse fibrous and as a somewhat fine and uniform powder, both having a light fawn-color.

EUROPEAN ELM BARK. It resembles the preceding, but is usually rather thinner, upon both surfaces of a cinnamon color, nearly inodorous, and of a mucilaginous, bitterish, and astringent taste.

Constituents.—Both barks contain a considerable amount of mucilage, which, as obtained from the European elm, according to Braconnot (1846), resembles the mucilage of flaxseed. The mucilage of slippery-elm bark is precipitated by acetate of lead, but alcohol separates from its solution a gelatinous liquid; starch is present in small grains. European elm bark contains a small quantity of a bitter principle which has not been isolated, and a little tannin, which is precipitated by gelatin and the salts of most metals, gives a dingy-green precipitate with ferric chloride, reduces gold and silver salts, is a glucoside, and on fusion with potassa yields pyrocatechin and acetic and butyric acids (Johansen, 1875). Starch is usually not present in the bast-layer of this bark.

Medical Action and Uses.—Slippery-elm bark is highly demulcent, and in some degree nutritious. It is grateful to the taste, and does not readily disorder the stomach. Like the inner bark of the European elm (U. Campestris), which is slightly astringent, it has been used with alleged advantage in chronic *cutaneous eruptions*, including some of syphilitic origin. It is also asserted to be a remedy for *tapeworm*. It is, however, chiefly employed in medicine to produce a mucilage which is officinal. The fibrous bark, disintegrated so as to form a mass of flexible spongy tissue, is, like sea-tangle, readily moulded into tents which are made use of to dilate the neck of the *uterus*, *fistulous openings*, etc., and which do not so readily become offensive as sponge tents. They have also been saturated with various medicinal extracts and used as vaginal and rectal suppositories. (Their preparation is described by Tuckerman, *Boston Med. and Surg. Jour.*, Jan. 1881, p. 46.)

UNGUENTA, *U. S., Br., F. Cod., P. G.*—OINTMENTS.

Pomata, F. Cod.—*Pommades*, *Onguents*, Fr.; *Salben*, G.

Preparation.—Ointments are unctuous preparations of such a consistence that they may be easily rubbed on the skin, and when in contact with it are gradually liquefied. They consist chiefly of benzoinated lard or lard, which is combined in some cases with a small quantity (about one-fifth) of wax, yellow wax being very properly preferred by the U. S. P. and P. G.; in some cases soft paraffin (petrolatum or paraffin ointment, see p. 1138) is used for the base. In the latter case the ointment is prepared by careful trituration; but if wax is a constituent this is first melted by a moderate heat, and the lard added in small quantities, or previously heated to about the same temperature; the ingredients being thoroughly liquefied, the vessel is removed from the fire, and its contents beaten with a spatula or transferred to a warm mortar, and then well stirred with the pestle to prevent the partial separation of the wax. The addition of aqueous liquids, which should not be too cold, is made in small quantities, and with continued stirring or beating, as soon as the ointment begins to assume an opaque appearance. In all cases the operation should be continued until the temperature of the ointment has been reduced to that of the surrounding atmosphere, and until the preparation is perfectly smooth and homogeneous. Solid substances may be incorporated in a similar manner, provided they have been previously reduced to an impalpable powder. But in most cases, and more particularly when the powder is heavy, much better and more uniform ointments are obtained by triturating the solid material until a powder is obtained, adding a small quantity of oil or of the ointment, and continuing the trituration until all signs of grittiness have disappeared; after which the remaining portion of the ointment may be gradually added and thoroughly incorporated. Salts and other substances which are soluble in water are often conveniently combined with the fatty base by dissolving them in a small quantity of hot water and incorporating this solution in a warm mortar, with the ointment gradually added. If extracts are to be added to ointments, they should be thoroughly softened in a warm mortar, by trituration with a little water, before the fat is added in small portions and with continued trituration. Alcoholic liquids, except when used in very small proportion, are less conveniently incorporated with ointments than concentrated aqueous solutions.

Most of the European pharmacopœias make no distinction between cerates and ointments, but designate both classes as *unguenta*. In France the term *onguent* is usually confined to an ointment into the composition of which resinous substances enter, while ointments with a purely fatty base are designated as *pommades*, and, if the base be a mixture of wax and fat, as cerats. In Europe olive or almond oil, melted together with some wax, is frequently employed as the base for ointments in preference to lard. (See also CERATA (p. 410), STEATINA (p. 411), GLYCERITUM AMYLI and GLYCELÆUM (p. 739).)

Preservation.—With few exceptions, ointments should be prepared extemporaneously when wanted for use. The fats should in all cases be free from incipient rancidity, and, if carefully prepared, the ointments may be kept for a limited time in well-closed vessels and in a cool place, at a temperature of about 15° C. (59° F.).

In addition to the formulas given farther on, the following are contained in *Br. P.* 1885:

UNGUENTUM ACIDI BORICI. Boric acid 1 oz.; soft paraffin 4 oz.; hard paraffin 2 oz.

UNGUENTUM ACIDI SALICYLICI. Salicylic acid 60 gr.; soft paraffin 1080 gr.; hard paraffin 540 gr.

UNGUENTUM EUCALYPTI. Oil of eucalyptus 1 oz.; soft paraffin 2 oz.; hard paraffin 2 oz.

UNGUENTUM GLYCERINI PLUMBI SUBACETATIS. Glycerin of subacetate of lead 3 oz.; soft paraffin 12 oz.; hard paraffin 4 oz.

UNGUENTUM STAPHISAGRIÆ. Stavesacre seeds 4 oz. Crush and macerate them for two hours in benzoated lard 8 oz., melted over a water-bath; strain and cool.

UNGUENTUM, *U. S.*—OINTMENT.

Unguentum simplex, Br.; *Unguentum adipis.—Simple ointment*, E.; *Pommade simple*, Fr.; *Wachssalbe*, G.

Preparation.—Lard 80 parts (8 oz. av.); Yellow Wax 20 parts (2 oz. av.); to make 100 parts (10 oz. av.). Melt the wax and add the lard gradually; then stir the mixture constantly while cooling.—*U. S.*

White wax 2 oz., benzoated lard 3 oz., almond oil 3 fluidounces. Melt the wax and lard in the oil on a water-bath; then remove the mixture, and stir constantly while it cools.—*Br.*

Off. Prep.—Ung. acidi carbolici, *U. S.;* Ung. antimonii tart., Ung. creasoti, Ung. elemi, Ung. hydrarg. ammon., Ung. hydrarg. iodidi rubri, *Br.;* Ung. hydrarg. oxidi flavi, Ung. hydrarg. oxidi rubri, *U. S.;* Ung. plumbi carb., Ung. plumbi iodidi, *Br.*

Medical Uses.—Simple ointment, as it was formerly and more appropriately called, is used as a protective for sores and excoriations and to facilitate the introduction of the hand or finger, surgical instruments, etc. into the urethra, vagina, rectum, etc.

UNGUENTUM ACIDI CARBOLICI, *U. S., Br.*—Ointment of Carbolic Acid.

Pommade phéniquée, Fr.; *Phenolsalbe,* G.

Preparation.—Carbolic Acid 10 parts (48 grains); Ointment 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Mix them thoroughly.—*U. S.*

Carbolic acid 60 gr.; soft paraffin 720 gr.; hard paraffin 360 gr. Melt and mix.—*Br.*

Medical Uses.—Carbolic acid ointment has been used in the treatment of *lupus* and other diseases of the skin, but carbolized oil is preferable as a dressing for wounds. It is probable that the proportion of carbolic acid in this ointment, 10 per cent., is excessive, since a 5 per cent. solution in oil has been found the safest as well as the most efficient surgical dressing.

UNGUENTUM ACIDI GALLICI, *U. S.*—Ointment of Gallic Acid.

Pommade d'acide gallique, Fr.; *Gallussäuresalbe,* G.

Preparation.—Gallic Acid 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the gallic acid with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.—*U. S.*

Medical Uses.—Gallic is superior to tannic acid for internal administration in many cases, but for topical use it is so much less efficient that its use in an officinal ointment appears to be superfluous.

UNGUENTUM ACIDI TANNICI, *U. S.*—Ointment of Tannic Acid.

Pommade de tannin, Fr.; *Tanninsalbe,* G.

Preparation.—Tannic Acid 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the tannic acid with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.—*U. S.*

Medical Uses.—No ointment made with a vegetable astringent is as powerful as a solution of the same substance in water, or even in glycerin. Tannic acid ointment is no exception to the rule. This preparation may, however, be applied on tampons to the vagina, and may be introduced into the rectum, in relaxed states of these parts.

UNGUENTUM ACONITINÆ, *Br.*—Ointment of Aconitine.

Pommade d'aconitine, Fr.; *Aconitinsalbe,* G.

Preparation.—Take of Aconitine 8 grains; Rectified Spirit ½ fluidrachm; Benzoated Lard 1 ounce. Dissolve the aconitine in the spirit, add the lard, and mix thoroughly.—*Br.*

Medical Uses.—This powerful local anæsthetic is chiefly of use in *neuralgia* of the superficial nerves, especially of the face and the back. It should be applied, by means of a soft thick brush or small pledget of lint, over the points of emergence and terminal distribution of the affected nerves. It should not be allowed to touch denuded cutaneous surfaces or mucous membranes.

UNGUENTUM ANTIMONII TARTARATI, *Br.*—Ointment of Tartarated Antimony.

Pomatum stibiatum, F. Cod.; *Unguentum tartari stibiati,* P. G.; *Unguentum antimonii, Ung. stibio-kali tartarici, Ung. stibiatum.*—*Antimonial ointment,* E.; *Pommade stibiée, P. d'Autenrieth,* Fr.; *Brechweinsteinsalbe, Pockensalbe,* G.

Preparation.—Take of Tartarated Antimony, in very fine powder, ¼ oz.; Simple Ointment 1 oz.; mix thoroughly.—*Br.*

Tartar emetic 1 part, benzoinated lard 3 parts.—*F. Cod.* Tartar emetic 1 part, paraffin ointment 4 parts.—*P. G.*

Medical Uses.—Antimonial ointment is occasionally employed to produce its characteristic pustular eruption in cases requiring vigorous counter-irritation, but the painful ulcers and the sloughs it sometimes occasions, and the permanent scars that it often leaves behind, have caused it to be generally abandoned, and there is no reason for a revival of its use.

UNGUENTUM AQUÆ ROSÆ, *U. S.*—OINTMENT OF ROSE-WATER.

Unguentum leniens, P. G.—*Cold cream*, E., Fr., G.

Preparation.—Expressed Oil of Almond 50 parts (5 oz. av.); Spermaceti 10 parts (1 oz. av.); White Wax 10 parts (1 oz. av.); Rose-Water 30 parts (3 oz. or 2⅞ fluidounces). Melt together, by means of a water-bath, the oil, spermaceti, and wax; then gradually add the rose-water, stirring the mixture briskly and constantly until it is cool, and continue the stirring until it has become uniformly soft and creamy.—*U. S.*

Other pharmacopœias direct: Almond oil 215, spermaceti 60, white wax 30, rose-water 60, tincture of benzoin 15 Gm., oil of rose 10 drops.—*F. Cod.* Almond oil 32, spermaceti 5, white wax 4, rose-water 16 parts, oil of rose 1 drop to 50 Gm.—*P. G.*

The successful preparation of this ointment depends mainly on the pains taken in incorporating the materials while cooling; to facilitate the process E. C. Marshall (1875) recommended the use of an ordinary egg-beater. The ointment should be very white, soft, and perfectly homogeneous. If well made it will retain these properties for some time, but gradually it becomes rancid.

Allied Ointments.—CERATUM GALENI, Cérat de Galien, *F. Cod.* White wax 1 part, expressed oil of almond 4 parts, distilled rose-water 3 parts. It is prepared in the same manner as cold cream.

CERATUM FLAVUM, Cérat jaune, *F. Cod.* Yellow wax 10 Gm., almond oil 35 Gm., water 25 Gm.

CERATUM LAUDANISATUM, Cérat laudanisé, *F. Cod.* Sydenham's laudanum 10 Gm., Galen's cerate 90 Gm.

Medical Uses.—Cold cream, as it is commonly called, is an agreeable and efficient protective in cases of *abrasions*, *ulcers*, *frost-bite*, and other superficial lesions of the skin. The addition to it of a small proportion of glycerin, and also of benzoic acid, tends both to preserve the ointment longer and to render it more efficient. As thus modified it is one of the best means of protecting the hands and lips from being chapped.

UNGUENTUM ATROPINÆ, *Br.*—OINTMENT OF ATROPINE.

Pommade d'atropine, Fr.; *Atropinsalbe*, G.

Preparation.—Take of Atropine 8 grains; Rectified Spirit ½ fluidrachm; Benzoated Lard 1 ounce. Dissolve the atropine in the spirit, add the lard, and mix thoroughly.—*Br.*

Medical Uses.—This preparation is, in most cases, preferable to belladonna ointment, on account of its superior cleanliness and the smaller quantity of it that is efficacious. It is chiefly used in superficial *neuralgia*, to relieve other *local pains*, and, applied to the perineum, to allay *urethral* and *rectal* irritation and spasm.

UNGUENTUM BELLADONNÆ, *U. S.*, *Br.*—OINTMENT OF BELLADONNA.

Pomatum cum extracto belladonnæ, F. Cod.; *Pommade belladonée*, Fr.: *Tollkirschensalbe*, G.

Preparation.—Alcoholic Extract of Belladonna 10 parts (50 grains); Diluted Alcohol 6 parts (30 grains or 34 minims); Benzoinated Lard 84 parts (420 grains); to make 100 parts (500 grains). Rub the extract with the diluted alcohol until uniformly soft, then gradually add the lard, and mix thoroughly.—*U. S.*

Other pharmacopœias direct—Alcoholic extract of belladonna 80 grains, benzoated lard 1 oz. av.—*Br.* Extract of belladonna 4 Gm., water 2 Gm., lard 24 Gm.—*F. Cod.*

Allied Ointment.—POMATUM POPULEUM, Pommade de bourgeon de peuplier, Onguent populeum, *F. Cod.* Digest the fresh leaves of belladonna, hyoscyamus, black nightshade, and poppy, of each 5 parts, in lard 40 parts; when the moisture has completely evaporated add poplar-buds 8 parts; digest for a day, express, and strain.

Medical Uses.—Belladonna ointment was originally used in all the cases of *local* *pain*, *spasm*, etc. to which atropia ointment is now applied, and where cleanliness is not imperative it answers nearly as well. It is better suited than the ointment of the alkaloid for application to absorbing surfaces, as the urethra, vagina, rectum, and ulcerated parts.

UNGUENTUM CADMII IODIDI, *Br.*—OINTMENT OF IODIDE OF CADMIUM.

Pommade d'iodure de cadmium, Fr.; *Jodkadmiumsalbe*, G.

Preparation.—Take of Iodide of Cadmium, in fine powder, 62 grains; Simple Ointment 1 ounce. Mix thoroughly.—*Br.*, 1867.

Medical Uses.—This ointment is reputed to be stimulating and resolvent. It has been applied to enlarged *glands* in the same manner as iodide of lead ointment. It has the advantage over the latter preparation of not staining the skin.

UNGUENTUM CANTHARIDIS, *Br.*—OINTMENT OF CANTHARIDES.

Unguentum cantharidum, P. G.; *Pomatum cum cantharide*, F. Cod.; *Ung. irritans*, *Ung. ad fonticulos.*—*Pommade épispastique*, Fr.; *Spanischfliegensalbe*, G.

Preparation.—Take of Cantharides, Yellow Wax, of each 1 ounce; Olive Oil 6 fluidounces. Infuse the cantharides in the oil in a covered vessel for 12 hours; then place the vessel in boiling water for 15 minutes, strain through muslin with strong pressure, add the product to the wax, previously melted, and stir constantly while the mixture cools.—*Br.*

Coarsely-powdered cantharides 2 parts, olive oil 8 parts; digest, express, filter, and to 7 parts of the filtrate add 3 parts of yellow wax.—*P. G.*

The ointment was dismissed from the U. S. P. 1880. Cantharidin being readily soluble in fats, the ointment prepared by digesting cantharides in olive oil has the active principle more uniformly diffused than by incorporating powdered cantharides with ointment. Cerate of extract of cantharides is well adapted for preparing this ointment extemporaneously; it has a greenish-yellow color.

Allied Ointment.—UNGUENTUM ACRE. Melt together yellow wax 15 parts, resin 30 parts, turpentine 60 parts, and lard 250 parts; add powdered cantharides 50 parts, and powdered euphorbium 10 parts; mix, and stir until cool.—*P. G.* 1870.

The French Codex recognizes a yellow and a green cantharides ointment, of which the former is prepared by infusing cantharides 1 part in melted lard 14 parts, adding a little turmeric, filtering, melting together with yellow wax 2 parts, and adding a little oil of lemon. The green ointment is a mixture of powdered cantharides 1 part, poplar ointment (see UNG. BELLADONNÆ) 28 parts, and wax 4 parts.

Medical Uses.—Ointment of cantharides is intended to be used as a dressing for recently blistered surfaces, in order to prolong the discharge from them, and also to act as a rubefacient upon the sound skin when blistering is not desirable. In this manner it may sometimes be applied in *muscular rheumatism*, in partial *paralysis*, and in *alopecia*. But in all these cases various stimulant liniments are more suitable. In many cases also for which this ointment is appropriate the plaster of Burgundy pitch with cantharides is much more efficient.

UNGUENTUM CETACEI, *Br.*—OINTMENT OF SPERMACETI.

Onguent de blanc de baleine, Fr.; *Walratsalbe*, G.

Preparation.—Melt together Spermaceti 5 oz., White Wax 2 oz., and Almond Oil 1 pint (Imper.); add Benzoin in coarse powder ½ oz., and, frequently stirring the mixture, continue the application of heat for 2 hours; strain the mixture and stir constantly until quite cold.—*Br.*

Except in consistence it resembles spermaceti cerate (p. 412).

Medical Uses.—This ointment, when freshly made, is an appropriate dressing for *wounds*, *excoriations*, and *blisters*.

UNGUENTUM CHRYSAROBINI, *U. S.*, *Br.*—CHRYSAROBIN OINTMENT.

Pommade de chrysarobine, Fr.; *Chrysarobinsalbe*, G.

Preparation.—Chrysarobin 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Mix thoroughly by trituration.—*U. S.*

Melt benzoated lard 480 grains, add chrysarobin 20 grains, and stir them together, maintaining a moderate temperature, so as to promote solution; then stir until cold.—*Br.*

This ointment has been admitted as a more uniform preparation than the *araroba ointment* originally proposed by Da Silva Lima. Balmano Squire (1877) recommended the solution of chrysarobin in lard to be effected by heating in a water-bath with benzol, and the latter to be evaporated by stirring the liquid in a warm dish while cooling and congealing. The ointment is of a yellow color, and should be entirely free from grittiness.

Medical Uses.—The various applications of this ointment are described under CHRYSAROBIN.

UNGUENTUM CREASOTI, *Br.*—OINTMENT OF CREASOTE.

Pommade créosotée, Fr.; *Kreosotsalbe*, G.

Preparation.—Take of Creasote 1 fluidrachm; Simple Ointment 1 ounce. Mix thoroughly.—*Br.*

Medical Uses.—Creasote ointment is a protective, and, like creasote-water, a wholesome stimulant in numerous cases, including *burns*, *chilblains*, *ulcers* of various descriptions, and especially those which have flabby, fungous granulations, an ichorous secretion, a tendency to gangrene, or a connection with carious bone. Even for *cancerous* ulcers it forms an eligible dressing, especially after they have been washed with creasote-water. Indeed, the applications of the latter, enumerated elsewhere, are, *mutatis mutandis*, those of creasote ointment.

UNGUENTUM DIACHYLON, *U. S., P. G.*—DIACHYLON OINTMENT.

Unguentum plumbi Hebræ.—Hebra's lead ointment, E.; *Onguent diachylon*, Fr.; *Diachylonsalbe*, G.

Preparation.—Lead Plaster 60 parts (300 grains); Olive Oil 39 parts (195 grains); Oil of Lavender 1 part (5 grains or 6 minims); to make 100 parts (500 grains). Melt together the lead plaster and olive oil at a moderate heat; then, having permitted the mass to become partly cool, incorporate with it the oil of lavender, and stir constantly until cold.—*U. S.*

Lead plaster 5 parts; free it from glycerin by washing, and from water by heating on a water-bath; melt it at a moderate heat with olive oil 5 parts; stir until cold, and after several hours stir again.—*P. G.*

The first formula is that of the Swiss Pharmacopœia. The second formula is an improvement upon that of the P. G. 1872, in replacing the linseed oil formerly used by olive oil, and in freeing the ointment completely from water and hygroscopic glycerin for the purpose of decreasing its liability to rancidity. If properly prepared, the ointment is nearly white and will keep unaltered for several weeks.

Medical Uses.—Speaking of the treatment of *eczema*, Hebra said of this ointment, "I have called it *Ung. diachyli*, and prescribed it either alone or in combination with balsam of Peru. It is either applied by means of the finger or rubbed in with balls of charpie from one to three times a day; or, if it be desirable to increase its effect, it may be spread on linen or flannel and applied like a plaster" (*Diseases of the Skin*, Sydenham Soc. ed., ii. 151). The eminent dermatologist recommends this ointment in *fetid sweating* of the feet (*Ibid.*, i. 89) and as a part of the treatment of *sycosis menti* (*Ibid.*, ii. 317).

UNGUENTUM ELEMI, *Br.*—OINTMENT OF ELEMI.

Unguentum (*Balsamum*) *Arcæi*, F. Cod.—*Onguent* (*Baume*) *d'Arcæus*, Fr.; *Elemisalbe*, G.

Preparation.—Take of Elemi ¼ ounce; Simple Ointment 1 ounce. Melt, strain through flannel, and stir constantly until the ointment solidifies.—*Br.*

Elemi and Venice turpentine, each 15 parts, suet 20 parts, lard 10 parts; melt, strain, and stir until cold.—*F. Cod.*

Medical Uses.—Ointment of elemi is a mild local stimulant, and as such may be used as a dressing for slightly indolent *ulcers* and for maintaining the suppuration of issues and setons. Formerly an ointment known as *Balsamum Arcæi*, and containing elemi and larch turpentine in equal proportions, was used for the same purpose, and, except in trifling cases, probably with more effect.

UNGUENTUM GALLÆ, *U. S., Br.*—OINTMENT OF NUTGALL.

Pommade de noix de galle, Fr.; *Galläpfelsalbe*, G.

Preparation.—Nutgall, in No. 80 powder, 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the nutgall with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Galls, in fine powder, 80 grains; benzoated lard 1 oz. av. Mix thoroughly.—*Br.*

Medical Uses.—Ointment of nutgall, like that of tannic acid, its active component, is appropriately applied to relaxed tissues, but especially to those of the *vagina* and *rectum*, to prevent or diminish *prolapsus* of these parts. In the latter case, when *piles* exist, an ointment composed of equal parts of the ointments of nutgall and stramonium and Goulard's cerate is a very efficient remedy.

UNGUENTUM GALLÆ CUM OPIO, *Br.*—OINTMENT OF GALLS AND OPIUM.

Preparation.—Take of Ointment of Galls 1 ounce; Opium, in powder, 32 grains. Mix thoroughly.—*Br.*

Medical Uses.—This preparation is intended to fulfil the same indications as those of the compound ointment mentioned under UNGUENTUM GALLÆ, but it is far less efficient as applied to the anus, and, owing to the large proportion of opium it contains, not without danger if introduced into the vagina or the rectum.

UNGUENTUM HYDRARGYRI, *U. S., Br.*—MERCURIAL OINTMENT.

Unguentum hydrargyri cinereum, P. G.; *Pomatum cum hydrargyro*, F. Cod.; *Unguentum mercuriale s. neapolitanicum.—Ointment of mercury*, *Blue ointment*, E.; *Pommade (Onguent) mercurielle à parties égales*, *P. napolitaine*, Fr.; *Graue Quecksilbersalbe*, G.

Preparation.—Mercury 450 parts (9 oz. av.); Lard 225 parts (4½ oz. av.); Suet 225 parts (4½ oz. av.); Compound Tincture of Benzoin 40 parts (350 grains or 6½ fluiddrachms); Mercurial Ointment 100 parts (2 oz. av.); to make 1000 parts (18 oz. av.). Mix the mercury with the tincture of benzoin in a mortar, add the mercurial ointment (which should contain 50 per cent. of mercury), and triturate the mixture until globules of mercury cease to be visible; then add the lard and suet, previously melted together and partially cooled, and continue the trituration until globules of mercury cease to be visible under a magnifying power of ten diameters.—*U. S.*

Mercury, prepared lard, each 1 pound; prepared suet 1 ounce; rub them together until metallic globules cease to be visible.—*Br.*

Mercury and benzoinated lard equal parts. Melt the lard, pour about one-third of it into an iron vessel, and keep it at a temperature so as to remain sufficiently soft; add the mercury very gradually, triturate until extinct, add the remainder of the lard, and continue the trituration until a perfect mixture is obtained.—*F. Cod.*

The German Pharmacopœia has a similar process, but uses lard and mutton-suet in the proportion of 13 : 7, and incorporates with this mixture 10 parts of mercury. This ointment contains one-third its weight of mercury, globules of which should not be visible to the naked eye.

With the exception of the French Codex, the pharmacopœias have very properly discarded *weak mercurial ointment*, leaving the physician to order the dilution of the strong ointment as he may think necessary.

The extinguishment of the mercury, if the directions of the last three formulas are literally followed, requires such a long time that few pharmacists will undertake the trouble of preparing the ointment. It may be hastened by the addition of a little sulphur or soft turpentine, yet to both there are serious objections—to the former, on account of forming an inert black sulphide; to the latter, on account of its irritating properties. The substitution of wax, spermaceti, stearin, cacao butter, and of similar solid fats and allied compounds for part of the lard answers the purpose but partially, and is more effectual with small than with larger quantities. The same is true if the mercury, finely divided by pressing it with a moderate force through chamois leather, is sprinkled on the semi-solid fat and incorporated without delay. On triturating mercury with a small quantity of liquid storax or with a mixture of liquid storax and lard, it is rapidly extinguished to such an extent that the metallic globules are not visible under a power of two or three diameters. Tincture of Tolu triturated with the mercury in the presence of a portion of the lard has a similar effect. But even such ointments have been objected to as being too irritating. Trituration with lard and oil of turpentine has also been recommended, but the latter does not evaporate as readily as has been supposed, and imparts to the ointment for a long time a turpentine odor. Higginbottom (1813) observed that the extinguishment of mercury is facilitated by means of mercurial ointment, usually through the incipient or more advanced rancidity of the fat contained in the ointment; and a similar result may be obtained by using about 5 or 10 per cent. of rancid fat in place of an equal amount of lard; but Buchner (1834) and others have shown that the mercurial ointment used for this purpose need not, and should not, be rancid. The formula of the U. S. P., which was proposed by Prof. Remington, makes use of both the ready-made ointment and of storax, the latter contained in the tincture ordered, for rapidly extinguishing the mercury; during the trituration the alcohol gradually evaporates, and the small amount of balsamic matter remaining behind tends to preserve the ointment from becoming rancid.

The objection to many of these additions has been their irritating properties. This cannot be urged against the use of ether, as proposed by Renoult. On mixing lard with about one-tenth of ether, and triturating this with mercury, the metal will be readily extinguished, and the ointment may be finished by incorporating the softened suet. Glycerin, glycerite of starch, and diastase have also been suggested for facilitating the extinguishment of the mercury. Chevallier (1826) proposed agitation of mercury with one-half of the liquefied fat in a strong bottle, and subsequently adding the remaining fat by trituration; in this manner, he stated, 1 pound of the ointment could be prepared in 30 minutes. Others were not as successful; according to Hæfner (1829), the extinguishment of mercury by succussion by means of the machinery of a saw-mill required 4 days, but the manual labor required did not exceed 1 hour. An apparatus for preparing the ointment in a similar manner has been constructed by Dr. Squibb (*Proc. Amer. Phar. Assoc.*, 1859, p. 359).

A clean iron mortar is well adapted for the preparation of this ointment on a limited scale, though a small portion of the mercury will superficially combine with the iron. A Wedgewood or marble mortar does not occasion even this slight loss.

The extinguishment of the mercury is most readily observed by the use of a lens of moderate power, or by rubbing a small portion of the ointment between folded paper, when no metallic globules should become visible to the naked eye. Rhigini observed that on triturating a little of the ointment in a marble mortar with a wooden pestle until the ointment has been absorbed, the pestle will have a bright metallic surface in case the mercury had not been completely extinguished.

On keeping mercurial ointment at a temperature at which it becomes soft without liquefying, it will slowly alter in composition in such a manner that the lower strata contain a larger proportion of mercury than the upper ones. Hence it is necessary in warm weather to employ fat or a mixture of fats having a higher fusing-point than lard, such as is directed by the U. S. Pharmacopœia.

When made with fresh and sweet fats the ointment contains the mercury in a minutely divided condition. As rancidity commences and increases, a portion of the mercury will be found in chemical combination, and this amount is increased at an elevated temperature. It follows from this that mercurial ointment should be kept in a cool place and in a well-closed jar, and that it may be still further protected by covering the surface of the ointment with paper which has been saturated with tincture of Tolu or tincture of storax.

Off. Prep.—Linim. hydrargyri, Suppos. hydrargyri, Ung. hydrarg. comp., *Br.*

Medical Uses.—By means of this ointment, duly rubbed upon the skin, the constitutional effects of mercury can be secured without as much risk of disordering the digestion of the patient as when mercury in any of its forms is given by the mouth. This was at one time the chief method of treating constitutional and even primary *syphilis*, and, in spite of its being "dirty, laborious, and troublesome," it is better than any other form of mercurial treatment, since "it cures the disease better, and does not damage the constitution half so much" (Brodie). The inunctions should be made upon different parts of the body successively, as the thighs, the flanks, the arms, the chest, and usually before a fire or in the direct sunlight. 1 or 2 drachms should be rubbed in daily; the patient should be clothed in flannel, sleep between blankets, and every two or three days cleanse the skin with a bath of warm water and soap. If he is able he should make the friction with his own hands; and if he cannot do this, the hands of the attendant making them should be protected by a caoutchouc glove or by a pig's bladder previously softened with warm water. In other cases, and especially when mercurial ointment is employed to supplement the internal use of mercurials, it may be spread upon a cloth and applied to a recently blistered surface. In cases of infantile syphilis a flannel roller smeared with the ointment may be secured around the body of the patient.

All chronic superficial *swellings* resulting from inflammation have their absorption hastened by frictions made with mercurial ointment. This treatment is peculiarly appropriate in *glandular* and other swellings arising from syphilitic infection, but it is sometimes also used to promote the resolution of chronic engorgement of the *liver* or *spleen. Paronychia* may be prevented from suppurating by frictions with mercurial ointment made every hour for five minutes at a time, while in the interval the part is kept enveloped in a poultice. In subacute and chronic inflammation of the joints much benefit has been derived from wrapping them, previously blistered or not, in cloths spread with mercurial ointment, and keeping them at rest by means of appropriate splints. A like advantage sometimes accrues in chronic or subacute *orchitis* from covering the affected organ in a similar manner. But the simple ointment is less efficacious than that of the iodide of mercury. There can be no doubt that mercury, applied in one form or another to an eruption of *small-pox* upon the face during its papular stage sometimes prevents the papules from maturating and leaving scars. The ointment may be spread, alone or rendered more tenacious by the admixture of starch, upon linen, with suitable apertures for the nostrils and mouth, and closely applied to the face like a mask. It has been used after the same manner in the treatment of *erysipelas* of the face, but, on the whole, without advantage, and frequently with the effect of causing salivation. It is also a palliative of *prurigo pudendi*, but in this case it is open to the same objection. Unna recommends for common *warts* and *condylomata acuminata* the continuous application of mercurial ointment containing 5 per cent. of arsenic. This dressing is said not to irritate the part, but to cause the warts to wither (*Boston Med. and Surg. Jour.*, Oct. 1882, p. 321).

UNGUENTUM HYDRARGYRI AMMONIATI, *U. S., Br.*—OINTMENT OF AMMONIATED MERCURY.

Unguentum hydrargyri præcipitati album, P. G.—*Pommade de mercure précipité blanc*, Fr.; *Weisse Quecksilbersalbe*, G.

Preparation.—Ammoniated Mercury, in very fine powder, 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the ammoniated mercury with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Ammoniated mercury 50 grains; simple ointment 450 grains.—*Br.* Ammoniated mercury 1 part; paraffin ointment 9 parts.—*P. G.*

Medical Uses.—Ammoniated mercurial ointment is used as a stimulant in cases of chronic *blepharitis* and in several cutaneous affections, especially in *psoriasis* of limited extent and in those of parasitic origin, including *ringworm* of the scalp (porrigo scutulata). In *herpes circinatus*, *sycosis*, and *pityriasis* it is also employed. In *herpes zoster* it has been reported, on insufficient grounds, to be useful. It is more efficacious in chronic forms of circumscribed *eczema* and of tubercular and squamous *syphilis*. Like other mercurial ointments, it is a destroyer of *lice*. It has over the others the advantage of cleanliness, and it may be perfumed with some agreeable essential oil, such as lavender or bergamot.

UNGUENTUM HYDRARGYRI COMPOSITUM, *Br.*—COMPOUND OINTMENT OF MERCURY.

Pommade mercurielle composée, Fr.; *Kampfer-Quecksilbersalbe*, G.

Preparation.—Take of Ointment of Mercury 6 ounces; Yellow Wax, Olive Oil, each 3 ounces; Camphor 1½ ounces. Melt the wax with a gentle heat, and add the oil; then, when the mixture is nearly cold. add the camphor in powder and the ointment of mercury, and mix the whole thoroughly together.—*Br.*

The ointment has a greenish tint, and is softened by the camphor.

Medical Uses.—It is impossible to discover any sufficient reason for the existence of this preparation, which probably has the virtues, and no others, of simple mercurial ointment.

UNGUENTUM HYDRARGYRI IODIDI RUBRI, *Br.*—Ointment of Red Iodide of Mercury.

Pommade d'iodure mercurique, Fr.; *Jodquecksilbersalbe*, G.

Preparation.—Take of Red Iodide of Mercury, in fine powder, 16 grains; Simple Ointment 1 ounce. Mix thoroughly.—*Br.*

Medical Uses.—This ointment is chiefly used as a stimulant of indolent *scrofulous* and *syphilitic ulcers* and scrofulous *glandular swellings*. In India *goitre* has been cured in many thousands of cases by rubbing into the tumor an ointment made with 60 grains of red iodide of mercury to a pound of lard, and then exposing the patient for several hours to the direct action of the sun. The operation is repeated twice a day for several days, the applied ointment being allowed to remain (Macnamara, *Dublin Quart. Jour.*, Nov. 1857, p. 500). A very similar method has been employed with remarkable success in the treatment of enlargement of the *liver* and *spleen*, the heat of a fire being substituted for that of the sun.

UNGUENTUM HYDRARGYRI NITRATIS, *U. S.*, *Br.*—Ointment of Nitrate of Mercury.

Pomatum citrinum, F. Cod.; *Unguentum hydrargyri citrinum*, *Unguentum citrinum*.—*Citrine ointment*, E.; *Pommade citrine*, *Onguent citrin*, Fr.; *Quecksilbernitratsalbe*, G.

Preparation.—Mercury 7 parts (1½ oz. av.); Nitric Acid 17 parts (3⅝ oz. av.); Lard Oil 76 parts (16¼ oz. av.). Heat the lard oil in a glass or porcelain vessel to a temperature of 70° C. (158° F.); then add, without stirring, 7 parts (1½ oz. av.) of nitric acid; continue the heat so long as a moderate effervescence continues, and allow the mixture to cool. Dissolve the mercury in the remainder of the nitric acid with the aid of sufficient heat to prevent the solution from crystallizing; add this solution to the mixture before it has become entirely cold, and mix them thoroughly, avoiding the use of an iron spatula.—*U. S.*

Take of mercury, by weight, 4 ounces; nitric acid 12 fluidounces; prepared lard 15 ounces; olive oil 32 fluidounces. Dissolve the mercury in the nitric acid with the aid of a gentle heat; melt the lard in the oil, by a steam- or water-bath, in a porcelain vessel capable of holding six times the quantity, and, while the mixture is at about 100° C., add the solution of mercury, also at about the same temperature, mixing them thoroughly. If the mixture do not froth up, increase the heat till it occurs. Keep it stirred until it is cold.—*Br.*

On mixing melted fats with a solution of mercuric nitrate containing free nitric acid a very complicated reaction takes place, resulting, on the one hand, in the oxidation of the fat and the evolution of nitric oxide (nitrogen dioxide) and hyponitric acid (nitrogen tetroxide), and, on the other hand, in the conversion by the latter of the olein contained in the fat into solid elaidin. The products of oxidation of the fat contain various volatile fatty acids, but must necessarily vary with the nature of the fat, the amount of free nitric acid, and the degree of the heat. Should the nitric acid be insufficient in quantity or the temperature rise to too high a degree, the oxidation is effected in part at the expense of the mercuric nitrate, which is thereby reduced to mercurous salt. The second formula given above orders a much larger quantity of nitric acid than is necessary, and indicates about 100° C. as the temperature at which the fat should be mixed with the mercuric solution. According to the temperature at which the nitric acid acts upon the mercury, the solution will contain mercurous or mercuric nitrate, or both salts, with or without hyponitric acid. If free from mercurous nitrate, the solution will yield with lard at 200° F. a citrine ointment having, at least at first, a bright-yellow color. In our experience an equally good and permanent ointment is obtained by heating both the mercuric solution and the fat to about 70° C. (158° F.) before mixing them; and even a lower degree of heat, about 50° C. (122° F.), will produce good results if the reaction is completed before the ointment is permitted to cool. All difficulties are, however, overcome by following the process suggested by R. Rother (1870), and which has been adopted by the U. S. P., using lard oil in the place of the neats' foot oil and lard formerly employed. Unsalted butter and many other fats, the drying oils excepted, similarly treated, will yield an equally handsome ointment. The French Codex directs 1 part of mercury and 2 parts of nitric acid to 20 parts of fat composed of equal weights of lard and olive oil; this salve is firm, and is sold in the form of square cakes.

Citrine ointment should be prepared in glass or porcelain vessels, and should not be brought into contact with iron or other metal.

Allied Ointment.—Unguentum nitricum, Ung. oxygenatum, *P. G.* 1872. Melt 50 parts of lard, add 3 parts of nitric acid spec. grav. 1.185, and heat slowly and with constant stirring until the reaction ceases; then pour into paper moulds (see page 411). It is of a light-yellow color.

Unguentum Hydrargyri nitratis dilutum, *Br.* Mix nitrate of mercury ointment 1 ounce with soft paraffin 2 ounces.

Medical Uses.—Citrine ointment is employed in nearly all of the cases mentioned under the head of white precipitate ointment, but especially in chronic diseases of the *skin*, and in the affections enumerated under ointment of red oxide of mercury. It is more stimulating than the former preparation, and generally needs dilution with lard. It is very apt to occasion salivation.

UNGUENTUM HYDRARGYRI OXIDI FLAVI, *U. S.*—Ointment of Yellow Oxide of Mercury.

Pommade d'oxyde jaune de mercure, Fr.; *Gelbe Quecksilberoxydsalbe*, G.

Preparation.—Yellow Oxide of Mercury, in very fine powder, 10 parts (48 grains); Ointment 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the oxide of mercury with the ointment, gradually added, until they are thoroughly mixed.—*U. S.*

Yellow oxide of mercury 1 part, petrolatum 15 parts.—*F. Cod.*

The yellow wax contained in the simple ointment will protect this preparation from rancidity, but it is best to keep the ointment on hand for a short time only or to prepare it when needed.

Medical Uses.—This preparation was introduced as a substitute for ointment of the red oxide of mercury, with which it is identical in its medicinal qualities; but owing to the amorphous condition and the greater fineness of subdivision of the particles of the oxide from which it is made, it appears to be more suitable for application to the *eye* and other delicate tissues.

UNGUENTUM HYDRARGYRI OXIDI RUBRI, *U. S., Br.*—Ointment of Red Oxide of Mercury.

Unguentum hydrargyri rubrum, P. G.; *Pomatum cum oxydo hydrargyrico*, F. Cod.; *Ung. præcipitatum rubrum.—Pommade d'oxyde rouge de mercure, Pommade de Lyon, Baume ophthalmique rouge*, Fr.; *Rothe Quecksilbersalbe*, G.

Preparation.—Red Oxide of Mercury, in very fine powder, 10 parts (48 grains); Ointment 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the oxide of mercury with a small quantity of the ointment until a perfectly smooth mixture is obtained; then gradually add the remainder of the ointment, and mix thoroughly.—*U. S.*

Take of red oxide of mercury, in very fine powder, 62 grains; hard paraffin ¼ ounce; soft paraffin ¾ ounce. Melt the hard and soft paraffins together, and when the mixture in cooling begins to thicken add the oxide of mercury in a glass or porcelain mortar, and mix the whole thoroughly.—*Br.*

Red oxide of mercury 1 part, petrolatum 15 parts, *F. Cod.* (paraffin ointment 9 parts, *P. G.*).

Made with finely-levigated oxide, the ointment has an orange color, and if good yellow wax be used remains unaltered for some months. The addition of alkali for neutralizing incipient rancidity, or the substitution of ointment made with castor oil or almond oil for the pharmacopœial ointment, is unnecessary.

Allied Ointments.—Unguentum ophthalmicum, *P. G.* 1872. Melt together 30 parts of expressed oil of almond and 19 parts of yellow wax, and mix these intimately with 1 part of very finely-levigated oxide of mercury.

Unguentum ophthalmicum compositum, s. Ung. ophthalmicum St. Yves, *P. G.* 1872. Melt together lard 140 parts and yellow wax 24 parts; add red oxide of mercury 15 parts and pure oxide of zinc 6 parts; and mix thoroughly with camphor 5 parts, previously dissolved in expressed oil of almond 10 parts.

Pomatum Dr. Regent.—Pommade de Régent, *F. Cod.*—Red oxide of mercury 1 Gm.; acetate of lead 1 Gm.; camphor 0.10 Gm.; petrolatum 18 Gm.

Medical Uses.—Red precipitate ointment, when used as a dressing for *ulcers*, is very apt to produce the specific effects of mercury upon the system. It should not, therefore, be too freely applied nor upon too large a surface at once. Its use is very much restricted to the treatment of indolent *syphilitic sores* and chronic inflammations of the edges of the eyelids (*blepharitis*). For the latter purpose the ointment should be diluted. 1 part of red precipitate ointment to 8 or 10 of simple ointment is usually strong enough.

UNGUENTUM HYDRARGYRI SUBCHLORIDI, *Br.*—OINTMENT OF SUBCHLORIDE OF MERCURY.

Unguentum calomelanos.—Pommade de chlorure mercureux, *P. de calomel*, Fr.; *Quecksilberchlorürsalbe*, G.

Preparation.—Take of Subchloride of Mercury 80 grains; Benzoated Lard 1 ounce. Mix thoroughly.—*Br.*

Calomel 1 part, benzoinated lard 9 parts.—*F. Cod.* This ointment, being known in France also as *pommade au précipité blanc*, should not be confounded with the ointment of ammoniated mercury (see also pp. 775 and 795).

Medical Uses.—Calomel ointment has the advantage over all the ointments made with salts of mercury of being wholly unirritating, and over simple mercurial ointment of not discoloring the skin or staining the clothing. It is therefore adapted to the local treatment of *cutaneous eruptions* of limited extent, and especially to those of a *syphilitic* nature. It is conveniently associated with white precipitate ointment in the affections to which that ointment is applied.

UNGUENTUM IODI, *U. S.*, *Br.*—IODINE OINTMENT.

Unguentum iodinii, U. S. 1870.—*Pommade d'iode*, Fr.; *Jodsalbe*, G.

Preparation.—Iodine 4 parts (18 grains); Iodide of Potassium 1 part (4½ grains); Water 2 parts (10 minims); Benzoinated Lard 93 parts (420 grains); to make 100 parts (450 grains). Rub the iodine and iodide of potassium first with the water, and then with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.—*U. S.*

Iodine and iodide of potassium each 32 grains; glycerin 1 fluidrachm; prepared lard 2 oz. av.—*Br.*

The water and potassium iodide are serviceable for effecting the fine division of the iodine. The lard should be added at first in very small quantities, and the trituration continued until the solid ingredients are perfectly levigated and the mixture is entirely free from grittiness and uniform in color.

Allied Ointment.—UNGUENTUM IODINII COMPOSITUM, *U. S.* 1870; Pomatum cum iodureto potassico iodurato, *F. Cod.*—Compound iodine ointment, *E.*; Pommade d'iodure de potassium ioduré, *Fr.*; Jodkaliumsalbe mit Jod, *G.*—Iodine 15 grains; iodide of potassium 30 grains; water 30 minims; lard a troyounce.—*U. S.* 1870. Iodine 2, iodide of potassium 10, water 10, and benzoinated lard 80 parts.—*F. Cod.*

Medical Uses.—Iodine ointment has been employed extensively to promote the absorption of the exudation occurring in local inflammations. It is used in indolent enlargement of the *tonsils*, the *thyroid*, and the *lymphatic glands*; also in *hydrarthrosis*, *cold abscess*, and chronic *peritonitis*. It may be applied to the *mamma* when abscess threatens to form in that gland, to promote the absorption of *pleural* and *pericardial effusions*, to prevent the development of inflammation in *tendinous sheaths*, that of *chilblains*, etc.

Compound iodine ointment, it will be observed, contains less iodine than the simple ointment. The advantage of the iodide of potassium in it must depend upon the absorption of the salt, which cannot be very great from the limited surfaces to which the ointment is usually applied. The compound and the simple ointments are used in the same affections.

UNGUENTUM IODOFORMI, *U. S.*, *Br.*—IODOFORM OINTMENT.

Pommade d'iodoforme, Fr.; *Jodoformsalbe*, G.

Preparation.—Iodoform, in very fine powder, 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the iodoform with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Dissolve iodoform 1 ounce in melted benzoated lard 9 ounces and cool.—*Br.*

The ointment should be perfectly smooth and free from grittiness; it has a light-yellow color and the peculiar odor of iodoform. (For disguising the odor consult pp. 827, 831.)

Allied Preparation.—Crayons d'iodoforme, *F. Cod.*, Iodoform pencils. Triturate iodoform 20 parts with powdered acacia 1 part, and by means of very little water and glycerin form a mass of pilular consistence which is rolled out into cylinders of suitable size.—*F. Cod.* Butter of cacao may be used with an equal weight of iodoform; these pencils are dusted with lycopodium.

Medical Uses.—Under Iodoform the numerous applications of this ointment have been mentioned. It is anæsthetic and stimulant.

UNGUENTUM MEZEREI, *U. S.*—Mezereon Ointment.

Pommade épispastique au garou, Fr.; *Seidelbastsalbe*, G.

Preparation.—Fluid Extract of Mezereon 25 parts (100 grains); Lard 80 parts (¾ oz. av.); Yellow Wax 12 parts (48 grains). Melt together the lard and wax with a moderate heat, add the fluid extract, and stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool.—*U. S.*

Extract of mezereon 4 parts; dissolve in alcohol 9 parts, and add to a melted mixture of lard 90 and wax 10 parts.—*F. Cod.*

Medical Uses.—Mezereon ointment is employed for the purpose of maintaining a discharge from suppurating surfaces created by *cantharides*, *caustics*, *setons*, *issues*, and other irritants.

UNGUENTUM PICIS LIQUIDÆ, *U. S.*, *Br.*—Tar Ointment.

Pomatum cum pice, F. Cod.—*Pommade de goudron*, Fr.; *Theersalbe*, G.

Preparation.—Tar, Suet, each 50 parts (8 oz. av.); to make 100 parts (1 ℔ av.). Mix the tar with the suet previously melted with a moderate heat, and, having strained the mixture through muslin, stir it constantly until cool.—*U. S.*

Tar 5 ounces; yellow wax 2 ounces; melt the wax with a gentle heat, add the tar, and stir the mixture briskly while it cools.—*Br.*

Tar 1 part, lard 9 parts; mix.—*F. Cod.*

Allied Ointment.—Unguentum picis betulæ, s. U. rusci, Wolff's tar ointment. Birch tar (see p. 1182) 8 Gm., simple ointment 42 Gm.

Medical Uses.—Tar ointment will sometimes cure *scabies*, but its action is uncertain and dilatory. In scaly eruptions, as *psoriasis* and *lepra*, its efficacy is much more decided, as well as in *chronic eczema* after the liquid secretion has ceased. In *ringworm* and in *prurigo* it is one of the best applications, and it may be used with advantage in the greater number of indolent and gangrenous *ulcers*.

UNGUENTUM PLUMBI ACETATIS, *Br.*—Ointment of Acetate of Lead.

Preparation.—Take of Acetate of Lead, in fine powder, 12 grains; Benzoated Lard 1 oz. av. Mix thoroughly.—*Br.*

Allied Ointments.—Unguentum narcotico-balsamicum Hellmundi, Hellmund's ointment. Triturate together acetate of lead 10 parts and extract of conium 30 parts; add gradually simple ointment 240 parts, balsam of Peru 30 parts, and wine of opium (with saffron) 5 parts, and mix thoroughly.—*P. G.* 1872.

Unguentum plumbi tannici (see page 1192).

Medical Uses.—The action and uses of acetate of lead ointment are probably identical with those of the cerate of subacetate of lead. It is applied as a dressing to *wounds*, *excoriations*, and *inflamed surfaces* generally.

UNGUENTUM PLUMBI CARBONATIS, *U. S.*, *Br.*—Ointment of Carbonate of Lead.

Pomatum cum carbonate plumbico, F. Cod.; *Unguentum cerussæ*, s. *Ung. album simplex*, P. G.—*Pommade de carbonate de plomb*, *Onguent blanc de Rhazès*, Fr.; *Bleiweissalbe*, G.

Preparation.—Carbonate of Lead, in very fine powder, 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the carbonate of lead with the benzoinated lard, gradually added, until they are thoroughly mixed. —*U. S.*

Other pharmacopœias direct: Carbonate of lead 62 grains; simple ointment 1 oz. av. —*Br.* Carbonate of lead 1 part; benzoinated lard 5 parts.—*F. Cod.* Carbonate of lead 3 parts; paraffin ointment 7 parts.—*P. G.*

Allied Ointment.—UNGUENTUM CERUSSÆ CAMPHORATUM. Ointment of carbonate of lead 95 parts, powdered camphor 5 parts.—*P. G.*

Medical Uses.—It is used for the same purposes as the last-mentioned ointment, from which it perhaps differs in being less astringent. It forms a suitable dressing for recent *burns* of the first degree. The danger of poisoning by the absorption of the lead it contains is an objection to its prolonged use.

UNGUENTUM PLUMBI IODIDI, *U. S., Br.*—OINTMENT OF IODIDE OF LEAD.

Pomatum cum iodureto plumbico, F. Cod.; *Pommade d'iodure de plomb*, Fr.; *Jodbleisalbe*, G.

Preparation.—Iodide of Lead, in very fine powder, 10 parts (48 grains); Benzoinated Lard 90 parts (1 oz. av.); to make 100 parts (1 troyounce). Rub the iodide of lead with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S., F. Cod.*

Iodide of lead, in fine powder, 62 grains; simple ointment 1 oz. av.; mix thoroughly. —*Br.*

Medical Uses.—The discutient influence of this ointment upon *enlarged glands* of the lymphatic system, and even upon certain *mammary tumors* of uncertain nature, is sometimes very distinctly marked. In chronic enlargement of the *testicle* following gonorrhœa it is often of palpable use. It has also been applied to some local *cutaneous eruptions*, but without demonstrable advantage.

UNGUENTUM POTASSÆ SULPHURATÆ, *Br.*—OINTMENT OF SULPHURATED POTASH.

Pommade de foie de soufre, Fr.; *Schwefellebersalbe*, G.

Preparation.—Take of Sulphurated Potash 30 grains; Hard Paraffin ¼ ounce; Soft Paraffin ¾ ounce. Triturate the sulphurated potash in a glass or porcelain mortar and gradually add the melted mixture of paraffins, rubbing them together until the ointment is perfectly smooth and free from grittiness. This ointment should be recently prepared.—*Br.*

Medical Uses.—Sulphurated potash ointment is only used in the treatment of *scabies*, for which it is an efficient remedy.

UNGUENTUM POTASSII IODIDI, *U. S., Br.*—OINTMENT OF IODIDE OF POTASSIUM.

Unguentum kalii iodati, P. G.; *Pomatum cum iodureto potassico*, F. Cod.—*Pommade d'iodure de potassium*, Fr.; *Jodkaliumsalbe*, G.

Preparation.—Iodide of Potassium, in fine powder, 12 parts (60 grains); Hyposulphite of Sodium 1 part (5 grains); Boiling Water 6 parts (30 grains or 30 minims); Benzoinated Lard 81 parts (405 grains); to make 100 parts (500 grains). Dissolve the iodide of potassium and the hyposulphite of sodium in the boiling water in a warm mortar; then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Iodide of potassium 64 grains; carbonate of potash 4 grains; distilled water 1 fluiddrachm; benzoated lard 1 oz. av.—*Br.* Potassium iodide 10 parts, water 10 parts, benzoinated lard 80 parts.—*F. Cod.* Potassium iodide 20 parts, water 10 parts, paraffin ointment 170 parts.

The first formula is an adaptation of that of the P. G. 1872, the hyposulphite being increased from ½ to 1 per cent. This addition is made for the purpose of preventing the liberation of free iodine and the gradual change of the color of the ointment from white to yellow and brown. Iodine added to this ointment will likewise be decolorized, with the formation of sodium iodide. (See SODII HYPOSULPHIS.) The addition of a little potassium carbonate, as directed by the Br. P., or of a few drops of potassa or soda solution, will likewise preserve the white color of the ointment.

Medical Uses.—The discutient powers of this ointment are certainly inferior to those of the ointments of iodine; its only advantages consist in its being colorless and in not staining the linen. It is used to promote the reduction of *enlarged glands*.

UNGUENTUM STRAMONII, *U. S.*—STRAMONIUM OINTMENT.

Pommade de stramoine, Fr.; *Stechapfelsalbe*, G.

Preparation.—Extract of Stramonium 10 parts (48 grains); Water 5 parts (25 minims); Benzoinated Lard 85 parts (408 grains); to make 100 parts (1 troyounce). Rub the extract with the water until uniformly soft, then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Medical Uses.—Stramonium ointment, although less efficient than belladonna ointment, may be used for the same purposes—viz. to allay *pain* and relieve *spasm*. It has been found to palliate the suffering caused by open *cancer* of the breast, and it affords much comfort in cancer of the *rectum*, *piles*, fissures of the *anus*, etc. An ointment composed of equal parts of stramonium ointment, ointment of galls, and cerate of subacetate of lead is very useful in these affections, and also to arrest the itching caused by vermicular *ascarides*.

UNGUENTUM SULPHURIS, *U. S.*, *Br.*—SULPHUR OINTMENT.

Pomatum sulfuratum, F. Cod.; *Unguentum sulfuratum simplex.*—*Pommade soufrée*, Fr.; *Schwefelsalbe*, G.

Preparation.—Sublimed Sulphur 30 parts (1½ oz. av.); Benzoinated Lard 70 parts (3½ oz. av.); to make 100 parts (4 oz. av.). Rub the sulphur with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Sublimed sulphur 1 ounce; benzoated lard 4 ounces.—*Br.* Washed sulphur 10 parts, almond oil 10 parts, benzoinated lard 80 parts.—*F. Cod.*

Allied Ointment.—UNGUENTUM SULFURATUM COMPOSITUM. Mix 1 part each of sublimed sulphur and powdered sulphate of zinc with 8 parts of lard.—*P. G.* 1872.

Medical Uses.—The chief use of sulphur ointment is in the treatment of *scabies*. The modes of using it and the conditions of its success have been described under SULPHUR.

UNGUENTUM SULPHURIS ALKALINUM, *U. S.*—ALKALINE SULPHUR OINTMENT.

Pomatum (Unguentum) antipsoricum, F. Cod.—*Pommade antipsorique, P. d'Helmerich*, Fr.; *Helmerich's Salbe*, G.

Preparation.—Washed Sulphur 20 parts (100 grains); Carbonate of Potassium 10 parts (50 grains); Water 5 parts (25 grains or minims); Benzoinated Lard 65 parts (325 grains = ¾ oz. av.); to make 100 parts (500 grains). Rub the sulphur with the carbonate of potassium and the water, gradually add the benzoinated lard, and mix thoroughly. —*U. S.*

Potassium carbonate 5 Gm., water 5 Gm., sulphur 10 Gm., expressed almond oil 5 Gm., lard 35 Gm. Mix in the order stated.—*F. Cod.*

Medical Uses.—The addition of potassium carbonate to sulphur ointment possesses no demonstrable advantage. Hebra says distinctly (*Sydenham Soc. ed.*, ii. 234), "Sulphur was found to be equally effectual, whether it was used alone or in combination with potassa, soda, or lime."

UNGUENTUM SULPHURIS IODIDI, *Br.*—OINTMENT OF IODIDE OF SULPHUR.

Pommade d'iodure de soufre, Fr.; *Jodschwefelsalbe*, G.

Preparation.—Take of Iodide of Sulphur 30 grains; Hard Paraffin ¼ oz.; Soft Paraffin ¾ oz. Triturate the iodide of sulphur in a glass or porcelain mortar, and gradually add the melted mixture of paraffins, rubbing them together until the ointment is perfectly smooth and free from grittiness.—*Br.*

Medical Uses.—Its tendency to speedy decomposition renders this ointment practically of little value, even in the treatment of limited chronic eruptions of *eczema*, *lepra*, and *acne*, and of *lupus*.

UNGUENTUM TEREBINTHINÆ, *Br., P. G.*—OINTMENT OF TURPENTINE.

Onguent térébenthiné, Fr.; *Terpenthinsalbe*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Resin, in coarse powder, 54 grains; Yellow Wax, Prepared Lard, each ½ ounce. Melt these ingredients together by the heat of a steam- or water-bath. Remove the vessel, and stir the mixture constantly while it cools.—*Br.*

Melt turpentine and yellow wax, of each 1 part, and add oil of turpentine 1 part.—*P. G.*

UNGUENTUM DIGESTIVUM SIMPLEX, *F. Cod.*—Onguent digestif simple, *Fr.*—Triturate Venice turpentine 40 parts with yelk of egg 20 parts, and add olive oil 10 parts.

Medical Uses.—This ointment has the same virtues as the compound resin cerate, but, being softer, is more convenient for application to *burns*, *erysipelas*, *erythema*, and other recent local inflammations of the skin.

UNGUENTUM VERATRINÆ, *U. S., Br.*—VERATRINE OINTMENT.

Unguentum veratriæ, U. S. 1870, Br.—*Veratria ointment*, E.; *Pommade de vératrine*, Fr.; *Veratrinsalbe*, G.

Preparation.—Veratrine 4 parts (20 grains); Alcohol 6 parts (30 grains or 40 minims); Benzoinated Lard 96 parts (480 grains). Rub the veratrine with the alcohol in a warm mortar until dissolved; then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Rub together veratrine 8 grains and olive oil 1 fluidrachm; melt hard paraffin ¼ ounce and soft paraffin ¾ ounce, and mix the whole thoroughly in a mortar until cold.—*Br.*

To prevent annoyance from the dust arising during the trituration of dry veratrine, the alkaloid should be previously covered with a small quantity of olive oil or thoroughly dampened with a little alcohol; the first formula directs it even to be dissolved in alcohol, the solvent evaporating on the continued trituration in a warm mortar.

Medical Uses.—The American is more than twice as strong as the British ointment. (For an account of its uses see VERATRINA.)

UNGUENTUM ZINCI OXIDI, *U. S.*—OINTMENT OF OXIDE OF ZINC.

Unguentum zinci, Br., P. G.; *Unguentum de nihilo albo.—Pommade d'oxyde de zinc*, Fr.; *Zinksalbe*, G.

Preparation.—Oxide of Zinc 20 parts (100 grains); Benzoinated Lard 80 parts (400 grains); to make 100 parts (500 grains). Rub the oxide of zinc with 20 parts (100 grains) of benzoinated lard, previously melted, until the mixture is perfectly smooth; then add the remainder of the benzoinated lard, and mix thoroughly.—*U. S.*

Other pharmacopœias direct: Oxide of zinc 80 grains, benzoinated lard 1 oz. av.—*Br.* Oxide of zinc 1 part, benzoinated lard (lard, *P. G.*) 9 parts.—*F. Cod.*

The Pharmacopœia has partially adopted a suggestion made in previous editions of this work, but instead of directing the benzoinated lard to be previously melted, it would have been more to the point to simply order the use of a hot mortar; for the oxide of zinc is readily obtained in an impalpable powder, and is uniformly diffused through the ointment by triturating it well in a warm mortar with about its own weight of benzoinated lard until the mixture is perfectly smooth, when the remainder of the lard may be added. Glycerin or expressed almond oil may also be used in sufficient quantity for forming a soft paste. On keeping, the ointment gradually acquires a tough consistence.

Allied Preparations.—UNGUENTUM ZINCI OLEATI, *Br.* Oleate of zinc 1 oz.; soft paraffin 1 oz. UNGUENTUM CALAMINÆ, *Br.* (Turner's cerate). Prepared calamine 1 oz.; benzoated lard 5 oz. CERATUM ZINCI CARBONATIS, *U. S.* 1870. Precipitated zinc carbonate 1 oz.; simple ointment 5 oz.

Medical Uses.—Oxide of zinc ointment is a protective, astringent, and mildly stimulant application, adapted to *ulcers* which are irritable, have loose granulations, and discharge pus copiously. It is especially useful as a dressing for *fissures* of the nipple and anus; for local eruptions of *eczema*, *herpes*, and *impetigo*; for all cases of simple *abrasion* or *ulceration*, including blistered surfaces, after their active inflammation has subsided; for *ophthalmia tarsi*, etc. The cerate, which is no longer officinal, was employed in similar affections.

UREA.—Urea.

Carbamid.—Urée, Fr.; *Harnstoff*, G.
Formula $CH_4N_2O = CO(NH_2)_2$. Molecular weight 60.

Origin.—Urea was discovered in urine by Rouelle (1773), and, in the impure condition in which he obtained it, designated as *extrait savonneux de l'urine*. Fourcroy and Vauquelin (1799) prepared it in the pure state. It has been found in the urine of mammals, more particularly in that of the Carnivora, in the urine of birds and other animals, and in many animal fluids. Human urine contains from 2 to 4 per cent. of urea. The transformation into urea of ammonium cyanate by evaporating its aqueous solution, as observed by Wöhler (1828), was the first instance in which an organic compound produced in the living organism was artificially formed. Urea has also been artificially prepared from other cyanogen compounds.

Preparation.—Urine is evaporated to a syrupy consistence, allowed to cool, and the residue mixed with an equal volume of nitric acid. The nitrate of urea, which crystallizes in scales and prisms, is purified by washing with cold water and by recrystallization, and is then decomposed by boiling with water and barium carbonate; the filtrate is evaporated and the residue exhausted with alcohol. Oxalic acid and calcium carbonate may be substituted in this process for nitric acid and barium carbonate.

Properties.—Urea crystallizes in colorless and inodorous four-sided prisms, which have a cooling saline taste and are permanent in dry air. It melts near 120° C. (248° F.), and at a higher heat is decomposed, giving off ammonia and leaving cyanuric acid, which at a still higher temperature yields cyanic acid. Urea dissolves in its own weight of cold water, is readily soluble in alcohol, but is slightly soluble in pure ether. In contact with nitrous acid urea is decomposed into carbonic acid, nitrogen, and water. A similar decomposition is effected by an acidulated solution of permanganate of potassium. Dissolved in pure water, urea keeps unchanged for a long time, but in the presence of putrefiable matter it is rapidly decomposed, yielding ammonia and carbonic acid; hence, foul urine contains no urea.

Urea forms crystallizable compounds with acids, with metallic oxides, and with many neutral salts. *Hydrochlorate of urea* is very deliquescent. *Nitrate of urea*, $CH_4N_2O.HNO_3$, is slightly soluble in cold water and alcohol and nearly insoluble in nitric acid; it contains 48.78 per cent. of urea. *Oxalate of urea*, $(CH_4N_2O)_2.H_2C_2O_4$, crystallizes in scales which dissolve at 15° C. (59° F.) in 23 parts of water, but require a much larger quantity of solution of oxalic acid; it contains 57.14 per cent. of urea. The amount of urea in urine is frequently determined by forming the compound either with nitric or oxalic acid.

Allied Compound.—Formamid, $CH_3NO = CHO.NH_2$. It is produced on the dry distillation of ammonium formate on heating a mixture of this salt and of urea to about 140° C. (284° F.), on heating ethylformate and ammonia, and by various other processes. It is a colorless oily liquid, which in vacuo distils without decomposition below 150° C. (302° F.), and which is soluble in water and alcohol in all proportions, but is insoluble in ether. Mercuric Formamid, Hydrargyrum formamidatum, has been used hypodermically.

Medical Action and Uses.—Half a century ago it was demonstranted by Ségalas that urea injected into the veins of animals increased notably the discharge of urine, with a greatly augmented proportion of urea, and, much more recently, Wöhler and Frerichs alleged that when introduced into an animal's stomach it reappeared almost entirely in the urine. Gallois, however, proved that only two-thirds at most of the urea thus administered was recoverable from the urine, and also that in very large doses, such as 300 grains, given to a rabbit, it occasioned prostration, trembling, convulsions, and death. Similar large doses injected into the veins or hypodermically produced the same effects, and non-lethal quantities of urea occasioned deep coma, paroxysmal spasms, hurried respiration, trembling, injection of the capillary vessels, and frequent urination.

Although, according to Rabuteau, it exhibits no diuretic action in man, even when taken to the extent of 75 grains (Gm. 5) a day, yet several physicians have testified to its virtues in *dropsy*, and one of high reputation particularly recommended the nitrate of urea as a remedy for scarlatinous dropsy. It was prescribed in *doses* of 2 or 3 grains (Gm. 0.12–0.18) several times a day. In the last edition of this work it was stated that this medicine is probably now quite obsolete, and should be consigned to the "Dreckapotheke," as Strumpf long ago suggested. But more recently we are assured by a Russian physician that *carbamid* may be used as a substitute for quinine. According to him, it is an apyretic, and yet does not depress the nervous system. He asserts that in Southern Russia the peasants cure themselves of intermittent fever by drinking their urine (*Med. News*, xlii. 215).

URTICA.—Nettle.

Ortie brûlante, Fr.; *Brennessel*, G.

Urtica dioica, *Linné*, and U. urens, *Linné*.

Nat. Ord.—Urticaceæ, Urticeæ.

Origin and Description.—Both plants are common in waste places, along hedges and roadsides, throughout the greater part of Europe and Northern Asia, and have been thoroughly naturalized in North America, where the small annual, U. urens, is less frequent than the taller perennial, U. dioica. Both species are covered with stiff stinging hairs and have opposite stipulate and petiolate leaves.

Urtica dioica. The leaves are 2 or 3 inches (5–8 Cm.) long, dark-green above, whitish downy beneath, ovate or ovate-lanceolate, heart-shaped, pointed, and coarsely serrate. The small greenish flowers are usually diœcious, in small clusters, and these are arranged in branching and hanging spikes. The bast-fibres have been used for the manufacture of *nettle-cloth*.

Urtica urens. The leaves are 1 or 2 inches (2–5 Cm.) long, pale-green, elliptic, deeply serrate, and almost five-nerved. The small and loose flower-clusters appear in axillary pairs.

Allied Plants.—Urtica (Laportea, *Gaudichaud*) canadensis, *Linné*. The leaves are alternate, 4 to 6 inches (10–15 Cm.) long, long-petioled, ovate or elliptic, obtusely serrate, and strongly feather-veined. The flower-clusters form axillary loosely-paniculate cymes. The plant is common in miry, shaded grounds, attains a height of 3 to 5 feet (.9–1.5 M.), is armed with stinging hairs, and has strong bast-fibres.

Urtica crenulata, *Roxburgh*, U. stimulans, *Linné*, and U. urentissima, *Blume*, are more violently irritating than the above species; they are indigenous to India and to the East Indian islands.

U. pilulifera, *Linné*, grows in India, Central Asia, and in Southern Europe. The fruit is a roundish and flat akene, glossy, gray-brown, somewhat resembles flaxseed, but is smaller, and has an oily, mucilaginous, and slightly acrid taste; it is used in Oriental countries as a galactogogue. The root is regarded as diuretic.

The bast-fibres of several nettles in addition to those mentioned above are valuable for cordage and woven fabrics. Urtica cannabina, *Linné*, is cultivated in Siberia. Bœhmeria nivea, *Hooker et Arnott*, of Eastern Asia, yields the *ramie* fibre, from which *China grass-cloth* is made. The variety candicans, *Weddell* (B. tenacissima, *Gaudichaud*) yields the *rhea* fibre. The fabrics often possess considerable brilliancy, and these fibres are used as a substitute for, or are mixed with, silk.

Constituents.—The analyses of the fresh nettle by Saladin (1830) and by Bohlig (1840) proved the presence of mucilage, salts, and other common constituents of plants, and on distilling the herb with water notable quantities of ammonia and carbonic acid were found in the distillate. B. Shoemaker (1866) observed that the watery distillate from the root had diuretic properties. Gorup-Besanez (1849) recognized the irritating compound contained in the stinging hairs as free *formic acid*, which is also contained in the aqueous distillate of the fresh herb. A. Buchner, however, observed that the inflammation produced by free formic acid is of a different character from that produced by nettles, and regarded the presence of another irritating compound besides formic acid as probable.

Medical Action and Uses.—The seeds and leaves of the nettle were much used in ancient times in poultices or bruised for unhealthy ulcers as well as for recent wounds and sprains. The bruised leaves were introduced into the nostrils to arrest epistaxis, and given in honey for the cure of pulmonary catarrhs. The well-known irritation of the skin caused by nettles is due to an acrid secretion contained in a minute vesicle situated at the base of each of the stiff hairs that beset the leaves. When the points of these sharp and hollow spines penetrate the skin, the poisonous juice is expressed into its tissue, and gives rise to a burning and stinging pain, with inflammatory redness and swelling. The case is recorded of a woman who, by mistake, drank 2 cupfuls of a decoction of nettle-leaves. On the following day she experienced severe burning over the whole of the upper part of the body, with formication and stiffness. The features were greatly swollen. Over the affected surface minute vesicles appeared, which burst and discharged a limpid and in some parts a bloody fluid. In the course of five or six days the eruption dried up. No fever accompanied the attack (*Archives gén.*, 1835).

Nettle-juice has always been reputed to be an efficient remedy for spontaneous hæmorrhage of nearly every variety, including *hæmoptysis*, *menorrhagia*, *post-partum hæmorrhage*, and *epistaxis*. Allowing for the difficulty of determining the efficacy of any medicine in arresting hæmorrhage, there appears to remain so great a preponderance of evidence in favor of the one under consideration as to render scepticism in regard to it unreasonable, especially as in most of the cases numerous hæmostatics of recognized activity had failed before this medicine was employed. The juice was administered in doses of half an ounce or an ounce at intervals of several hours, and in no case does it appear to have given rise to any disagreeable or untoward effects. This preparation is also reported to have been very efficacious in certain cases of *gravel*, *jaundice*, and *dropsy*, and the seeds have been used in *diarrhœa*, *dysentery*, *leucorrhœa*, and nocturnal *incontinence of urine*. The decoction of the leaves and stalks is also said to display curative powers in chronic *diseases of the skin*, and, as well as the expressed juice, to cure ulcerative affections of the mouth and throat. Poultices made by boiling the fresh leaves have been reputed to cure gangrenous, scorbutic, and other unhealthy *ulcers*. Urtication is the name applied to producing an irritation of the skin by means of nettles. It is performed by taking in the gloved hand a bunch of nettles and flagellating the skin with it until the redness and the stinging pain denote that the intended effect is produced. This peculiar stimulant revulsion and counter-irritation has been long employed for arousing to consciousness persons affected with *lethargy*, *congestion of the brain*, *intoxication* by *alcohol* or *opium*, or *hysterical insensibility*. It has also been used upon the loins and thighs to cure *amenorrhœa* and *sexual impotence*, and, above all, as a means of restoring power to *paralyzed* limbs. The advantages it presents over blistering, pustulation by croton oil, etc. consist in the vivid and intense impression it produces, and which likens it to electricity and massage. It seems to be a rude expedient, but cases may occur, particularly in the country, for which it would be peculiarly adapted.

In Germany the dried young shoots are used in a decoction made with from 10 to 20 parts to 100 parts of water. The juice of the fresh plant is given internally in tablespoonful doses.

USTILAGO, *U. S.*—USTILAGO.

Cornsmut, *Corn-ergot*, E.; *Maisbrand*, *Beulenbrand*, G.

Ustilago (Uredo, *De Candolle*) Maydis, *Leveillé.*

Nat. Ord.—Fungi, Ustilagineæ.

Origin.—The numerous species of the genus Ustilago grow upon living plants, the tissue of which is penetrated by the mycelium. The spores are produced in the hyphæ or their branches, which gradually form a gelatinous mass, and this is subsequently resorbed, so that finally the isolated spores remain behind. These are of a black or brown color, consist of a single cell, and have the outer membrane or exosporium either smooth or variously marked. The species mentioned above lives upon maize (Zea Mays, *Linné*, nat. ord. Graminaceæ), attacks the vegetative and reproductive organs, and in the latter often attains a considerable size.

Description.—Cornsmut forms irregular globose masses, which are somewhat lobed or obtusely branched, and sometimes 6 inches (15 Cm.) or more thick. The smooth or gelatinous membrane forming the covering of the fungus is diaphanous, and shows a blackish tint from the enclosed spores. Enclosed by this membrane is found a blackish-brown or brownish-black powder, consisting of innumerable spores, which are globular or oval, and when observed under the microscope have a nodular or spiny appearance, from the projections of the exosporium. Cornsmut has a peculiar rather heavy odor and an unpleasant taste. It should be preserved in a dry place, and should be kept on hand not longer than a year. Ustilago segetum, *Dittmar* (U. Carbo, *Tulasne*), which attacks oat, barley, wheat, and other grasses, has somewhat smaller globular spores, which are smooth.

Constituents.—C. H. Cressler (1881) showed the presence of a volatile base, which is probably identical with *trimethylamine*, and a sugar which crystallizes in needles, is very sweet, and does not reduce Trommer's test solution; it is probably *mycose;* fixed oil, resin, and gummy matter were likewise obtained. Examined by J. H. Hahn (1881) and H. B. Parsons (1882), air-dry cornsmut yielded 9 to 10 per cent. of moisture, 2.5 to 4.2 per cent. of ether extract, and 4 to 5.5 per cent. of ash. Alcohol takes up about 10 per cent., and water about 6.6 per cent., of soluble matter, from the latter of which Prof. Parsons obtained 5.5 per cent. of an acid compound which is probably identical with sclerotic acid, and is prepared by the same process (see p. 580).

Medical Action and Uses.—It appears that several other cereals are subject to diseases which form products resembling ergot in their action. In 1870, Haselbach related that on several occasions cows had calved prematurely from having eaten maize affected with smut (Husemann, *Arch. f. Pathol. u. Pharmakol.*, ix. 276). In 1877, Estachy published the note of a case in which he successfully made use of smutted maize to revive suspended *labor-pains*. Afterward he employed it successfully in the treatment of *hæmoptysis*, *seminal pollutions*, and *post-partum hæmorrhage* (*Bull. de thérap.*, xciv. 85). It may be questioned whether such facts justify granting an officinal rank to this product. From a series of experiments with it, Dr. James Mitchell (*Inaug. Thesis*, Univ. of Penna., 1883) concluded that it destroys consciousness, paralyzes first the sensory portion of the spinal cord, and, after depressing, paralyzes also the motor centres of the cord and motor nerves, and that probably the sensory nerves share in the general paralysis.

The *stigmata* of *maize*, or "corn silk," have for a long time had a popular reputation in the south of France as a remedy for *strangury* and *calculous affections*, and they have also been held to possess anodyne virtues (*Bull. de thér.*, xcvii. 377). In 1879, Dufau described this product as actively *diuretic* in cardiac and renal *dropsy*, and stated that the best effects followed its use in cases of *uric* and *phosphatic gravel*, *pyelitis*, *retention* and *incontinence of urine*, and *vesical catarrh* (*Med. Record*, xvi. 252). These statements have been confirmed and extended by various others, including Landrieux, who insists strongly on the diuretic action of the medicine (*Practitioner*, xxiv. 453; xxv. 379), Busey (*Med. Record*, xix. 319), Ducasse (*Amer. Jour. of Med. Sci.*, April, 1883, p. 565), and Stuver (*Med. News*, xliii. 372). According to Vauthier, maizenic acid is the active principle of the stigmata. It is recommended to be given in *doses* of ⅛ grain. An extract of the stigmata has been given in syrup to the extent of 20 or 30 grains (Gm. 1.30–2) a day.

Dupont particularly insists on the efficacy of the medicine in *cardiac dropsy* and in obstructive valvular disease of the heart (*Gaz. med. de Paris*, No. 9, 1884).

UVÆ, *Br.*—RAISINS.

Uva passa, U. S. 1870; *Passulæ.—Raisins*, Fr.; *Rosinen*, *Zibeben*, G.

The dried fruit of Vitis vinifera, *Linné.* Bentley and Trimen, *Med. Plants*, 66.

Nat. Ord.—Vitaceæ.

Origin.—The Vitis vinifera is indigenous to Western Asia and probably to Northern Africa, and has been cultivated in Europe from a very early period; it has been introduced into North America, chiefly on the Pacific coast, and into other temperate countries. A large number of varieties have been produced, differing in the shape, size, and color of their berries and in other characters. Some botanists refer the different varieties of grapevine to three or four species. The *Catawba*, *Isabella*, *Concord*, and other grapes usually cultivated in the United States, are varieties of the indigenous Vitis Labrusca, *Linné.*

The genus Vitis consists of shrubs climbing by tendrils, and bearing these and the greenish, compound-racemose flowers opposite the leaves. The calyx is small, the five petals are united at the apex, fall off together by separating at the base, and alternate with five stamens, which enclose a two-celled ovary, ripening into a juicy berry containing about four hard pyriform seeds.

The tender branchlets (*pampini vitis*) with the leaves are sometimes employed for their agreeable acidulous flavor. The unripe berries (*agresta*) contain a considerable amount of tartaric acid, and yield, when expressed, a very acerb juice (*omphacium*), which after fermentation is suc de verjus. *F. Cod.* The mature fruits, dried, constitute the raisins.

Collection.—When the grapes are ripe their stalks are cut half through or a portion of the bark is removed, and the grapes are allowed to remain upon the vines for a few weeks, and then cut off, sometimes steeped for a short time in a weak lye to remove the waxy bloom, and then completely dried: or the ripe grapes are cut off, spread out upon a hard clay floor, and dried by exposure to the sun, which requires a week or two. In rainy weather artificial heat is used for drying them.

Description.—The ripe berry of the grapevine is one-celled from the obliteration of the cell-wall, and is globular or oblong in shape. After drying it is shrivelled and flattened, more or less orbicular, of a brownish color, and somewhat translucent. When long kept, raisins become more opaque, owing to the crystallization of the sugar and cream of tartar. Raisins are produced in Southern Europe, and in commerce are distinguished generally by the ports of exportation.

Varieties.—Uvæ malacenses, *F. Cod.*, Passulæ majores.—Raisins de Malaga, *Fr.*—Those produced in Spain are usually preferred, and are ordered by the Br. P. They have either been removed from the stalks, like the *Valencia raisins*, or are sold in bunches, like the *Malaga* or *Muscatel raisins*. The *seedless* or *Sultana raisins* are rather smaller than the Spanish and Italian raisins, and are exported from Asia Minor.

Uvæ corinthiacæ, *F. Cod.*, Passulæ minores.—Corinthian raisins, *E.;* Raisins de Corinth, *Fr.:* Korinthen, *G.*—They are produced in Greece and the adjacent islands, and are often incorrectly called *currants;* they are much smaller than those previously described, are usually deprived of their stalks, mostly adhere together in masses, and have a vinous odor and a sweet and acidulous taste.

Constituents.—The *skin* of ripe grapes contains tannin and coloring matter. The chief constituents of the *pulp* are grape-sugar and acid tartrate of potassium, besides gummy matter, calcium tartrate, and a small quantity of malic acid. The *seeds* contain about 5 per cent. of tannin, green resin, and over 10 per cent. of a bland oil (see p. 1065).

Off. Prep.—Tinct. cardamomi comp., Tinct. sennæ, *Br.*

Medical Uses.—The pulp of raisins is nutritive and demulcent, and is used to flavor mucilaginous and amylaceous infusions, such as those of flaxseed, oatmeal, rice, barley, etc.

UVA URSI, *U. S., F. Cod.*—Uva Ursi.

Uvæ ursi folia, Br., P. G.—*Bearberry-leaves*, E.; *Busserole*, *Raisin d'ours*, Fr.; *Bärentraubenblätter*, G.

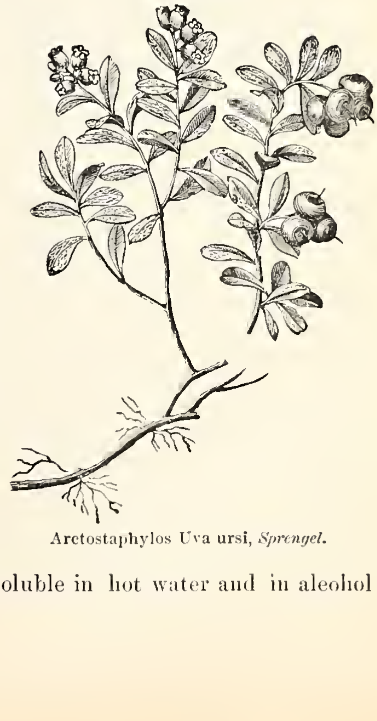
The dried leaves of Arctostaphylos (Arbutus, *Linné*) Uva ursi, *Sprengel* (Arct. officinalis, *Wimmer*). Woodville, *Med. Bot.*, plate 70; Bentley and Trimen, *Med. Plants*, 163.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—The bearberry is a trailing, much-branched, evergreen shrub, which is distributed throughout the northern portion of the northern hemisphere, and grows in most parts of Europe, in Northern Asia, and throughout the North American continent as far south as New Jersey and in the mountains of Colorado. It is found in dry, rocky, or sandy places and in pine woods; southward it grows chiefly in hilly or mountainous regions. It bears short and drooping racemes of from three to twelve whitish, urn-shaped flowers and small, bright-red drupes containing five flattened nutlets, each with one seed. The flowers appear in May, and the fruit ripens in autumn, at which time the leaves should be collected.

Description.—Bearberry-leaves are nearly sessile, about $\frac{4}{5}$ inch (2 Cm.) long, $\frac{1}{4}$ or $\frac{1}{3}$ inch (6–8 Mm.) wide, obovate or oblong-spatulate, entire, and slightly revolute on the margin, obtuse or apparently retuse at the apex, and almost wedge-shaped at the base. They have a leathery texture, a dark-green rather glossy upper surface, with depressed veins, are paler, smooth, and reticulately-veined beneath, and the leaves have a faint hay-like odor and a strongly astringent and slightly bitter taste.

Fig. 302.



Arctostaphylos Uva ursi, *Sprengel.*

Constituents.—Meissner (1824) found in uva ursi gallic acid and tannin, producing with ferric salts a blue-black precipitate. Kawalier (1852) corroborated the existence of gallic acid in bearberry-leaves, and to its presence is due the red and violet color produced by a fragment of ferrous sulphate when agitated with an infusion made from 1 part of uva ursi with 50 parts of water. Bowman (1869) determined the amount of tannin, by means of gelatin, to be 6.33 per cent. Besides resin, sugar, and some other unimportant constituents, Kawalier isolated from the leaves arbutin and ericolin, and Trommsdorff another crystalline body, ursone. *Arbutin*, $C_{24}H_{32}O_{14}.H_2O$, is obtained from the decoction of the leaves by precipitating it with subacetate of lead, treating the filtrate with sulphuretted hydrogen, and evaporating to crystallize. It forms neutral, colorless, silky needles, of a bitter taste, freely soluble in hot water and in alcohol and sparingly soluble in ether. Julius Jungmann (1872) observed that an aqueous solution of arbutin, rendered alkaline by ammonia or potassa, acquires a deep azure-blue color on the addition of phosphomolybdic acid. On being dissolved in strong nitric acid, arbutin yields, after the addition of alcohol, pale-yellow needles of *binitro-arbutin*. By emulsin or by hot diluted sulphuric acid arbutin is decomposed into glucose and *hydrokinone* or *arctuvin*, $C_6H_6O_2$, and *methylhydrokinone*, $C_7H_8O_2$. Hydrokinone crystallizes in colorless, fusible, and sublimable prisms, is easily soluble in water, alcohol, and ether, and is also produced from kinic acid by destructive distillation. On oxidizing hydrokinone or arbutin with binoxide of manganese and sulphuric acid *kinone* is formed (see page 466). Hughes' *ursin* (1847) was proven by Jungmann to be impure arbutin.

The mother-liquor from the preparation of arbutin contains *ericolin* (see page 876). After washing the alcoholic extract of bearberry-leaves with water and ether, boiling alcohol extracts from the residue *ursone*, $C_{20}H_{34}O_2$; this crystallizes in tasteless, silky, fusible, and sublimable needles, is insoluble in water, dilute acids, and alkalies, and is sparingly soluble in ether and cold alcohol.

Arbutin, ericolin, and ursone have been obtained also from the leathery leaves of other ericaceous plants.

Adulterations and Substitutions.—The leaves of the following plants are said to have been sometimes mistaken for those of uva ursi:

VACCINIUM VITIS-IDÆA, *Linné*. It is known as *cowberry*, and grows from New England northward and in Europe. The leaves resemble those of uva ursi, but are not reticulate, and on the lower surface are dotted with fine, blackish, bristly points.

VACCINIUM ULIGINOSUM, *Linné*. This is known as *bog-bilberry*, and grows in Europe and the northern part of North America. The leaves are scarcely leathery, and are pale blue-green and pubescent on the lower surface; otherwise they resemble the leaves of uva ursi.

LEIOPHYLLUM BUXIFOLIUM, *Elliott*. The *sand-myrtle*, indigenous to the United States from New Jersey southward, is a small shrub about 6 inches (15 Cm.) high. Its leaves are about ⅓ inch (8 Mm.) long, oval or oblong, shining, reticulate, and revolute on the margin.

BUXUS SEMPERVIRENS, *Linné*. The *box*, commonly cultivated in gardens, has ovate leaves, which are narrower towards the apex than near the base. The leaves contain tannin (Buchner), butyraceous volatile oil, bitter extractive, etc. (Bley, 1834); the bitter taste is due to *buxine* and *parabuxine*. (See NECTANDRA and PAREIRA BRAVA.)

Allied Species.—ARCTOSTAPHYLOS GLAUCA, *Lindley*. This shrub or small tree grows in dry and rocky localities on the western slope of the Sierras in California, where it is known as *manzanita*. The leaves are about 2 inches (5 Cm.) long, coriaceous, ovate-oblong, acute above and rounded or obtuse at the base, entire on the margin, and of a pale-green color. It was examined by J. H. Flint (1873), and found to contain arbutin, 9.8 per cent. of tannin, and 6 per cent. of ash. The leaves are employed like uva ursi.

Off. Prep.—Extr. uvæ ursi fluid., *U. S.*; Infus. uvæ ursi. *Br.*

Medical Action and Uses.—Uva ursi, or bearberry, in small doses appears to promote the appetite and confine the bowels, but in large quantities it occasions vomiting and purging, rendering it probable that its medicinal effects do not depend solely upon its astringent principles. On the healthy system it does not produce any diuretic action, but in calculous affections the urine sometimes seems to augment under its influence. It gives to this secretion a dark color and a peculiar odor.

Uva ursi appears to have been first used by physicians about the middle of the eighteenth century. It was then employed in calculous affections and in all chronic disorders of the urinary passages, from the kidneys to the urethra. It has proved useful in chronic *pyelitis* and *cystitis*, and even in calculous forms of those affections, probably by constringing the mucous membrane of the kidneys and bladder, diminishing its vascularity, and thereby obtunding its sensibility. In many cases, as a consequence of this mode of action, it has caused the parts affected to become more or less insensible to the mechanical irritation of the concretions enclosed by them, and thereby lessened the impediment to the passage of the urine. In this manner, no doubt, it often relieves *incontinence of urine*, *dysury*, and *strangury*. So complete is the relief sometimes afforded by it that a notion once gained credit of its being a solvent of *urinary calculi*. But in truth its mode of action is in great part like that of lime-water, whose efficacy under analogous circumstances is well known: it renders the mucous membrane of the urinary passages less susceptible to mechanical irritation. The benefits of the medicine in most of the cases referred to are only to be obtained by its persistent use. But in strangury from blisters its action is sometimes very prompt. Uva ursi has been also used with advantage for chronic *bronchitis* and atonic *diarrhœa*, *leucorrhœa*, and *hæmorrhage*, especially uterine hæmorrhage. It is alleged to act as an *oxytocic*. Arbutin is alleged to be an efficient diuretic in *cardiac dropsy*, and it has also been prescribed with alleged advantage in *urethritis.* It may be given in large doses without any ill effect. As a diuretic it has been given in doses of about 12 grains (Gm. 1) per diem, mixed with powdered sugar; and also in a 5 per cent. watery solution.

The *dose* of the drug in powder is generally stated to be from 20 to 60 grains (Gm. 1.30–4), but its most striking effects have been obtained by doses not greater than a fourth of that just mentioned. The decoction, infusion, and fluid extract of uva ursi are efficient; the last is official.

Buxus sempervirens was found by Ringer and Murrell to produce tetanus, followed by paralysis, in frogs (*Med. Chir. Trans.*, lix. 389).

VALERIANA, *U. S.*—VALERIAN.

Valerianæ rhizoma, Br.; *Radix valerianæ*, P. G.; *Radix valerianæ minoris.—Valerian-root*, E.; *Valériane officinale*, Fr.; *Baldrianwurzel*, G.

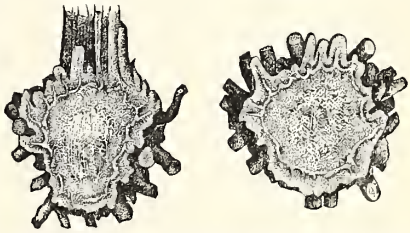
The root of Valeriana officinalis, *Linné.* Woodville, *Med. Bot.*, plate 96; Bentley and Trimen, *Med. Plants*, 146.

Nat. Ord.—Valerianaceæ.

Origin.—Valerian is a native of Europe from the Mediterranean northward, and of Northern Asia, and is cultivated to some extent in Holland and England, and in this country in New England and New York. It is an herbaceous perennial, and grows on the banks of streams and other wet places, and likewise in uplands and dry situations. It varies considerably in size and in foliage, and several of the varieties have been regarded by some botanists as distinct species. The plant is easily propagated from short horizontal runners. It is 2 to 4 feet (.6–1.2 M.) high, branching at the top, has opposite, clasping, long-petiolate and oddly pinnate leaves, with from four to ten pairs of oval or lance-linear, entire or toothed, sessile, and smooth leaflets, and bears compound cymes composed of numerous small pinkish, triandrous flowers. The fruit is an ovoid, compressed akene, crowned by a plumous pappus. The rhizome with the rootlets attached constitute the official portion, and is collected in autumn.

Description.—The rhizome of valerian is upright, subglobular or obconical, truncate below, and at the apex often crowned with short portions of the overground stem or with a tuft of short leaf-bases, and indistinctly marked with closely approximate leaf-scars. It varies in length between about ½ and 1¼ inches (1–3 Cm.), has a diameter nearly of the same dimensions, and is on all sides furnished with numerous slender nearly cylindrical rootlets. These are from 2 to 6 inches (5–15 Cm.) long, about ⅛ inch (3 Mm.) thick at the base, simple, except near the tip, where they are divided into numerous fine fibres, which are rarely present in the commercial drug. A few short stolons, with long internodes, are occasionally attached to the rhizome. The rhizomes collected from dry situations are the smallest, have a light yellowish-brown color, are subglobular in shape, have a comparatively large number of rather short, thin, and light-colored rootlets attached, and are preferred for medicinal purposes on account of the larger proportion of volatile oil contained in them. The rhizomes collected in wet localities are more elongated, of larger dimensions, more fleshy and hygroscopic, and are therefore frequently cut longitudinally to facilitate their drying; they are darker in color, near the lower end marked by scars from decayed rootlets, and near the middle and upper portion have longer, thicker, and darker-colored rootlets than the preceding variety, attaining a length of 10 or 12 inches (25–30 Cm.). The rootlets of valerian are rather brittle and break with a short fracture; the rhizome is tougher, and in the interior rather horny and of a light grayish-brown color. It has a thin bark, which by a dark cambium-line is separated from a narrow circle of whitish woody tissue, and this encloses a large central pith. The rootlets have a thick bark surrounding a slender ligneous cord. Under the microscope the parenchyma is seen to contain cells filled with starch, extractive matter, and oil or resin. The recent rhizome has a very slight odor, but on drying a peculiar somewhat camphoraceous and terebinthinate odor appears, which on long keeping gradually changes to a strong somewhat cheese-like odor. The taste of valerian is at first sweetish, afterward unpleasant, cam-

FIG. 303. FIG. 304.



Longitudinal and transverse section of rhizome of Valerian.

phoraceous, and somewhat bitter. The rootlets of the commercial drug sometimes cover a large amount of dirt.

Constituents.—The most important constituent of valerian is its volatile oil (see page 1100), which varies in proportion between about ½ and 2 per cent., the fresh rhizome from dry soil yielding the larger amount. Cultivated valerian seems to be less rich in volatile oil. Recent valerian on being distilled with water yields a distillate which, according to Schoonbroodt (1868), is neutral or nearly so. Free valerianic acid does not exist in fresh valerian, but is generated from the volatile oil on exposure. The relative proportions of the volatile oil and valerianic acid must therefore vary with the age of the drug. Aschoff (1846) found in the root also malic, acetic, and formic acids. The constituents which are of less medicinal importance are tannin, extractive, sugar, starch, mucilage, resin, etc.

Admixtures.—Although valerian is readily distinguished from other medicinal roots, it has been sometimes observed sophisticated with poisonous drugs somewhat resembling valerian in appearance, and from contact with the latter having acquired to some extent its peculiar odor. Cynanchum Vincetoxicum (p. 537) was noticed by Charbonnier (1877), Veratrum album (see below) by Holmes (1877), and Sium latifolium (p. 452) by Bernbeck (1880).

Pharmaceutical Preparations.—AQUA VALERIANÆ. Distil 1 part of bruised valerian with sufficient water to obtain 4 parts of distillate.—*F. Cod.*

SYRUPUS VALERIANÆ. Extract of valerian 4 Gm., valerian-water 100 Gm., sugar 180 Gm.—*F. Cod.*

SPIRITUS ANGELICÆ COMPOSITUS. Valerian 4 parts, juniper-berries 4 parts, angelica 16 parts, alcohol 75 parts, and water 125 parts; distil 100 parts, and dissolve in the distillate camphor 2 parts.—*P. G.*

Off. Prep.—Abstractum valerianæ, Extr. valerianæ fluid., *U. S.;* Infusum valerianæ, *Br.;* Tinct. valerianæ, Tinct. valerianæ ammoniata, *U. S.*, *Br.*

Allied Drugs.—Valeriana Phu, *Linné*, is a tall perennial of Western Asia and Southern Europe, and is occasionally cultivated. The root was known as *radix valerianæ majoris*, and consists of an oblique rhizome which is 4 to 6 inches (10–15 Mm.) long, about ½ inch (12 Mm.) thick, is distantly annulated, of a brown color, on the lower side furnished with numerous yellowish rootlets, and has a much weaker odor and taste than officinal valerian.

NARDUS SPICA CELTICA is the rhizome of Valeriana celtica, *Linné*, a native of the Alps. It is thin, about 3 inches (75 Mm.) long, densely covered with brown scaly leaf-remnants, has long simple rootlets on the lower side, and possesses a strong odor and taste of valerian.

NARDUS INDICA, s. SPICA NARDI, or true *spikenard*, formerly much employed, is obtained from Nardostachys (Valeriana, *Roxburgh*) Jatamansi, *De Candolle*, indigenous to India. It is about ¼ inch (6 Mm.) thick, densely beset with numerous fibrous remnants of leaf-stalks, and has a bitter aromatic taste and penetrating odor resembling that of serpentaria.

PATRINIA SCABIOSÆFOLIA, *Link*. The root is known in Japan as *kesso*, and was sent to England in 1879. It resembles valerian in appearance, odor, and taste, but has a short rhizome, not over ⅓ inch (8 Mm.) thick, and this is densely covered with dark-brown scaly rootlets, which are 2 to 4 inches (5–10 Cm.) long.

Medical History.—Valerian is described by ancient authors as diuretic and emmenagogue, as a remedy for epilepsy, and locally as a detergent. The singular passion for it displayed by cats has long been known. Valerian was anciently called in English *setwall*, a name properly applied to *zedoary;* and the root was so much valued for its medicinal virtues that, as Gerarde (1567) remarks, the poorer classes in the north of England esteemed "*no broths, pottage, or physicall meats*" to be worth anything without it. Its odor, now considered intolerable, was not so regarded in the sixteenth century, when it was the custom to lay the roots among the clothes as a perfume in the same way as those of Valeriana Celtica, *Linné*, and the Himalaya valerians are still used in the East (Flückiger and Hanbury, *Pharmacographia*).

Physiological Action.—When taken habitually in moderate doses, valerian improves the appetite and digestion without confining the bowels. 2 drachms at a single dose may occasion a sense of heat and weight in the abdomen, eructations, and even vomiting, colic, and diarrhœa; also some excitement of the pulse, general warmth, and either perspiration or diuresis. In somewhat smaller doses its operation is chiefly restricted to the nervous system; it renders the mind tranquil, disposes to good-humor and activity, produces sometimes a lively formication in the hands and feet, and a sensation about the head and spine which has been compared to the aura epileptica. Sometimes, on the contrary, there is a sense of embarrassment in the head, with heaviness and pain. In states of morbid nervous excitement without fever, when through exhaustion the pulse has become small and frequent, valerian lessens its frequency and increases its force and volume.

Given to rabbits in doses of from 1 to 3 drachms, valerianic acid renders the heart's action more rapid, but feebler; the respiration is hurried at first, and then slower; and death usually takes place in three or four hours, preceded by prostration and convulsions. If death occurs speedily, the gastric mucous membrane is pale, but if delayed it may be congested; the kidneys are apt to be congested and the urine bloody. Oil of valerian appears to lessen the excitability of the spinal cord, and even to paralyze it, since two Cgm. ($\frac{1}{3}$ gr.), injected under the skin of a frog, have been found capable of preventing tetanic spasms after a like injection of 5 Mgm. ($\frac{1}{12}$ gr.) of strychnine. Given alone to these animals hypodermically, it impairs mobility and sensibility. Valerianic acid, applied to the human skin, produces a white spot, followed by irritation and redness, and upon the tongue it may cause the epithelium to exfoliate.

Medical Uses.—Valerian is not a cure for *hysteria*, but it is a most valuable palliative when employed to avert or mitigate hysterical paroxysms provoked by some accidental cause. Especially is this the case in females of weak constitution and excitable temperament, and who are exhausted by care and anxiety. It is still more efficient in preventing the development of those hysteroidal attacks which weak and morbidly sensitive girls and women are liable to, and which consist in an excessive susceptibility to impressions, and in the power of converting into real sensations the suggestions of a disordered fancy, whereby countless subjective perceptions and various disordered actions of the lungs, heart, stomach, etc. arise. In mild cases of *mental derangement*, especially when caused by nervous shock or strain; in nervous *atony* simulating paralysis; in cases also of irregular distribution of the blood, accompanied, it may be, with indications of cerebral congestion, or, on the other hand, of cerebral anæmia, of which the chief symptoms are *vertigo*, a sense of rush of blood to the head, or fainting, confusion of sight and hearing, etc., which more than at any other time are apt to occur about the menopause, —valerian is the most promptly efficient of all the palliatives that have been used. In all these cases valerian exhibits the same potency as asafetida, musk, and castor, and more decidedly. Oil of valerian dissolved in ether may be administered by inhalation in such attacks. Valerian is one of the best remedies for *nervous headache*, especially when it is associated with ammonia, as in the ammoniated tincture of valerian or the popular valerianate of ammonium. These preparations may be used advantageously, along with a carminative tincture, in cases of *flatulence* accompanied with palpitation of the heart. The same medicines are equally efficient in relieving *infantile colic*, an affection for which domestic medicine generally provides an analogous remedy in catnep.

Valerian is one of the innumerable articles that from time to time have been vaunted as remedies for *epilepsy*, and, allowing for the common error of confounding epilepsy with epileptiform reflex convulsions, and even with hysteria, there can be no doubt that it has sometimes cured the disease in females and young children, and especially when it originated in fright or some analogous impression. Even in these cases it must be administered in large doses and be long continued, while other and especially hygienic measures are employed to give permanent strength to the nervous system.

Valerian is useful in the treatment of the milder forms of *delirium tremens*, especially when they follow surgical operations or injuries, and in the ataxic phenomena which belong to the *typhoid state* of fevers and inflammations. It has had some reputation as a *vermifuge* for children when associated with purgatives, such as jalap, and by enema as a remedy for ascarides of the rectum. It has also been used successfully for the relief of *dysmenorrhœa* and in *polyuria* or *diabetes insipidus*. Bouchard, however, claims that when the urine contains an excess of urea (azoturia) or of sugar (glycosuria), valerian diminishes the amount of solids discharged and thus acts as a conservator of tissue and of force.

Valerian may be prescribed in powder in *doses* of from 30 to 90 grains (Gm. 2–6), repeated three or four times a day. Its disagreeable taste may be masked by the addition of an aromatic powder. Of its several preparations, the infusion and the fluid extract are to be preferred; next to these ranks the oil. The tincture, however, is officinal, and so is the ammoniated tincture, which is decidedly preferable to either the simple tincture or the fluid extract.

VALERIANATE OF CAFFEINE (so called) was tried by Paret (1875) in hysteria to moderate *nervous vomiting*, and in some cases with success, the medicine appearing to act as a general stimulant; in the vomiting of phthisis it was useless, but in *whooping cough* it decidedly lessened the paroxysms. It was given in pills, in the dose of 2 grains (Gm. 0.10), three times a day.

VANILLA, *U. S.*—Vanilla.

Fructus (s. Siliqua) vanillæ, P. G.—*Vanille*, Fr., G.

The prepared unripe fruit of Vanilla planifolia, *Andrews*. Bentley and Trimen, *Med. Plants*, 272.

Nat. Ord.—Orchidaceæ.

Origin.—The name "vanilla" is derived from the Spanish *baynilla*, the diminutive of *bayna*, a pod. The plant is indigenous to Eastern Mexico, where it grows in hot, moist woods, and is cultivated by fastening shoots to trees just above the ground, where they soon strike root, begin to produce fruits in about three years, and continue to bear for about thirty years. The plant has a long, fleshy stem, supporting itself by simple aërial rootlets, alternate sessile, fleshy, oval-lanceolate leaves, and axillary spikes of large greenish-white flowers, with a depressed recurved and crenate lip, and with an elongated, fleshy, cylindrical ovary. The cultivated plant is Schiede's Vanilla sativa. The wild growing plant (Schiede's V. sylvestris) is usually regarded as a mere variety of the former, and yields a smaller and less aromatic fruit, known in Mexico as *baynilla cimarona*. The vanilla-plant has been introduced into some of the West Indian islands, into Bourbon, Madagascar, and several East Indian islands. In its native country it is probably fertilized through the agency of insects; in other countries artificial fertilization is required.

Collection.—The fruit is collected before it is ripe, when the green color begins to change. In order to develop its aroma and to prevent its dehiscence, the unripe fruit is partly sun-dried or exposed to artificial heat, and then wrapped in blankets until it begins to sweat, when the exposure and subsequent wrapping up are repeated. Steeping in hot water is said to be in some places resorted to previously to drying. Some of the constituents are supposed to undergo a kind of fermentation, through which the odorous principle is developed. After the fruits have obtained the proper dark color, agreeable aroma, and sufficient dryness, they are tied into bundles of fifty, weighing a little over 8 ounces, and these are sometimes wrapped in tin-foil and packed in tin boxes. 16,570 pounds of vanilla were imported into the United States in 1877, and 98,542 pounds in 1882.

Properties.—The cultivated vanilla-fruit is known in Mexico as *baynilla corriente*, and is further distinguished and assorted according to its size and the thickness of its integuments. The finest quality attains a length of 12 inches (30 Cm.), has a thin pericarp, and is rarely seen in our market. The varieties usually met with are from 6 to 10 inches (15–25 Cm.) long, about ⅓ inch (8 Mm.) thick, and somewhat triangular, but flattened. Vanilla is of a dark-brown color, glossy, longitudinally wrinkled, somewhat narrowed at both ends, bent or hooked at the base, and rather oblique at the apex. The surface is frequently marked with a few circular or oblong warts, and some varieties are more or less covered with an efflorescence of acicular crystals. The integuments of the fruit are leathery, of a brown color; the interior is filled with a blackish-brown fragrant pulp, in which very numerous minute black flattish-ovate seeds are imbedded. The fruit is one-celled, and has three parietal placentæ, each projecting with four curved branches into the interior. The parenchyma of the integuments contains extractive, oil drops, and crystals of vanillin and calcium oxalate, and an irregular circle of about twenty delicate fibro-vascular bundles.

Varieties.—Mexican vanilla is regarded as the best. Bourbon vanilla resembles it, and is usually covered with crystals, but has an odor somewhat suggesting that of tonka. Costa Rica vanilla is less attenuated at the ends, and has hardly the fine flavor of the Mexican variety. Vanilla from the Seychelles is considerably thinner. A vanilla is produced in Venezuela which is 3 to 6 inches (7–15 Cm.) long, rather thick, and of a decided tonka flavor. Van. microcarpa, *Karsten*, a native of Venezuela, has a very aromatic fruit, about 3 inches (75 Mm.) long and ⅕ inch (5 Mm.) broad. In Brazil, Peru, and other parts of South America a broad and fleshy vanilla is obtained which is 6 to 8 inches (15–20 Cm.) long, about ½ inch (12 Mm.) wide, and of an inferior vanilla odor; it is probably the fruit of Vanilla pompona, *Schiede*. It is not unlikely that several other species besides those mentioned above yield vanilla, but the different species are very imperfectly known. Vanilla guianensis, *Splitberger*, indigenous to the north-eastern portion of South America, may yield some of the South American vanilla. Vanilla palmarum, *Lindley*, a native of Bahia, has a thick cylindrical not very fragrant fruit about 2 inches (5 Cm.) long. Vanilla aromatica, *Swartz*, is indigenous to South America, but not to Mexico, and its fruit is said to be not aromatic.

Constituents.—According to the analysis of Bucholz (1828), vanilla contains about 11 per cent. of fixed oil, 2.3 per cent. of soft resin, 6 per cent. of sugar, 11 per cent. of gum, and considerable extractive matter. Leutner (1872) obtained 4 per cent. of resin, 6.6 gum, 10 sugar, 4.7 per cent. of ash, and, besides a little wax and tannin, also oxalic and other acids. The odor of vanilla is not due to a volatile oil. The crystalline efflorescence was for a long time regarded as identical with either benzoic or cinnamic acid, but Bley (1831) proved it to be distinct from both, and Gobley (1858) established its difference from coumarin and named it *vanillin*. It is obtained from the alcoholic extract of vanilla by diffusing it in a little water, agitating with ether, and evaporating the ethereal liquid; the brown odorous residue yields to boiling water vanillin, which is purified by recrystallization and treatment with animal charcoal. Vanillin crystallizes in hard, colorless, four-sided prisms; has the odor of vanilla and a pungent, warm taste, melts near 80° C. (176° F.); sublimes when carefully heated; has a feeble acid reaction, and is freely soluble in boiling water, in alcohol, ether, fats, and volatile oils. It does not decompose alkaline carbonates, but dissolves in caustic alkalies, and is precipitated unaltered from the solutions on the addition of an acid; its aqueous solution is not affected by salts of tin, mercury, and silver, yields a pale-yellowish precipitate with basic lead acetate, and strikes a dark-violet color with ferric chloride. It dissolves in sulphuric acid with a yellow color, and by nitric acid is oxidized to oxalic acid. On account of its feeble acid properties Stokkebye (1864) proposed to name it *vanillic acid* (see below). Carles (1870) found its formula to be $C_8H_8O_3$, and this was corroborated by Tiemann and Haarmann (1874–78), who prepared vanillin artificially from *coniferin*, $C_{16}H_{22}O_8$, a compound contained in the sap of coniferous trees; this on being treated with emulsin is split into sugar and *coniferyl alcohol*, $C_{10}H_{12}O_3$, which on being oxidized with a mixture of sulphuric acid and potassium bichromate, like coniferin itself, yields vanillin. Vanillin was recognized as the aldehyd of methyl-protocatechuic acid, $C_6H_3.OCH_3.OH.CHO$; by careful oxidation this is converted into the nearly inodorous *vanillic acid*, $C_6H_3.OCH_3.OH.COOH$. The same authors have further shown the relation of these interesting principles to creosol, eugenol, ferulaic acid, caffeic acid, and other compounds, and devised a process for the artificial preparation of vanillin from oil of cloves, and proposed (1875) to estimate the amount of vanillin by completely exhausting not less than 30 Gm. of cut vanilla with ether, concentrating the ethereal tincture, agitating the liquid repeatedly with the solution of bisulphite of sodium, decomposing the mixed aqueous liquids with dilute sulphuric acid, and dissolving the liberated vanillin by agitation with ether. Mexican vanilla yielded 1.3–1.7, Java vanilla 1.6–2.75, and Bourbon vanilla 0.75–2.9 per cent. of pure vanillin; the last two varieties were found to contain, in addition, an oily matter having a disagreeable odor; and the fruit of Van. pompona, which yielded .4–.7 per cent. of vanillin, was observed to contain another compound, probably *benzaldehyd*, which modifies the odor of the former.

The poisonous effects repeatedly observed to be due to the use of vanilla as a flavor for ices have been referred by Schroff, in the absence of metallic poisons, to the presence of cardol, resulting from the alleged employment of the fixed oil of the cashew-nut (see p. 201) for improving the appearance of vanilla.

Pharmaceutical Uses.—Vanilla is employed in perfumery, for preparing Tinct. vanillæ, *U. S.*, and as a flavoring ingredient in Troch. ferri, *U. S.*

PULVIS VANILLÆ CUM SACCHARO, *F. Cod.*, VANILLA SACCHARATA. 1 part of finely-cut vanilla and 9 parts of sugar are triturated together until a grayish-white uniform powder is obtained, or 2 parts of vanillin dissolved in alcohol are mixed with 98 parts of sugar.

SYRUPUS VANILLÆ. Mix simple syrup with sufficient tincture of vanilla until the desired flavor is obtained.

Medical Action and Uses.—Workmen engaged in handling vanilla-beans are said to suffer from itching of the hands and face; the skin is covered with a pruriginous eruption, and swells, reddens, and desquamates. Others are affected with dizziness, weariness, and muscular pains. The eruption is produced by an acarus, which irritates without penetrating the skin (*Jour. Amer. Med. Assoc.*, i. 621). In Mexico, its native country, the Spanish conquerors found vanilla in common use for flavoring chocolate, and for this purpose it continues to be extensively used. Very probably it promotes the digestion of this aliment, as it does that of many other fatty and farinaceous articles of food, and therefore may be classed with the aromatics. In its action it has some analogy with balsam of Peru. Like the aromatics generally, aphrodisiac qualities are attributed to it. In medicine it is rarely employed alone, but it may be prescribed in powder in *doses* of from 5 to 30 grains (Gm. 0.30–2), mixed with sugar. A syrup made with it and the officinal tincture form agreeable flavoring ingredients of mixtures. It may be added also to troches for a similar purpose, as it is in the officinal troches of iron.

VAPORES.—INHALATIONS.

These are mixtures consisting of water with a volatile substance which are perhaps never made by the apothecary, and appear to be better adapted for extemporaneous prescription. The *vapores*, as originally employed in medicine, are external applications.

VAPOR ACIDI HYDROCYANICI, *Br.*—INHALATION OF HYDROCYANIC ACID.

Take of Diluted Hydrocyanic Acid 10 to 15 minims; Water (cold) 1 fluidrachm. Mix in a suitable apparatus, and let the vapor that arises be inhaled.—*Br.*

Medical Action and Uses.—The "inhalation of hydrocyanic acid" is too dangerous a remedy to be recommended under any circumstances. The difficulty, if not impossibility, of determining the exact strength of the solution, the various degrees of susceptibility to its action, and the promptly fatal effects of an overdose inhaled, should condemn it as a medicine.

VAPOR CHLORI, *Br.*—INHALATION OF CHLORINE.

Take of Chlorinated Lime 2 ounces; Water (cold) a sufficiency. Put the powder into a suitable apparatus, moisten it with the water, and let the vapor that arises be inhaled.—*Br.*

Medical Uses.—This preparation is a convenient means of obtaining chlorine for inhalation, but the necessity of making it officinal by prescribing the exact amount of chlorinated lime to be used is the reverse of apparent.

VAPOR CONINÆ, *Br.*—INHALATION OF CONINE.

Take of Juice of Hemlock ½ fluidounce; Solution of Potash 1 fluidrachm; Distilled Water 1 fluidounce. Mix. Put 20 minims of the mixture on a sponge in a suitable apparatus, so that the vapor of hot water passing over it may be inhaled.—*Br.*

The potassa is added for the purpose of liberating the conine contained in the juice.

VAPOR CREASOTI, *Br.*—INHALATION OF CREASOTE.

Take of Creasote 12 minims; Boiling Water 8 fluidounces. Mix the creasote and water in an apparatus so arranged that air may be made to pass through the solution and may afterward be inhaled.—*Br.*

VAPOR IODI, *Br.*—INHALATION OF IODINE.

Take of Tincture of Iodine 1 fluidrachm; Water 1 fluidounce. Mix in a suitable apparatus, and, having applied a gentle heat, let the vapor that arises be inhaled.—*Br.*

Medical Uses.—According to our experience, the proportion of tincture of iodine in this "inhalation" is entirely too large for ordinary use if the iodine is vaporized rapidly. It should be left to the judgment of those who are skilful enough to use such a preparation at all. Conine, creasote, and iodine are more efficaciously used by inhalation in atomized solutions.

VAPOR OLEI PINI SYLVESTRIS, *Br.*—INHALATION OF FIR-WOOL OIL.

Take of Fir-wool Oil 40 minims; Light Carbonate of Magnesium 20 grains; Water a sufficiency. Rub the fir-wool oil with the carbonate of magnesium and gradually add sufficient water to produce 1 fluidounce. Put 1 fluidrachm of this mixture with 10 ounces of boiling water into an apparatus so arranged that air may be made to pass through the solution and may afterward be inhaled.—*Br.*

VERATRINA, *U. S., Br., F. Cod.*—VERATRINE.

Veratria, Br.; *Veratrinum,* P. G.—*Vératrine,* Fr.; *Veratrin,* G.
Formula $C_{32}H_{52}N_2O_8$. Molecular weight 592.

Origin.—The mixture of alkaloids which is recognized by the pharmacopœias under the above names was first prepared by Meissner (1819) from sabadilla and named *sabadilline.* Pelletier and Caventou (1819) prepared similar substances from sabadilla and white veratrum, and called them *veratrine*, which name has since been applied to the product from the former source only (see also VERATRUM ALBUM), and this was known in an amorphous condition, and supposed to be uncrystallizable until Merck (1855) showed that a portion of it could be crystallized. Sabadilla-seeds are used for preparing veratrine; Schroff (1863), however, has shown that the capsules are very poisonous and probably contain the same alkaloids.

Preparation.—Take of Cevadilla 2 pounds; Distilled Water, Rectified Spirit, Solution of Ammonia, Hydrochloric Acid, each a sufficiency; Purified Animal Charcoal 60 grains. Macerate the cevadilla with half its weight of boiling distilled water in a covered vessel for 24 hours. Remove the cevadilla, squeeze it, and dry it thoroughly with a gentle heat. Beat it now in a mortar, and separate the seeds from the capsules by brisk agitation in a deep, narrow vessel or by winnowing it gently on a table with a sheet of paper. Grind the seeds in a coffee-mill, and form them into a thick paste with rectified spirit. Pack this firmly in a percolator, and pass rectified spirit through it till the spirit ceases to be colored. Concentrate the spirituous solution by distillation so long as no deposit forms, and pour the residue, while hot, into twelve times its volume of cold distilled water. Filter through calico, and wash the residue on the filter with distilled water till the fluid ceases to precipitate with ammonia. To the united filtered liquids add the ammonia in slight excess; let the precipitate completely subside, pour off the supernatant fluid, collect the precipitate on a filter, and wash it with distilled water till the fluid passes colorless. Diffuse the moist precipitate through 12 fluidounces of distilled water, and add gradually, with diligent stirring, sufficient hydrochloric acid to make the fluid feebly but persistently acid. Then add the animal charcoal, digest at a gentle heat for 20 minutes, filter, and allow the liquid to cool. Add ammonia in slight excess, and when the precipitate has completely subsided pour off the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water till the washings cease to be affected by nitrate of silver acidulated with nitric acid. Lastly, dry the precipitate first by imbibition with filtering-paper, and then by the application of a gentle heat.—*Br.*

Alcohol extracts from sabadilla-seeds veratrine in its natural combination with veratric acid. On evaporating the alcohol, diluting the syrupy liquid with water, and filtering from the resin the liquid contains veratrate of veratrine, and this salt is decomposed by ammonia or potassa; the alkaloid thus isolated requires to be purified by washing with water, dissolving in a dilute acid, and freeing from coloring matter by animal charcoal; ammonia will then precipitate veratrine as a white powder.

The concentrated alcoholic extract may also be deprived of its alkaloidal constituents by boiling with acidulated water, and the acid solution decomposed by magnesia, the excess of which remains with the liberated alkaloids; the latter are taken up by alcohol combined with sulphuric acid, the alcohol evaporated, the remaining aqueous solution decolorized by animal charcoal, and the veratrine precipitated by ammonia. This was the process of the U. S. P. 1870.

The outlines of the process of the French Codex are as follows: Exhaust with alcohol acidulated with sulphuric acid, add slaked lime to the tincture to liberate the alkaloids, filter from the calcium compounds, distil off the alcohol, dissolve the residue in dilute sulphuric acid, decolorize by means of animal charcoal, precipitate by ammonia, again dissolve in alcohol, and repeat the treatment as before; finally, dissolve the washed and dried veratrine in ether, filter, and evaporate spontaneously.

Several other processes have been recommended for the preparation of veratrine, in which advantage is taken of its ready solubility in acidulated water. Delondre (1855) exhausts the powdered seeds by percolation with water acidulated with hydrochloric acid, precipitates with potassa, and exhausts the washed and dried precipitate with ether, on the evaporation of which the alkaloid is left behind. Merck's process is somewhat similar: powdered sabadilla is boiled with very dilute hydrochloric acid, the solution concentrated to a syrupy consistence, and further acidulated with hydrochloric acid as long as a precipitate of veratric acid appears. The filtrate is precipitated with lime; the precipitate is collected and exhausted with alcohol; the alcohol is distilled off, and the residue dissolved in dilute acetic acid. On the addition of ammonia, veratrine is precipitated; it is obtained as a crystalline powder by dissolving it in ether and evaporating, as directed by the French Codex.

Properties.—As obtained by the first process, veratrine is a white or whitish amorphous powder, permanent in the air, without odor, powerfully sternutatory, and very irritating to the nostrils, and has a persistently acrid taste, "leaving a sensation of tingling and numbness on the tongue and producing constriction of the fauces" (*U. S.*). It imparts to water an acrid taste, but requires about 1000 parts of boiling water for solution, the excess of the alkaloid cohering in lumps without melting. It has an alkaline reaction to test-paper, neutralizes acids, and when heated melts, and afterward is decomposed, forming a spongy charcoal, and is finally dissipated without leaving any residue. Veratrine is soluble in 3 parts of alcohol and dissolves in about 6 parts of ether (Delondre), in 1.6 (Pettenkofer) or 8.6 (Schlimpert) parts of chloroform; in 96 parts of glycerin (Cap and Garot) and 56 parts of olive oil (Pettenkofer). Nitric acid imparts to veratrine a yellow color or forms a reddish-yellow solution. Its solution in concentrated hydrochloric acid acquires by heat a deep-red color, which remains unaltered for several weeks (Trapp 1862). Sulphuric acid dissolves veratrine with a yellow color, changing in a few minutes to orange-red, then to blood-red, in about 30 minutes to carmine-red, and subsequently to violet color (Henry). Masing (1869) observed that .00017 Gm. of veratrine may be detected with the last two tests, but that the reaction with hydrochloric acid is less interfered with by the presence of extractive matter. The fresh solution of veratrine in sulphuric acid becomes at once purple-colored on the addition of bromine-water. "On triturating 1 part of veratrine with 100 parts of sulphuric acid, the solution shows a green-yellow fluorescence, the color gradually changing to red" (*P. G.*). The U. S. P. directs for this test no definite quantity of sulphuric acid, but states that the fluorescence first observed becomes more intense on adding more sulphuric acid. On sprinkling powdered sugar upon a thin layer of the solution of veratrine in sulphuric acid, a yellow color is produced, changing to green and blue, and becoming paler after an hour (Weppen, 1874).

Tests.—The tests just described establish the identity of veratrine. On being ignited upon platinum-foil no residue should be left.

Composition.—The formula given above is that ascertained by Merck for the crystalline alkaloid in large colorless, rhombic prisms, which on exposure become white, opaque, and friable, and lose their shape in boiling water without melting or dissolving. The crystals are obtained by dissolving medicinal veratrine in alcohol, adding water until a permanent precipitate begins to appear, and evaporating spontaneously; the residue will consist of crystals imbedded in a brown amorphous resin-like mass, which is removed by cold alcohol, after which the crystals may be purified by recrystallizing from strong alcohol. Weigelin (1871) ascertained that veratrine exists in two distinct modifications, one of which is soluble in water, and by heating the solution is converted into the insoluble variety, which has a resinous appearance; analysis led to the composition $C_{52}H_{86}O_2N_{15}$. According to E. Schmidt (1877), commercial veratrine contains three distinct modifications—namely, a crystalline base soluble in water, and two amorphous bases, one of which is soluble, the other insoluble, in water. The crystalline base predominates, and is regarded by Schmidt as veratrine proper; he gives it the formula $C_{32}H_{50}NO_9$; its platinochloride was found to be easily soluble in alcohol, less soluble in water, and insoluble in ether. The amorphous modifications appear to have the same formula, which differs from that given by Merck chiefly in the amount of nitrogen.

On treating medicinal veratrine with ether, a residue is left from which Couërbe (1834) isolated a second crystallizable alkaloid, *sabadilline*, for which Weigelin gives the formula $C_{41}H_{66}N_2O_{13}$. It is not sternutatory, and dissolves more or less freely in water, benzol, petroleum benzin, amylic alcohol, and chloroform; neutralizes the acids completely, but yields amorphous gum-like salts with sulphuric and hydrochloric acid, which are not precipitated by alkalies or their carbonates, and yield but slight precipitates with phosphotungstic acid and potassio-cadmium iodide. That portion of medicinal veratrine which is soluble in ether yields to hot water, in which veratrine is insoluble, a third alkaloid, which Weigelin named *sabatrine*, and found to have the composition $C_{51}H_{86}N_2O_{17}$. It is likewise soluble in benzol, petroleum benzin, amylic alcohol, and chloroform, is amorphous and yields amorphous salts, which are precipitated by hot potassium hydrate and carbonate if not added in excess.

The most recent investigation on the sabadilla alkaloids was made by C. R. A. Wright and A. P. Luff (1878), who were unable to find sabadilline. They regard sabatrine as an alteration-product. They retain the name *veratrine* for the amorphous alkaloid of medicinal veratrine, and deny the existence of isomeric modifications; they give it the formula $C_{37}H_{53}NO_{11}$, and state that on saponification it splits up into veratric acid and a new base, *verine*, $C_{28}H_{45}NO_8$. Merck's crystallizable base is named by them *cevadine*, and is stated to have the composition $C_{32}H_{49}NO_9$, and, on saponification, to be resolved into a new base, *cevine*, $C_{27}H_{43}NO_8$, and the cevadic acid of Pelletier and Caventou, which is methyl-crotonic acid, $C_5H_8O_2$. The third alkaloid, *cevadilline*, $C_{34}H_{53}NO_8$, is insoluble in ether, is probably identical with sabadilline, but separates in an amorphous condition from benzol, and on saponification yields methyl-crotonic acid and the base *cevilline.* 20 pounds of sabadilla-seeds yielded between 60 and 70 Gm. of mixed alkaloids.

It will be observed that medicinal veratrine is a mixture of two or three alkaloids naturally existing in sabadilla, and of several derivatives from these alkaloids.

Off. Prep.—Oleatum veratrinæ, *U. S.;* Ung. veratrinæ, *U. S.*, *Br.*

Physiological Action.—*On Animals:* The action of this alkaloid has been illustrated by numerous experimenters, who agree substantially in their description of it. Administered in moderate doses to hogs, horses, and other quadrupeds, it occasions anxiety and restlessness, a profuse secretion of saliva, colic, vomiting, and purging (the last effects whether the agent is administered by the mouth or hypodermically), general muscular debility, and some spasmodic movements. Under the influence of larger doses the nervous phenomena, spasmodic as well as paralytic, are more marked; the limbs are unable to support the body; the action of the heart becomes slow, irregular, and intermittent, and the respiration deep and labored; the vomiting is violent, and the stools may be bloody. In directly fatal doses veratrine depresses the whole nervous system; the respiration and circulation are gradually suspended, the convulsive movements pass into tetanus, the rigidity of the muscles of the chest impede respiration, and death takes place by asphyxia. Accordingly, after death the lungs and heart are found gorged with blood, and the latter organ has lost its irritability, but there is no trace of inflammation of the stomach. The tetanizing and paralyzing actions of veratrine appear to occur as direct effects of the poison upon the muscles, and not through the intervention of the spinal cord, for they may take place in the muscles of a limb whose nervous connection with the spinal marrow is destroyed; and. conversely, they do not occur when, all other connections being severed, the spinal nerves communicating with the limb are left intact. That the tetanizing effect results not from an action of the poison upon the spinal marrow, but from a direct action upon the muscles or upon the ends of the nerves, is also to be inferred from the fact that in the animal operated upon tetanic spasm is not excited by a direct mechanical irritation of the nerves, but by the voluntary muscular acts of the animal. It also follows irritation of the muscles themselves, which may then take on prolonged, and even permanent, tetanic contraction until their vitality is completely exhausted. Karewski's experiments on frogs show that veratrine arrests the heart in systole, precisely as digitalis does, by progressively increasing the contraction of the heart-muscles (*Zeitsch. f. klin. Med.*, v. 450); and those of Pécholier and Redier equally demonstrate that it arrests the heart in diastole (*Bull. de thérap.*, cv. 430).

On Man: Veratrine has a bitter and acrid taste, and the least portion of it placed upon the tongue produces a peculiar and persistent numbness and tingling, with irritation of the throat and salivation. The minutest quantity of it introduced into the nostrils, and even the casual approach of a vial containing it to the nose, occasion protracted irritation and sneezing, and sometimes coughing. Applied in alcoholic solution or in an ointment to the sound skin, it produces a slight prickling sensation, and upon very delicate portions of the integument a pain compared to that which might be occasioned by its puncture with hot needles. The pain, however, is transient, and is followed by a sense of coolness and numbness. If the preparation is strong and is applied with friction, an eruption of vesicles may follow. If well rubbed in, particularly upon the face, slight twitching of the muscles is sometimes observed, and, more rarely, formication, which extends to remote parts of the body. Applied to the denuded skin or injected hypodermically, it causes severe pain, muscular twitching, and the other ordinary effects of its internal administration. These effects vary with its dose. The fortieth and from that to the twentieth of a grain (Gm. 0.001–0.003) occasions tingling which begins in the fingers and toes, and thence extends to the whole body, followed by a sense of numbness in the same parts and more or less lowering of the pulse. If the usual limit of medicinal doses is exceeded, and from one-twentieth to one-tenth of a grain (Gm. 0.003–0.006) of the alkaloid or of its acetate is taken, there may occur great faintness and pallor; increased frequency, irregularity, and weakness of the pulse; nausea and vomiting, usually of bilious liquids; diarrhœa, sometimes with bloody stools; cold sweating and muscular twitching; and aching along the spine. If the dose is repeated at intervals, the gastro-intestinal symptoms subside, but the pulse falls considerably below the normal rate. There is also a good deal of irritation and constriction of the fauces, with secretion of mucus.

A woman who swallowed about 3 grains (Gm. 0.20) of veratrine in a liniment containing chloric ether and opium was affected with giddiness, faintness, nausea, thirst, diarrhœa, tenesmus, and constriction of the abdomen; the tongue was swollen, the mouth and throat sore, the pupils contracted, the breathing hurried, the pulse small and quick, the action of the heart feeble. There was extreme itching of the skin which lasted for several days, a tingling which did not cease for two months, and a peculiar spasmodic snapping of the lower jaw (*St. George's Hosp. Rep.*, v. 69).

Medical Uses.—Veratrine was used first internally as a remedy for *neuralgia*, and in the most obstinate form of that affection, *sciatica*, which so often depends upon material alterations of structure. It is now very seldom given internally in this or any other variety of neuralgia, but is of common use as a topical application in the functional forms of the affection. Although inferior for this purpose to aconitine, it is nevertheless efficient in many cases of neuralgia of the fifth pair, of the intercostal nerves, and others. Very probably it acts both by obtunding the sensibility of the painful part and by its counter-irritant operation upon the skin when it is applied in due strength directly to the sensitive points of the nerve. It is sometimes injected hypodermically, $\frac{1}{6}$ grain (Gm. 0.01) at a time, but an application of the officinal ointment of veratrine is preferable. It is rendered much more efficient by the addition to each drachm of it of 2 or 3 grains of muriate or sulphate of morphine. In various forms of *pruritus* the topical use of veratrine is an efficient palliative. It may be given internally with advantage when the itching is general.

In the treatment of *acute articular rheumatism* this medicine has been systematically employed, by beginning on the first day of the treatment with a single dose of $\frac{1}{13}$ grain (Gm. 0.005), and on each successive day giving an additional dose until the sixth or seventh day, unless the disease sooner yielded or the toxical effects of the medicine were developed. In the latter case it was suspended or its dose diminished. It was claimed for this treatment that it speedily reduced the fever and subdued the pain of the disease, and that in a patient of unimpaired constitution it frequently triumphed over an acute attack of the disease in a week. It was further asserted that it did not, like copious bloodletting, exhaust the patient's strength and develop anæmia. This advantage over the older sanguinary method may be admitted, but there is not a shadow of evidence to demonstrate its power of shortening an attack of rheumatism, or, above all, of preventing the most serious of the ordinary complications of the disease, inflammation of the heart and its membranes. Indeed it is seldom employed at present, and those who imagine that the cure of rheumatism consists in repressing certain of its symptoms find in the preparations of green hellebore equally efficient and less dangerous agents. The same remark is literally applicable to the use of veratrine in *pneumonia*. The strongest reason that could be found by an eminent therapeutist for employing veratrine in this disease was that "the results from its use appear to be comparable to those of the antimonial treatment" (Trousseau). But since the latter is one of the most mischievous that was ever employed, the merit of the former may be duly estimated. If some will use this medicine as they would green hellebore, digitalis, aconite, etc. in febrile affections, they should be prepared with diffusible stimulants to combat its sedative effects when they grow alarming.

Veratrine has occasionally been used to allay disordered action of the *heart* in acute and also in chronic diseases of that organ, and it may sometimes become a useful palliative of this distressing symptom, and thereby even avail to diminish cardiac dropsies. But for such purposes other preparations of veratrum are preferable. It is unnecessary to discuss its virtues in eruptive fevers or in typhoid fever, for which it has sometimes been prescribed, or in nervous affections, such as whooping cough, chorea, hysteria, and functional paralysis, or to do more than state the fact of its having been employed topically to reduce enlarged glands, scrofulous swellings of joints, etc. It is sufficient to state that Liebermeister (*Handbuch des Fiebers*, S. 643), even while advocating its use, warns against giving it to persons with a feeble heart, and, while admitting that it may produce collapse, claims that food and alcohol will rescue the patient from that peril. It is alleged by Féris that various *tremors*, including those due to alcohol, fever, nervous degeneration, etc., are benefited by veratrine in doses of gr. $\frac{1}{120}$ (Gm. 0.0005) three or four times a day (*Practitioner*, xxxii. 212). The statement seems highly improbable.

Administration.—Owing to its very acrid taste, veratrine is generally given internally in pilular form in doses varying from $\frac{1}{40}$ to $\frac{1}{4}$ grain (Gm. 0.0016–0.016). The dose should be rapidly but cautiously increased from the minimum until nausea or slowing of the pulse occurs. Externally, the officinal ointment is a convenient preparation for application by friction, which should be made with a mop or with the finger guarded by a glove, and until a feeling of burning or prickling is perceived by the patient. Solutions in oil and in glycerin may be applied in the same manner. For endermic use from $\frac{1}{8}$ to $\frac{1}{2}$ grain (Gm. 0.008–0.033), mixed with starch, may be prescribed. Hypodermically, $\frac{1}{6}$ grain (Gm. 0.01) may be employed at a single operation, but the method is objectionable on account of the pain it occasions and the probability of abscess being caused by it. In poisoning by veratrine the stomach should first be evacuated, then washed with a solution of tannin, and the sedation combated with alcohol, ammonia, electricity, artificial respiration, etc.

Tulipine, an alkaloid derived from the common tulip, is said by Dr. Ringer to be a muscle-poison, like veratrine, although weaker. It paralyzes either the cord or the afferent nerves, or both; its action on the motor nerves, if any, is slight; it affects the heart of frogs like veratrine, and does not affect the pupil (*Practitioner*, xxv. 241).

VERATRUM ALBUM.—White Veratrum (Hellebore).

Rhizoma veratri, P. G.; *Radix hellebori albi.*—*Vératre* (*Hellébore*) *blanc*, Fr.; *Weisse Nieswurzel*, *Weisser Germer*, G.

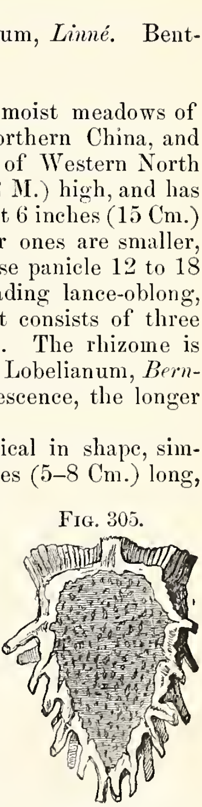
The rhizome (*F. Cod.*), with the rootlets (*P. G.*), of Veratrum album, *Linné*. Bentley and Trimen, *Med. Plants*, 285.

Nat. Ord.—Melanthaceæ.

Origin.—Veratrum album is an herbaceous perennial growing in moist meadows of the Pyrenees and Alps and eastward throughout Russia, Siberia, Northern China, and Japan. It has likewise been found in Colorado and in other parts of Western North America (Ver. californicum, *Durand*). The stem is 2 to 4 feet (.6–1.2 M.) high, and has numerous alternate elliptic or broadly oval, entire leaves, which are about 6 inches (15 Cm.) long, strongly ribbed and plicate, and sheathing at the base; the upper ones are smaller, narrower, and lanceolate in form. The inflorescence is a large racemose panicle 12 to 18 inches (30–45 Cm.) long, with polygamous flowers having six spreading lance-oblong, yellowish-white, and externally green sepals. The three-horned fruit consists of three partly-united follicles containing numerous flattened and winged seeds. The rhizome is collected in autumn. The variety viridiflorum, *Mertens et Koch* (Ver. Lobelianum, *Bernhardi*), grows in Europe, and differs chiefly in the more simple inflorescence, the longer bracts, and the pale-green flowers.

Description.—The rhizome of white veratrum is upright, obconical in shape, simple or occasionally divided above into two branches; it is 2 to 3 inches (5–8 Cm.) long, and about 1 inch (25 Mm.) thick, tufted above with the remnants of the leaf-bases, truncate below, the lower half beset with dead and the upper portion with yellowish fleshy nearly simple rootlets, which shrink considerably in drying and are 8 to 12 inches (20–30 Cm.) long and about $\frac{1}{12}$ inch (2 Mm.) thick. In the commercial drug the rootlets were formerly often cut off close to the rhizome, and this has been occasionally divided to facilitate the drying. The rhizome is somewhat annulate, externally of a dull black-gray color, and either closely surrounded with rootlets or tuberculated from the root-remnants; internally it is whitish or grayish-white, and shows upon transverse or longitudinal section, at a distance of about $\frac{1}{8}$ inch (3 Mm.) from the outer surface, a brownish wavy nucleus-sheath, and in the inner portion numerous small wood-bundles, which are scattered, irregularly curved in various directions, and rather crowded near the nucleus-sheath; outside thereof only a few small wood-bundles are seen passing into the rootlets. The nucleus-sheath consists of one or occasionally two rows of cells, having the inner cell-walls much thickened; the parenchyma-cells are filled with small starch-granules or a few of them with raphides of calcium oxalate. The drug is inodorous, but its dust is strongly sternutatory; its taste is bitter and burningly acrid.

Fig. 305.



Veratrum album, *Linné*: longitudinal section of rhizome.

Constituents.—Pelletier and Caventou (1820) obtained from white veratrum liquid and solid fat, a volatile acid, gum, starch, and an alkaloid, which they declared to be identical with veratrine, and to be combined with gallic acid. The existence in veratrum of gallic acid was, however, denied by Pfaff and by Weigand (1841). The latter found in it about 10 per cent. of pectin. E. Simon (1838) announced the isolation of a second alkaloid, *jervine*, $C_{30}H_{46}N_2O_3$. After Charles Bullock (1865) had proved the non-existence of veratrine in Veratrum viride Dragendorff (1872) announced its absence also from white veratrum; and this observation was corroborated by C. L. Mitchell (1874), who found in it, besides jervine, a second alkaloid, which he named *veratralbine*. Wright and Luff (1879) announced the presence in 1 kilogram of white veratrum of 4.20 Gm. of alkaloids, of which 1.30 is jervine, $C_{26}H_{37}NO_3$, 0.40 pseudojervine, $C_{29}H_{43}NO_7$, 0.25 rubijervine, $C_{26}H_{43}NO_2$, 2.20 veratralbine, $C_{28}H_{43}NO_5$, and 0.05 another sternutatory base, probably veratrine.

Jervine, when pure, is a white powder, crystallizes from alcohol, is tasteless, not sternutatory, insoluble in water and ether, soluble in alcohol and chloroform, and melts between 198° C. (Bullock) and 237° C. (Wright). Its salts with acetic and phosphoric acids are soluble in water, and these solutions are precipitated by sulphuric, hydrochloric, and nitric acids and their soluble salts. According to Bullock (1875), its acetic acid solution, treated with potassium nitrate, affords a ready method for obtaining the alkaloid in a pure state. Sulphuric acid colors jervine yellow, changing to green, and finally to turbid yellow; on the addition of bromine the green color changes to a faint brownish tint. The other color reactions (yellow by nitric or boiling hydrochloric acid) are not very characteristic.

Pseudojervine, like jervine, dissolves in strong sulphuric acid with a yellow color, the solution gradually turning green; its sulphate is tolerably soluble in water. The alkaloid melts at 299° C. and is insoluble in ether.

Rubijervine is soluble in ether, melts at 237° C., is colored red by sulphuric acid, forms a readily soluble sulphate, and is not sternutatory.

Veratralbine is white, uncrystallizable, bitter, burningly acrid, and violently sternutatory. It dissolves in alcohol, amylic alcohol, ether, chloroform, carbon bisulphide, and in dilute acids, forming soluble and uncrystallizable salts. It melts near 170° C. (338° F.) and sublimes in small feathery crystals. In its behavior to reagents it closely resembles *veratroidine*, and is regarded by Tobien (1877) as being identical with it. According to Wright and Luff, pure veratralbine is not sternutatory.

Weppen (1872) could not find Weigand's pectin, and leaves it undecided whether the presence of that compound is due to an adulteration or to the period at which the rhizome had been collected. Pelletier and Caventou's gallic acid was recognized as a new acid, called jervic acid, and the coloring matter as *veratramarin*, a light-yellow, very bitter, and deliquescent neutral principle, which is present in very minute quantity, so that 60 pounds of the rhizome yielded a quantity insufficient for a thorough chemical investigation. Veratramarin is easily soluble in water and alcohol, insoluble in ether, benzol, chloroform, and petroleum benzin, and is precipitated from its solutions by subacetate of lead and tannin.

Jervic acid, $C_{14}H_{10}O_{12}.2H_2O$, is a white crystalline powder, has an acid taste, is insoluble in benzol, carbon bisulphide, chloroform, petroleum benzin, and amylic alcohol, is very sparingly soluble in absolute alcohol and ether, and requires more than 100 parts of cold water for solution. The acid is neither fusible nor sublimable; its silver salt crystallizes from the solution in hot water, is insoluble in dilute nitric acid, and is not altered on exposure to light.

Dr. Jos. Waltl (1828) considered the rhizome, with the rootlets attached, to be more active than the rhizome alone, and Schroff (1860) announced the rootlets to have a more powerful action than the rhizome, and somewhat different from it.

Medical History.—White hellebore—or hellebore, as it was distinctively called by the Greeks—was used by them in the treatment of chronic diseases rebellious to ordinary remedies, such as insanity (especially melancholy), dropsy, diseases of the skin, tetanus, gout, hydrophobia, tic douloureux, etc. It was always associated with lenitives to moderate its violent action. It gradually fell into disuse.

Physiological Action.—*On Animals:* White hellebore is poisonous to all animals. Its effects are nearly the same when, experimentally, it is introduced into the system by the stomach or the blood-vessels. They consist of retching or vomiting, salivation, general debility, a small, feeble, irregular, or rapid pulse, slow and labored breathing, spasm of the abdominal muscles, general tonic or clonic convulsions, tremulousness and tottering, urination, sweating, contracted pupils, and insensibility. After death the lungs are congested, and when the poison has been administered by the stomach its mucous membrane is very red.

On Man: When taken internally in poisonous doses it occasions soreness of the mouth and swelling of the tongue, burning heat in the stomach, vomiting, anxiety, tremor, vertigo, weakness of the limbs, syncope, aphonia, interrupted respiration, a feeble pulse, convulsions, sinking, distortion of the eyes, dilated pupils, blindness, mental aberration, prolonged insensibility, and cold sweating. Among these symptoms purging is not mentioned, but it occurs under the prolonged use of the drug. When death has resulted directly from poisonous doses, signs of active gastro-intestinal inflammation and congestion of the lungs have been found. In poisoning with recovery there have been observed for several days debility, tremulousness, muscular twitching, and a sense of constriction and distress in the præcordial region.

Medical Uses.—White hellebore is now hardly used as an internal medicine. Externally, it has been applied in decoction to destroy *vermin* in man and beast and for the relief of *pruritus vulvæ.* It was formerly employed in the treatment of *itch.* Its irritant properties caused it to be used as an *errhine* when diluted with starch or some other inert powder or with snuff. In this way it is sometimes made use of to relieve the frontal headache which occurs in certain cases of *coryza.* If it is administered internally the commencing *dose* should not exceed 1 or 2 grains (Gm. 0.06–0.12).

VERATRUM VIRIDE, *U. S.*—Veratrum Viride.

Veratri viridis rhizoma (radix), Br.—*American or Green veratrum (hellebore), Indian poke,* E.; *Vératre vert,* Fr.; *Grüner Germer,* G.

The rhizome and rootlets of Veratrum viride, *Aiton* (Ver. album, var. viride, *Baker,* Melanthium virens, *Thunberg*). Bentley and Trimen, *Med. Plants,* 286.

Nat. Ord.—Melanthaceæ.

Origin.—Green veratrum grows in swampy places and on the border of damp thickets in Canada, and in the United States as far south as Georgia. It resembles the white veratrum so closely that no important botanical difference between them can be ascertained, and Asa Gray remarks that it is "much too near Veratrum album of Europe." It more especially resembles the green flowering variety, Lobelianum, and Regel (1861) regarded it as identical with a variety growing in Eastern Siberia. Its flowers are yellowish-green and appear in June. The rhizome is collected in autumn.

Description.—The rhizome agrees in size, shape, color, taste, and structure so closely with that of white veratrum that it is difficult, if not impossible, to distinguish the two drugs if they have been trimmed alike. The American veratrum is nearly always dried with the rootlets attached, and these are from 4 to 10 inches (10–25 Cm.) long, about $\frac{1}{12}$ inch (2 Mm.) thick, much shrivelled, and of a light yellowish-brown color; those on the lower part of the rhizome, if present, are thinner and black. We have occasionally found considerable portions of the leaf-stalks and stems present in the commercial drug; these parts appear to be inert or nearly so, and should be rejected.

Constituents.—H. W. Worthington (1838) isolated an alkaloid from green veratrum which he regarded as identical with veratrine. The same conclusion was arrived at by J. G. Richardson (1857) and by G. J. Scattergood (1861). But Charles Bullock (1865) proved that American veratrum contains two alkaloids, neither of which is identical with veratrine. These alkaloids were subsequently named by Prof. G. B. Wood *viridine* (insoluble in ether) and *veratroidine* (soluble in ether). E. Peugnet (1872) recognized the so-called viridine as impure *jervine,* and C. L. Mitchell (1874) made the same observation. In the same year Mitchell characterized *veratroidine* as follows: It is a white uncrystallizable powder of a bitter taste, leaving a tingling sensation in the fauces, violently sternutatory, and extremely irritating. It fuses near 130° C. (265° F.), is soluble in alcohol, amylic alcohol, ether, chloroform, carbon bisulphide, and when freshly precipitated slightly in petroleum benzin. It forms soluble salts with the acids, most of which are uncrystallizable. Sulphuric acid colors it yellow, changing to dark-red. Boiling hydrochloric and nitric acids color it yellow. Tobien's (1877) elementary analysis leads to the formula $C_{51}H_{78}N_2O_{16}$ or to $C_{24}H_{37}NO_7$. He obtained both jervine and veratroidine also from the rhizome and the young leaves of Veratrum lobelianum, and found in the dried rhizome of Veratrum album but little jervine and a larger quantity of veratroidine. C. A. Robbins (1877) announced that he had isolated from American veratrum, besides jervine, another crystallizable alkaloid, which is soluble in ether, and which produces with sulphuric acid and sugar a yellow color changing to blue, and with sulphuric acid a yellow color quickly changing to a pink-red, and after several hours to indigo-blue; presence of jervine or of coloring matter prevents the appearance of the blue color. Bullock (1879) obtained 0.66 per cent. of mixed alkaloids. Wright and Luff (1879) only 0.08 per cent., that portion remaining with the resins probably escaping their notice. The latter investigators consider over one-half of the alkaloids to be cevadine (see Veratrina), one-fourth to be jervine, nearly one-fifth to be *pseudojervine*, and the remainder *rubijervine*, while less than 0.0004 per cent. is regarded by them as *veratrine*, the presence of which, besides jervine, in both the American and white veratrum was announced by Prof. Wormley in 1876. Bullock, however, obtained fully two-thirds of the alkaloids as nitrate of jervine, the remainder being Wright's rubijervine, with probably some pseudojervine. (See Veratrum Album.)

In the investigations recorded above no notice has been taken of the probable difference in the composition of the rootlets and rhizome, as suggested by Prof. Schroff. The rhizome of American, like that of the white veratrum, contains considerable resin, from which the alkaloids are not easily purified.

Off. Prep.—Extr. veratri vir. fluid., *U. S.;* Tinct. veratri viridis, *U. S.*, *Br.*

Medical History.—Green veratrum was well known to the aborigines of this country for its poisonous properties, and was subsequently used by farmers to poison the birds that ravaged their crops. It was also employed at a later period (1835) in the treatment of various fevers and inflammations, but its vogue remained local until 1850, when extravagant accounts of its virtues were widely disseminated. Since that time it has been more generally used both at home and abroad, but chiefly by those physicians who disregard the interdependence of morbid phenomena, forget that the suppression of a symptom is not the cure of a disease, and overlook the consideration that while the exhibition of fever may be prevented the causes of fever may be destroying life.

Physiological Action.—*On Animals:* Birds poisoned by corn soaked in an infusion of green veratrum have their muscular power temporarily so much impaired as to prevent their flying or walking. The alkaloids and resin, given internally, occasion prolonged vomiting, salivation, prostration, and slowing of the pulse. The tincture injected hypodermically in frogs, dogs, and rabbits causes the pulse to fall as much as 40, 50, or even 100 beats in a minute, while the temperature declines by from 1°–5° C., and the breathing grows slow and irregular. In animals that vomit vomiting and purging precede the other symptoms. The most conspicuous symptom is complete prostration, which no stimulants overcome, but which, in course of time, ceases spontaneously. According to Dr. H. C. Wood, veratroidine slows the respiration, and ultimately produces asphyxia, while the pulse beats rapidly. But until asphyxia threatens the heart and pulse act more slowly and the blood-pressure is reduced, and if asphyxia is prevented by artificial respiration the pulse continues to fall. In all doses it affects the respiration, but only in large doses appears to act directly upon the cardiac muscles. Its power of lowering the pulse-rate appears to be exercised through the par vagum. Like many other medicines, it produces opposite effects, inhibitory or stimulating, according as its dose is large or small. Poisonous doses are sufficient to neutralize the influence of the most intense faradaic currents. Viridine (or jervine), according to the same authority, in its action upon the circulation, and as compared with the influence upon the respiration, is much more powerful than veratroidine. Like veratroidine, it slows the pulse and lessens the arterial pressure by a direct action upon the cardiac muscles and upon the vaso-motor centres. It seems not to affect the inhibitory and accelerator nerves of the heart, as veratroidine does.

On Man: Green veratrum is a powerful irritant. Its powder, snuffed into the nostrils, causes violent and prolonged sneezing. Applied to the skin in a moist state, it occasions redness and burning. Taken internally in full doses, it excites nausea, with persistent and violent vomiting, sometimes accompanied by purging, and a reduction of the force and frequency of the pulse and the animal temperature. The pulse may be reduced to 35 or 40 in a minute, and in some exceptional cases to 22. Excessive doses give rise to the following symptoms: faintness, somnolency, coma (?), dimness of sight, dilatation of the pupils, vertigo, headache, rarely delirium, impaired muscular power, general numbness, slow and infrequent respiration, hiccough, a pale cold skin covered with a clammy sweat, persistent vomiting, excruciating pain in the præcordium, flatulence, profuse watery diarrhœa in some cases, and a small, infrequent, and feeble pulse. It is remarkable that diarrhœa so rarely is present as an effect of excessive doses of this medicine, and that, notwithstanding the sedation of the heart and the general appearance of collapse produced by them, only one case of fatal poisoning of an adult by green veratrum should have been recorded. "A gentleman aged about thirty years went into a drugstore which he frequented and helped himself to what he supposed was a *drink* of whiskey. It proved to be veratrum viride, and it killed him in about four hours" (Kirk, *Med. and Surg. Reporter*, Apr. 26, 1879). It is said to have caused death in two cases of children, the one eighteen months and the other eleven months old. It has been supposed to be an abortifacient, but there is no evidence that it is so, except in so far as all violent emetics may produce abortion.

Medical Uses.—The greater number of reports which have been published concerning the medicinal uses of green veratrum are, unfortunately, not only deficient in the details on which a judgment could securely rest, but exhibit great ignorance of the natural history of disease and of the relation of medicines to its cure. There are many reporters who attribute to this medicine equal curative virtues in asthenic and sthenic diseases, in inflammations and in fevers, and not a few who extol its virtues when it formed only one of several active agents simultaneously administered to the patient. The only conclusion to be drawn from a critical study of the mass of conflicting evidence respecting its use in the diseases referred to is, that the patients would have been better off not only without its use, but also without that of the medicines associated with it. The suggestion has been made that the effects of veratrum viride and of depletion are so similar that the drug may serve as a substitute for that operation; upon which it may be remarked that the condemnation of venesection *upon scientific grounds* has been so general and complete that to advocate a medicine on account of its supposed analogy to depletion is not to recommend it. Nor should it be forgotten that this identical reason was at one time urged in favor of substituting digitalis for depletion. Now, veratrum viride and digitalis are physiological antagonists. But venesection does much more than reduce the pulse-rate in inflammatory affections (and, indeed, in comparison with green veratrum, its action is in this respect very insignificant), it takes away from the blood a portion of the solids which sustain the inflammatory process, and supplies their place with water; it also removes from the system a portion of the effete matters produced by inflammation and which tend to convert the circulating fluid into a poison. The artificial production of perspiration by veratrum or by any other medicine does not accomplish this purpose. It may in this manner occasion a profuse discharge of water, and so far may diminish the amount of liquid in the blood-vessels; but there is no reason to believe that it removes the "materies morbi," the "peccant matter," which constitutes the disease materially and essentially. If it were really curative in this manner, then jaborandi and pilocarpin ought to be the most efficient remedies for fevers and inflammations, which is not claimed in their behalf. What has been observed of its effects in acute rheumatism is true of other febrile diseases. As expressed by Boulter (*St. Bartholomew's Hosp. Rep.*, xv. 164), "Veratrum viride has little or no effect in reducing the temperature in rheumatic fever; the pains subside no more quickly (?) than under other ordinary modes of treatment; it has no power of warding off cardiac complications; and its only effect—which, however, only takes place in some cases—is to depress the vascular system, as shown by the slowness and irregularity of the heart's action." Cardiac sedatives, of which the medicine under consideration is the type, tend to retain in the blood all that is injurious in it, and at the same time reduce the patient to a state of such wretchedness that he is unable to take food, or to digest it if he ate it, or even to find energy enough to cling to that last refuge of sufferers, hope.

There is but one class of cases in which the utility of this medicine is presumable—cases of imminent or commencing congestion or inflammation, in which the maintenance of its sedative action on the heart for a short period would allow the conservative powers of the system to operate within normal limits. This statement applies to certain *wounds* which tend to dangerous results, like those of the head, pericardium and heart, and peritoneum. The comparative immobility in which the inflamed parts are maintained by the infrequent arterial movement may favor their cure. In some cases of organic *heart disease*, as well as of *nervous palpitation*, this medicine is reported to have afforded great relief, probably by allowing the heart sufficient rest for recovering its power. It would certainly be unsuited for the treatment of cardiac affections depending upon absolute debility of the organ. It has been used with alleged benefit in *puerperal mania*. *puerperal convulsions*, *epileptiform convulsions*, *chorea*, and *mania-à-potu*. In a case of persistent *priapism* affecting only the corpora cavernosa, and after failure to reduce it by means of many medicines, including tartar emetic, belladonna, and bromide of potassium, the penis began to be relaxed as soon as veratrum viride had reduced the pulse to 50 (Walker, *Am. Jour. Med. Sci.*, Apr.

1877, p. 565). It will be observed that nearly all of the affections in which the medicine has been most equivocally useful were marked by nervous, and not febrile, excitement; in other words, they were amenable to it as a sedative of the nervous and not of the circulatory system.

Externally, the tincture is used as a discutient and anodyne.

The proper remedies in poisoning by this drug are diffusible stimulants, and especially alcohol, which should be given by the rectum if the patient vomits. Its efficacy is shown by the case of a physician who took an ounce of the tincture at one draught; so completely did the alcohol counteract the green veratrum of the preparation that except nausea, vomiting, and some dyspnœa no evil results followed. Besides alcohol, ammonia may be administered, and sinapisms should be applied over the heart, while stimulant (that is, small and repeated) doses of some liquid preparation of opium may be administered. During the treatment the patient's head should be kept as low as his body, or even lower.

Administration.—Green veratrum may be administered in powder in the *dose* of 2 grains (Gm. 0.12), but the liquid preparations are more eligible. Of these the fluid extract and the tincture are officinal; the dose of the former is from 1 to 3 drops (Gm. 0.05–0.15), and of the latter from 4 to 8 drops (Gm. 0.20–0.40). They should be given at intervals of about three hours. Their tendency to cause vomiting may be prevented by the administration of from 5 to 10 drops of deodorized laudanum ten or fifteen minutes before each dose. As soon as the pulse begins to fall the dose should be diminished. Females and growing persons ought not to take doses exceeding two-thirds of those mentioned, and for children from one to five years old a sufficient quantity is 1 drop (Gm. 0.06) of the tincture. From 10 to 15 minims (Gm. 0.60–1) of the tincture, largely diluted with water, have been administered hypodermically.

VERBASCUM.—Mullein.

Flores verbasci, P. G.—*Bouillon-blanc*, *Molène*, Fr.; *Wollkraut*, *Königskerze*, G.

The leaves and flowers of Verbascum Thaspus, *Linné* (V. Schraderi, *G. Meyer*), *F. Cod.*; the corolla of V. phlomoides, *Linné*, and V. thapsiforme, *Schrader* (V. Thapsus, *G. Meyer*), *P. G.*

Nat. Ord.—Scrophulariaceæ.

Origin.—The genus Verbascum consists of tall, more or less woolly, biennial or perennial herbs, with the flowers in dense spikes or paniculate racemes. The flowers have a five-parted calyx, a wheel-shaped somewhat unequally five-lobed corolla, five more or less woolly stamens, and a two-celled, two-valved, and many-seeded capsule. Three species have been naturalized in North America—Verb. Blattaria, *Linné*, V. Lychnitis, *Linné*, and V. Thapsus, *Linné*, having the leaves respectively nearly smooth on both sides, tomentose on the lower surface, and densely woolly on both sides.

Description.—Folia verbasci. The leaves are from 4 to 8 or 12 inches (10–20 or 30 Cm.) long, the upper ones sessile on the stem, and all decurrent. They vary in shape between elliptic, oblong, and oval-lanceolate, are acute, more or less crenate on the margin, and densely covered with soft whitish stellate hairs. The leaves are nearly inodorous and have an insipid, mucilaginous, faintly bitter taste.

Flores verbasci. The calyx is rejected, and only the corolla with the adhering stamens is preserved. The wheel-shaped corolla is 1 to 1½ inches (25–37 Mm.) broad, bright-yellow, smooth above, and stellately tomentose beneath, has five obovate roundish lobes about ⅗ inch (15 Mm.) long, and bears in the short tube the stamens, of which the three upper ones have reniform anthers and the filaments covered with a white wool; the two lower stamens are longer and smooth and have elongated decurrent anthers. V. Thapsus has the corolla only about ½ inch (12 Mm.) broad, and the lower stamens with long filaments. V. Lychnitis and V. Blattaria have the anthers reniform upon equal filaments, which are white-woolly in the former and purple-woolly in the latter species. To preserve their bright color the flowers should be thoroughly dried and kept in a dry and well-stopped bottle; if permitted to become damp they acquire a blackish color. The flowers have a slight, agreeable, honey-like odor and a mucilaginous and sweet taste.

Constituents.—The leaves and flowers contain mucilage. Morin (1826) obtained from the flowers a trace of yellowish volatile oil, a fatty substance, sugar, and coloring matter which is insoluble in ether and cold water and yields in alcoholic solution a yellow precipitate with acetate of lead.

Medical Action and Uses.—The chief medicinal constituent of this plant is the mucilage furnished by its leaves, but its flowers contain an essential oil in small proportion, to which the agreeable odor of the fresh plant and its slightly stimulant qualities are due. Fish are said to become stupefied by eating the seeds. The infusion of mullein is useful in catarrhal affections of the *respiratory organs*, and in Ireland is in popular use to palliate *cough* and *diarrhœa*. For this purpose it should be boiled with milk. It is recommended in irritations of the *urinary bladder*. It may be used in enema for *dysentery*. A poultice made with the leaves boiled in milk is a convenient application to inflamed *hæmorrhoids*. Olive oil saturated with mullein-flowers during prolonged exposure to the sun, or kept near a fire for several days in a corked bottle, is a popular preparation in Germany for *bruises*, *frost-bite*, and irritable *piles*. The infusion should be made of the fresh leaves and flowers, if possible, in the proportion of an ounce to a pint (Gm. 32 to Gm. 500) of boiling water. When cool it should be strained to free it from the irritating hairs which cover the leaves.

VERONICA.—SPEEDWELL.

Véronique mâle, Fr.; *Ehrenpreis*, G.

Veronica officinalis, *Linné*.
Nat. Ord.—Scrophulariaceæ.

Origin and Description.—The common speedwell is distributed over a considerable portion of the northern hemisphere, and grows in grassy places and open woods. It is a procumbent pubescent perennial with ascending branches and with opposite, short-petiolate, obovate, or elliptic and coarsely crenate or serrate, grayish-green leaves, which are about an inch (25 Mm.) long. The flowers are in one or two axillary racemes on the upper part of the branches, are on short pedicels, and have a wheel-shaped four-parted pale-blue corolla with dark-blue stripes and two exserted stamens. The fruit is an inversely heart-shaped, two-celled capsule. The fresh herb is faintly aromatic; after drying it is inodorous and has a bitterish and slightly astringent taste.

Constituents.—Speedwell contains a little tannin and a bitter principle.

Allied Species.—VERONICA BECCABUNGA, *Linné*.—Brooklime, *E.;* Beccabunga, Cressonée, *Fr.;* Bachbungen, *G.*—It grows in Europe and Asia near springs and in brooks, and has an ascending smooth stem, with opposite, short-petiolate, oval or oblong, crenate-serrate, obtuse, and smooth leaves, about 1½ inches (38 Mm.) long, and with axillary loose racemes of pale-blue and veined flowers. It is used in the fresh state (*F. Cod.*).

VER. AMERICANA, *Schweinitz*, resembles the preceding, but has petiolate, ovate, acutish, and often slightly heart-shaped leaves.

Brooklime is inodorous, and has a bitterish, somewhat saline, and slightly pungent taste.

Medical Action and Uses.—Veronica is bitter, astringent, and slightly aromatic, in which qualities it resembles horehound and several other plants which, like it, have been used in the treatment of chronic *bronchitis*. Its decoction has been applied externally in *scabies*, papular *cutaneous eruptions*, and *ulcers*, and given internally in *urinary* and *calculous disorders*. V. Beccabunga is regarded as anti-scorbutic and diuretic, and is said to be slightly stimulant and tonic. It has been employed in chronic affections of the skin, in scrofula, and in scurvy, both internally and topically. It is reported that V. parviflora (*Koroniko*), a New Zealand plant, is very efficient in the treatment of chronic dysentery (*Practitioner*, xxix. 300).

VIBURNUM, *U. S.*—VIBURNUM (BLACK HAW).

The bark of Viburnum prunifolium, *Linné*.
Nat. Ord.—Caprifoliaceæ.

Origin.—The black haw is a tall shrub or small tree from 10 to 20 feet (3–6 M.) high, and grows in thickets throughout the greater portion of the United States east of the Mississippi. Its leaves are opposite, about 2 inches (5 Cm.) long, shining, oval or obovate, sharply serrulate, and have short slightly margined petioles. The small white pentamerous flowers are in terminal cymes, have a wheel-shaped corolla, and produce small blue-black edible drupes containing a flattish, smooth putamen. The bark is employed in medicine.

Description.—Black-haw bark is in thin quills, and has externally a somewhat glossy purplish-brown, and when older a grayish-brown, color. The surface is marked with scattered small roundish or transversely elongated warts, and often with minute black dots. The thin, papery, corky layer is easily removed from the green outer bark.

The inner bark is white and the inner surface smooth. The bark breaks with a short smooth fracture, is without odor, and has a slightly astringent and distinctly bitter taste.

Allied Species.—VIBURNUM OBOVATUM, *Walter*, grows in the Southern United States, and is a shrub about 8 feet (2.4 M.) high; it is also known as *black haw*. The leaves are ½ to 1 inch (12–25 Mm.) long, rather leathery, broadly obovate or spatulate, narrowed into a short petiole, slightly revolute on the margin, either entire or crenate near the apex, and on the lower surface marked with minute brownish dots. The cymes are small and three-rayed, the flowers white, and the fruit black and ovoid-oblong. The leaves are inodorous and have a bitter taste, which is more persistent than that of the brown or reddish-gray bark.

VIBURNUM OPULUS, *Linné*.—Cranberry tree, *E.;* Obier, *Fr.;* Wasserholder, *G.*—It is a native of Canada, of the Northern United States, and of Europe and Northern Asia. It grows to a height of from 10 to 15 feet (3–4.5 M.), and has a gray or brown-gray bark, three-lobed serrate leaves, and white or yellowish-white flowers. The fruit is a bright-red, elliptic, one-seeded drupe resembling the cranberry. The brittle gray bark has a pungent taste, and is known as *cramp-bark*.

VIBURNUM LANTANA, *Linné*, is a European shrub with ovate or oval, slightly heart-shaped, acutely serrate leaves, and with red, finally black, mealy drupes of a mucilaginous and sweet taste. The inner bark is acrid.

Constituents.—The *viburnic acid* of Krämer (1844), obtained from the bark of the cranberry tree, was proved by Monro (1845) to be identical with valerianic acid. The *viburnin* of Krämer is a light-yellowish mass or whitish powder of a neutral reaction and of a purely bitter taste; it is slightly soluble in water and more freely soluble in alcohol. Enz (1863) found in the fruit of V. lantana a hygroscopic, neutral, bitter principle readily soluble in water; also valerianic, acetic, tartaric, and tannic acids. H. Van Allen examined black-haw bark, and obtained valerianic acid, viburnin, a resinous body of a very bitter taste containing sugar, tannin (greenish-black with ferric salts), and oxalic, citric, and malic acids. The air-dry bark contained 7 per cent. of moisture and yielded 8.3 per cent. of ash, consisting mostly of earth carbonates and phosphates.

Off. Prep.—Extractum viburni fluidum, *U. S.*

Medical Action and Uses.—Nothing definite appears to be known respecting the mode of action of this plant. Incongruous qualities are assigned to it, such as that it is at once nervine, astringent, diuretic, and tonic. The only medicinal operation attributed to it does not involve any of these operations—viz. a power of preventing *abortion*, particularly when attempted by the use of cotton-root. A case intended to illustrate such virtue in the drug has been published (*Therapeutic Gaz.*, Nov. 1882), but as the patient also took enormous doses of morphine, as well as bromide of potassium, it is impossible to believe that the viburnum had any share in the result. At a meeting of the Materia Medica Society of New York (1883) the value of this drug was discussed, and no conclusive evidence of its alleged virtues was adduced. On the same occasion the use of V. Opulus was urgently advocated as a very efficient anti-spasmodic in asthma, hysteria, puerperal and other convulsions, and as "a powerful uterine sedative" (*Med. Record*, xxiii. 188). In 1876 another physician described it as "a uterine sedative, and often a remedy for neuralgic *dysmenorrhœa* and for the commonly associated spinal irritation." Indeed, it has been credited with increasing, and also with diminishing, the menstrual flow. The medicine seems to be worthy of a rational study. Viburnum has been administered in the form of an infusion or a decoction made with an ounce of the bark to a pint (Gm. 32 in Gm. 500) of water, and in *doses* of 1 or 2 ounces (Gm. 32–64), repeated every two or three hours. The officinal fluid extract may be given in doses of from ½ to 2 fluid-drachms (Gm. 2.00–8).

VINA MEDICATA.—MEDICATED WINES.

Vins médicinaux, *Œnolés*, Fr.; *Medicinische Weine*, G.

Medicated wines are preparations analogous to tinctures, but differ from them in the menstruum, which contains a much smaller and a somewhat variable quantity of alcohol and a certain proportion of extractive matter and bitartrate of potassium. The menstruum directed for the medicated wines is either dry white wine (*F. Cod.*, *P. G.*), a mixture of white wine and alcohol (*U. S.*, *F. Cod.*), sherry wine (*Br.*, *P. G.*), or red, Lunel, Grenache, Malaga, and other wines (*F. Cod.*). Since even the strongly alcoholic officinal wines cannot be kept unaltered for an indefinite period if exposed to the air, the medicated wines, which necessarily contain various principles subject to gradual decomposition, should be kept in well-stopped bottles.

VINUM ALBUM, *U. S.*—WHITE WINE.

Vinum generosum album, P. G.—*Vin blanc*, Fr.; *Weisswein*, G.

The fermented juice of the fruit of different species of Vitis.

Nat. Ord.—Vitaceæ.

Origin.—American wines are mostly obtained from the fruit of cultivated varieties of Vitis Labrusca, *Linné*, and more particularly from Catawba, Concord, and Isabella grapes. The Clinton grape is a variety of V. æstivalis, *Michaux;* the Delaware grape is derived from V. cordifolia or V. riparia, *Michaux;* and the Scuppernong grape from V. vulpina, *Linné*. The European grape was introduced into California at an early period, and large quantities of wine are now manufactured from the different varieties. All European wines are prepared from the fruit of Vitis vinifera, *Linné* (see UVÆ), which is a native of Western Asia and has been cultivated for many centuries; it is not unlikely that this species originated from two or three different plants, supposed by some botanists to be indigenous to India, and by others to be still found in the wild state in Eastern countries and in Southern and Central Europe.

Manufacture of Wine.—In addition to the constituents of grapes enumerated under UVÆ, vegetable albumen, glutinous matter, pectin, and various extractive matters are found in the juice of grapes, and occasionally racemic acid, either in the free state or partly combined with bases. Besides tartrates, the saline constituents are sulphate of potassium, chloride of sodium, phosphate of calcium, magnesia, alumina, and silica. The relative amount of these principles varies considerably, depending on the nature of the soil and on atmospheric conditions during the growth and ripening of the fruit, when the free acid is gradually diminished and the sugar considerably augmented in quantity. The sugar varies in amount between 12 and 30 per cent., the larger quantity being produced in warm climates. It is obvious from this that the treatment of the grape-juice for the production of wine must vary under different circumstances and in different countries. The grapes are either crushed and the juice fermented in the presence of the husks, or the juice, called *must*, is fermented by itself, in which case a light-colored wine is obtained. Red wines are made by fermenting with husks and seeds, called the *marc*, of red or purple grapes. In a short time after the must has been pressed, fermentation commences, and continues for two or three weeks, when the liquid becomes somewhat clear, and is removed from the precipitate into another vessel, where a slow fermentation, called the *after-fermentation*, proceeds for several weeks or months, requiring the occasional removal of the liquid from the sediment formed, until it is fit to be transferred into casks, where it is allowed to "ripen." The best wines are usually bottled some time after they have become perfectly clear, the complete clarification being effected by gelatin, which, in combining with the tannin present, forms an insoluble compound, carrying down with it all traces of yeast and other matters held in suspension. The "bouquet" of wine is much improved after bottling, and red wines, which do not contain a large amount of tannin, become darker, while wines rich in tannin form a deposit in the bottle and become lighter in color.

The conditions under which fermentation takes place, and the results, are explained on page 140. In the presence of the numerous constituents of grapes odorous principles are generated during fermentation to which wines owe their peculiar aroma or bouquet. If the must contains a moderate quantity of sugar, this is entirely or nearly decomposed into alcohol and carbonic acid, resulting in a *dry wine*. But in a strongly saccharine must fermentation ceases before the sugar is completely consumed, and the product is a *sweet wine* (vin de liqueur, *Fr.*). In some cases the amount of sugar in the juice is increased by exposing the cut ripe grapes for some time to the sun until a portion of the water has evaporated, or by concentrating a portion of the juice before fermentation. As the alcohol increases during the fermentation of the must, the acid tartrate of potassium becomes less soluble and is gradually deposited, the deposition continuing for some time after the storing of the wine in casks.

If wine is bottled before it has undergone the after-fermentation, a *sparkling wine* will be obtained. The fermentation will slowly proceed in the bottle, which is placed upside down, so that the precipitate which forms may settle in the neck, and may be finally withdrawn by carefully removing the stopper and quickly replacing it. The effervescence of sparkling wines is produced by the carbonic acid confined in the bottle.

Improving.—This term is used to include all those manipulations designed to preserve wine or render it more pleasing in appearance and taste by the addition of alcohol, glycerin, coloring matters, sugar, and other substances. In many cases so-called improving must be considered to be merely adulteration; but from the natural variation of the composition of grape-juice it is sometimes desirable to correct an excess or deficiency of one or more constituents, and for this purpose the following processes have been suggested:

1. Gypsum is largely employed in some parts of Europe as an addition to the must, for the purpose of hastening the clarification of wine, which then contains potassium sulphate in the place of bitartrate.
2. Chaptal (1800) proposed the removal of excessive acidity by marble and the addition of sugar to the must.
3. Gall proposed to correct excessive acidity by the addition to the must of sugar and water, whereby, evidently, an acid grape-juice is made to yield a correspondingly larger amount of wine.
4. Petiot (1859) suggested the utilization of the marc left on expressing the must, by fermenting with it a solution of sugar, the product being either sold as wine or mixed with other wines.
5. Liebig (1848) suggested the removal of free acid by the addition of a concentrated solution of potassium tartrate in such proportion as to form bitartrate, which will be deposited from the wine.
6. To render weak wines stronger without foreign additions, Melsens (1873) introduced the freezing process, whereby a portion of the water is removed in the form of ice.
7. Pasteur's method consists in the heating of wine to from 50° to 65° C. (122°–149° F.), air being excluded, for the purpose of destroying fungoid germs and rendering the wine more permanent.

Properties.—As a class, white wines are distinguished from red wines by the absence of red coloring matter and of notable quantities of tannin, though minute proportions of this compound are usually present. They are never colorless, but vary in shade between pale-yellow and deep-amber color.

Sherry wine (Vinum Xericum, *U. S.* 1870, *Br.*; V. Xerense, *P. G.* 1872) has a rather deep-amber color, an agreeable vinous odor, and a warm and very slightly acid taste. We found (1886) its specific gravity to range between .978 and .995, and its average alcoholic strength to be 20.34 volumetric per cent.; the sugar and extractive averaged 3.27 (highest 5.3) per cent. in 67 samples examined. Similar wines are produced in various parts of Spain, Portugal, the Canaries, and Madeira, several of which are met with in our commerce. *Lisbon wine* has a density of about .990, and contains 19 or 20 per cent. of alcohol. *Teneriffe wine* closely resembles the preceding in properties. A stronger wine is *Madeira wine*, which usually contains between 19 and 22 per cent. of alcohol; it has a different somewhat nutty flavor.

Wines of similar strength in alcohol are also made in Italy (*Marsala*), Greece (*vino santo*), and the Cape Colony (*Constantia*). Southern France produces wines containing 14 to 16 per cent. of alcohol, of which those of *Lunel* and *Grenache* are ordered by the Codex. *Burgundy* wines are of about the same strength. Very sweet wines, rich in alcohol, are, among others, *Tokay* (Hungary), *Lachrymæ Christi* (Italy), and *Malaga* (Spain).

The white *Rhenish wines* are known here as *hock* (from *Hochheimer*). They have a more acidulous taste than the preceding wines, from the presence of acid tartrate of potassium and the nearly total absence of sugar. They are of a pale-yellow color, and usually contain between 8 and 10 per cent. of alcohol. *Moselle wine* is nearly of the same strength. The *French wines*, both white and red, are required to contain about 10 per cent. of alcohol (*F. Cod.*).

The white wines of the Mississippi and Ohio Valley and the *California wines* resemble the wines of Central and Southern Europe in appearance, flavor, and alcoholic strength; the weaker varieties of the latter, which are known as *California hock*, have not the fine bouquet of the better qualities of Rhenish wines, but the quality of American wines has considerably improved of late years.

The sparkling *champagne wines* contain between 10 and 12 per cent. of alcohol.

Constituents.—The principal constituents of all wines are water and alcohol. The amount of the latter present in different wines has been given above. The acidulous taste of wine is due to *acid tartrate of potassium*, and small quantities of *acetic acid* are met with in old wines, resulting from the spontaneous oxidation of alcohol. A somewhat larger proportion of acetic acid is usually present in the wine of the Eastern section of the United States. The amount of *sugar* varies considerably; while the weaker dry wines contain none or but very little, it is found in sherry to the extent of from 1 to 5 per cent., increases in champagne sometimes to 5 or 6 per cent., in port wine to 6 or 7 per cent., and in the sweet wines, like *Malmsey Madeira*, to 11 or 15 per cent. or more. The "body" of wine has been ascribed by Fauré to a principle which he named *œnanthin*, and which is probably of the nature of gum or dextrin. *Tannin* seems to be present in all wines—in minute proportion in the white, and in larger proportion in the red wines. The *coloring matter* of wine varies for causes stated above; the color of red grapes is not soluble in water, but is extracted during fermentation as the alcohol increases. The *aroma* of wine is doubtless due to the presence of various compound ethers formed in the juice while fermenting. These exist in very minute quantities, and have for this reason not been accurately examined; but the following have been stated to contribute to the aromatic odor of wine: acetic, butyric, caprylic, caproic, œnanthic, pelargonic, capric, and propionic ethers, besides aldehyd, acetal, and probably other compounds. The inorganic constituents of wine are the same as those of grape-juice, except that tartrate of calcium and the greater portion of acid tartrate of potassium have been deposited; the ash varies between about .1 and .5 per cent.

The U. S. Pharmacopœia not only permits, but evidently encourages, the use of native wines, provided they be pure and contain between 10 and 12 per cent. by weight of absolute alcohol. From causes explained before, the composition of wines made from the same variety of grape grown in different localities, or from different vintages in the same locality, must be expected to vary to some extent; every quantitative analysis of wine, therefore, refers only to the sample examined. A large number of American wines have been analyzed by Prof. H. B. Parsons, which, classified in principal groups, show the following results for 100 parts of white wines:

	51 Dry Wines.			7 Sherry Wines.			22 Sweet Catawba, Angelica, etc.			15 Sparkling Wines.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Specific gravity	.9926	1.0105	.9845	.9974	1.0074	.9873	1.0318	1.0515	.9948	1.0255	1.0402	1.0174
Alcohol, per cent., weight	9.35	13.94	7.03	15.47	20.09	12.84	11.46	17.33	8.48	8.28	10.02	6.24
Alcohol, per cent., volume	11.70	17.37	8.80	19.43	25.17	16.15	14.85	22.46	10.82	10.64	12.96	8.01
Total residue	1.75	2.64	1.18	4.84	6.83	1.95	12.67	18.04	3.39	9.74	13.31	7.78
Total ash	.181	.335	.090	.270	.479	.166	.171	.371	.101	.130	.164	.102
Glucose	trace.	.300	none.	2.86	4.84	.61	10.57	16.94	1.31	8.28	12.02	6.60
Total acid, as tartaric	.680	.855	.422	.616	.721	.476	.546	.925	.331	.725	.885	.501
Fixed acid, as tartaric	.313	.561	.121	.277	.418	.209	.313	.465	.234	.425	.626	.322
Volatile acid, as acetic	.294	.508	.068	.263	.380	.164	.208	.463	.046	.252	.472	.119

One sweet wine (Muscatel) contained 25.37 per cent. of glucose and 31.34 per cent. of total residue.

Changes.—Like other weak alcoholic liquids, wine is apt to undergo acetic fermentation, which is prevented by excluding atmospheric oxygen. Mucous fermentation causes wine to become ropy; white wines are subject to this change more than red wines, caused by the presence of insufficient tannin in the must for precipitating all the albuminoids. Some wines, like Burgundy, are liable to acquire a bitter taste, and occasionally wine becomes mouldy. Scrupulous cleanliness of the vessels in which wine is kept and exclusion of air will prevent most of these changes.

Tests.—With the exception of the U. S. P., none of the pharmacopœias give any tests for determining the quality of wine, which is directed to be ascertained as follows: "White wine should have a full, fruity, agreeable (and red wine a moderately astringent) taste, without excessive sweetness or acidity (red wine without decided sweetness or excessive acidity), and it should have a pleasant odor, free from yeastiness. Its sp. gr. at 15.6° C. (60° F.) should not be less than 0.990 (red wine .989) nor more than 1.010. If 10 Ccm. of white wine be diluted with an equal volume of distilled water and treated with 5 drops of test solution of ferric chloride, only a faint, greenish-brown color should make its appearance (absence of tannic acid) (with red wine the liquid should acquire a brownish-green color, due to tannic acid). Upon evaporation and 12 hours' drying on the water-bath it should leave a residue of not less than 1.5 per cent. nor more than 3.0 per cent. (red wine between 1.6 and 3.5 per cent.). Using litmus-paper as an indicator, 250 Ccm. of white wine should require for complete neutralization not less than 15 nor more than 26 Ccm. of the volumetric solution of soda. Tested by the following method, white (and red) wine should contain not less than 10 per cent. nor more than 12 per cent., by weight, of absolute alcohol: Weigh a definite volume of the wine at the temperature of 15.6° C. (60° F.); evaporate it in a porcelain capsule to one-third of its original volume, cool, and add distilled water until the mixture measures its original volume at the temperature of 15.6° C. (60° F.); then weigh again. The first weight divided by the second will afford a quotient (to be carried out to four decimal places) which corresponds to the percentage of absolute alcohol, by weight, in the wine."—*U. S.*

Aside from the coloring matter, the requirements and tests of the Pharmacopœia are alike for white and red wine, with slight modifications for the latter, as indicated above. Wines from fruits other than the grape, and artificial or sophisticated wines, may correspond closely with the above requirements. For the detection of such the following brief summary from the observations of Prof. Nessler will be useful: By far the largest number of dry grape-wines contain between 1.6 and 2.2 per cent. of *solid matter;* this is conveniently estimated by evaporating the alcohol and diluting the residue with water to the original volume, when the liquid should have the specific gravity 1.007 or 1.008, and should not be less than 1.005. Grape-wines contain no *citric acid* and little or no free *tartaric acid.* The latter is best detected by agitating the wine with powdered potassium bitartrate until saturated, and adding to the filtrate potassium acetate, when in the presence of free tartaric acid a precipitate will be produced. Most pure wines yield a precipitate with tartaric acid, proving the presence of potassium salts other than bitartrate. To detect citric acid add to the wine an excess of lime, filter, acidulate with acetic acid, add excess of barium chloride, filter from the barium sulphate, and add excess of ammonia, when barium citrate will be precipitated. For the detection of free sulphuric acid strips of filtering-paper about 12 inches (30 Cm.) long are suspended in such a manner that the lower end dips into the wine, which is gradually absorbed and evaporates from the upper part, where the extractive matters and sulphuric acid become more concentrated; after 24 hours the paper is carefully dried, and then heated to 100° C. (212° F.), when the portion charged with extractive becomes brown or black and frequently brittle from the free sulphuric acid, the reaction being more delicate in the presence of 0.1 or 0.2 per cent. of sugar. The brown-yellow *coloring matter* of wine containing a little tannin is precipitated on agitation with egg albumen, while the color produced by caramel is not altered.

Winckler stated that cider and other fruit-wines contain lactic acid and calcium lactate, which are not found in grape-wine. Tuchschmid (1870) found the amount of carbonate of calcium obtainable in the ashes of grape-wine never to exceed 0.049 per cent., while other fruit-wines yield between 0.11 and 0.40 per cent. of the same salt. The amount of sulphates in wine varies in most cases, so as to represent between .01 and .03 per cent. of sulphuric acid; Nessler found occasionally .11 per cent. Wines treated with gypsum contain a larger quantity.

The determination of alcohol is usually effected by one of the two following methods: A definite quantity of wine is distilled by means of a water-bath until one-half of the liquid has passed over; the distillate is diluted with distilled water to the original volume or weight of the wine, when its specific gravity indicates the alcoholic strength; or, the residue in the still is diluted with water to the original volume or weight of the wine; its specific gravity is now ascertained, and from this figure is deducted the specific gravity of the wine; the difference, representing the solid constituents, is deducted from 1.000 (density of water), and the figure thus obtained gives the density of the alcohol present. The method adopted by the Pharmacopœia is a modification of the last one described, and was suggested by Prof. Parsons. A number of instruments have been constructed by means of which the alcoholic strength may be determined either from the pressure or the heat of the vapors of the boiling liquid; volatile acids, if present, must be previously neutralized.

History.—The dietetic history of wine is almost coeval with that of the human race, for all the countries inhabited by nations whose remote history has come down to us abound in grapes, and the first sin committed after the Deluge was drunkenness. Its medicinal virtues were treated of by Hippocrates, Galen, Pliny, and the Arabian physicians. The last described in full detail the consequences of its excessive use, which, indeed, had already been done by Jewish as well as Roman writers. They are essentially those which have been enumerated in the article on ALCOHOL. Nevertheless, it would be a grave error to conclude that a given quantity of wine is equivalent to an equal quantity of water containing a like percentage of alcohol. The peculiar effects of a true wine depend upon its ethereal and saline elements, its sugar, tannic acid, etc., which modify materially those which would be produced by its alcohol alone. The true medicinal effects of wine are to be sought in the products of the vineyards of continental Europe and a few other places. Those of our own country have not yet attained such a degree of perfection as to enable them to compete with the better class of foreign wines, yet even in their comparatively crude state they are probably less mischievous than distilled spirits, provided they can be obtained pure. Improvement in their manufacture, by rendering them generally acceptable, would not only confer a priceless boon upon the sick, but would provide even for the drunkard a potation less injurious to himself than alcohol, and save the commonwealth from a large proportion of the infamous crimes which disgrace our civilization, and from the physical deterioration which threatens to produce national decrepitude. In France, drunkenness, as it is known in this country and in the north of Europe, was comparatively rare as long as wine and cider were the only alcoholic beverages in general use; but the vice has greatly extended of late years, and its increase has been mainly in the cider-drinking departments, where alcohol distilled from grain is largely used, because it is more accessible than wine. In the wine-growing districts, where brandy of a less injurious quality is made, the use of the latter beverage is comparatively small; and in the departments where wine is not produced the cases of drunkenness requiring legal action are five times greater than in those which consume wine principally. In like manner, the proportion of cases of insanity originating in alcoholic drinks is in direct proportion to the use of distilled spirits, and especially of those which are not procured from wine.

Physiological Action.—Wine, including all forms of genuine wine, is essentially a stimulant of the nervous and circulatory systems, but its mode of stimulation is unlike that of mere alcohol. In due proportion it gives to all the faculties increased activity and freedom of action, quickening and brightening the intellect and the imagination, warming the feelings, invigorating the digestive powers, and diffusing a cordial satisfaction throughout the whole being. Distilled spirits, on the other hand, tend to benumb the faculties even while stimulating them, so that they seem to be struggling under a brute force; the exhilaration they produce is usually fierce or maudlin, and they leave behind them a dull and inert dejection. As already stated, the peculiar effects of wine are due to the salts, acids, sugar, and, above all, the ethereal elements, in which it abounds, and which, while they tend to mitigate the anæsthesia produced by the alcohol of the liquid, ensure a more rapid discharge of this substance from the system. The white wines, as a class, are distinguished by the rapidity with which they exhilarate and intoxicate, as well as by the relatively transient character of the excitement they produce, and by their marked diuretic action. Most of the red wines, and especially port wine, contain a portion of tannin, which retards their absorption, and therefore lessens their immediate stimulant effects. They are, on the other hand, more or less tonic, and hence become well adapted to the convalescent stages of acute disease and to states of chronic debility. (See VINUM RUBRUM.) The effects of wine in excessive doses resemble more nearly those produced by distilled spirits, yet even then they are less extreme and debasing. Its habitual use is conducive to the health of those who drink it in moderation, and is the best corrective of the brutality and preventive of the crime which everywhere attend the consumption of ardent spirits. The very quantity of it required to produce intoxication tends to limit the mischiefs of its inordinate use; and even when "the sweet poison of the misused wine" is indulged in beyond measure, its mischievous influence upon the health is less than that of alcohol, for, while the latter tends directly to occasion fatal disease of the liver, heart, and kidneys, the intemperate use of wine is more apt to engender gout, gravel, and nervous affections. Even these results are rarely attributable to some of the wines which are most largely used, as the Rhenish, Bordeaux, and most Italian wines, both white and red.

Medical Uses.—Wine is employed in the treatment of the same forms of disease for which distilled alcohol is appropriate, but, according to general usage, in the less grave forms, and for women, children, and old persons rather than for adult men. The clearest indication for its use is furnished by *adynamic fevers*, and most of all typhus fever, a disease in which enormous quantities of wine have sometimes been administered with the most salutary results. In a less degree it is useful in *typhoid fever* and in all febrile affections which assume the *typhoid state*, provided that symptoms of the following character are present: viz. prostration, wandering, delirium, petechiæ, stupor, and brown tongue; feebleness, irregularity, dicrotism or softness of the pulse; and particularly feebleness or absence of the first sound of the heart. When delirium, unconsciousness, and dryness of the tongue have been succeeded by a state of exhaustion, languor, and debility, with imperfect sleep and anorexia, the cordial operation of wine is a precious help toward the cure. But it is as true of wine as of distilled spirits, that the necessity for it is often more apparent than real, and that a premature and excessive use of it renders the patient insensible to its operation when it has become essential to his recovery. We have never had such good reason to be pleased with the results of treatment in typhoid fever as when in a large hospital service the use of alcohol in this disease was almost wholly omitted.

During *convalescence* from many diseases wine taken with food is often a potent aid to recovery, and it is often also of essential utility in chronic affections which waste the strength by profuse *discharges* or by *pain* or by inducing an *anæmic* condition. In all of these cases red wines are more efficacious than white. The latter, however, and in general the more stimulating wines, are best adapted to cases in which a speedy but transient influence is intended, as where *syncope* is imminent or the patient is reviving from it after powerful nervous shocks, exhausting fatigue of body or mind, severe pain, hæmorrhage, etc., and in cases of debility of the heart arising from structural alterations in it. In the milder forms of *delirium tremens*, especially as they occur in females, and notably in those of the better classes, wine is greatly to be preferred to distilled spirits. In some minor *spasmodic affections*, as the *vomiting* of pregnancy or of sea-sickness, the sparkling wines are often of great service. Infantile reflex *convulsions* may frequently be prevented or mitigated by a timely dose of wine administered by the rectum or the mouth. It is equally efficient in all other affections in which danger arises from debility and its immediate consequences, and among them *capillary bronchitis* may be particularly noted. *Tetanus* has been successfully treated by wine, and the depressing action of *tobacco* and other sedatives of the heart and nervous system may be counteracted by its means.

It seems superfluous to say a word of the special virtues of sherry wine, since it is almost impossible to procure any of it which is pure and presents that peculiar "nutty" flavor, and that "dryness," or slight acidity, which at one time were characteristic of this wine, and which rendered it a valuable cordial in exhaustion of the nervous system and of the heart and a wholesome aid to feeble digestion. In England, where, more than elsewhere, it was generally used by the better classes, it was regarded as especially appropriate for dyspeptic, gouty, and rheumatic invalids. At present those who prescribe "sherry wine" should know that there is seldom any wine in the liquid at all, but that it consists usually of alcohol, water, and flavoring ingredients. It is far better to use medicinally whiskey made from wheat or rye, which there is less temptation for the dishonest dealer to adulterate, than the mischievous compounds sold under the name of sherry. Sherry is less astringent, and, according to some analyses, slightly less, and according to others slightly more, alcoholic than port. Commercial sherry wine is less suited than pure wine for making *wine whey*, which is prepared by adding the wine to milk at the boiling temperature, in the proportion of from 2 to 8 fluidounces of the former to a pint of the latter, straining off the whey and sweetening it. It is a mild and slightly nutritious stimulant much used in cases of debility from exhaustion and in the *typhoid state*. Wine diluted with water may be given by enema with scarcely less advantage than by the stomach. (For a fuller description and history of wines the reader is referred to STILLÉ, *Therapeutics*, 4th ed., ii. 710.)

VINUM ALBUM FORTIUS, *U. S.*—STRONGER WHITE WINE.

Preparation.—White Wine 7 parts (42 oz. av. or about 40½ fluidounces); Alcohol 1 part (6 oz. av. or 7 fluidounces); mix them.—*U. S.*

This wine is used as the menstruum for preparing the various medicated wines of the present Pharmacopœia, which become reasonably permanent and little liable to undergo acetous fermentation in consequence of the increase of the alcoholic strength. If the materials used are of pharmacopœial strength, the mixture will contain between 20 and 22 per cent. of absolute alcohol; the Pharmacopœia permits a variation of between 20 and 25 per cent. if tested in the manner described under VINUM ALBUM.

VINUM ALOES, *U. S., Br.*—Wine of Aloes.

Vinum aloeticum.—*Vin (Œnolé) aloétique*, Fr.; *Aloewein*, G.

Preparation.—Purified Aloes 6 parts (1½ oz. av.); Cardamom 1 part (¼ oz. av.); Ginger 1 part (¼ oz. av.); Stronger White Wine a sufficient quantity; to make 100 parts (25 oz. av.). Mix the aloes, cardamom, and ginger, and reduce them to a moderately coarse (No. 40) powder. Macerate the powder with 90 parts (22½ oz. av. or 22 fluidounces) of stronger white wine for 7 days, with occasional agitation, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 100 parts (25 oz. av. or about 24 fluidounces).—*U. S.*

Socotrine aloes 1½ oz. av.; cardamom-seeds, freed from the pericarps and bruised, ginger, in coarse powder, each 80 grains; sherry sufficient to make 2 pints.—*Br.*

Medical Uses.—This preparation is rarely used, because, like all liquid preparations of aloes, its taste is repulsive, and the pilular forms of the medicine are therefore more acceptable. Yet it probably has the advantage over them of being already a solution, and therefore of acting in a relatively smaller dose than aloes itself. It is useful in cases of habitual *constipation* from torpor of the colon and rectum, especially when associated with flatulent dyspepsia, gout, or amenorrhœa. *Dose*, as a laxative, about half a fluidounce (Gm. 16).

VINUM ANTIMONII, *U. S.*—Wine of Antimony.

Vinum antimoniale, Br.; *Vinum stibiatum, s. emeticum*, P. G.—*Antimonial wine*, E.; *Vin émétique*, *Vin antimonié*, *Vin stibié*, Fr.; *Brechwein*, G.

Preparation.—Tartrate of Antimony and Potassium 4 parts (30 grains); Boiling Distilled Water 60 parts (450 grains or 1 fluidounce); Stronger White Wine a sufficient quantity; to make 1000 parts (7500 grains = 17⅛ oz. av.). Dissolve the tartrate of antimony and potassium in the water, and, while the solution is hot, add 600 parts (4500 grains or 10⅛ fluidounces) of stronger white wine, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 1000 parts (17⅛ oz. av. or about 16 fluidounces).—*U. S.*

Nearly the same proportions are the following: Tartarated antimony 40 grains; sherry 1 pint (Imperial).—*Br.* Tartar emetic 1 part; sherry 250 parts.—*P. G.*

If made with good wine and judiciously preserved, antimonial wine will keep unaltered for a long time.

Off. Prep.—Mistura glycyrrhizæ comp., *U. S.*

Medical Uses.—The chief value of antimonial wine consists in its being a convenient addition to febrifuge solutions, and especially in association with a liquid preparation of opium and spirit of nitrous ether. In such combinations it greatly promotes the diaphoresis which is a natural crisis of *fever*. The direct sedatives of the heart have no such salutary operation. In like manner it may be added to mixtures for promoting expectoration in febrile affections of the air-passages, as in the officinal compound liquorice mixture. It should seldom be used as an emetic, for its action in children is too depressing, and for adults the necessary dose of it is such that the stimulant action of the wine counteracts the sedative or nauseant operation of the antimonial. As a febrifuge and expectorant the *dose* of antimonial wine is about 10 drops (Gm. 0.60), repeated at longer or shorter intervals, according to its effects. This dose is preferable to the larger ones generally recommended.

VINUM AROMATICUM, *U. S., F. Cod.*—Aromatic Wine.

Vin (Œnolé) aromatique, Fr.; *Kräuterwein*, G.

Preparation.—Lavender 1 part (¼ oz. av.); Origanum 1 part (¼ oz. av); Peppermint 1 part (¼ oz. av.); Rosemary 1 part (¼ oz. av.); Sage 1 part (¼ oz. av.); Wormwood 1 part (¼ oz. av.); Stronger White Wine a sufficient quantity; to make 100 parts (25 oz. av.). Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with 4 parts (1 oz.) of stronger white wine, pack it moderately in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts (25 oz. av. or about 24 fluidounces).—*U. S.*

This is equivalent to the preparation, somewhat simplified, of the old French Codex. The present Codex orders vulnerary tincture 1 part, red wine 7 parts.

Tinctura vulneraria, Alcoolature (Teinture) vulnéraire, *F. Cod.*, is made by macerating 100 Gm. each of the fresh leaves and tops of eighteen plants, including the six of the above formula, and 3000 Gm. of alcohol sp. gr. .863.

Action and Uses.—Aromatic wine is designed for topical purposes only. It represents a class of preparations which were formerly in common use as vulneraries, either as applications to recent *wounds* or to stimulate indolent *ulcers*. An almost identical preparation was used by Ricord as a dressing for *chancres*, and is now officinal in France. It is applied on charpie.

VINUM AURANTII, *Br.*—Orange Wine.

Wine made in Britain by the fermentation of a saccharine solution to which the fresh peel of the bitter orange has been added.—*Br.*

It is a vinous liquid, having a golden-sherry color and a taste and aroma derived from the bitter orange-peel. It contains about 12 per cent. of alcohol, and is but slightly acid to test-paper.

Off. Prep.—Vinum ferri citratis, Vinum quiniæ, *Br.*

Medical Uses.—Orange wine is used exclusively as a flavoring ingredient of mixtures and as an excipient in certain British officinal preparations.

VINUM COLCHICI RADICIS, *U. S.*—Wine of Colchicum-Root.

Vinum colchici, Br.; *Vinum de colchico*, F. Cod.—*Vin* (*Œnolé*) *de bulbe de colchique*, Fr.; *Zeitlosenknollenwein*, G.

Preparation.—Colchicum-Root, in No. 30 powder, 40 parts (10 oz. av.); Stronger White Wine a sufficient quantity; to make 100 parts (25 oz. av.). Moisten the powder with 10 parts of stronger white wine, pack it moderately in a conical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts (25 oz. av. or about 24 fluidounces).—*U. S.*

Colchicum, sliced, dried, and bruised, 4 oz. av.; sherry sufficient to make 1 pint (Imperial).—*Br.* Fresh colchicum-root 100 Gm., strong wine (vin de Grenache) 1000 Gm.—*F. Cod.*

This preparation is recognized in Great Britain as *wine of colchicum*, under which name in the United States the wine of colchicum-seeds is usually understood. Owing to the deterioration of colchicum-tuber when long kept, the preparation is apt to be deficient in strength, since the drug cannot be at all times obtained fresh or recently dried. The first formula yields a preparation of about the same strength as that of the U. S. P. 1870.

Medical Uses.—This preparation, which is believed to possess all the virtues of colchicum, may be prescribed in *doses* of 10 minims (Gm. 0.60), and gradually increased.

VINUM COLCHICI SEMINIS, *U. S.*—Wine of Colchicum-Seed.

Vinum colchici, P. G.—*Vin* (*Œnolé*) *de semence de colchique*, Fr.; *Zeitlosenamenwein*, G.

Preparation.—Colchicum-Seed, in No. 20 powder, 15 parts (3¾ oz. av.); Stronger White Wine a sufficient quantity; to make 100 parts (25 oz. av). To the powder add 90 parts (22½ oz. av.) of stronger white wine, and macerate for 7 days, with occasional agitation; then filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 100 parts (25 oz. av. or about 24 fluidounces).—*U. S.* 5 oz. av. of seeds yield about 32 fluidounces of this wine.

Bruised colchicum-seed 60 Gm., strong wine 1000 Gm.—*F. Cod.* Coarsely powdered colchicum-seed 1 part, sherry wine 10 parts.—*P. G.*

In order to extract the colchicine the seeds require to be well bruised. By passing them several times through a good drug-mill, regulating at the same time the grinding surface, they may be obtained of a sufficiently fine powder. If a suitable mill is not at hand, they should be macerated in a portion of the wine for several days, and be bruised in a mortar while damp. None of the pharmacopœias permit digestion of the unbroken seeds. 10 parts *U. S.* are equal to 15 parts *P. G.* and 25 parts *F. Cod.* of this wine.

Medical Uses.—The commencing *dose* is about half a fluidrachm (Gm. 2).

VINUM ERGOTÆ, *U. S.*—Wine of Ergot.

Vin de seigle ergoté, Fr.; *Mutterkornwein*, G.

Preparation.—Ergot, recently ground and in No. 30 powder, 15 parts (3¾ oz. av.); Stronger White Wine a sufficient quantity; to make 100 parts (25 oz. av.). Moisten the powder with 4 parts (1 oz. av.) of stronger white wine, pack it moderately in a cylindrical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts (25 oz. av. or about 24 fluidounces).—*U. S.* 5 oz. av. of ergot are contained in about 2 pints of the wine.

This preparation is about 14 per cent. stronger than that of the U. S. P. 1870. The manipulation is similar to that of the U. S. P. 1860. By paying proper attention to the quality of the ergot and to the directions given above, an efficient preparation will be obtained. The same must be said if a properly-prepared fluid extract, made from good ergot, is used, as was directed by the last Pharmacopœia; in our experience the latter represents ergot even better than the vinous percolate.

Medical Uses.—The wine is less frequently employed than other preparations of ergot, but may be prescribed in *doses* of from 1 to 3 fluidrachms (Gm. 4–12).

VINUM FERRI, *Br.*—WINE OF IRON.

Vinum chalybeatum, s. martiatum.—*Vin chalybé*, Fr.; *Eisenwein, Stahlwein*, G.

Preparation.—Take of Fine Iron Wire (about No. 35) 1 ounce; Sherry 1 pint. Macerate for 30 days in a closed vessel, the iron being almost, but not quite, wholly immersed in the wine, the vessel frequently shaken, and the stopper removed; then filter.—*Br.*

The acid tartrate of potassium dissolves the iron, with the evolution of hydrogen, resulting in the formation of ferrous tartrate or of its double salt with potassium tartrate. Owing to the variable acidity of different wines, and to the necessarily variable composition of this preparation, it has very properly been discarded by most pharmacopœias, or has been replaced by one of more definite strength in iron, like the wine of citrate of iron.

Medical Uses.—This preparation is one of the mildest of ferruginous medicines. It is, however, quite as well prepared extemporaneously by making a solution of tartrate of iron and potassium in sherry or Rhenish wine, in the proportion of 10 grains to the fluidounce. The *dose* of the officinal wine is from 1 to 4 fluidrachms (Gm. 4–16), and of the magistral solution nearly twice as much.

VINUM FERRI AMARUM, *U. S.*—BITTER WINE OF IRON.

Vinum de cinchona martiatum, F. Cod.; *Vinum chinæ ferratum.*—*Vin (Œnolé) de quinquina ferrugineux*, Fr.; *Chinaeisenwein*, G.

Preparation.—Solution of Citrate of Iron and Quinine 8 parts (2 oz. av. or 1½ fluidounces); Tincture of Sweet Orange-Peel 12 parts (3 oz. av. or 3⅜ fluidounces); Syrup 36 parts (9 oz. av. or 6⅝ fluidounces); Stronger White Wine 44 parts (11 oz. av. or about 11 fluidounces); to make 100 parts (25 oz. av. or about 22½ fluidounces). Mix, and filter through paper.—*U. S.*

This is an adaptation of the formula adopted by the American Pharmaceutical Association in 1875, and resembles that of the old French Codex, but contains more iron. The new French Codex directs 2 Gm. each of ferrous sulphate and citric acid to be dissolved in 10 Gm. of boiling water, and this solution added to 990 Gm. of wine of pale cinchona.

Medical Uses.—This solution contains in each fluidrachm nearly 1 grain of the citrate of iron and quinine. It is a mild preparation, but is very efficient in cases of moderate *anæmia* and *debility*. The ordinary *dose* is 1 or 2 fluidrachms (Gm. 4–8).

VINUM FERRI CITRATIS, *U. S., Br.*—WINE OF CITRATE OF IRON.

Vinum chalybeatum, F. Cod.—*Vin chalybé, Vin (Œnolé) ferrugineux*, Fr.; *Eisenwein*, G.

Preparation.—Citrate of Iron and Ammonium 4 parts (1 oz. av.); Tincture of Sweet Orange-Peel 12 parts (3 oz. av. or 3⅜ fluidounces); Syrup 12 parts (3 oz. av. or 2¼ fluidounces); Stronger White Wine 72 parts (18 oz. av. or about 18 fluidounces); to make 100 parts (25 oz. av. or about 24 fluidounces). Mix, and filter through paper.—*U. S.*

Dissolve citrate of iron and ammonia 160 grains in orange wine 1 pint (Imperial), and after 3 days filter.—*Br.*

Citrate of iron and ammonia 5 Gm., strong wine (vin de Grenache) 1000 Gm.—*F. Cod.*

Medical Uses.—The wine of citrate of iron has nearly the same qualities as wine of iron, and, like it, may be used when the stomach is irritable. The *dose* is from 1 to 4 fluidrachms (Gm. 4–16).

VINUM IPECACUANHÆ, *U. S.*, *Br.*, *P. G.*—WINE OF IPECAC.

Vin d'ipécacuanha, Fr.; *Brechwurzelwein*, G.

Preparation.—Fluid Extract of Ipecac 7 parts (700 grains = 1⅗ oz. av.); Stronger White Wine 93 parts (9300 grains = 21¼ oz. av.); to make 100 parts (10,000 grains = 22⅞ oz. av. or about 22¾ fluidounces). Mix, and filter through paper.—*U. S.*

Macerate for a day ipecacuanha 1 oz. in acetic acid 1 fl. oz.: obtain with water 20 oz. of percolate; evaporate to dryness over a water-bath; powder; macerate in sherry wine 1 pint (Imp.) for two days, and filter.—*Br.* Ipecac 1 part, sherry wine 10 parts.—*P. G.*

Medical Uses.—Wine of ipecacuanha contains all the virtues of the drug. It is a very inappropriate form for the production of emesis, since the large proportion of alcohol contained in it counteracts the emetic operation of the ipecacuanha, and may be unsuited to the febrile elements of the affections for which it is prescribed. This objection applies less forcibly to its use as a diaphoretic and expectorant. It is especially useful when associated with spirit of nitrous ether, in favoring diaphoresis in *catarrhal fever*, *muscular rheumatism*, etc. In infantile and also in senile *bronchitis* it is very serviceable when the bronchial secretions obstruct the air-passages, and when an emetic as well as a stimulant operation is called for. In the *vomiting* of pregnancy this preparation, in hourly doses of 1 drop, sometimes arrests that distressing symptom. It is probable that in doses nearly as small it would be found as useful as powdered ipecacuanha has proved in relieving atonic *dyspepsia* and *chronic diarrhœa* from intestinal debility.

The *dose* of wine of ipecacuanha as an emetic is stated to be a fluidounce (Gm. 32) for an adult, and a fluidrachm (Gm. 4) for an infant, but, for the reasons assigned, it is not eligible for this purpose. As an expectorant or diaphoretic the proper dose is from 5 to 10 drops (Gm. 0.30–0.60), repeated every half hour or hour.

VINUM OPII, *U. S.*, *Br.*—WINE OF OPIUM.

Vinum opii compositum, F. Cod.; *Tinctura opii crocata*, P. G.; *Laudanum liquidum Sydenhami.—Sydenham's laudanum*, E.; *Laudanum de Sydenham*, *Vin d'opium composé*, Fr.; *Safranhaltige Opiumtinktur*, G.

Preparation.—Powdered Opium 10 parts (1 oz. av.); Cinnamon, in No. 60 powder, 1 part (44 grains); Cloves, in No. 30 powder, 1 part (44 grains); Stronger White Wine a sufficient quantity; to make 100 parts (10 oz. av.). To the mixed powders add 90 parts (9 oz. av.) of stronger white wine, and macerate the mixture for 7 days, with occasional agitation; then transfer it to a cylindrical percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts (10 oz. av. or about 9½ fluidounces).—*U. S.*

Extract of opium 1 oz. av.; cinnamon-bark, bruised, cloves, bruised, each 75 grains; sherry 1 pint (Imperial).—*Br.*

Both pharmacopœias have discarded the use of saffron, which is still retained by the French and German Pharmacopœias. Otherwise, the preparation is now practically identical as ordered by the four pharmacopœias. The wine has been replaced in the P. G. by a diluted alcohol. The other formulas are: Opium 200, saffron 100, Ceylon cinnamon 15, Cloves 15, wine 1600 Gm.—*F. Cod.* Opium 30, saffron 10, Chinese cinnamon 2, cloves 2, alcohol (sp. gr. .894) 150, and water 150 parts.—*P. G.* That of the French Codex, being made with a sweet wine, is denser (sp. gr. 1.05 to 1.07) than the other preparations. On keeping, this wine deposits some extractive matter and occasionally some narcotine.

The opium strength has been somewhat reduced, 1 grain of powdered opium being now represented by 10.5 minims *U. S.*, and formerly by 8 minims *U. S.* 1870.

LAUDANUM DE ROUSSEAU, *F. Cod.*, contains about one-fourth its weight of opium, and is therefore considerably stronger than the preceding; it is made by fermenting a mixture of opium 200 Gm., honey 600 Gm., water 3 liters, and beer-yeast 40 Gm.; the filtered liquor is then evaporated to 600 Gm and mixed with alcohol (sp. gr. .913) 200 Gm.

Medical Uses.—This preparation, also known as "Sydenham's laudanum," is much superior to the tinctures of opium as an internal medicine, on account of its being less apt to nauseate and less offensive in taste and smell. 8 minims, or from 16 to 17 drops (Gm. 0.60–1), may be given as a full *dose*. It is sometimes used as an application to the *conjunctiva* in granular and other chronic forms of inflammation of that membrane.

VINUM QUININÆ, *Br.*—Wine of Quinine.

Vin de quinine, Fr.; *Chininwein*, G.

Preparation.—Take of Sulphate of Quinia 20 grains; Citric Acid 30 grains; Orange Wine 1 pint (Imperial). Dissolve first the citric acid, and then the sulphate of quinia in the wine; allow the solution to remain for 3 days in a closed vessel, shaking it occasionally; and afterward filter.—*Br.*

Allied Preparation.—Vinum de cinchona, *F. Cod.*; Vinum chinæ, *P. G.* Tincture of cinchona 100, glycerin 100, sherry wine 300 parts.—*P. G.* Cinchona 5, alcohol (sp. gr. .913) 10, red wine 100 parts.—*F. Cod.* The latter formula is alike for pale, red, and yellow cinchona, and in each case the cinchona wine may also be prepared with a strong wine (vin de liqueur), such as Grenache, Lunel, Malaga, Madeira, and others, in which case no alcohol is added.

Medical Uses.—It is difficult to perceive the advantages of this preparation over an extemporaneous solution of the citrate of quinia in wine. The *dose* is from 4 to 8 fluidrachms (Gm. 16–32).

VINUM RHEI, *U. S.*, *Br.*—Wine of Rhubarb.

Tinctura rhei vinosa, *Tinctura rhei Darelii*, P. G.—*Vin de rhubarbe*, Fr.; *Weinige Rhabarbertinktur*, G.

Preparation.—Rhubarb, in No. 30 powder, 10 parts (1 oz. av.); Calamus, in No. 30 powder, 1 part (44 grains); Stronger White Wine a sufficient quantity; to make 100 parts (10 oz. av.). Moisten the mixed powders with 5 parts (½ oz.) of stronger white wine, pack the mixture in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts (10 oz. av. or about 9½ fluidounces).—*U. S.*

The proportions directed by other pharmacopœias are: Rhubarb-root, in coarse powder, 1½ oz. av.; canella alba bark 60 grains; sherry sufficient for 1 pint (Imperial).—*Br.* Rhubarb 6 parts; Grenache wine 100 parts.—*F. Cod.* Rhubarb, finely cut, 8 parts; bitter orange-peel 2 parts; cardamom 1 part; sherry wine 100 parts; in 7 parts of the tincture dissolve 1 part of sugar.—*P. G.*

Medical Uses.—Wine of rhubarb has the same general virtues as the tincture of rhubarb, but is preferable, as being less stimulant. It may be described as cordial, carminative, and *laxative*, and may be used by persons of a *constipated* habit and gouty constitution, and especially by females who add to these conditions scanty and painful menstruation and leucorrhœa. The *dose* is from 1 to 4 fluidrachms (Gm. 4–16).

VINUM RUBRUM, *U. S.*—Red Wine.

Vin rouge, Fr.; *Rothwein*, G.

The juice of the colored fruit of different species of Vitis, fermented in the presence of the pericarp.

Origin and Description.—The fruit of most cultivated varieties of the American grapevines and of numerous varieties of the European species have either an amber color or are purple, dark-blue, or nearly black. The juice of these grapes is colorless or nearly so, and if fermented alone yields a white wine, but if fermented with the pericarp or skins the coloring matter of the latter is extracted, and the wine has a red color, varying in shade with the variety of grapes, with the quantity of skins, the length of time they have been in contact with the fermenting liquid, and with the amount of alcohol and acid present. Although many white wines contain tannin, taken up from the pericarp of the fruit or from the seeds, the quantity is usually minute as compared with that present in red wines, and which comes from the same sources. It is obvious, therefore, that red wine agrees in properties and composition with white wine, except so far as these are modified by the red coloring matter and the tannin, the most striking differences being the deep-red color, the distinctly astringent taste, and the effect produced by alkalies, ferric chloride, lead acetate, and other reagents, either changing the color of, or producing precipitates with, tannin and the coloring principle.

Vinum portense, *U. S.* 1870.—Port wine, *E.*; Vin d'Oporto, *Fr.*; Portwein, *G.* —This is the product of the grape cultivated in the district near the river Douro in Portugal, and is chiefly exported from Oporto. When recently made it is of a red color, which by age changes to a deep reddish-brown, while at the same time a considerable portion of altered astringent matter is deposited and the wine acquires its full flavor.

Port wine is considered to be best when about eight or ten years old. As exported from Portugal, it is always mixed with a certain quantity of spirit, which is added for the purpose of better preservation; its alcoholic strength is thereby increased to from 18 to 22 per cent. Ripeness and strength are said to be imparted to new wine by adding brandy toward the end of fermentation, and the product, particularly the cheaper varieties of port wine, is often artificially colored with preparations containing the juice of elderberries. Port wine has a pleasant vinous odor and an agreeable, warm, sweetish, and slightly astringent taste. In the place of true port wine a variety of French wine, known in commerce as *Burgundy port wine*, is much used in the United States; it resembles port wine in appearance and flavor, and contains about 14 or 16 per cent. of alcohol. California port wine is very similar, and is the product of grapevines originally obtained from the port-wine district of Portugal, and chiefly cultivated in Los Angeles county. Similar wines are also made in other parts of the United States.

CLARET is the English name of dry red wines containing a moderate amount of alcohol, and was originally used for French red wines (*vin clairet*, clarified wine), but is now applied to many wines of American growth from California, as well as from the Mississippi Valley and eastward to the Atlantic coast. Some of the most esteemed red wines of France are produced in Gironde and exported from Bordeaux, and the red wines produced in other sections of France have, like the former, been known in Europe as *Bordeaux wines*. Much of the wine exported is more or less artificial. (See VINUM ALBUM, process of Petiot and Gall for wine-improving.)

Constituents.—In addition to the constituents mentioned elsewhere (see VINUM ALBUM), red wine contains tannin, partly derived from the casks, but mainly from the seeds and integuments of the grape, and giving with ferric salts green-brown or green-black precipitates. The red coloring matter, *œnolin* or *œnolic acid*, is a red-brown or purplish-red powder, which is nearly insoluble in water, in carbon bisulphide, and in chloroform, but soluble in dilute acids and in alcohol; it is not unlikely that the coloring principles of different grapes vary, and are more or less modified by the constituents and treatment of wine.

The following summary of analyses of American red wines by Prof. H. B. Parsons shows the variation in composition:

	64 Dry Wines.			12 Port Wines.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Specific gravity	.9933	1.0011	.9894	1.0261	1.0508	1.0116
Alcohol, per cent., weight	8.92	12.21	5.71	13.23	16 93	10.25
" " volume	11.04	15.21	7.17	17.09	21.89	13.05
Total residue	2.28	3.16	1.65	11.17	17.04	6.89
Total ash	.231	.532	.130	.283	.355	.139
Glucose	trace.	.450	none.	8.05	11.80	4.15
Total acid as tartaric	.723	.997	.511	.632	.828	.370
Fixed acid as tartaric	.360	.646	.226	.356	.600	.196
Volatile acid as acetic	.290	.517	.138	.216	.386	.128

Tests.—The pharmacopœial requirements as to the quality of red wines are practically identical with those for white wine. (See VINUM ALBUM.) The nature of the coloring matter and its freedom from aniline colors is characterized as follows: "If 50 Ccm. of red wine be treated with a slight excess of water of ammonia, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 Ccm. of ether, the greater portion of the ethereal layer removed and evaporated in a porcelain capsule with excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color (absence of aniline colors). With test solution of acetate of lead red wine should form a heavy precipitate, which may vary in color from bluish-green to green."—*U. S.*

On the gradual addition of ammonia the red color of wine is changed to purple, blue-green, and is destroyed, with the production of a brown tint. Many other organic coloring matters have a similar behavior, while others are changed to purple (cochineal, logwood); fuchsin is slowly discolored, with the formation of rosaniline, which is soluble in ether, and on the addition of acetic acid again produces a red color. The precipitate produced by lead subacetate is dingy gray, with a blue or green tint; the age of the wine and the presence of tannin and other constituents influence the shade of the color. Other organic coloring matters are precipitated by the same reagent red (Brazil-wood), green (elderberries), or blue (logwood). Similar shades of color are produced upon white filtering-paper which has been steeped in a solution of lead acetate. Fuchsin is not precipitated, but may be extracted by agitating the liquid with ether. According to Andrée (1880), the coloring matter of huckleberries is identical with that of wine, and in order to detect the addition of the juice of these berries it is necessary to show the presence of citric acid. (See Vinum Album.)

Pastrovich (1882) again recommends black oxide of manganese, which was originally suggested by Facen (1870), and states that, after repeated agitation with the oxide, after 15 minutes genuine red wine, also wine colored with huckleberries, elderberries, or cochineal, become nearly colorless, while the color of Brazil-wood, logwood, and orchil changes to brownish-yellow, and that of fuchsin remains unaltered. Wine containing only .002 Gm. of fuchsin to the liter, treated in this manner, yields a rose-colored filtrate.

Medical Action and Uses.—The essential difference between red and white wines consists in the presence of tannic acid in the former, which is derived from the crushing of the stems of purple grapes in the process of manufacturing wine. This ingredient is most abundant in port and heavy Bordeaux wines, and hence they and the other wines that resemble them, including several American varieties, differ from white wines in the relative slowness of their absorption from the stomach, and consequently in their less prompt production of intoxication. Moreover, from the same cause they act less injuriously upon the coats of the stomach. Red wines, in general, have relatively more of the tonic and less of the excitant properties possessed by white wines, and are especially to be preferred to the latter when a sustained instead of a transient stimulation is desired, and when, in addition to this, an astringent action is intended. Hence the red wines are eminently the wines of convalescence, and are of general use in all cases of excessive discharges of blood, pus, etc. in which they are not contraindicated by other reasons. Unfortunately, red wines are more generally adulterated or factitious than white wines, with the exception of sherry. In an English manual for wine-dealers it is said: "To keep wine from turning sour put in the casks 2 pounds 3 ounces of small shot." And, as if this were not villainous enough, it proceeds: "In extreme cases, when all the previous recipes have been tried without any satisfactory result, take a pinch of oxalic acid and put it into the bottle" (*Brit. and For. Med.-Chir. Rev.*, Apr. 1858, p. 324). Red wines are often manufactured out of alcoholic dilutions colored by logwood, rhatany, beets, litmus, etc. Astringency is given them by means of alum, oak- or willow-bark, etc., as elsewhere more particularly described.

The more astringent red wines are used for injecting *hydroceles*, the *vagina*, *urethra*, etc. affected with chronic profluvia, *fistulous sinuses*, etc. But the various astringent tinctures would answer equally well.

VIOLA TRICOLOR, *U. S.*—Viola Tricolor.

Herba violæ tricoloris, *s. Herba jaceæ*, P. G.—*Pansy*, *Heart'sease*, E.; *Pensée sauvage*, Fr.; *Stiefmütterchen*, *Freisamkraut*, *Dreifaltigkeitskraut*, G.

The wild-grown flowering herb of Viola tricolor, *Linné*.

Nat. Ord.—Violaceæ.

Origin.—The violets are mostly perennial, or rarely annual or biennial, herbs, with alternate stipulate leaves, and with axillary flowers having five persistent auriculate sepals, five somewhat unequal petals, of which the lower one is saccate or spurred, five strongly connivent stamens, of which the two lower ones bear a spurred nectary upon the back, and one superior pistil with three placentas, ripening into a three-valved, many-seeded capsule; the globular or ovate seeds have a small caruncle and hard testa, and contain a straight embryo imbedded in fleshy albumen. The officinal species is an annual or biennial indigenous to Europe and Northern Asia, naturalized in the United States, and frequently cultivated in many varieties as an ornamental plant. Only the wild-grown plant is to be collected.

Description.—Pansy has a thin, spindle-shaped root and an erect or ascending angular and branching, nearly smooth stem, 4 to 8 inches (10–20 Cm.) high. The leaves vary between roundish-cordate and oval, crenate and nearly entire, are about an inch (25 Mm.) long, petiolate, and have prominent, leaf-like, lyrately-pinnatifid stipules. The flowers are on long peduncles, and have the corolla partly yellowish, blue, and purple, or occasionally variegated and longer than the calyx (variety vulgaris, *Koch*), or the corolla scarcely exceeds the calyx, and is yellowish or occasionally partly purplish (var. arvensis, *Murray*). The last form is the only one recognized by the French Codex; it is frequent in sandy fields of North America, and apparently indigenous. The dry herb is inodorous and has a bitterish, mucilaginous, and slightly acrid taste, the acridity residing mainly in the root.

Constituents.—Boullay (1824) found in the herb a yellow coloring matter and much mucilage, but no violine; Cuseran (1847), in addition to these, sugar, bitter principle, resin, and potassium nitrate. Mandelin (1879) detected free *salicylic acid* in this plant, and subsequently (1881) determined it to amount to .1068 per cent. in the wild-grown, air-dry plant of the variety arvensis, while other varieties contained less, and the cultivated plant only .043 per cent. The acid is obtained by agitating the aqueous solution of the alcoholic extract with ether; the petals contain a minute quantity, the seeds a mere trace, of the acid. A salt of salicylic acid could not be found. Mandelin examined also the yellow coloring matter, which is the glucoside *violaquercitrin*, yielding with dilute acids 3 molecules of sugar and 1 of quercetin, besides a fluorescing compound.

Allied Species.—Viola pedata, *Linné*, Bird's foot violet. The leaves and rhizome were formerly officinal. It grows in sandy soil from the New England States southward, and westward to the Mississippi. It has a short, erect, and truncate rhizome, about an inch (25 Mm.) long and nearly as thick, and beset with slender rootlets. The leaves are radical, smooth, pedately five- or seven-parted, and have the divisions linear or narrowly spatulate, and occasionally slightly toothed at the apex. The flowers are large, about an inch (25 Mm.) broad, beardless, vary in color between light-blue and dark-purple, and have a very faint violet color, which is observable only with a large number of flowers. The leaves and flowers have a mucilaginous and sweet taste; the taste of the rhizome is mucilaginous, bitter, and somewhat acrid. The plant flowers in May, and frequently a second time in August and September.

Viola cucullata, *Aiton*, is the common blue violet of North America, growing in meadows and in dry grassy places and open woods. The rhizome is spreading, forms compact masses, and is covered with numerous short fleshy branches. The leaves are very variable, heart-shaped at the base, with the basal lobes rolled up. The flowers are somewhat bearded, light- or dark-blue, violet-colored, or variegated. The variety V. palmata has the later leaves palmately lobed.

Viola odorata, *Linné* (Bentley and Trimen, *Med. Plants*, 25).—Sweet-scented violet, *E.*; Violette odorante, *Fr.*; Märzveilchen, *G.*—It is indigenous to Europe and Northern Asia, is frequently cultivated, and grows to a certain extent spontaneously in various parts of North America. It has an oblique rhizome and produces long, filiform runners. The leaves are reniform or heart-shaped, obtuse, and crenate. The flowers are dark-blue or sometimes whitish, bearded, and have a very agreeable odor. For pharmaceutical purposes the dark-blue flowers alone are collected, deprived of the calyx, and only the corolla is used in the fresh state for preparing

Syrupus violæ odoratæ, *F. Cod.* Fresh violet-petals 10 parts, boiling water 20 parts; in 21 parts of the infusion dissolve 38 parts of sugar.

The rhizomes of the perennial, and more particularly the acaulescent, violets appear to contain *violine*, which Boullay (1828) obtained from all parts of the sweet-scented violet, but in largest quantity from the rhizome. It is prepared by removing from the alcoholic extract chlorophyll and fat by means of ether, boiling the residue with diluted sulphuric acid, adding to the filtrate oxide of lead, evaporating, and exhausting the residue with strong alcohol. Violine is a yellowish, bitter, and fusible powder, which is more readily soluble in water than emetine, but less so in alcohol; is insoluble in ether, and appears to combine with acids to not well-defined saline compounds. It merits further investigation. The blue coloring matter of violets turns green, and afterward yellow, with alkalies.

Anchietea salutaris, *Saint-Hilaire*, s. Noisettia pyrifolia, *Martius*. The root of this shrub, which is indigenous to Brazil, is used as a cathartic and emetic. It is about the thickness of a finger, is brownish-red, and has a yellowish, nauseous, and bitter bark, covering the hard brownish wood. Peckolt (1859) found in the root starch, sugar, gum, tannin, a little resin, and about ⅖ per cent. of *anchietine*, which forms crystallizable salts, crystallizes in straw-colored needles, is insoluble in ether, sparingly soluble in water, and freely soluble in alcohol, and acquires with sulphuric acid a violet color, turning black.

Medical Uses.—Very little is known of the medicinal virtues of the formerly officinal violet, V. pedata, which, as far as can be judged, does not differ much in its qualities from the European species, which have long been used in medicine. Sweet violets (V. odorata) were anciently held to be refrigerant and astringent in "ardor of the stomach," inflammation of the eyes, and prolapse of the anus and of the uterus, and also to restrain suppuration. By the Arabians they were employed in coughs and affections of the kidneys and of the liver, and, when prepared with sugar, as a laxative. The syrup of violets, which to this day is used in France, was directed by the Arabians in pulmonary affections. It was also formerly recommended as a local remedy for *aphthæ*; internally, an infusion of the flowers was given in infantile *convulsions*; and the powder, as well as an infusion of the root, has been used in the same manner as ipecacuanha in the treatment of infantile *dysentery.*

An alkaloid procured from this species is represented to have exhibited the properties of emetine, causing vomiting, purging, and great prostration in dogs, and in man analogous effects in some cases, but not uniformly. The powdered root applied to the denuded skin has sometimes acted as an emeto-cathartic. Similar effects have been obtained from V. canina.

V. tricolor (heart'sease) also produces disturbance of the stomach and bowels, and sometimes diuresis. Its continued use is said to occasion sweating and a pustular eruption of the skin, and to impart to the urine a smell like cat's urine or that of conium. It once had a great popular repute in Europe as a purifier of the blood and as a remedy in chronic *bronchial* and *intestinal catarrh*, in *cutaneous eruptions*, and particularly in *crusta lactea* (eczema infantile). In these affections it was administered in a decoction of milk and applied in fomentations. Cazin (*Traité des Plantes médicinales indigènes de France*, 2ème éd., p. 734) sets forth at length the virtues ascribed to it in the cure of scrofulous and other cutaneous diseases by Bergius, Matthiolus, Bauhin, Boeckler, Strack, Murray, Hufeland, and many others, including the imaginative Hahnemann, and also the denial of their existence by other physicians. A similar history had long before been given by Richter (*Ausfürliche Arzneim.*, ii. 235), who concludes it by observing, "After all, viola has no special virtues in these affections; at the best, it can only afford some support to other and more efficient remedies." It had also some repute in constitutional *syphilis.* In Europe the syrup of violets is sometimes employed as a laxative for infants, but its chief use is to give a fine color to mixtures.

VISCUM.—MISTLETOE.

Gui de chêne, *Gillon*, Fr.; *Mistel*, G.

Viscum album, *Linné*, and Viscum (Phoradendron, *Nuttall*) flavescens, *Pursh.*
Nat. Ord.—Loranthaceæ.

Origin and Description.—The mistletoes are small parasitic evergreen shrubs, growing mostly upon deciduous-leaved trees, and penetrating with their simple roots through the bark into the wood. Viscum album is indigenous to Europe, and is chiefly found upon apple, pear, plum, and similar trees, but grows also upon poplars, birches, beeches, and others. Viscum flavescens is an American species, growing upon oaks, elms, apples, etc. in the Southern United States and northward to New Jersey, and westward in the Mississippi Valley. Both plants are of a yellowish-green color, ½ to 2 feet (15–60 Cm.) high, much branched, jointed, and have opposite, often scale-like leaves and monœcious or diœcious flowers in small clusters or short spikes. The leaves of the European species are lanceolate or spatulate, obtuse and entire; those of the American plant are obovate or oval. The fruit of both species is a small, whitish, one-seeded berry. The branches are usually collected. They have an unpleasant heavy and rather weak odor and a mucilaginous, sweetish, bitter, and somewhat astringent taste.

LORANTHUS EUROPÆUS, *Linné*, is the *viscum quernum* of ancient writers. It is a somewhat larger and thicker shrub, which grows upon oaks and chestnuts in Eastern and Southern Europe, and has a grayish or dark-brown bark and pale-yellow berries.

Constituents.—Mistletoe has been analyzed by Gaspard, Funcke, Winckler, Macaire, and Reinsch. It contains mucilage, sugar, an odorous principle, fixed oil, resin, traces of tannin, and various salts. The most interesting constituent is *viscin*, also called *bird-lime*, or more properly *bird-glue*, from the German name *Vogelleim.* It is insoluble in water, alcohol, and fixed oils, but dissolves in ether and oil of turpentine, and on evaporating the solvents remains behind as a yellowish viscous and tenacious mass. It seems to be present in the mistletoe in small proportion, but a larger quantity is formed by a kind of fermentation. The same or a similar compound may be obtained from the inner bark of the European holly, Ilex aquifolium, *Linné*, from the root of Gentiana lutea, *Linné*, and from other plants. It is employed for catching small birds; hence the name *Vogelleim.*

Medical Action and Uses.—The operation of mistletoe is as uncertain as its virtues are doubtful. The berries are reported by some writers (Cazin) to be innocuous, but others state that they are emetic and purgative, and instances are given in which very young children have suffered convulsions, and even death, from eating large quantities of them. It seems not impossible that these effects may have been due to indigestion alone. It is true that a case is recorded in which after several children had eaten the berries of V. flavescens they were affected with vomiting, great thirst, tenesmus, and bloody and mucous stools. In one case death ensued in a state of collapse. In Europe, however, the dried young twigs and leaves of mistletoe have long been used in medicine for various nervous affections, including *chorea*, *asthma*, and *spasmodic colic*, but chiefly for *epilepsy*, although sometimes for *hysteria* (Richter, *Ausf. Arzneim.*, ii. 822). Long (*New Preparations*, 1878) "used mistletoe in the forms of infusion, tincture, decoction, and fluid extract in many cases of *menorrhagia* and *post-partum hæmorrhage* with gratifying results." He conceived that it incited the natural rather than the tonic contraction of the uterus. A physician in South Carolina refers to three cases of abortion in negroes produced by this growth (*Med. Record*, xvii. 276). In 1881 it was alleged to act upon the heart like digitalis (Park, *Practitioner*, xxvii. 346). It was formerly given in powder in the *dose* of from 10 to 60 grains (Gm. 0.60–4), or in a decoction made from ½ ounce to 2 ounces of the plant in 8 ounces of water (Gm. 16–64 in Gm. 250), and in tablespoonful doses several times a day.

VITELLUS, *U. S.*—Yelk of Egg.

Ovi vitellus, Br.; *Yelk of egg*, E.; *Jaune d'œuf*, Fr.; *Eidotter*, *Eigelb*, G.

The yelk of the egg of Gallus Bankiva, var. domesticus, *Temminck*, s. Phasianus Gallus, *Linné*.

Class Aves; *order* Gallinæ.

Origin.—The domestic fowl originated from the *red jungle-fowl*, G. Bankiva, which inhabits Java and the adjacent islands, Northern India, Cochin China, and the Philippines. At the present time numerous varieties of it are found in all civilized countries. The eggs (Ovum, *U. S.* 1870, Ovum gallinaceum—Egg, *E;* Œuf, *Fr;* Ei, *G.*), which are the part employed for pharmaceutical and medical purposes, consist of the shell and lining membrane 10.7 parts, albumen 60.4 parts, and yelk 28.9 parts (Prout, 1822).

Description and Composition.—1. Testa ovi.—Egg-shell, *E.;* Coquille, *Fr;* Eierschale, *G.*—It consists, according to Prout, of 97 parts calcium carbonate, 1 part calcium and magnesium phosphates, and 2 parts organic matter. Vauquelin's results were 89.6, 5.7, and 4.7 respectively.

2. Albumen ovi, *Br.*—White of egg, *E.;* Blanc d'œuf, *Fr;* Eiweiss, *G.*—It consists of two or three laminæ, the total average weight being 23.01 Gm. (Lehmann), or 24.8 Gm. (Poleck), and contains 82 to 88 per cent. of water, and on the average 13.32 of solid constituents, including 0.65 of ash, as well as minute traces of fat, sugar, and extractive. The ash of the egg albumen consists of 42 per cent. chloride of potassium, 9 of chloride of sodium, 12 of carbonic acid, the remainder being phosphates and sulphates of the alkalies, silica, iron, lime, and magnesia. The organic portion of the white, the *albumen* proper, is a protein compound; the average elementary composition is 53.7 C, 15.5 N, 7.1 H, 22.1 O, and 1.6 S. Its aqueous solution rotates the plane of polarized light to the left, and may be evaporated in thin layers below 50° C. (122° F.) without change, but on being heated to near 75° C. (176° F.) it is coagulated and becomes insoluble in water. Albumen is precipitated from its solutions by most mineral and by some organic acids, but not by phosphoric or acetic acid. It is soluble in caustic alkalies, and precipitates the salts of most heavy metals, hence its value in cases of poisoning by salts of mercury, copper, etc. Albumen is also precipitated by volatile oils, camphor, phenol, and by tannin, the last precipitate being soluble in an aqueous solution of tannin. Alcohol coagulates albumen, and ether precipitates it, the precipitate being only partially soluble in water. Farsky (1878) succeeded in obtaining what appears to be a definite compound of salicylic acid with albumen, by stirring the two together for some time, washing with ether and hot water, and drying in an air-bath at about 120° C. (248° F.); it was found to contain 14.16 per cent. of salicylic acid and 85.84 of albumen, and to be as easily digestible as the uncombined albumen. When boiled with *Millon's reagent* the precipitate as well as the liquid turns red, and albumen cautiously heated with strong hydrochloric acid is colored violet-blue. Other protein compounds show a like behavior.

3. Vitellus ovi.—The yelk is a viscid yellow or reddish-yellow opaque liquid, which is without odor, has a bland taste, an alkaline reaction, and must be regarded as a dense emulsion consisting of oil suspended in water by means of albumen. When triturated with water a whitish emulsion is obtained; the addition of alcohol causes it to coagulate, and when agitated with ether it separates a white mass and yields to ether an orange-yellow fat. Yelk is coagulated by heat. It contains 48 to 55 per cent. of water, 16 to 18 per cent. of *vitellin* (which is probably a proteid closely related to casein, and mixed with about one-fourth of albumen), 29 to 31 per cent. of fat (21.3 parts of which are

olein and margarin, according to Gubley), 1.5 per cent. inorganic salts, coloring matter, a small portion of sugar, and 0.42 of cholesterin. Gubley has separated from the ethereal extract of yelk a substance which he named *lecithin*, and which on boiling with baryta yields *neurine* and stearic and *phosphoglyceric acids*. The fat obtained by expressing the coagulated yelk, or by exhausting it with ether, is occasionally used under the designation of *oleum ovi* (Oil of eggs, *E.;* Huile d'œufs, *Fr.;* Eieröl, *G.*).

Preservation.—Eggs may be preserved for a considerable length of time by covering the shell with a substance impervious to water, thus closing the pores so as to exclude the air. This may be done by wax, fat, paraffin, gum, or by similar substances. Packing them with the small end downward in dry salt, milk of lime, etc. has likewise been recommended.

Phamaceutical Uses.—The white of egg is used for the clarification of syrups, honey, and other liquids. The yelk is employed for emulsionizing fixed and volatile oils and camphors.

Off. Prep.—Glyceritum amyli, Mistura chloroformi, *U. S.;* Mist. spir. vini gallici, *Br.*

The dietetic value of yelk of egg cannot be considered in this work. Its value in pharmacy has been described.

Medical Action and Uses.—*Egg-shells* were long used for the various purposes to which chalk is now applied internally. Like crabs' eyes and claws, corals, and oyster-shells, which were formerly employed, they contain a certain proportion of animal matter which mitigates the action of the calcareous constituent. They were an ingredient of a secret remedy for *gravel*, for a knowledge of which the British Parliament paid an extravagant sum of money. The *white of egg* forms with solutions of corrosive sublimate and of sulphate of copper compounds which are nearly insoluble, and hence it has been used in *poisoning* with these salts, first to neutralize and then to evacuate them. Its demulcent and protective action is also advantageous. It is applied to the treatment of *burns* and *erysipelas*, either alone or emulsified with oil, or coagulated by alum in the form of alum curd. The latter is an excellent application in acute *conjunctivitis*. Diluted with water, sweetened, and flavored, fresh egg albumen forms an agreeable and useful drink in numerous cases of *gastro-intestinal* inflammation and irritation. Albumen is sometimes used as a substitute for starch in the application of fixed *bandages*. The *yelk of egg* is more nutritious and digestible than the white, and is habitually employed whenever it is desired to give the largest amount of nutriment in a small bulk and in the most digestible form. The yelk of a hard-boiled fresh egg readily crumbles, and is therefore easily acted upon by the gastric juice. The fresh yelk, beaten with sugar and mixed with hot water, and with the addition of a little brandy and nutmeg or cloves, forms a customary draught at the commencement of catarrhal and rheumatic (muscular) affections. It is used also to make emulsions for the administration of castor oil, cod-liver oil, oil of turpentine, etc., either by the mouth or the rectum. Externally, it is sometimes, and very usefully, employed as a dressing for *burns, scalds, abrasions*, etc., and to soften the crusts of *cutaneous eruptions, cerumen* in the auditory canal, etc.

WINTERA.—Winter's Bark.

Cortex winteranus.—Écorce de Winter, Canelle de Magellan, Fr.; *Winter's Zimmt*, G.

The bark of Drimys Winteri, *Forster*, s. Wintera aromatica, *Murray*.

Nat. Ord.—Magnoliaceæ, Wintereæ.

Origin.—Drimys Winteri is a small tree growing in the western part of South America from the Straits of Magellan northward to Mexico. It has coriaceous, oblong and obtuse or lance-oblong, dark-green, and on the lower side pale bluish-green, entire leaves, axillary clusters of whitish flowers, and about four or eight black obovate berries containing three or four seeds. D. mexicana, *Sessé*, s. chilensis, *De Candolle*, and D. granatensis, *Linné filius*, are now regarded as varieties, and the last one is mentioned by the French Codex as the present source of the drug.

Description.—Winter's bark is curved or in quills, between $\frac{1}{5}$ and $\frac{1}{3}$ inch (5–8 Mm.) thick, externally of a gray or whitish color with brown patches, and underneath the corky layer brown. The inner surface is brown, and marked with longitudinal ridges from the prominent bast-fibres. The bark breaks with a short fracture, and has a peculiar odor and a warm and very pungent taste. The transverse section is of a brown-red color, mottled with whitish sclerenchyma, which in the primary bark underneath the thin corky layer forms transversly-elongated groups, and in the bast-layer is seen partly in groups, partly in long radial lines; resin-cells are scattered in the outer and inner tissue.

Substitutions.—The Winter's bark of commerce has usually been an entirely different bark, occasionally that of Canella alba, *Linné*, but more frequently obtained from Cinnamodendron corticosum, *Miers* (see page 372).

Constituents.—The principal constituents of Winter's bark, as ascertained by Henry (1820), are 1.2 per cent. of volatile oil, about 10 per cent. of pungent resin, and 9 per cent. of tannin, with extractive matter and a little starch.

Allied Species.—The Australian species, Drimys axillaris, *Forster*, and D. lanceolata (Tasmannia aromatica, *R. Brown*) have likewise pungently aromatic barks, and the fruit of the latter is used like pepper.

Medical Action and Uses.—The action and uses of Winter's bark resemble those of cascarilla and canella. It is a warm tonic of the digestive organs, increasing the appetite and improving the digestion, especially when deranged by *flatulence* and *colic*. The *dose* of the powder is about 30 grains (Gm. 2), and a vinous infusion may be prepared by displacement with an ounce of the bark to 12 ounces (Gm. 32 in Gm. 380) of sherry wine.

XANTHORRHIZA.—YELLOW-ROOT.

The rhizome and root of Xanthorrhiza apiifolia, *L'Heritier*. Bentley and Trimen, *Med. Plants*, 9.

Nat. Ord.—Ranunculaceæ.

Origin.—This plant is also known as *shrub yellow-root* to distinguish it from Hydrastis canadensis. Xanthorrhiza is a shrub 1 or 2 feet (30–60 Cm.) high, growing in shady places near streams in New York and from the mountains in Pennsylvania southward to the Gulf of Mexico. The clustered stems are thin, of a grayish color externally, smooth, and annulate from the distant leaf-scars. The leaves are alternate, crowded at the ends of the branches, long-petiolate, pinnate, and have three or five ovate or lanceolate, cleft, and toothed leaflets, with wedge-shaped bases. The flowers are polygamous and in compound drooping racemes, appearing in early spring.

Description.—Yellow-root consists of a much-branched and bent rhizome several feet long. The thicker portions are about ½ inch (12 Mm.) in diameter, the branches thinner, some being only $\frac{1}{16}$ inch (1.5 Mm.) thick, longitudinally wrinkled, of a light yellowish-brown color externally, and rather sparingly beset with brittle rootlets. The bark is thin, internally of a deep-yellow color, and separates readily from the bright-yellow, tough wood, which is radially striate by medullary rays and encloses a thin central pith. The rhizome breaks with a short fibrous fracture, is inodorous, and has a bitter taste, which is more marked in the cortical portion. Portions of the stems, having a larger brownish pith and yellow wood, are often present.

Constituents.—Perrins (1862) showed that yellow-root contains berberine; he obtained only 7½ grains of the nitrate from 1 pound of the drug. About the same time W. M. Merrill made a similar observation. Whether berberine is associated with a white alkaloid, as is frequently the case, has not been determined. The parenchyma contains starch. The other constituents of the drug are not known.

Medical Uses.—Yellow-root has long been known as an indigenous *tonic* medicine, and compared either to quassia or columbo. It may be given in decoction, tincture, or powder. Of the last the *dose* is said to be 40 grains (Gm 2.60).

XANTHOXYLUM, *U. S.*—PRICKLY ASH.

Toothache tree, Angelica tree, Suterberry, E.; *Clavalier, Frêne épineux*, Fr.; *Zahnwehrinde, Zahnwehholz*, G.

The bark of Xanthoxylum fraxineum, *Willdenow* (s. X. americanum, *Miller*), and of Xanthoxylum carolinianum, *Lambert*.

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Both species of prickly ash are indigenous to North America, and have pinnate leaves and diœcious, tetramerous or pentamerous flowers, the pistillate ones containing from three to five free ovaries, which produce thick and fleshy two-valved and one- or two-seeded capsules.

X. AMERICANUM grows in rocky woodlands and on river-banks from Canada southward to Virginia and North Carolina. It is shrubby, and attains a height of 10 or 12 feet (3–3.6 M.). The leaves have nine or eleven ovate-oblong, nearly sessile, somewhat serrulate, and on the lower surface downy leaflets. The small, greenish flowers are in umbellate, axillary clusters, appear in April before the leaves, and are destitute of a calyx. The capsules are roundish, red, and contain black, shining seeds.

X. CAROLINIANUM is found near the coast from Virginia southward to Florida and westward to Texas. It is a small tree, but sometimes grows to the height of 30 or 40 feet (9–12 M.). Its leaves have from seven to eleven ovate-lanceolate, crenate-serrulate, unequal-sided, and shining leaflets, the terminal one alone being equilateral. The numerous greenish flowers are in terminal cymes, appear in June after the leaves, and contain three pistils.

Description.—NORTHERN PRICKLY-ASH BARK is in small, curved, or quilled fragments, about 2 inches (5 Cm.) or less long, mostly about $\frac{1}{25}$ inch (1 Mm.) thick, and occasionally mixed with pieces nearly $\frac{1}{8}$ inch (3 Mm.) thick. The corky layer is very thin, of a brown-gray color, nearly smooth or faintly furrowed longitudinally, occasionally superficially fissured transversely, and marked with some scattered warts, becoming transversely elongated. Irregular whitish patches are usually observed on the surface of the bark, and numerous minute, black, and shining hemispherical dots, which are the perithecia of a lichen, probably a species of *Verrucaria.* The brown, glossy spines are not numerous, but are about $\frac{1}{4}$ inch (6 Mm.) long, straight, two-edged, and have a narrow linear base about $\frac{3}{4}$ inch (18 Mm.) long. The outer bark underneath the corky layer is of a green color, and the inner bark whitish or yellowish. The inner surface is smooth, or finely striate if obtained from older branches. The bark is quite brittle, breaks with a short, non-fibrous fracture, and exhibits upon transverse section a somewhat tangential arrangement of the tissue. It is inodorous and has a slightly aromatic, bitterish, and strongly pungent taste.

SOUTHERN PRICKLY-ASH BARK resembles the preceding, except that it is about $\frac{1}{12}$ inch (2 Mm.) thick, and bears on its surface many conical, corky projections, which are $\frac{2}{3}$ to $\frac{4}{5}$ inch (1–2 Cm.) high, and have an oblong or roundish base an inch (25 Mm.) or more in length. Sometimes a number of these cones are crowded together. The stout brown spines are situated upon elevated corky bases.

Substitution.—The bark of Aralia spinosa, *Linné*, which plant is known by the same common names as the two species of Xanthoxylum, is sometimes collected in place of the bark of the latter. Aralia-bark is described on p. 255.

Allied Species.—XANTHOXYLUM CLAVA HERCULIS, *Linné.* This is the Hercules' club of the West Indian Islands, is closely allied to the Southern prickly ash, and is considered by some botanists as being identical with it.

X. FLORIDANUM, *Nuttall*, is known as *satin-wood*, and considered to be identical with X. caribæum, *Lamarck.*

X. PTEROTA, *Kunth*, grows from Florida and Texas to Brazil. The wood is yellow, dense, and very hard; the bark and leaves are pungent.

X. ALATUM, *Roxburgh*, of Northern India, X. PIPERITUM, *De Candolle*, a native of Japan, and several other species, yield pungently aromatic fruits which are employed as condiments in the East. The bark, leaves, and fruit of most species are pungent or acrid.

Constituents.—Prickly-ash bark was examined by Dr. Staples (1829), who obtained from it a little volatile oil, a green-colored fixed oil, resin, and other common vegetable principles, and a crystalline body which he named *xanthoxylin*, but the nature of which was not further characterized. The bitter principle of the bark of X. clava Herculis was isolated by Chevallier and Pelletan (1827), and designated as *xanthopicrit*, but was found by Perrins (1863) to be identical with *berberine.* G. H. Colton (1880) examined Southern prickly-ash, and obtained an alkaloid which seems to differ from berberine; it is yellowish, bitter, soluble in alcohol and water, insoluble in benzin, ether, and chloroform, and becomes purplish-brown with sulphuric acid, and bright-red, changing to yellow, with nitric acid. Colton obtained also a trace of volatile oil, sugar, resins, a colorless and tasteless crystalline principle, and 12.4 per cent. of ash, of which 20 per cent. was soluble in water, the remainder in hydrochloric acid. Prof. Lloyd (1876) isolated from Northern prickly ash a crystalline substance which is probably identical with the one previously mentioned; it is insoluble in water, soluble in boiling alcohol, is turned yellow by nitric acid, and dissolves with a deep-red color in sulphuric acid.

The fruit of X. piperitum was examined by Stenhouse (1854, 1857). On being distilled with water, volatile oil is obtained, which on exposure to cold yields crystals of *xanthoxylin*, $C_{20}H_{24}O_8$. It melts at 80° C. (176° F.), has a slight odor and aromatic taste, and a neutral reaction. The liquid portion of the volatile oil is *xanthoxylene*, $C_{20}H_{16}$, is colorless, has a strong, agreeable odor, boils at 162° C. (324° F.), and yields, with hydrochloric acid a liquid compound.

Medical Action and Uses.—Xanthoxylum appears to be an arterial and nervous stimulant, which displays its virtues in producing diaphoresis, expelling *flatus*, and allaying muscular *rheumatic* pains. Locally it is an acrid irritant, and hence has been much used as a sialagogue. Its infusion may be applied on compresses or otherwise for producing revulsion. These qualities have caused it to be compared with mezereon, and, like it, to be used as a remedy for chronic constitutional *syphilis.* It has also been employed as an *emmenagogue,* like other acrid stimulants; and doubtless, like them, it will promote the *secretion of milk* when applied to the mammæ under appropriate circumstances. A decoction may be prepared by boiling an ounce of it in 3 pints of water until reduced to 2 pints (Gm. 32 in Gm. 1500, reduced to Gm. 1000). About a pint should be taken, in divided doses, within 24 hours. A saturated tincture may be used in the dose of 10 drops (Gm. 0.60).

X. Naranjillo has attracted notice from its being sialagogue, sudorific, and diuretic, like jaborandi.

XYLOL.—XYLOL.

Xylol, Xylène, Fr.; *Xylol,* G.

Formula C_8H_{10}. Molecular weight 106.

Origin and Preparation.—Xylol was discovered by Cahours (1850) in crude wood-spirit, and was subsequently found by Völckel (1853) in wood-tar (see PIX LIQUIDA), and by Church (1855) in coal-tar. It is obtained from the oily liquid separating from diluted crude wood-spirit and from the light oil of wood-tar or coal-tar, by treating these liquids first with sulphuric acid, and afterward subjecting them to fractional distillation, collecting only that portion which distils between 136° and 141° C. (277°–286° F.). It may also be prepared artificially from several benzol derivatives.

Properties.—Xylol is a thin, colorless, oily liquid, resembling benzol in odor, has a burning taste, and is insoluble in water, but dissolves readily in alcohol. It is *dimethylbenzol,* $C_6H_4(CH_3)_2$, and there are three modifications of it, two of which boil at 137° C. (278.6° F.), while orthoxylol boils at 141° C. (285.8° F.). The boiling-point of the isomeric *ethylbenzol,* $C_6H_5.C_2H_5$, is 134° C. (273.2° F.). Xylol unites with sulphuric acid to *sulphoxylolic acid,* the barium salt of which crystallizes from hot water in transparent scales (Church). On treating xylol with cold concentrated nitric acid, *nitroxylol* is obtained as an oily liquid having a less agreeable odor than nitrobenzol. By oxidation xylol is converted into *toluic acid,* $C_8H_8O_2$, and *phthalic acid,* $C_8H_6O_4$.

Medical Action and Uses.—The only purpose for which this preparation appears to have been employed in medicine is to moderate the angina and eruption in the throat and to diminish the fetid exhalation from this part and from the skin in *small-pox.* It seems to have been efficient, when applied to the throat in a gargle, spray, or wash, in lessening the swelling and difficulty of swallowing, and destroying the fetor when used upon the skin in a similar manner. It may also be given suspended in mucilage and syrup. The *dose* for an adult is stated to be 10 or 15 drops (Gm. 0.60–1), and for children 3 or 4 drops (Gm. 0.15–0.20), but its topical application is to be preferred.

ZEDOARIA.—ZEDOARY.

Rhizoma zedoariæ, P. G.—*Zédoaire,* Fr.; *Zittwerwurzel,* G.

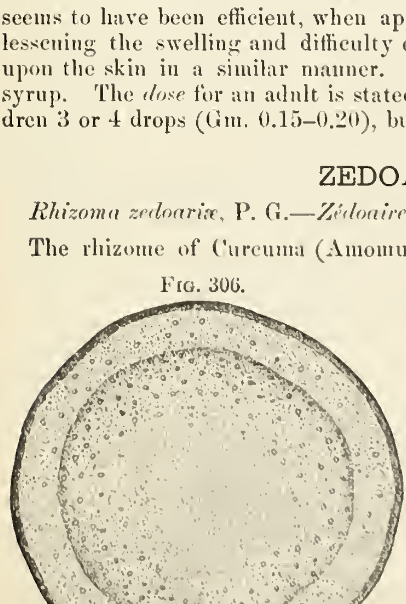
The rhizome of Curcuma (Amomum, *Willdenow*) Zedoaria, *Roscoe,* s. Curcuma (Amomum, *Koenig*) Zerumbet, *Roxburgh.*

Nat. Ord.—Zingiberaceæ.

Origin.—The zedoary-plant is indigenous to India and some of the East Indian islands, has long dark-green leaves with a large purple spot in the centre, and produces a short scape bearing a raceme of yellow flowers. The tuberous ovate or pear-shaped rhizome is about 1½ or 2 inches (4–5 Cm.) long, and is usually cut into transverse slices before drying.

Description.—Zedoary is met with in the market in the form of nearly circular disks, varying in diameter from ½ to 1½ inches (1–4 Cm.) It is externally of a grayish-brown color, upon the transverse surface grayish, and has near the edge a dark-colored circular nucleus-sheath. The central portion contains a large number of small orange-colored resin-cells and irregularly scattered wood-

FIG. 306.



Zedoary: transverse section magnified 3 diameters.

bundles; both are seen also outside of the nucleus-sheath, though in smaller number. The disks break with a short mealy or somewhat waxy fracture, have a peculiar aromatic odor, and a warm aromatic somewhat camphoraceous taste. The starch-granules are very similar to those of ginger.

Allied Drugs.—The French Codex recognizes long and round zedoary, without giving descriptions, and refers the latter to Curcuma aromatica, *Salisbury.* The rhizome of this plant is internally yellow, and may furnish the bright-yellow disks which are occasionally seen among commercial zedoary. The rhizome of several other species is likewise yellow.

Constituents.—Bucholz (1817) obtained from zedoary starch, mucilage, bitter extractive, a pungent soft resin, and volatile oil; the latter is pale-yellow, of a thick consistence, heavier than water, and has a bitterish, pungent, and somewhat camphoraceous taste.

Medical Action and Uses.—Zedoary is usually regarded as being almost identical in its qualities with ginger, but more agreeable, because less burning and acrid. It is used for similar purposes—viz. to promote *digestion*, expel *flatus*, etc. The powder may be prescribed in *doses* of from 10 to 30 grains (Gm. 0.60–2), or an infusion may be made with 3 or 4 drachms (Gm. 12–16) of the bruised root to ½ pint (Gm. 250) of wine or water, and given in tablespoonful doses.

ZINCI ACETAS, *U. S., Br.*—Acetate of Zinc.

Zincum aceticum, P. G.; *Acetas zincicus*, F. Cod.—*Acétate de zinc*, Fr.; *Zinkacetat, Essigsaures Zinkoxid*, G.

Formula $Zn(C_2H_3O_2)_2 3H_2O$. Molecular weight 236.9.

Preparation.—Digest for some time Commercial Oxide (or Carbonate) of Zinc 2 parts in Acetic Acid and Distilled Water, each 5 parts; then heat to the boiling-point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother liquor to one-half, slightly acidulating with acetic acid, and crystallizing. —*U. S.* 1870, *Br.*

On digesting oxide or carbonate of zinc with acetic acid, the zinc is dissolved, in the latter case with the evolution of carbonic acid gas; $ZnO + 2HC_2H_3O_2$ yields $Zn(C_2H_3O_2)_2 + H_2O$. An excess of the zinc compound is used to avoid loss of acetic acid, and is removed by filtration. Should the acetic acid not have been diluted with too large a quantity of water, the hot filtrate, on cooling, will deposit most of the zinc acetate as crystals. The mother-liquor should be evaporated without boiling, so as to avoid loss of acetic acid and the formation of basic salt; acidulating the concentrated mother-liquor with a little acetic acid will restore the normal from the basic acetate, should the latter have been formed. $Zn(C_2H_3O_2)_2 2H_2O$ is the formula recognized by the Br. P.

Properties.—Acetate of zinc crystallizes in soft white pearly six-sided tablets or scales, which on exposure to the air lose their transparency from the evaporation of some acid and water of crystallization, and have a slight acid reaction, a slight acetous odor, and a sharp metallic taste. The salt melts readily in its water of crystallization, and on continuing the heat parts with the latter, the loss amounting to 22.8, which is gradually reabsorbed in a moist atmosphere. On dry distillation acetic acid, carbonic acid gas, acetone, and empyreumatic products pass over, a white pearly sublimate is formed, and oxide of zinc, mixed with a little charcoal, remains behind; when strongly heated in the air upon a porcelain plate, the salt is decomposed, and burns with a greenish light and the production of a white smoke to zinc oxide. At ordinary temperatures the salt dissolves in 3 (2.7 *P. G.*) parts of water, and in a smaller quantity (1.5 *U. S.*, or 2 parts *P. G.*) at the boiling-point. It requires about 30 parts (35.6 parts *P. G.*) of cold alcohol and about 3 parts (*U. S.*) of boiling alcohol for solution. Treated with sulphuric acid, it is decomposed with the evolution of acetic acid. The aqueous solution of the salt acquires a dark-red color with ferric salts, the color being discharged on the addition of hydrochloric acid, and yields white precipitates with potassium ferrocyanide, hydrosulphuric acid, sulphide of ammonium, ammonia, and potassa, the precipitates with the two last reagents being soluble in an excess of the precipitant, and the colorless solution giving again a white precipitate with hydrosulphuric acid.

Tests.—"The solution of the salt in 10 parts of water should give with an excess of hydrosulphuric acid a purely white precipitate (absence of lead, copper, etc.), and the filtrate on being evaporated should leave no fixed residue (iron, earths, alkalies). On warming the salt with sulphuric acid it should not turn black (empyreumatic products and other organic matters). Its solution in 3 parts of water should be clear, and should remain clear on the further addition of water (absence of basic salt)."—*P. G.* The U. S. P. does not give any tests for organic impurities or basic salt, and directs testing for lead and copper in the acidulated aqueous solution by hydrosulphuric acid, and for iron, aluminium, calcium, etc. by adding to the solution excess of ammonium carbonate, in which the hydrates and carbonates named are insoluble. "On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths)."—*U. S.* If this precipitate, formed in the solution of the salt, has a white color, the test excludes all impurities except aluminium. "The dilute watery solution should not be affected by barium chloride or silver nitrate (sulphate and chloride)."—*Br.*

Medical Action and Uses.—Acetate of zinc acts locally as an irritant and astringent. Internally, in large doses, it occasions vomiting. There is no reason to believe that in any dose it produces poisoning. Internally, it is rarely used in this country. Some years ago it was recommended after this manner by certain German physicians in the treatment of erysipelas and other febrile affections attended with *delirium*, and occasionally it has been employed to check *diarrhœa* in typhoid fever and similar cases. Its chief use, however, is as a local substitutive and astringent application in *conjunctivitis*, *gonorrhœa*, and *leucorrhœa*. For the first-named affection a collyrium may be made with rose-water or mucilage of sassafras-pith in the proportion of about 1 or 2 grains (Gm. 0.06–0.12) of the salt to the fluidounce, to which a few drops of wine of opium may be added. In gonorrhœa and leucorrhœa a customary injection is prepared by dissolving sulphate of zinc and acetate of lead, of each 12 grains (Gm. 0.80), in 8 fluidounces (Gm. 250) of water. The salts react upon one another, producing acetate of zinc and sulphate of lead, the latter of which is precipitated. The value ascribed to this preparation appears to depend partly upon the modifying influence of the insoluble lead salt which sheathes the inflamed parts. When injected the mixture should be shaken. A similar injection is prepared with sulphate of zinc gr. vj; solution of subacetate of lead ♏xxx; water f℥iv.

ZINCI BROMIDUM, *U. S.*—Bromide of Zinc.

Zincum bromatum, Bromuretum zincicum.—Bromure de zinc, Fr.; *Zinkbromid*, G.
Formula $ZnBr_2$. Molecular weight 224.5.

Preparation.—This salt is most conveniently prepared by digesting granulated zinc in hydrobromic acid, in which it dissolves with the evolution of hydrogen; the solution (filtered through asbestos or powdered glass) is carefully concentrated, acidulated with a little hydrobromic acid, and dried by the heat of a water-bath.

Properties.—Bromide of zinc crystallizes with difficulty from its aqueous solution, and is therefore usually obtained in the form of a white granular powder. The salt is very deliquescent, has a slight acid (neutral, *U. S.*) reaction, is inodorous, and has a sweet and styptic metallic taste in diluted solution. It is freely soluble in water and in alcohol, and is also soluble in ether. Its aqueous solution yields with silver nitrate a white curdy precipitate, which is insoluble in dilute nitric acid and nearly insoluble in ammonia; it gives white precipitates with potassium ferrocyanide, ammonium sulphide, ammonia, and potassa, the precipitates with the last two reagents being soluble in an excess of the precipitant, and the colorless solution giving again a white precipitate with hydrosulphuric acid. The salt melts on heating, with partial decomposition, to a colorless or yellowish liquid which boils near 700° C. (1292° F.) and sublimes in white needles.

Tests.—"On adding some disulphide of carbon to the aqueous solution, then chlorine-water drop by drop, and agitating, the disulphide will separate with a yellow to brownish-red color, free from violet tint (absence of iodide). 1 Gm. of the dry salt, when completely precipitated by nitrate of silver, yields 1.67 Gm. of dry bromide of silver. (In presence of chloride the precipitate weighs more.) When acidulated with hydrochloric acid, the aqueous solution should yield no dark-colored precipitate with hydrosulphuric acid (absence of lead, copper). On adding test solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent (absence of iron, aluminium, and most alkaline earths). On completely precipitating the zinc from this alkaline solution by sulphide of ammonium the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths)."—*U. S.* The aqueous solution of the salt should be clear (absence of basic salt), should not be precipitated by barium nitrate (sulphate), and if precipitated by silver nitrate and the mixture rendered alkaline by ammonia, the filtrate, on being acidulated with nitric acid, should merely produce a slight turbidity, but not a curdy precipitate (chloride).

Action and Uses.—It may be conjectured that in proposing this compound as a medicine a vague idea was entertained of its uniting in itself the powers of two medicines, both of which are useful in spasmodic affections, and especially in chorea and epilepsy. That any dose of bromine which can be combined with a suitable dose of zinc should exert a sensible effect is quite improbable. We know of nothing that proves the clinical value of this salt, unless it be the statement that some years ago it was tested at the Salpêtrière in Paris with satisfactory results in the treatment of *epilepsy*. The commencing *dose* of 1 grain daily was increased to 25 grains or more. Had its virtues been proven, it would probably have been heard of again, which has not been the case. Gowers (1880) says of it, "it seemed of small value, and is borne badly." Its *dose* may safely be that of the oxide of zinc—viz. 1 grain and upward (Gm. 0.06).

ZINCI CARBONAS PRÆCIPITATUS, *U. S.*—Precipitated Carbonate of Zinc.

Zinci carbonas, Br.; *Hydrocarbonas zincicus*, F. Cod.; *Zincum carbonicum.—Sous-carbonate (Hydrocarbonate) de zinc*, Fr.; *Zinkcarbonat, Kohlensaures Zinkoxyd*, G.

Formula $(ZnCO_3)_2.3Zn(HO)_2$. Molecular weight 546.5.

Preparation.—Take of Sulphate of Zinc 10 ounces; Carbonate of Soda 10½ ounces; Boiling Distilled Water a sufficiency. Dissolve the carbonate of soda with a pint of the water in a capacious porcelain vessel, and pour into it the sulphate of zinc, also dissolved in a pint of the water, stirring diligently. Boil for 15 minutes after effervescence has ceased, and let the precipitate subside. Decant the supernatant liquor, pour on the precipitate 3 pints of boiling distilled water, agitating briskly; let the precipitate again subside, and repeat the processes of affusion of hot distilled water and subsidence till the washings are no longer precipitated by chloride of barium. Collect the precipitate on calico, let it drain, and dry it with a gentle heat.—*Br.*

The French Codex has adopted a similar process, and directs adding 10 parts of zinc sulphate, dissolved in 50 parts of water, to a boiling solution of 11 parts of sodium carbonate in 50 parts of water, and drying the washed precipitate at 50° C. (122° F.).

On adding cold solutions of sodium carbonate and zinc sulphate together, neutral zinc carbonate is precipitated; $Na_2CO_3 + ZnSO_4$ yields $Na_2SO_4 + ZnCO_3$. The gelatinous precipitate rapidly undergoes decomposition, carbonic acid gas being evolved; and this renders another portion of the precipitate soluble. But if the mixture is boiled, the carbonic acid is expelled from the liquid and the whole of the zinc is precipitated. Adding the solution of zinc sulphate to that of sodium carbonate while boiling hot keeps the precipitate free from sodium compound, and the sulphate of sodium which is formed at the same time is readily removed by washing with water. Carbonate of potassium is not so well adapted for this process as the sodium salt, because the resulting potassium sulphate is less freely soluble in water; and ammonium carbonate is unsuitable, since a complete precipitation of the zinc cannot be effected.

Properties.—Carbonate of zinc is a soft, impalpable, white, inodorous, and tasteless powder, permanent in the air, insoluble in water and other simple solvents, but dissolving readily in acetic and dilute mineral acids, with the evolution of carbonic acid gas, and soluble also in aqueous solutions of ammonium salts. When heated in a crucible to redness it parts with its water and carbonic acid, and leaves about 70 per cent. of oxide of zinc. Its solution in dilute sulphuric acid shows the chemical behavior described under Zinci Sulphas.

Composition.—According to H. Rose (1852), this is influenced by the temperature during the preparation and drying of the salt; it contains between 5 and $7ZnO$ to $2CO_2$, but the proportion of water is more variable. The formula given above is that adopted by the U. S. P., while $(ZnCO_3)_3.5Zn(HO)_2.H_2O$ is given by the French Codex.

Tests.—The purity of carbonate of zinc is ascertained by dissolving it in dilute sulphuric acid and testing in precisely the same manner as for sulphate of zinc. The Pharmacopœia directs testing this solution for lead; but sulphate of lead is insoluble in water or diluted acids.

Medical Uses.—Carbonate of zinc is seldom given internally, and its topical application is confined to those excoriated or inflamed surfaces which it is desirable to protect from the air and moderately to constringe. Hence in powder it is very useful in healing *blisters* and other superficial *sores* which resist milder applications, to prevent the friction that occasions *intertrigo*, and to cure such abrasions when they occur. It is most frequently applied in the form of the officinal oxide of zinc ointment.

ZINCI CHLORIDUM, *U. S., Br.*—Chloride of Zinc.

Zincum chloratum, P. G.; *Chloruretum zincicum*, F. Cod.—*Chlorure de zinc*, Fr.; *Zinkchlorid*, *Chlorzink*, G.

Formula $ZnCl_2$. Molecular weight 135.7.

Preparation.—The British Pharmacopœia repeats the directions given for preparing Liquor Zinci Chloridi (see p. 938), except that the last filtrate is to be evaporated in a porcelain basin until a portion of the liquid, withdrawn on the end of a glass rod and cooled, forms an opaque white solid; the liquid is then poured into proper moulds, and when the salt has solidified, but before it has cooled, it is placed in closely-stopped bottles.

The reactions occurring in the preparation and purification of chloride of zinc are explained on page 928. Since zinc chloride destroys vegetable fibre and transforms cellulose and starch into soluble modifications, its solution should not be filtered through paper, but through asbestos or powdered glass; otherwise the fused salt will be black. Toward the close of the evaporation of the solution the heat should be regulated so as not to decompose the salt, and in case the fused mass should become opaque from the separation of basic salt a little hydrochloric acid should be added. If the salt is desired for solution in water, the liquid is evaporated and continually stirred until a granular powder remains, a few drops of hydrochloric acid being added toward the close of the process.

Properties.—Chloride of zinc is either in the form of a white crystalline powder or in opaque tablets or rods. It is inodorous, has a strongly caustic and metallic taste, is very deliquescent on exposure, has an acid reaction, and when heated to a little over 100° C. (about 115° C. = 230° F., *U. S.*) it melts to a colorless liquid which congeals to a white mass; at a higher heat it is partly volatilized, forming white fumes and leaves a yellowish residue; but when heated in a current of chlorine gas the salt sublimes in acicular crystals. Chloride of zinc is freely soluble in water, but usually yields with water an opalescent solution from the presence of a little oxychloride, which is readily dissolved by a few drops of hydrochloric acid; the solution dissolves starch, paper, and other organic compounds. Chloride of zinc dissolves also freely in alcohol, and somewhat less freely in ether. In contact with sulphuric acid it is converted into sulphate of zinc. Its solutions yield white precipitates with sulphydrate of ammonium, ammonia, and with nitrate of silver, the last two being readily soluble in an excess of ammonia. On mixing a concentrated solution of zinc chloride with oxide of zinc a plastic mass of oxychloride of zinc is obtained, which soon hardens.

Tests.—The solution of chloride of zinc in water acidulated with hydrochloric acid should remain clear (absence of lead), and should not yield a dark-colored precipitate with sulphuretted hydrogen (lead, copper, etc.). With an excess of ammonium carbonate a clear solution should be obtained (aluminium, iron, calcium, etc.), which should not be precipitated by a drop of phosphoric acid (magnesium), and which yields with sulphuretted hydrogen or sulphide of ammonium a white precipitate, the filtrate from which, on being evaporated and ignited, should leave no fixed residue (potassium, sodium). The U. S. P. requires that the aqueous solution of this salt should be miscible with alcohol without precipitation (absence of basic salt); yet it permits the salt to form with water a faintly opalescent liquid, the opalescence to be removable by a few drops of hydrochloric acid. The P. G. more correctly permits the presence of a little oxychloride, and requires the salt to form a clear and colorless solution with an equal weight of water; on the addition of 3 parts of alcohol a flocculent precipitate may form which should dissolve on adding 1 drop of hydrochloric acid.

Pharmaceutical Uses.—Causticum cum chlorureto zincico, *F. Cod.*—Chloride of zinc pencils, *E.*; Pâte de Canquoin, *Fr.*—Dissolve chloride of zinc 32 Gm. in cold distilled water 4 Gm.; add oxide of zinc 8 Gm., previously mixed with well-dried wheat flour 24 Gm.; triturate so as to obtain a paste, and form this into cylinders or other shaped pieces, which are to be completely dried in an air-bath at a temperature gradually raised from 50° to 100° (122°–212° F.).

Physiological Action.—In small and properly-adjusted doses chloride of zinc is said to act as a stimulant and tonic to the nervous system and increase the urinary secretion, but the grounds of these statements are more than equivocal. In large doses it is a powerful irritant poison, occasioning pain in the stomach, nausea, vomiting, anxiety, quick and short breathing, a small and rapid pulse, cold sweats, syncope, and convulsions. Generally, after death, the mucous membrane of the throat and œsophagus, if not of the mouth, is found abraded, and the coats of the stomach are disorganized and converted into a leathery substance. The body shows no signs of putrefaction.

Applied externally, it is powerfully corrosive, and, although very painful, is perhaps less so than corrosive sublimate or arsenic. Its first application produces a sense of warmth and more or less redness. Upon the denuded skin its action is more rapid as well as more painful, but it does not extend beyond the limits of the caustic. If it is made to penetrate deeply, it coagulates the blood in the vessels and converts the soft tissues into a tough, dry, and uniform mass which is not fetid, and which separates in from one to two weeks, leaving behind a clean granulating surface that tends to rapid cicatrization.

Medical Uses.—The rare occasions in which chloride of zinc may be given internally have been already pointed out. (See Liquor Zinci Chloridi.) In the same connection its uses as a disinfectant were noticed. When, owing to the timidity of patients or any other cause, the knife cannot be employed for the removal of *malignant* and other *morbid growths*, this preparation is preferred before other caustic applications, because it runs no risk of poisoning the system, and because its action is limited to the points of its contact with the tissues. It was originally alleged to be much more successful than excision in the treatment of cancer, and, indeed, to have cured four-fifths of the cases in which it was employed; it was also thought to possess the advantage of acting on the diseased rather than on the healthy tissues. These conclusions have been proved groundless, as well as the allegation that the pain produced by the application is inconsiderable. On the contrary, the pain caused by chloride of zinc far exceeds that occasioned by the knife, even without the use of anæsthetics, and is of much longer duration. To what degree this caustic is capable of preventing a return of cancerous disease is still undetermined. It is very positively alleged by competent authorities that the recurrence of cancerous tumors is due mainly to their incomplete extirpation by excision, and that this and some other caustics reach and destroy the cancerous germs more effectually than a surgical operation.

The mode of action here attributed to chloride of zinc was long since pointed out by Bonnet. He remarked that when applied as a paste in the neighborhood of large blood-vessels, arteries, or veins, its caustic action does not occasion hæmorrhage, but under its influence they contract and shrivel, and only remain as thin, hard, and apparently solid strings. The experiments of Gersuny and Gjorgjević on dogs and rabbits exhibited a similar result, for even when the chloride was applied to wounds in which large veins were exposed the vessels were not penetrated, there was no hæmorrhage, and their walls collapsed and shrivelled. In 1878, Dr. Carl Langenbuch treated a case of *rodent ulcer*, or of *lupus exedens*, affecting the face and neck and laying bare the large blood-vessels of the cervical region—a case in which instrumental interference was out of the question—by means of chloride of zinc, with the result of arresting the ulceration, suspending the circulation through the exposed vessels, and securing a perfect cure. He also refers to a similar treatment of gangrenous ulcers in the Franco-German War of 1870–71. In these cases the pure chloride was applied in the manner described below as Cooke's. It appears, therefore, that the action of this compound is not properly a caustic action; it mummifies the tissues, but does not destroy them.

Several modes of applying chloride of zinc as a caustic have been employed. The oldest is that of Canquoin, who made use of a paste containing 1 part by weight of the chloride to 2, 3, 4, or 5 parts of rye flour; or 5 parts of the chloride and 10 of rye flour made into a paste with 2 parts of glycerin may be used. Gluten has been used as an excipient instead of flour. Mayet's paste is made as follows: Chloride of zinc 8 parts; oxide of zinc 1 part; wheaten flour, dried at 212° F., 7 parts; water 1 part. Mix the oxide of zinc and the flour, dissolve the chloride of zinc in the water, and add to the solution the mixture of oxide of zinc and flour. Rub the paste in a mortar for ten minutes. Cooke's method consists in saturating lint with the deliquesced salt, and keeping it, after it is dried, in a close box of wood or pasteboard. The lint when used must be cut with scissors that can be spared, since it ruins steel instruments. A convenience of this preparation is that it can be applied in pieces proportioned to the size of the part to be acted upon. A similar advantage is possessed by a mixture of chloride of zinc and gutta-percha in equal parts; its caustic action is attenuated by the inert and insoluble portion of it. Conical or arrow-shaped bodies made with chloride of zinc alone, or of this salt and nitrate of potassium, are sometimes thrust into incisions made in the tumor to be acted upon. Before applying any of these mixtures the cuticle, if unbroken, must be removed by means of strong ammonia. In 1879 cases of *nasal polypi* were cured by injecting the tumors with chloride of zinc, and in the following year several others were reported (*Archives gén. de Med.*, Mars, 1880, p. 353; *Med. Record*, xviii. 433). In 1881 additional cases were furnished by Dr. Reynolds of Kentucky (*Trans. Amer. Med. Assoc.*, xxxii. 237). The stronger preparations have been used to destroy anastomotic *aneurisms* and to open *abscesses* where puncture or incision might be dangerous, as abscesses of the liver. Chloride of zinc has been applied to destroy the hardened tissues surrounding cavities and fistulæ following the suppuration of *scrofulous glands*, and is said to possess the advantage over other methods of local treatment of not leaving behind it irregular or unsightly scars. It has also been employed to fill the cavities of *carious teeth*, especially of the incisors.

ZINCI IODIDUM, *U. S.*—IODIDE OF ZINC.

Ioduretum zincicum.—*Iodure de zinc*, Fr.; *Zinkjodid*, G.
Formula ZnI_2. Molecular weight 318.1.

Preparation.—This salt may be prepared by dissolving oxide or carbonate of zinc in hydriodic acid, or, according to Doepp (1839), by digesting in a flask 3 parts of granulated zinc, 10 parts of iodine, and 20 parts of water until the liquid has become colorless, when it is filtered through asbestos or powdered glass, and rapidly evaporated to dryness at a moderate heat. The yield is 12½ parts. The salt should be at once put into vials, which are to be kept carefully stopped.

Properties.—Iodide of zinc resembles the chloride and bromide of zinc, is a white granular, crystalline, inodorous powder, and has a caustic and metallic or in diluted solution a sweetish and styptic taste and an acid reaction. On exposure it is very deliquescent, and gradually becomes colored by, and acquires the odor of, free iodine. It is freely soluble in water and alcohol, and the solution on being largely diluted with water separates a gelatinous precipitate of hydrate of zinc (Rammelsberg). It readily forms basic compounds, an oxyiodide soluble in warm and insoluble in cold water being produced by the prolonged digestion of iodine and zinc with water. The iodide melts when carefully heated to a colorless liquid, and may be sublimed in quadrangular needles, but on being heated in the air is decomposed into iodine and zinc oxide. The aqueous solution gives white precipitates with ammonium sulphide, potassium ferrocyanide, ammonia, and potassa, the last two being soluble in an excess of the precipitants, and it yields a scarlet-red precipitate with mercuric chloride, a bright-yellow one with lead acetate, and a pale-yellow one with silver nitrate, the latter being insoluble in ammonia and in nitric acid. The salt, warmed with strong sulphuric acid, liberates iodine and sulphur dioxide, zinc sulphate being formed at the same time.

Tests.—The absence of foreign metals is ascertained in precisely the same manner as in chloride and bromide of zinc, and the absence of sulphate by the solution not producing a precipitate with barium chloride. The absence of other zinc salts may be ascertained as follows: "1 Gm. of the dry salt, when completely precipitated with nitrate of silver, yields 1.47 Gm. of dry iodide of silver."—*U. S.* Bromide and chloride, if present, increase the weight of the silver precipitate. The test as given proves the absolute purity of the salt, the weight theoretically obtainable being 1.473 Gm. This seems to be too strict a requirement, in view of the alterations taking place on exposure. Hager suggests the following test, which requires at least 95 per cent. of pure ZnI_2: 0.5 Gm. of the dry salt should yield with 5 Gm. of alcohol a nearly clear solution free from crystalline deposit; add to this liquid 0.6 Gm. of silver nitrate dissolved in 30 Gm. of water, afterward 5 Gm. of ammonia-water, agitate well, and filter; the precipitate when dried should weigh not less than 0.7 Gm., and the filtrate on being acidulated with nitric acid should remain clear or at most become faintly opalescent, but should not produce a curdy precipitate.

Pharmaceutical Preparation.—SYRUPUS ZINCI IODIDI, Syrup of iodide of zinc. Digest 2 troyounces of iodine and 5 drachms of granulated zinc in 8 ounces of water, and when the color of iodine has disappeared pass the liquid through a small filter into a bottle containing 15 troyounces of sugar; wash the filter with a little water and dissolve the sugar by agitation. The syrup should measure 20 fluidounces, and is of about the same iodine strength as the syrup of iodide of iron (A. B. Taylor, 1852). This is the most convenient form for the administration of iodide of zinc.

Medical Uses.—As long ago as 1853 this compound was recommended in hysterical chorea (*Lancet*, Dec. 1853, p. 624), and externally in various scrofulous affections of the skin and eyes (Guibert, *Nouveaux Médicaments*, 1864). It was used by Lente as an application to the Eustachian tube in certain cases of deafness (*Amer. Jour. of Med. Sci.*, Oct. 1859, p. 390), and by Ross as an application to enlarged and indurated *tonsils*. A solution of 1 or 2 grains in an ounce of water (Gm. 0.06–0.12) has been employed as an injection in *gonorrhœa* and *leucorrhœa*. It seemed to be entirely obsolete when it was revived in the Pharmacopœia of 1880. Its *dose* is said to be from half a grain to 2 grains (Gm. 0.03–0.12).

ZINCI OXIDUM, *U. S., Br.*—Oxide of Zinc.

Zincum oxydatum, P. G.; *Oxydum zincicum*, F. Cod.; *Flores zinci.*—*Oxyde de zinc*, Fr.; *Zinkoxyd*, G.

Formula ZnO. Molecular weight 80.9.

Preparation.—Place carbonate of zinc in a loosely-covered Hessian crucible, and expose it to a dull red heat until a portion, taken from the centre of the contents of the crucible and cooled, no longer effervesces when dropped into diluted sulphuric acid. Let the crucible cool, and transfer the product to stoppered bottles.—*Br.*

Nearly identical is the process of the French Codex for *oxyde de zinc par voie humide.* When heated, carbonate of zinc parts with its water and carbonic acid, leaving oxide of zinc behind. The operation is known to be finished when a small portion, taken from the centre of the vessel and mixed with a little water, no longer produces effervescence on being dropped into dilute sulphuric acid. A dull red heat, as directed by both pharmacopœias, is not necessary for this purpose. Mohr observed that a temperature of 280° C. (536° F.) is sufficient for obtaining the oxide, and, according to Hager, all carbonic acid is expelled at 250° C. (482° F.). With quantities of from 6 to 12 ounces of carbonate of zinc the operation is conveniently performed in a glass flask placed in a sand-bath and heated by means of gas or on a stove. The capacity of the flask should be about double the volume of the powdered carbonate. If the carbonate of zinc is not previously powdered, a higher heat and a longer time are required for expelling all the carbonic acid. If the carbonic acid be driven off below a red heat, or if the heating to dull redness has not been prolonged unnecessarily, the cold zinc oxide has a white color, but after having been exposed to a full red heat it will retain after cooling a more or less decided yellow tint.

The French Codex recognizes also an *oxyde de zinc par voie sèche*, which is made by melting pure zinc in an inclined crucible in contact with air to a bright-red heat, when it takes fire and burns to oxide, which condenses in the upper part of the crucible or in suitable vessels suspended over it, and after cooling is passed through a fine sieve. The same product, though less pure, was recognized by the U. S. P. 1870 as Zinci oxidum venale (Zinc-white); Zincum oxydatum crudum, *P. G.;* Flores zinci, Pompholix, Nihil album, Lana philosophica. This was recommended by Courtois (1780) as a pigment in place of white lead, but began to be used as such since about 1844, after Leclair had elaborated a process for making it at a sufficiently low rate. At present it is usually prepared directly from zinc ores by processes identical with or similar to those recommended by W. J. Taylor (1861) and G. Darlington (1862). A mixture of zinc ore and coal is packed in a suitable furnace upon a layer of coke, previously ignited and heated by means of a blast, and the vapors of oxide of zinc, which are at first more or less mixed with particles of charcoal, are conducted into a chamber, where they condense as a gray powder. As soon as the condensing product has a white color the vapors are passed into another chamber, where they condense as zinc-white. The gray product is identical with the impure oxide of zinc, which was formerly used in medicine under the names of *tutia*, *cadmia fornacum*, or *tutty*.

Properties.—Oxide of zinc is a soft, inodorous, and tasteless, pale-yellowish, nearly white powder, which on being heated acquires a deep lemon-yellow color, and on cooling becomes again nearly white. After having been heated to bright redness it continues for some time to emit light in the dark. It dissolves in dilute acetic and other acids without effervescence, is completely insoluble in simple solvents and in saccharine liquids, and is without action on test-paper. According to Daubrée, it may be obtained crystallized by heating chloride of zinc in a current of steam. On exposure to the atmosphere it slowly absorbs water and combines very gradually with carbonic acid.

Tests.—Oxide of zinc may contain traces of chloride or sulphate, which are detected in the solution in dilute nitric acid by nitrate of silver and nitrate of barium. The liquid obtained on boiling oxide of zinc with water and filtering should not have an alkaline reaction from the presence of carbonate of sodium. The solution of the oxide in hydrochloric acid should not assume a red color on the addition of sulphocyanide of potassium (iron), should not be colored or precipitated by sulphydric acid (lead and similar metals), and should be completely precipitated with a white color by sulphydrate of ammonium; the filtrate from this precipitate, after having been boiled, should not be disturbed on the addition of oxalate of ammonium (calcium) or of phosphate of ammonium (magnesium). The U. S. P. does not give any tests for acidulous radicals, and directs testing for foreign bases after dissolving the oxide in diluted sulphuric acid in the same manner as directed for sulphate of zinc; this solution cannot contain lead, though the Pharmacopœia mentions it among the possible impurities. Zinc-white should respond to the same tests, but a minute proportion of lead is permitted by the P. G. by the following test, which fails to detect about ½ per cent. of PbO: Dissolve 0.2 Gm. of the zinc oxide in 2 Gm. of acetic acid; after cooling, the solution should not be affected (become yellow and turbid) on the addition of potassium iodide.

Off. Prep.—Unguentum zinci oxidi (zinci), *U. S.*, *Br.*

Physiological Action.—It is conjectured that oxide of zinc, when received into the stomach, is converted into an albuminate if sufficient food or mucus is contained in the organ, and that otherwise it acts as a local irritant, and even as a caustic. However this may be, it is certain that when continuously given to rabbits in large doses it causes erosion and ulceration of the stomach, and ultimately wasting of the flesh. In experiments upon healthy men it has been found that repeated doses of 4 grains or more of this salt occasioned nausea, eructation, vomiting, confusion of the mind and senses, heat in the epigastrium, thirst, fever, a jerking pulse, muscular spasm, etc. Sometimes, when prescribed in very large and continued doses, it has produced marasmus, œdema of the feet, diarrhœa, etc. These and similar effects are arrested by suspending the medicine, but even when it has been continuously given in doses of 20, 40, or even more grains a day, such symptoms have rarely arisen. That, however, they are really due to the poisonous action of zinc is proved by the manner in which smelters of the metal are affected—viz. with cough, dyspnœa, and even hæmoptysis, or dyspeptic symptoms, vomiting, and diarrhœa, loss of flesh, neuralgia, muscular spasm, and debility. Besides these symptoms are observed a gradual anæsthesia of the skin, diminished reflex excitability, muscular tremors, especially of the legs; in a word, the signs of disorder of the spinal marrow (Schlochow, *Monthly Abstract*, Mar. 1880, p. 158).

Medical Uses.—Oxide of zinc has been used in medicine chiefly for the cure of nervous diseases, and long before the experiments above referred to denoted its special mode of action; for it was introduced by Paracelsus, and proposed as a remedy for epilepsy by Gaubius, who learned its virtues from a charlatan. Many physicians have claimed for it a curative virtue in *epilepsy*, and among them some whose names have the weight of authority; nevertheless, a rigid scrutiny of facts has proved that this medicine never cures, and seldom even palliates, the disease. In six out of twenty cases under the care of Russell a decided impression was made on the course of the disease by the zinc given to the extent of 18 grains three times a day (*Practitioner*, xxx. 83). The utility of oxide of zinc is still less in *chorea*, a disease which as naturally tends to cure as epilepsy is rebellious to all treatment that is not merely palliative. The utility of the medicine in these affections is claimed by some physicians who have used it along with the bromides! Such a confusion of ideas is a fruitful source of error in therapeutics. Oxide of zinc has also been used with alleged benefit in *hysteria* and *spasmodic asthma*. In the nervous state consequent upon *delirium tremens*, and in *chronic alcoholism* attended with want of sleep, trembling, vertigo, tinnitus aurium, muscæ volitantes, and occasional hallucinations, it sometimes is very beneficial. In such cases it may be given in doses of 2 grains (Gm. 0.12) three times a day, and gradually increased. There is little doubt that this medicine is one of the best for colliquative *sweats*, although it sometimes fails, and is not superior to the sulphate of zinc. It should be prescribed in 1-grain (Gm. 0.06) doses every hour for three or four hours in the evening. Murrell recommends that it be given "at bed-time in from 5- to 10-grain doses, made up into pill with extract of henbane or conium" (*Practitioner*, xxiii. 91). Such doses appear to us fitted to produce vomiting and even poisonous effects. In *diarrhœa* and *dysentery* it was recommended by J. Waring-Curran

(1868) as being their best and most speedy cure. Some time later it was advised by Gubler in diarrhœa, and in imitation of him by Bonamy (1876), who employed it successfully when other remedies had failed in an epidemic of dysenteric diarrhœa. He mixed 50 grains of oxide of zinc with 10 grains of bicarbonate of sodium (Gm. 3.50 and Gm. 0.66), and divided the mixture into three or four parts, which were administered during the day at intervals of three hours. The effect of the medicine is said to have been prompt and decisive even in the most chronic cases. This conclusion was subsequently confirmed in Scotland by Brakenridge and by Renton (1877), and by Jacquier in France (1878). In infantile diarrhœa it was given to a child of six months in doses of 2 grains (Gm. 0.12) every two hours. In this country it was used with advantage by James L. Tyson, although sugar was associated with it, which Renton found to impair its efficiency. Associated with belladonna, it is more efficient than is either medicine alone. Oxide of zinc with valerian in large and increasing doses is said to have cured *diabetes insipidus* (*Amer. Jour. Med. Sci.*, Jan. 1882, p. 276). In fine powder it forms an admirable application for promoting the healing of *intertrigo*, superficial *burns* and *scalds*, *fissures* of the *nipples* or *anus*, *balano-posthitis*, flabby *ulcers*, *leucorrhœa*, and moist *eruptions of the skin*. For some of these purposes it may be mixed with powdered starch, acacia, or lycopodium. The officinal ointment is used for similar purposes. The following preparation has also been recommended: Glycerin 16 parts, starch 8 parts, oxide of zinc 4 parts. Warm the glycerin and starch in a porcelain capsule until they form a jelly, and then stir in the oxide of zinc.

Oxide of zinc may be administered in powder or in pill, and in *doses* of from 1 to 5 grains (Gm. 0.06–0.30). It is best given after meals.

OLEATE OF ZINC made into an ointment with 1 part of vaseline or olive oil, or 2 parts of lard or simple ointment—vaseline being preferable, as not liable to change—has been used with excellent results in the treatment of *eczema*, especially during the stage of active secretion (Crocker, 1879).

Commercial oxide of zinc may be used in powder as an external application in the various local affections mentioned above, to diminish secretion and protect parts from the action of the air.

ZINCI PHOSPHIDUM, *U. S.*—PHOSPHIDE OF ZINC.

Phosphoretum zincicum, F. Cod.—*Phosphoret of zinc*, E.; *Phosphure de zinc*, Fr.; *Phosphorzink*, G.

Formula Zn_3P_2. Molecular weight 256.7.

Preparation.—If zinc is fused in a crucible, and phosphorus is added in small pieces at a time, the crucible being kept covered as much as possible, a union of the two elements takes place, but it is difficult to obtain the compound of uniform composition. According to Schrötter (1849), finely-divided zinc is heated to dull redness while the vapor of phosphorus is being passed over it. Vigier's modification of this process consists in heating the zinc in a current of hydrogen; after all atmospheric air has been expelled vapors of phosphorus are passed over the zinc. On account of the great danger connected with this process, owing to the liability to violent explosions, Proust (1869) proposed the following process: Nitrogen gas is evolved by heating nitrite of ammonium, and the gas is passed through a bottle in which phosphoretted hydrogen is prepared by introducing phosphide of calcium through a wide tube into diluted hydrochloric acid contained in the bottle. The mixed gases are passed through a wash-bottle into a porcelain tube in which zinc is heated to redness, when the metal will combine with the phosphorus and the liberated hydrogen will escape together with the nitrogen. If the apparatus is filled with nitrogen gas before phosphoretted hydrogen is generated, there is no danger of an explosion.

Properties.—Phosphide of zinc is stated to be permanent in the air, but the slight phosphorus odor emitted by it indicates its gradual oxidation; it should therefore be preserved in well-stopped vials. It forms a gray crystalline or friable mass, having upon the fractured surface a bright metallic lustre. Vigier (1875) recommends it to be powdered and freed by sifting from metallic zinc which may be present; in this state it resembles iron reduced by hydrogen, has a blackish-gray color and a slight taste of phosphorus, is readily soluble in dilute sulphuric or hydrochloric acid, with the copious evolution of phosphoretted hydrogen, and by concentrated nitric acid is converted into zinc phosphate. It melts at a higher temperature than zinc, and volatilizes unchanged, condensing in needles if the air be excluded; but when heated in contact with air it is oxidized to zinc phosphate.

Composition.—Pure phosphide of zinc consists of 24.12 per cent. of phosphorus and 75.88 per cent. of zinc.

Tests.—"1.171 Gm. of phosphide of zinc in contact with officinal hydrochloric acid should evolve 200 Ccm. of phosphoretted hydrogen, which should be completely absorbed by a concentrated solution of copper sulphate."—*F. Cod.* This test proves the absence of metallic zinc, which would evolve hydrogen; phosphoretted hydrogen produces in the copper solution a black precipitate of phosphide of copper. The U. S. P. directs testing only for foreign metals after dissolving the compound in diluted sulphuric acid; such a solution is free from lead, the possible presence of which is assumed by the Pharmacopœia.

Physiological Action.—Phosphide of zinc in the dose of 1 grain is sufficient to kill a rabbit weighing 7 pounds, and dogs treated with this compound for the purpose of producing fatty degeneration of the liver all died when the dose reached $1\frac{1}{4}$ grains. "It contains one-fourth of its weight of phosphorus, and yet its toxical action represents a strength of only one-eighth. Or 8 Mgm. of the phosphide are equivalent to 1 Mgm. of the phosphorus in activity. The reason of this difference is that the phosphide is decomposed by the muriatic acid of the stomach, and one-half of the product becomes hypophosphide of zinc, whose action in small quantity is negative; and the remainder is converted into chloride of zinc and phosphoretted hydrogen" (Vigier). Pills containing $\frac{1}{8}$ gr. of phosphide of zinc are said to occasion slight alliaceous eructations, which are more marked if this dose is exceeded, and it is alleged that $\frac{2}{3}$ gr. may be used without greater inconvenience. Indeed, Vigier states that, having taken $1\frac{1}{2}$ gr. of the phosphide in a single dose, he only experienced a transient gastric oppression, but that on the following day a like dose caused vomiting. In numerous cases two pills, each containing $\frac{1}{13}$ gr. of the phosphide, have occasioned excessive diarrhœa, gastric oppression, anorexia, alliaceous eructations, and rectal discharges. In other and more numerous cases the medicine is well tolerated, especially when taken some time before meals.

Medical Uses.—Phosphide of zinc has been used principally in nervous disorders attributed to defective nutrition of the brain and spinal marrow. Among these *locomotor ataxia* and *general paralysis* are especially to be mentioned. It is alleged that in certain cases of the former affection co-ordination of the movements has been restored and the evidences of sexual power revived; but the paucity of reports of its success in a disease which is ordinarily rebellious to all medicinal treatment would argue badly in its favor, even if its total want of curative power in other cases of the same disease were not well established. An almost identical statement may be made respecting the other affection mentioned, for only one or two cases of paralysis, ascribed to disseminated sclerosis of the cord, and an equal number of cases of *mercurial* tremor, are recorded in which any advantage appears to have been derived from the medicine. A very similar summary may be given of its effects in *anaphrodisia.* Several persons have published accounts of its curative virtues in *neuralgia*, *spinal irritation*, *hysteria*, and *cerebral disorders*, with an excessive elimination of phosphates with the urine, in *chlorosis*, *anæmia*, *amenorrhœa*, *dysmenorrhœa*, and *metrorrhagia.* But these reports, dating as far back as 1868, have not been sufficiently confirmed. Mercier (1878) found this medicine very useful in neuralgia, capable of retarding the progress of locomotor ataxia, almost certain in relieving anaphrodisia, and efficient in dysmenorrhœa and amenorrhœa. But they do not accord with general experience. It was claimed (1874) to be an efficient remedy for the neuralgic pains of *herpes zoster*, but the claim has not been confirmed.

Phosphide of zinc may be given in the dose of $\frac{1}{16}$ to $\frac{1}{8}$ gr. (Gm. 0.004–0.008), which is estimated to equal $\frac{1}{65}$ to $\frac{1}{32}$ gr. of phosphorus, but some of those who have most recommended it direct doses of $\frac{1}{3}$ gr. (Gm. 0.02) every two hours. It may be prescribed in pills with liquorice powder and syrup or in powder with starch. It is suggested that it be given when the stomach does not contain food, as being then less apt to disengage phosphoretted hydrogen.

Dr. R. W. Gardner has objected to phosphide of zinc that, as no oxygen enters into its composition, it must produce in the stomach the same irritant effects as uncombined phosphorus. He therefore proposes in its stead the *hypophosphite of zinc*, as not irritant and as admitting the use of such doses as fully to meet all indications for either phosphorus or zinc. The salt is perfectly soluble, and therefore readily absorbable. Its administration is recommended in a syrup containing 8 grains of the salt to a fluidounce, of which a teaspoonful is suggested as an average dose.

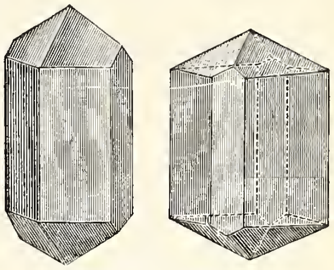
ZINCI SULPHAS, *U. S., Br.*—SULPHATE OF ZINC.

Zincum sulfuricum, P. G.; *Sulfas zincicus*, F. Cod.; *Vitriolum album.—White vitriol*, E.; *Sulfate de zinc*, *Vitriol blanc*, *Couperose blanche*, Fr.; *Zinksulfat*, *Schwefelsaures Zinkoxyd*, *Weisser Vitriol*, *Galitzenstein*, G.

Formula $ZnSO_4.7H_2O$. Molecular weight 286.9.

Preparation.—Take of Granulated Zinc 16 ounces; Sulphuric Acid 12 fluidounces; Distilled Water 4 pints; Solution of Chlorine a sufficiency; Carbonate of Zinc ½ ounce or a sufficiency. Pour the sulphuric acid, previously mixed with the water, on the zinc contained in a porcelain basin, and when effervescence has nearly ceased aid the action by a gentle heat. Filter the fluid into a gallon bottle, and add gradually, with constant agitation, the solution of chlorine, until the fluid acquires a permanent odor of chlorine. Add now, with continued agitation, the carbonate of zinc until a brown precipitate appears; let it settle, filter the solution, evaporate till a pellicle forms on the surface, and set aside to crystallize. Dry the crystals by exposure to the air on filtering-paper placed on porous tiles. More crystals may be obtained by again evaporating the mother-liquor.—*Br.*

FIG. 307.



Crystals of Zinc Sulphate.

Zinc dissolves in dilute sulphuric acid with the evolution of hydrogen, forming sulphate of zinc; $Zn_2 + 2H_2SO_4$ yields $2ZnSO_4 + 2H_2$. Arsenic, copper, and lead, which are sometimes present in commercial zinc, are removed by the continued digestion with an excess of the metal, as ordered in the above process; but iron will dissolve, together with the zinc, to ferrous sulphate. This is converted into ferric salt by chlorine-water, and ferric hydrate is now precipitated on agitating the liquid with precipitated oxide or carbonate of zinc. The filtered liquid is free from the metals named, and on being sufficiently concentrated will yield crystals of pure sulphate of zinc.

The same salt is economically prepared on the large scale from zinc-white, or by roasting the native sulphide of zinc, ZnS, called *blende*, whereby this compound is oxidized to sulphate; this is extracted with hot water, and the clear solution, evaporated, yields *crude white vitriol*, which should be purified by redissolving it in water, boiling with zinc, treating with chlorine and carbonate of zinc, filtering, and evaporating to crystallization; magnesium and alkali sulphates are not removed by this treatment. The importation of white vitriol into the United States has increased from 10 pounds in 1878 to 577,304 pounds in 1883.

Properties.—Sulphate of zinc crystallizes readily in large transparent rhombic prisms, which are isomorphous with those of sulphate of magnesium. As seen in commerce, it is in small prisms or prismatic needles, obtained by disturbed crystallization from concentrated solutions. On exposure the crystals become slowly opaque from the loss of water of crystallization, of which 6 molecules, or 37.6 per cent., are given off at 100° C. (212° F.); the last portion, amounting to 6.3 per cent., is expelled at a low red heat or at 110° C. (230° F.) in a current of dry air. Sulphate of zinc is inodorous and has a strongly styptic and nauseous metallic taste and an acid reaction. According to Poggiale, 1 part of the crystallized salt dissolves

at	10°	20°	30°	50°	100° C.
in	.724	.620	.585	.380	.153 parts of water.

The pharmacopœias give the solubility for 1 part of the salt at 15° C. (59° F.) in 0.74 part (*F. Cod.*), 0.6 part (*U. S.*, *P. G.*), and at 100° C. in 0.3 part (*U. S.*) 0.15 part (*F. Cod.*) of water; also in .86 part of glycerin (*F. Cod.*). Supersaturated solutions are easily obtained, particularly in contact with air which has been previously filtered through cotton. 100 parts of 40 per cent. alcohol dissolve, according to Schiff, only 3.48 parts of the salt, and in strong alcohol it is insoluble. The aqueous solution of sulphate of zinc yields white precipitates with chloride of barium, with sulphide of ammonium, and with ferrocyanide of potassium.

Tests.—Commercial or crude zinc sulphate is not sufficiently pure for medicinal purposes; it contains iron, occasionally also copper, aluminium, and calcium sulphate, and sometimes cadmium. These salts and the alkali sulphates cannot be removed by recrystallization. Lead cannot be present in this salt if completely soluble in water, owing to the insolubility of its sulphate; yet the Pharmacopœia mentions it among the possible impurities. If a large proportion of chloride be present the salt will be hygroscopic; the Pharmacopœia permits a trace of this impurity, so that a 1 per cent. solution of the salt, acidulated with nitric acid, should not be rendered turbid by nitrate of silver. Other possible impurities are detected as follows: The aqueous solution, on being acidulated with hydrochloric acid and treated with sulphuretted hydrogen, should yield neither a yellow, brown, nor black coloration or precipitate (cadmium, arsenic, copper, and similar metals). In case iron be present the solution will afford with a little ferrocyanide of potassium a more or less deep-blue precipitate. An excess of ammonia added to the aqueous solution should yield a clear and colorless liquid, in the presence of copper the color of the solution would be blue, and iron and aluminium would remain undissolved. The solution of the salt, after having been precipitated by sulphide of ammonium, or the ammoniacal solution after treatment with sulphuretted hydrogen, yields a filtrate which on evaporation to dryness and ignition should leave no fixed residue (potassium, sodium, magnesium, and calcium). Ammonium sulphate is detected by the ammoniacal odor given off on the addition of an excess of potassa or soda. Nitrate is detected by adding to the solution sulphuric acid, test zinc, gelatinized starch, and a little potassium iodide, when the nascent hydrogen will cause the reduction of nitric to nitrous acid, and the latter will liberate iodine, causing a blue color with the starch.

Composition.—Sulphate of zinc has the formula given above, and contains 43.9 per cent. of water, 28.22 per cent. of oxide of zinc, and 27.88 per cent. of SO_3. The sulphate may also be obtained with less water by crystallizing from its solution above 30° C. (86° F.).

Off. Prep.—Zinci carbonas, Zinci valerianas, *Br.*

Physiological Action.—This salt in a certain proportion coagulates liquid albumen, but in excess redissolves it. It acts upon mucous membranes as an irritant, but not as a true caustic, for it hardens but does not destroy the tissues. Internally, in doses of from 6 to 12 grains, it occasions vomiting, and sometimes purging. Very large doses produce a styptic taste in the mouth, constriction of the fauces, pain in the stomach and bowels, retching, violent vomiting, purging, distress, thirst, a slow and contracted pulse, slow respiration, cold extremities, spasms, and sometimes death. This last result is, however, of rare occurrence. In no case is the mind affected. Even 4 ounces of the salt in 5 ounces of water are said to have been taken for Epsom salts without causing death (*Lancet*, July, 1865, p. 52). In a fatal case death did not occur before the fifth day, and the only lesions found were some red patches near the pyloric end of the stomach and in the duodenum (*Times and Gaz.*, Sept. 1862, p. 262). The secondary effects of the medicine, or those which result from its absorption, are more or less astringent, tonic, and antispasmodic.

Medical Uses.—Externally and locally, sulphate of zinc acts as a stimulant astringent; it is commonly applied to quicken vital action as well as to check secretion. It enters into a paste which is very useful in *cancrum oris*, and contains besides extract of cinchona, catechu, and honey of roses. A similar preparation is to be recommended for *aphthæ*. In *conjunctivitis* and in *gonorrhœa*, in the forming stage, or again on the decline, a solution may be employed containing about 1 grain of the salt to an ounce of water (Gm. 0.06 in Gm. 32). In *ophthalmia neonatorum* the following has been used as a collyrium: ℞. Sulphate of zinc gr. xx; water f℥x; solution of subacetate of lead f℥ss; tincture of camphor f℥i–ij. A small portion of this solution may be injected between the eyelids several times a day. A solution applied with a brush or sponge to the *throat* or *larynx* should not exceed the strength of 10 grains to the ounce; an atomized solution for inhalation may contain 1 or 2 grains to the ounce (Gm. 0.06 to Gm. 32). In the first-named form it is useful in commencing inflammation of the fauces. To arrest *hæmorrhage* it is often used in solution and injected into the bladder, uterus, rectum, or nostrils, though for all except the first-mentioned case it is more efficient when applied upon a sponge. In powder this salt has been employed by insufflation in the treatment of *polypi* of the nostrils, and in solution applied to the seat of these growths after evulsion and to prevent their reproduction. Sir J. Y. Simpson recommended a paste containing 120 grains of lard to an ounce of the sulphate (Gm. 8 to Gm. 32), or a glycerate made with 40 grains of glycerin to the same quantity of the sulphate (Gm. 2.60 to Gm. 32), for the treatment of ulcers and soft *tumors* about the vagina, anus, etc., which it dries and shrivels; and if the part be very soft and of feeble vitality, it may produce a superficial eschar. The same preparations have been applied to *lupus exedens*, *tumors* of the female *urethra*, etc., and even to *cancer* of the breast (*Med. News*, xl. 401). They will not act upon parts covered with cuticle or epithelium. The application causes severe pain, which may be palliated by morphine; its action does not tend to spread, and the eschar separates more rapidly than that of most other caustics. Sulphate of zinc may be used in weak solution to lessen the secretion in *eczema* and appease the itching in that and other cutaneous affections.

Internally, sulphate of zinc is given chiefly as an *emetic* to empty the stomach of indigestible or poisonous ingesta, especially such as are not themselves local irritants, and notably narcotic poisons, such as opium, strychnine, mushrooms, rhus toxicodendron, etc. As it is a mechanical and not a sedative emetic, it is greatly to be preferred before tartarized antimony in these cases, and also when the *air-passages* are obstructed by foreign bodies or by *false membrane*, as in *croup* and occasionally in *diphtheria*. It was claimed in 1879 by Fukala that he cured sixty-two out of seventy-two cases of *pseudo-membranous croup* by repeated applications of a 2½ per cent. solution of sulphate of zinc to the interior of the larynx by means of a syringe with a long curved pipe (*Bull. de thérap.*, xcvii. 143). Evidently, the statement is inadmissible. This medicine has been used alone or combined in *dysentery* and *typhoid fever*, but it is only in the chronic form of the first-named disease, and in greatly prolonged cases of the latter with predominant intestinal symptoms, that it is indicated. In *atonic dyspepsia*, with flatulent distension of the digestive canal, it is certainly of use, perhaps by its stimulant and astringent operation. It is reported to be efficacious in nervous *palpitation* of the heart, but probably in dyspeptic cases only. Possibly, a similar explanation may be applied to its alleged success in *spasmodic asthma*, but when this affection is associated with bronchorrhœa the efficiency of the medicine is more probable. In *whooping cough* it has enjoyed a certain reputation which may have been due to a similar mode of action—*i. e.* to its influence in eliminating the catarrhal element. Certainly, when associated with belladonna its usefulness is increased. The efficacy claimed for it in *chorea* is not sufficiently demonstrated. Very often it was associated with valerian, which of itself is at least as potent as the zinc. (Compare *Med. News*, xli. 261.) The latter is, however, as much to be depended upon as any other single medicine.

Administration.—As an emetic sulphate of zinc may be prescribed in *doses* of from 10 to 60 grains (Gm. 0.60–4) dissolved in tepid water. Internally, from 1 to 3 grains (Gm. 0.06–0.18) may be given several times a day, and gradually increased. In the treatment of chorea it has been so given until more than 20 grains a day were taken, and without injurious effects. It is best administered in pill and after meals, except when it is intended to act upon the stomach itself.

A solution of *sulphide of zinc* has been prepared by dissolving equal parts of sulphate of zinc and sulphuret of potassium in water. Such a solution, containing from 5 to 15 grains of each salt in an ounce of water, with the addition of a few drops of alcohol, is recommended by Dr. Duhring in the superficial inflammatory form of *lupus erythematosus*, and in *seborrhœa* of the face. The lotion should be shaken before being applied by means of a sponge or rag mop, and its sediment should be allowed to adhere to the surface. Its immediate effect is said to be soothing and cooling in the first-named disease, and its permanent influence more favorable than that of the numerous applications which are apt to be fruitlessly made in this affection (*Med. News*, xliii. 507).

ZINCI VALERIANAS, *U. S., Br.*—VALERIANATE OF ZINC.

Valeras zincicus, F. Cod.; *Zincum valerianicum.*—*Valérianate* (*Valérate*) *de zinc*, Fr.; *Zinkvalerianat*, *Baldriansaures Zinkoxyd*, G.

Formula $Zn(C_5H_9O_2)_2.H_2O$. Molecular weight 284.9.

Preparation.—Take of Valerianate of Sodium 5 oz. av.; Sulphate of Zinc 5½ oz. av.; Distilled Water a sufficient quantity. Dissolve the salts separately, each in 2 pints (Imperial) of distilled water; raise both solutions to near the boiling-point, mix them, cool, and skim off the crystals which are produced. Evaporate the mother-water at a heat not exceeding 200° F. to 4 fluidounces, cool again, remove the crystals which have formed, and add them to those which have already been obtained. Drain the crystals on a paper filter, and wash them with a small quantity of cold distilled water till the washings give but a very feeble precipitate with chloride of barium. Let them now be again drained and dried on filtering-paper at ordinary temperatures.—*Br.*

The above process was originally proposed by Trommsdorff. On mixing hot solutions of valerianate of sodium and sulphate of zinc the salts are mutually decomposed, resulting in the formation of sulphate of sodium, which remains dissolved, and valerianate of zinc, which crystallizes partly on cooling, the remainder being obtained on concentrating the liquid.

The salt of the French Codex is obtained by adding freshly-prepared moist carbonate of zinc to valerianic acid, diluted with 30 parts of water, and when the acid is nearly saturated warming the mixture slightly, filtering, and carefully evaporating the liquid.

Properties.—Valerianate of zinc crystallizes in soft white pearly scales, which are not deliquescent, and have a slight odor of valerianic acid and a sweet styptic and metallic taste. It has an acid reaction on litmus-paper, melts at about 140° C. (284° F.), at a higher heat gives off white inflammable vapors, and finally burns with a bluish flame, leaving oxide of zinc. The salt is stated to be soluble at 15° C. in 90 (*P. G.* 1872), 100 (*U. S.*), 160 (Wittstein) parts of water; the salt used in France, which contains $12H_2O$, dissolves in 50 parts of cold water (*F. Cod.*); on being boiled with water it loses water of crystallization. But, according to Lieben and Rossi (1871), 100 parts of water dissolve at 25° C. (77° F.) 2.54 parts of anhydrous valerianate of zinc. On heating the solution moderately it becomes turbid, and clear again on cooling; but after the saturated solution has been boiled it does not become entirely clear after cooling, in consequence of the production of a basic salt, which is less freely soluble in water. The salt is also soluble in 40 (*U. S.*), 60 (Wittstein) parts of cold alcohol, and this solution is likewise rendered turbid by heat. Hot ether, however, dissolves it more freely than cold ether. When kept over sulphuric acid the salt becomes anhydrous.

Tests.—Valerianate of zinc should be completely soluble in ammonia-water. Its aqueous solution yields a white precipitate with sulphuretted hydrogen, and when an excess of the reagent has been used the filtrate on being evaporated should leave no fixed residue. Acetate of zinc, being freely soluble in water, if present as an adulteration would impart a red color to solution of ferric chloride. Butyrate of zinc resembles the valerianate closely; it is detected, according to the British Pharmacopœia, by distilling the suspected salt with dilute sulphuric acid and adding the distillate to a solution of acetate of copper, when, if the valerianate be pure, it does not immediately affect the transparency of the fluid, but forms after a little time oily drops, which gradually pass into a bluish-white crystalline deposit. This is the test suggested by Larocque and Huraut, who first directed attention (1846) to the similar physical properties of the two salts. The U. S. P. has adopted Hager's test, using cold concentrated solutions of zinc valerianate and copper acetate. It also requires the salt to yield 28.3 (theory 28.4) per cent. of oxide; owing to its volatility, the salt requires to be decomposed by nitric acid before it is finally ignited.

Medical Action and Uses.—This compound was originally introduced as uniting in itself the peculiar virtues of its two elements in a multiple ratio. This illogical and unscientific judgment did not prevent it from being largely used in spite of its high price and excessively offensive smell. It is very doubtful whether valerianic acid possesses any medicinal virtues; those belonging to valerian seem to reside in its oil. For a time valerianate of zinc was lauded in *neuralgia*, both external and internal, in *nervous headache*, *nervous vertigo*, *whooping cough*, infantile *convulsions*, and a variety of nervous and *hysterical* affections, including *chorea*. It was even declared to be a remedy for *cholera!* The only real merit it possesses consists in its sometimes alleviating neuralgic pains and headache occurring in very excitable or hysterical persons. A case is recorded of its having cured *diabetes insipidus*, but as valerian alone is recognized as one of the best remedies for that disease, and as the patient was also taking opium, the influence of the zinc salt cannot be regarded as proved. A recent case, however, gives some color to this alleged virtue of the salt (*Lancet*, Oct. 1881, p. 662). The *dose* of this preparation is variously stated at from half a grain to several grains. Probably 1 grain (Gm. 0.06) should be the average dose. It may best be given in pill with mucilage or conserve of roses.

ZINCUM, *U. S.*, *Br.*—ZINC.

Speltrum.—*Zinc*, Fr.; *Zink*, G.

Symbol Zn. Atomicity bivalent. Atomic weight 64.9.

Origin.—The metal zinc has been known in the isolated state only since about the beginning of the eighteenth century, when Stahl showed it to be obtainable from calamine; some of its compounds, however, have been long known. Brass was used in ancient times, but no other metal, besides copper, was supposed to exist therein. The oxide was likewise known at an early date, and, like the ore from which it was obtained, was called *cadmia*. White vitriol appears to have been prepared by Valentinus in the fifteenth century, who was also acquainted with blende, in which Brandt (1735) showed the presence of zinc, and Glauber (1648) prepared "oleum lapidis calaminaris," and studied some of the properties of zinc chloride.

The metal is rather abundant, and exists most generally in combination either as silicate or carbonate, known as *calamine*, or as sulphide, known as *blende*. Zinc ores have been found in Pennsylvania and Missouri, in Great Britain, Belgium, and different parts of Germany, particularly in Silesia. They are frequently associated with lead and other metals.

CALAMINA PRÆPARATA, *Br.* (Lapis calaminaris præparata), is native zinc carbonate, calcined in a covered earthen crucible at a moderate temperature, powdered, and freed from gritty particles by elutriation. It is a pale pinkish-brown powder, almost entirely soluble with effervescence in acids. The mineral varies in color from whitish to reddish or greenish, and is sometimes crystalline, or more frequently amorphous.

Preparation.—On smelting lead and other ores containing zinc an impure oxide of zinc is condensed in the cooler portions of the furnace. By the long-continued roasting of blende or calamine oxide is likewise obtained. This is mixed with powdered charcoal, and the mixture heated nearly to whiteness in shallow iron retorts, when the zinc distils, and is collected in suitable condensers. The impure metal is purified by a descending distillation in crucibles furnished with an open tube reaching to the upper half of the crucible and passing through its bottom.

Properties.—Zinc is a bluish-white metal, having a lamellar or a granular structure. Its density varies between 6.9 and 7.2, rolled zinc being the heaviest. Ordinarily, it is rather brittle, but between 120° and 150° C. (248° and 302° F.) it is ductile, and may be rolled into sheets and converted into wire. Heated to 205° C. (401° F.), it becomes so brittle that it may be reduced to powder. It melts at about 415° C. (779° F.), and at near a white heat it boils and volatilizes, and in the presence of air burns with a bluish-green flame to oxide. Melted zinc on congealing expands in volume 0.2 per cent. (Nies and Winkelmann 1882), and afterward contracts considerably. On bending, zinc emits a slight cracking noise, weaker than that of tin. It has a bright metallic lustre, but on exposure becomes superficially tarnished. It is not much acted on by cold concentrated sulphuric acid, but on heating unites with it, evolving sulphurous acid gas. Diluted sulphuric and hydrochloric acids dissolve it readily, with the evolution of hydrogen.

Zinc is extensively used in the arts for roofing and other purposes; melted together with copper it forms *brass*. It is useful in protecting surfaces of iron and copper from oxidation; iron having its surface coated with zinc is known as *galvanized iron*.

The *salts of zinc* are usually colorless, soluble in water, have an acid reaction, and a disagreeable metallic taste, and by prolonged heating are mostly converted into oxide. Their aqueous solutions, acidulated with hydrochloric acid, are not precipitated by sulphuretted hydrogen, but they yield with ammonia and potassa white precipitates soluble in an excess of the alkali. White precipitates are also obtained with sulphide of ammonium, alkali carbonates, and ferrocyanide of potassium; ferricyanide of potassium yields an orange-red precipitate.

Pharmaceutical Uses.—ZINCUM GRANULATUM, *Br.* Granulated zinc is obtained by melting commercial zinc in an earthen crucible and pouring the liquid metal in a thin stream into cold water. The congealed zinc is drained and dried.

The following *chemical compounds* of zinc are officinal: Zinci acetas, Zinci carbonas, Zinci chloridum, Zinci oxidum, Zinci sulphas, Zinci valerianas, *U. S., Br.;* Zinci bromidum, Zinci iodidum, Zinci phosphidum, *U. S.*

The following *pharmaceutical preparations* contain compounds of zinc: Liquor zinci chloridi, Unguent. zinci oxidi, *U. S., Br.*

Unofficinal Zinc Salts.—ZINCI CYANIDUM, Cyanuretum zincicum, *F. Cod.*, Cyanide of zinc, $Zn(CN)_2$. It is obtained by precipitating a solution of acetate of zinc with hydrocyanic acid, whereby acetic acid is liberated, which retains a portion of the zinc cyanide in solution; the liquid should therefore be kept nearly neutral by the occasional cautious addition of an alkali. Cyanide of zinc is a white, inodorous, and tasteless powder, which is insoluble in water and alcohol, but dissolves in potassa, ammonia, and in dilute acids. When long kept it undergoes decomposition and acquires a sweetish and metallic taste.

ZINCI ET POTASSII CYANIDUM, K_2ZnCy_4. On dissolving zinc cyanide in a solution of pure potassium cyanide a slightly alkaline liquid is obtained, which on evaporation yields colorless or white octahedrons of a sweet and metallic taste. Small quantities of acids precipitate from its solution cyanide of zinc.

Zinci ferrocyanidum, Zincum ferrocyanatum, Ferrocyanide of zinc. It is prepared by precipitating a soluble zinc salt with ferrocyanide of potassium, and forms a white tasteless powder, which is insoluble in water, alcohol, and dilute acids, and evolves hydrocyanic acid on being heated with dilute sulphuric acid.

Zinci lactas, Lactas zincicus, *F. Cod.*, Zincum lacticum, Lactate of zinc, $Zn(C_3H_5O_3)_2$-$3H_2O$. It is prepared as described on page 71, or by dissolving carbonate of zinc in dilute lactic acid with the aid of heat. It crystallizes in short quadrangular crystals which have an acid reaction and an acidulous metallic taste. The salt is not fusible, requires about 58 parts of cold and 6 parts of boiling water for solution, and is nearly insoluble in alcohol. It yields 27.1 per cent. of oxide of zinc.

Zinci salicylas, Salicylate of zinc, $Zn(C_7H_5O_3)_2.3H_2O$. Vigier (1878) prepares this salt by heating salicylic acid with distilled water, adding gradually oxide of zinc suspended in a little water, and, when the oxide is no longer dissolved, filtering the solution. The salt crystallizes in long satiny needles, has a sweet somewhat styptic and bitter taste, dissolves in about 20 parts of cold water, and is freely soluble in hot water, alcohol, ether, and methylic alcohol. The crystals represent 20.6, and the anhydrous salt 23.9, per cent. ZnO.

Zinci sulphocarbolas, *Br.*, Zincum sulfocarbolicum (s. sulfophenylicum), *P. G.*, Sulphocarbolate of zinc, $Zn(C_6H_5SO_4)_2.8H_2O$. It is prepared by dissolving 10 parts of crystallized carbolic acid in 12 parts of sulphuric acid, heating the mixture for several hours in a water-bath, neutralizing with carbonate of barium, filtering from the precipitated barium sulphate, and precipitating the filtrate accurately with sulphate of zinc; the precipitate of barium sulphate is filtered off, and the clear liquid evaporated to crystallization. Sulphocarbolate of zinc crystallizes in reddish, or if the solution has been acidulated with sulphuric acid in colorless, inodorous prisms or tablets, which are soluble in twice their weight of water or alcohol, have an acid reaction, and when heated are decomposed without melting. The aqueous solution acquires a violet color with ferric chloride, should yield with barium nitrate merely a slight turbidity (sulphate), should not be affected by ammonium oxalate or sulphuric acid (barium, etc.), and after precipitation with excess of ammonium sulphide yields a filtrate which on evaporation and ignition should leave no residue. When heated to redness the salt yields 14.6 per cent. ZnO.

Other sulphocarbolates may be prepared in an analogous manner by substituting for sulphate of zinc the carbonate or sulphate of the metal which is desired in the form of sulphocarbolate.

Medical Uses.—Zinc is never used as a medicine in the metallic state.

Cyanide of zinc, according to some early experimenters, occasioned, in doses of half a grain repeated at intervals, cephalic congestion, anxiety, somnolence, nervous tremors, etc. Given in large doses to animals, its effects are identical with those of hydrocyanic acid and its alkaline compounds. It has been used in *epilepsy*, *chorea*, and other convulsive affections, and also in *gastralgia* and other forms of *neuralgia*. In the last-named affection, and especially in neuralgia of the fifth pair produced by cold, its good effects appear to be proven. It may be prescribed in such cases in doses of about half a grain (Gm. 0.03) suspended in mucilage, or preferably in pill, to ensure its more precise administration. It should be given at intervals of an hour or two, since its physiological operation is transient. This salt has also been used with alleged benefit in acute articular *rheumatism*, but the evidence in its favor appears to be inconclusive.

A *cyanide of potassium and zinc*, which is permanent, and also perfectly soluble in cold water, has been proposed, and is to be preferred to cyanide of zinc on account of its solubility; it is prescribed in the doses already mentioned in sweetened aromatic water.

Lactate of zinc is reputed to be efficacious in the same affections for which the oxide is used, and to be less apt than the latter to disagree with the stomach. Its *dose* is stated to be from ½ grain to 1 grain (Gm. 0.03–0.06) several times a day.

Salicylate of zinc is believed to be a valuable astringent and antiseptic agent. It has been applied to cancerous and other *ulcers*, and used for the treatment of *ophthalmia* and *gonorrhœa*, in a solution containing from ½ to 1 per cent. of the salt.

Sulphocarbolate of zinc has been employed externally as a substitute for carbolic acid in surgical dressings, for the prevention of *septicæmia*, and as an injection in *gonorrhœa*, *leucorrhœa*, etc. It is less liable than carbolic acid itself to act as an irritant. A solution in water of the strength of from 1 to 5 per cent. is used as a topical application, and for injections a solution of from 1 to 5 parts in 1000.

ZINGIBER, *U. S., Br.*—GINGER.

Rhizoma zingiberis, P. G.—*Gingembre*, Fr.; *Ingwer*, G.

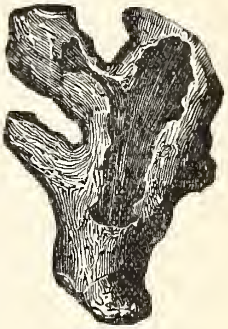
The rhizome of Zingiber officinale, *Roscoe*, s. Amomum Zingiber, *Linné.* Woodville, *Med. Bot.*, plate 11; Bentley and Trimen, *Med. Plants*, 270.

Nat. Ord.—Zingiberaceæ.

Origin.—The ginger-plant is a perennial herb indigenous to tropical Asia, and at the present time cultivated in most tropical countries, but it is not known in the wild state. It has numerous stems, about 40 inches (1 M.) high, and covered with elongated leaf-sheaths, of which the upper ones have a lancelinear spreading blade 8 to 12 inches (20–30 Cm.) long. The flowering stems are much shorter, have a few loose leaf-sheaths, and are terminated by a short thick spike of bracted yellow and variegated flowers. The rhizome is the part employed. 3,393,860 pounds of ginger were imported into the United States, in 1880, and 1,463,139 pounds in 1882.

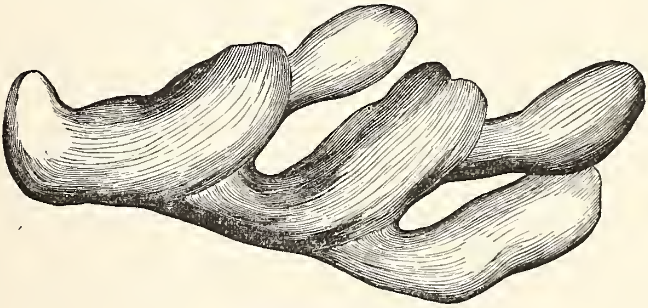
Description.—Ginger is seen in commerce in two forms—either with the outer integuments present or else removed by scraping. The former kind is called *coated*, the latter kind *uncoated* or *scraped*, ginger; and this variety is recognized by the pharmacopœias. Commercial ginger consists of flattened branches of the horizontal rhizome, which are somewhat palmately lobed, are known in commerce as *races* or *hands*, and bear at the somewhat thickened end of each lobe a scar from the overground stem. The coated variety has simply been washed and dried, or slightly scraped upon the flattened sides; it is externally of a brown or yellowish-brown color, wrinkled, somewhat annulate from the leaf-bases, and has a more or less shrivelled appearance. The uncoated ginger is of handsomer appearance, of a pale-buff color, striated, and nearly smooth externally, or somewhat fibrous from detached fibro-vascular bundles; it breaks with a mealy and rather fibrous fracture, which is of a whitish or yellowish color. Well-dried coated ginger is slightly darker internally, but some varieties are quite dark-colored and break with a horny fracture. Coated ginger is often designated as *black ginger*, though this name is sometimes restricted to the horny kind, which appears to have been dried by artificial heat or after having been scalded in boiling water. Uncoated ginger is sometimes called *white ginger;* and this name is also used for certain varieties which have been artificially bleached, it is stated, by exposure to the fumes of burning sulphur, whereby they acquire a chalky color, or by immersion in a mixture of chlorinated lime and water or in lime or gypsum. A transverse section shows near the surface a nucleus-sheath, and outside of this numerous small cells containing oil and resin; the central portion contains in the loose parenchyma many scattered small fibro-vascular bundles and a smaller number of oil-cells. The starch-granules of ginger are flat, vary in shape between narrow and broadly elliptical or ovate, have a small hilum near the narrow end, and are marked by numerous fine lines. They resemble the starch-granules of East India arrowroot, but are smaller (see page 197).

FIG. 308.



Coated Ginger.

FIG. 309.

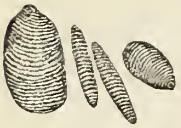


Uncoated Ginger.

The variety of ginger preferred in the United States is known as *Jamaica ginger*, comes chiefly from Jamaica, and is distinguished by being longer and having more slender lobes than the African and East Indian ginger. Jamaica ginger affords a yellowish powder; that of the other varieties is darker-colored. Ginger has a peculiar aromatic odor and a warm pungent taste.

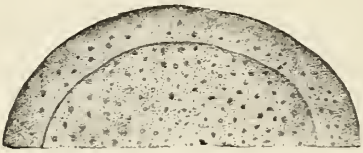
Constituents.—The analysis of ginger by Bucholz (1817) proved the presence of volatile oil, a pungent soft resin, starch, and gummy and extractive matters. *Oil of ginger* is obtained to the amount of about ¾ to 1½ or 2 per cent., has a pale-yellow color, the specific gravity 0.88 or 0.90, and has the peculiar odor of ginger, but rather a mild taste. According to Papousek, it is a hydrate of $C_{10}H_{16}$. J. C. Thresh (1881) found the oil to boil between 150° and 300° C. (302°–572° F.), and to contain hydrocarbons of the formula $C_{15}H_{24}$, cymene, a little formic and acetic acids, and various oxygenated compounds, without notable quantities of ethers and aldehyds. Thresh (1879–82) recognized in ginger the presence of traces of an alkaloid, and named the pungent principle *gingerol*. It is a straw-colored, viscid, odorless fluid, has an extremely pungent taste, is sparingly soluble in petroleum benzin, freely soluble in alcohol, diluted alcohol, benzol, volatile oils, carbon bisulphide, alkalies, and glacial acetic acid. It is not a glucoside, has an alkaline reaction, gives precipitates with lead, barium, and magnesium salts, slowly loses weight at 100° C., is decomposed by boiling water and alkali, and readily oxidized; its isolation is a matter of great difficulty. Jamaica ginger yields the smallest, and African ginger the largest, amount of volatile oil, resins, and gingerol, and the former variety yielded the largest percentage of mucilage, metarabin, starch, and albuminoids. Stenhouse and Groves (1877) obtained a little protocatechuic acid on melting the resinous extract with soda. Thresh ascertained that the greater portion of the resin is a neutral compound, and the remainder consists of two acid resins. The ash of air-dry ginger varies between 3.5 and 4.8 per cent., and the moisture between 13.4 and 14.5 per cent.

Fig. 310.



Ginger Starch-Granules.

Fig. 311.



Transverse section, magnified 3 diam.

Off. Prep.—Acid. sulphur, aromat., Confectio opii, Conf. scammonii, *Br.;* Extract. zingiberis fluid., *U. S.;* Infus. sennæ, *Br.;* Oleoresina zingiberis, *U. S.;* Pilulæ scillæ comp., Pulv. aromaticus (P. cinnamomi comp.), *U. S., Br.;* Pulv. jalapæ comp., Pulv. opii comp., *Br.;* Pulv. rhei comp., *U. S., Br.;* Pulv. scammonii comp., Syrup. rhamni, *Br.;* Syrup. zingiberis, Tinct. zingiberis, *U. S., Br.;* Tinct. zingiberis fortior, *Br.;* Vinum aloes, *U. S., Br.*

Other Products of Zingiberaceæ.—ZINGIBER (Amomum, *Linné*) ZERUMBET, *Roscoe.* The zerumbet-root of Java is referred to this species. The rhizome is tuberous, somewhat flattened, spongy, internally yellowish, with pale-brown fibro-vascular bundles, and has an agreeable odor and a ginger-like somewhat bitter taste.

ZINGIBER CASSUMUNAR, *Roxburgh.* The cassumunar-root of India is probably obtained from this plant; it is about 2 inches (5 Cm.) in diameter, jointed, compressed, with numerous white fleshy radicles and some white tubers; it is externally scaly and light-brown, internally yellow and rather woody, and has a camphoraceous odor and a hot, aromatic taste.

GRANA PARADISI, Grains of paradise. Under this name the seeds of two plants are met with in commerce which resemble cardamom-seeds in size and appearance, but are destitue of the furrow seen on the latter. One variety is about $\frac{1}{12}$ inch (2 Mm.) in diameter, is irregularly roundish and angular, reddish-brown, somewhat glossy and finely warty on the surface, and has a rather broad and depressed hilum; it has been referred to Amomum Granum-paradisi, *Afzelius*, a native of Sierra Leone. The other variety is obtained from Amomum Melegueta, *Roscoe*, which is likewise indigenous to Western Africa; the seeds are rather larger, $\frac{1}{10}$ or $\frac{1}{8}$ inch (2–3 Mm.) in length, and are distinguished from the preceding by the conical gray-brown tufted hilum; they are also known as *melegueta pepper* and *Guinea grains*. Both varieties are feebly aromatic and have a very pungent and burning taste. They yield about 0.3 per cent. of aromatic volatile oil, and contain acrid resin, starch, gum, etc. Grains of paradise are a constituent of some cattle powders, but are chiefly used for imparting artificial strength to liquors.

See also CARDAMOMUM, CURCUMA, GALANGA, and ZEDOARIA.

Medical History.—Ginger was introduced from Asia through Arabia into Greece and Europe generally, and the Arabian and later Greek physicians employed it as a condiment and carminative, and also as an aphrodisiac and general stimulant. They also recognized the effect of its excessive use in debilitating the stomach.

Medical Action and Uses.—Ginger is a carminative stimulant when taken internally, and when applied to the skin it occasions redness, heat, and tingling. Snuffed into the nostrils it is a powerful sternutatory, and when the rhizome is chewed it causes a copious secretion of saliva. Ginger is largely employed in cooking, as the spices proper are, to render more digestible various preparations of flour, sugar, and certain vegetables, and also to expel the flatus produced by the decomposition of food in the digestive canal. In *flatulent colic* ginger is prescribed in powder or in tincture as a carminative and anodyne. It may be given in powder mixed with hot water, but the tincture is preferable. The infusion and tincture have been largely used to correct *diarrhœa* occasioned by cold, and even for a similar purpose in the forming stage of epidemic *cholera.* Ginger has also been recommended in *chronic bronchitis.*

As a rubefacient and anodyne it is much employed in cataplasms and fomentations for the relief of *colic, muscular rheumatism, neuralgia, toothache, headache*, etc. The infusion is of use in recent cases of relaxation of the *uvula*, and of *aphonia* from a similar condition of the larynx. The rhizome may be used as a masticatory in *paralysis* of the tongue, cheek, and parts supplied by the portio dura of the fifth pair.

The *dose* of powdered ginger is from 10 to 30 grains (Gm. 0.60–2.). The infusion, tincture, fluid extract, syrup, and oleoresin are officinal.

Grains of paradise are generally ranked with cardamom-seeds, but their acrid and exciting qualities are akin to those of ginger, for which they may in most cases be substituted.

ADDENDA.

ANTIPYRINA.—Antipyrine.

Antipyrine, Fr.; *Antipyrin*, G.
Formula $C_{11}H_{12}N_2O$. Molecular weight 198.

Origin and Preparation.—The hypothetical compound N_2H_4, which has been named *hydrazine* by E. Fischer, consists of the double molecule $H_2N.NH_2$ of amidogen. One or more of the hydrogen atoms may be replaced by hydrocarbons yielding volatile bases. By a complicated process *phenyl-hydrazine*, $C_6H_8N_2$ or $C_6H_5HN.NH_2$, is obtained; it is crystalline, melts at 23° C. (73.4° F.), and boils at 233° C. (451.4° F.). On treating this base with acetic ether at the temperature of the water-bath, L. Knorr (1883) obtained the crystalline compound $C_{10}H_{10}N_2O$, which has both basic and acid properties, and is the methyloxy derivative of *chinizine*, a hypothetical base having the composition $C_9H_{10}N_2$. For the preparation of antipyrine equal parts of methyloxy-chinizine, methyl iodide, and methyl alcohol are heated together in a sealed tube to 100° C.; the mass is then decolorized by boiling with sulphurous acid; the alcohol is distilled; and on the addition of concentrated soda solution the base is separated as a heavy oil and recrystallized from toluol or ether.

Properties.—Antipyrine crystallizes readily in laminæ, or from water in rhombic prisms. The commercial article is a voluminous crystalline powder of a white or whitish color, having usually a grayish or reddish tint; it is almost inodorous, and has a mild bitter taste. At 15° C. (59° F.) it dissolves in about two-thirds its weight of water, in about one part of alcohol or chloroform, and in about 50 parts of ether, and is freely soluble in benzol, but slightly soluble in benzin. The aqueous solution yields precipitates with basic lead acetate, mercuric chloride, and most reagents for alkaloids, except potassio-mercuric iodide, and reduces Fehling's solution. 2 Cc. of a 1 per cent. solution acquire with 2 drops of fuming nitric acid a green color, changing to red on the addition of another drop of the acid to the previously boiled liquid. One drop of ferric chloride solution, added to 2 Cc. of a $\frac{1}{10}$th per cent. solution of antipyrine, causes a deep-red color, changing to pale yellow on the addition of 10 drops of sulphuric acid. The solution of antipyrine in water should have a neutral reaction, should be colorless or faintly yellowish, should not have an acrid taste, and should not be affected by sulphuretted hydrogen. On the addition of nitrous acid or of nitroso-nitric acid to a cold concentrated aqueous solution of antipyrine, green crystals are separated. Antipyrine melts at 113° C. (235.4° F.), and when further heated turns red, then brown, and acquires an empyreumatic odor resembling oil of amber, the residue being soluble in alcohol and with a red color in chloroform. Antipyrine dissolved in wine causes the gradual precipitation of the coloring-matter from the latter. Syrup, or a fruit syrup with an aromatic spirit, has been found to be a suitable adjuvant for the solution. The powder as well as the solution should be carefully protected from contact with iron compounds, and the solution should not be combined with spirit of nitrous ether.

Composition.—Antipyrine is dimethyloxy-chinizine, and has the formula $C_{11}H_{12}N_2O$. It is isomeric with methyl derivatives of tolylhydrazines, which, however, have an acid character. These compounds were discovered by Knorr (*Berichte d. Chem. Ges.*, 1884, pp. 546, 2032).

Physiological Action.—*On Animals:* Antipyrine exalts the reflex excitability of frogs, and ultimately excites tetanoid spasms; but when the spinal cord is divided these spasms cease below the point of section. They differ from those induced by strychnine. The affected animals may remain rigid for twenty-four hours, after which relaxation takes place, but anæsthesia continues twice as long. These effects seem to be represented by the conclusions of certain experimenters, who describe the agent as first stimulating and then paralyzing the nervous centres. In frogs the pupils are always dilated, and the respiratory movements, quickened at first, become slower until they cease. In these animals the heart is generally unaffected, but sometimes is arrested in systole, according to Cappola; but Demme alleges that antipyrine destroys frogs and rabbits by paralyzing the heart, and that it is essentially a muscle-poison. Six grains administered in three successive hypodermic injections suffice to kill a rabbit of medium size. Beyer, however, found that it intensifies rather than diminishes the force of the cardiac contractions unless the dose be excessive (*Amer. Jour. Med. Sci.*, Apr., 1886, p 401). *Non nobis est tantas componere lites.* Clinical experience proves that a dose which one person will readily tolerate may, under certain conditions, become dangerous to another person. Some experimenters assert that in rabbits and other warm-blooded animals tetanoid spasm and increased blood-pressure are primarily associated, but that afterward the pulse grows weak and irregular. Anseroff found that, although the external temperature might be greatly raised, there was a corresponding depression of the temperature of internal parts. This statement differs from that of Jaccoud, given below.

On Man: When antipyrine was first introduced little allusion was made to the vomiting it is apt to occasion. But afterward depression verging on collapse, with coldness, profuse sweating, irregular pulse, feeble voice, and vomiting, especially in females, were found to be ordinary consequences of what were then held to be efficient doses. To counteract them, cordial and nervine stimulants were administered. It often happened that the pulse and temperature did not fall in an equal ratio, and sometimes, indeed, the pulse-rate was increased instead of being slightly lowered, as it usually is. In healthy persons the temperature is but little if at all reduced by antipyrine; but in fever it begins to decline soon after the medicine is administered, and its subsidence is most marked within from four to six hours after the administration of 15 grains (Gm. 1), and by a repetition of the dose or the administration of a smaller one may be prevented from rising again. It appears that in children the sedative action on the pulse is insignificant. In all cases sweating is apt to be provoked by an excessive dose. Antipyrine is eliminated largely with the urine, but does not irritate the urinary tract. According to Jacubowitsch, the quantity of urea, sodium chloride, and acids is notably diminished in children, and sometimes the urine itself is so to the extent of one-half. The experiments of Müller and the observations of Frankenberg (*Med. Record*, xxix. 585) and of Umbach (*Therap. Gaz.*, x. 621) go to show that under the influence of antipyrine a very large proportion of urea, that should be eliminated, is retained in the system. The addition to the urine of chloride of iron and the application of heat develop a dark-reddish color. Within ten minutes after the hypodermic injection of 6 grains of antipyrine it has been detected in the urine (Hage). The experiments undertaken to explain the action of this compound have been contradictory and insufficient in their results. Jaccoud, indeed, alleges that its lowering action upon the temperature does not extend to the internal organs. In many cases antipyrine produces an erythematous, measly eruption upon the trunk and limbs. It has been described as consisting of "irregularly rounded pimples lying close together and forming patches," and followed by a slight desquamation. It abounds most on the extensor surfaces, may present a few vesicles, and occasions itching. In some cases even bloody vesicles have occurred. The sedative action of antipyrine has occasioned death. A woman suffering from metroperitonitis (?) took 35 grains of it, and three hours later half of the like dose. She fell into collapse and died in thirty-two hours (*Lancet*, Feb. 28, 1885). Another case was reported by May of collapse which threatened death after the administration of 75 grains of the preparation (*Lancet*, 1885, p. 382). Strauss reports the occurrence of collapse in two instances during the second week of typhoid fever and after the administration of antipyrine in doses of 45 grains (*Therap. Gaz.*, ix. 862); and a third case occurred in the practice of the same physician (*Lancet*, Oct. 3, 1885). Welch describes another caused by only 10 grains (*Med. News*, xlviii. 9). and Graham one of a woman in the fourth week of typhoid fever who had taken five doses of 12 grains each at intervals of three hours. She fell into collapse, and was saved only by active stimulation (*Boston Med. and Surg. Jour.*, March, 1886, p. 261). In a report on the use of the preparation in the Boston Hospital, Dr. Mason states that 6 out of 100 patients suffered collapse after taking from 20 to 30 grains of it (*Boston Med. and Surg. Jour.*, Dec., 1885, p. 536). A case of sunstroke treated with antipyrine, given hypodermically, seems to have had a narrow escape from the lethal sedation of the medicine (*New York Med. Jour.*, July 25, 1885).

Medical Uses.—We have on many occasions protested against the use of merely antithermic medicines in the treatment of fevers. The study of antipyrine offers an occasion for renewing the protest, and declaring that the reduction of temperature in healthy animals by poisons affords no warrant for employing such poisons in treating the fevers of human beings. The conditions in the two cases are neither identical nor analogous. All antithermic agents agree in demonstrating that behind its high temperature each febrile disease presents a specific element, be it a definite morbid poison, an alteration of the constitution of the blood, or some change in the solid tissues. The fever of phthisis, for instance, has a different nature from that of malarial fever, and the fevers of both these from that of an acute exanthem. To lower the temperature merely, even if it were possible at will to reduce it to the normal degree, is therefore a very different thing from removing the cause upon which the fever depends. But the cure involves the latter. Huchard, and after him Arduin, have insisted that a high temperature alone does not call for antipyretic interference, and that a temperature which is essentially normal in one disease is excessive in another, but only to such an extent as it exceeds the ordinary temperature in that disease. The worst mischiefs of antipyretics are due to a disregard of such laws and precepts. Antipyrine has been compared with other agents of the same class. Huchard has pointed out the following contrasts: Quinine is transient in its action; salicylic acid and its salts are uncertain, and if hæmorrhage already exists are apt to increase it; carbolic acid causes sweating, pulmonary congestion, and collapse; resorcin does not moderate hectic fever: it causes vertigo and auditory disorder, and but slightly modifies the temperature in typhoid fever; while kairine, although inducing a transient subsidence of fever, also occasions profuse sweat and chills, and, indeed, acts only after having brought about serious blood-lesions (*Bull. de thérap.*, cvii. 511). This is a succinct and emphatic condemnation of the antithermic agents enumerated, but it is nearly as applicable in degree, and quite as much so in kind, to antipyrine. If, too, kairine is to be rejected because it induces sweating, then antipyrine is quite as open to the same objection, for Frankenberg relates a case in which the loss of weight in this way amounted to a pound and a quarter in two hours; and yet it is in the hectic fever of phthisis that antipyrine is emphatically recommended, even while the advice is given that its tendency to promote sweating should be combated with atropine or agaricine!

Typhoid fever has been extensively treated by means of antipyrine. According to the most trustworthy reports, it moderates delirium and dryness of tongue in proportion as it reduces the temperature, whether the pulse-rate fall or not. But it does not shorten the course or lessen the mortality of the disease. The sole indication for its use in this as in other febrile diseases is hyperpyrexia, and hence the necessity for it cannot be very frequent. It has been noted that in this as in other febrile affections the urea diminishes and the sulphates increase in the urine under its use; and for this reason some leading clinicians reject antipyrine absolutely. In *intermittent fever* antipyrine is valueless, notwithstanding the plausible reasons assigned for its efficacy. It has been used with alleged advantage in the treatment of *puerperal metro-peritonitis*, but the cases published to illustrate its virtues do not appear to sustain the claim. In *pneumonia* it seems to have been less injurious than its action upon the heart would lead one to apprehend. It reduces the pulse-rate and temperature, and has been thought sometimes to bring about a critical sweat. But on the duration and mortality of pneumonia it exerts no favorable influence. Indeed, Posadski, who treated two series of cases, the one with antipyrine and the other with calomel, concluded that the latter was the superior remedy, in that it was followed by an earlier recovery. Moreover, of the 25 patients treated with antipyrine, no less than 5 suffered collapse, and 4 vomiting; 2 presented the specific eruption; and 11 the characteristic dark-red urine. These patients lost weight more than those of the parallel series, and their convalescence was slower (*Centralblatt f. d. g. Therapie*, iv. 215). Its virtues in the hectic fever of *phthisis* have been highly lauded; but experience has shown that only moderate doses of it should be used, such as 5 to 10 grains (Gm. 0.25–0.50) every hour or two. Sometimes, when the proper dose has been learned, the medicine renders more tolerable the sweats that beset the *consumptive* in the advanced stages of his disease. Beyond this it has no influence. In some cases of acute articular *rheumatism* antipyrine has appeared to reduce the pain and swelling in the joints. Neumann inclined to admit it almost to an equality with salicylic acid and the salicylates (*Centralblatt f. d. g. Med.*, iii. 542), and even claimed efficiency for it in the treatment of chronic rheumatism and rheumatic neuralgia. But Bamberger, whose authority is very high, expressly excludes antipyrine from the treatment of rheumatism and typhoid fever (*Therapeut. Gaz.*, x. 277), and to that judgment we adhere. In *diphtheria* the natural tendency of the disease to occasion syncope is increased by antipyrine.

Demme reports the case of a boy in which its administration was followed by fluttering of the heart, dilated and fixed pupils, and spasms of the limbs. Some recorded cases seem to indicate that antipyrine may be found useful in sunstroke or "thermic fever," but not in heat-exhaustion. But it should be used cautiously, and by the hypodermic method. Huchard ascribes *hæmostatic* virtues to antipyrine, which are also claimed for its internal as well as its topical use by Casati, who employed 5- and 6-per-cent. solutions. The judgment of the latter, that it is superior to ergot and the persalts of iron, is probably premature.

The estimate we have expressed of the medicinal value of antipyrine receives stronger confirmation the longer the medicine is submitted to clinical tests. One of the largest and latest contributions to our knowledge of the subject is furnished by Reihlen (*Deutsches Archiv für klinische Medicin*, April, 1886); and his inevitable conclusion is that, except in reducing febrile temperature, it exerts no favorable influence on any disease. This is in exact accord with what we have maintained.

Administration.—Filehne proposed that from 75 to 90 grains (Gm. 5–6) be given daily in divided doses, but others have advised only 7 or 8 grains (Gm. 0.50) as the whole daily dose. These methods had reference especially to the treatment of hectic fever, and the smaller quantities have been generally preferred. Demme recommended for infants under a year old 3 grains (Gm. 0.15) as a single dose, but for adults 30 grains (Gm. 2). It must be cautiously used for children. On the whole, it is prudent in every case to begin with a minimum dose and gradually increase it, or administer the same dose at longer intervals. Antipyrine may be given in an aromatic water or in a wafer. By the rectum it is claimed that 60 grains (Gm. 4) produce a more permanent effect than three times that quantity by the mouth (*Med. Record*, xxix. 254); but the more common opinion is that the results are nearly equal whether the medicine be given by the mouth or by the rectum. Suppositories have been used containing from 8 to 15 gr. (Gm. 0.50–1.) and 30 gr. (Gm. 2) of cacao-butter. They are recommended in bleeding *piles*. The medicine has also been given hypodermically, and it is said not to excite inflammation if used in a solution made with equal parts by weight of hot water and antipyrine. By this method doses only one-third as large as those given by the mouth are required, and their effects are more speedily produced.

COCAINÆ HYDROCHLORAS, *Br.*—HYDROCHLORATE OF COCAINE.

Cocainum hydrochloricum.—*Chlorhydrate de cocaïne*, Fr.; *Cocainhydrochlorat*, G.
Formula $C_{17}H_{21}NO_4HCl$. Molecular weight 339.4.

Preparation.—The outline of Lossen's process for the preparation of the alkaloid has been given on page 590. Niemann's process consists in preparing a tincture with alcohol acidulated with sulphuric acid, treating this with milk of lime to remove wax and coloring-matter, neutralizing the filtrate with sulphuric acid, distilling off the alcohol, diluting the residue with water, filtering, adding sodium carbonate, and agitating with ether. The impure alkaloid left on evaporation of the ether is again treated with acidulated water, sodium carbonate, and ether, then decolorized, neutralized with hydrochloric acid, and recrystallized.

Properties.—The salt crystallizes from water in delicate radiating groups of needles, and from alcohol in short and thin prisms. It usually is seen as a white crystalline powder, which is nearly inodorous, has a slight acid reaction and a bitter taste, produces on the tongue a tingling sensation followed by numbness, and is readily soluble in water, alcohol, and glycerin, but insoluble in ether and fixed oils. Cold mineral acids dissolve the salt without color. The aqueous solution yields yellow or light-yellow precipitates with gold chloride, platinum chloride, and picric acid, and white precipitates with mercuric chloride, stannous chloride, tannin, and with the alkalies and alkali carbonates, the latter precipitates being soluble in ammonia and ammonium carbonate. Giesel (1886) observed that the solution of the salt in water, if not too dilute, gives with solution of potassium permanganate a violet-purple crystalline precipitate of cocaine permanganate. A 2-per-cent. solution of the salt should not become brown on the addition of a drop of decinormal solution of potassium permanganate (absence of coloring and other organic matter, Lyons, 1886), and should yield no turbidity with barium chloride (sulphuric acid) or ammonium oxalate (calcium salt). Heated on platinum foil, the salt burns without leaving any residue.

Allied Salt.—COCAINE BENZOATE may be obtained by combining 2 parts of benzoic acid and 5 parts of cocaine with water and crystallizing at a low temperature. A solution of the salt may be readily prepared from the acid and alkaloid in the proportion given. The salt crystallizes with difficulty in needles, and is very freely soluble in water; its solution yields with ammonia a precipitate of cocaine, and with hydrochloric acid a precipitate of benzoic acid. These reagents do not affect a solution of *benzoyl-ecgonine*, which Paul (1886) observed has been sold in the place of the benzoate; it crystallizes more readily than the latter, is less freely soluble in cold water, and is formed from cocaine by the influence of water and heat, more particularly under increased pressure.

History.—It is claimed by Dr. Samuel R. Percy of New York that in 1857 he extracted from coca an alkaloid which he called erythroxylin, and which, as a muriate, had "a peculiar but not unpleasant benumbing and paralyzing effect upon the tongue, unlike that produced by aconitia, and not so persistent" (*Med. Record*, xxvi. 550). Toretti, a chemist of Bolivia, claims that Pizzi isolated the alkaloid of coca in 1857 (*Med. News*, xlix. 111). In 1862, Schroff accurately described its action. Between that date and 1865 sulphate of cocaine was used in the treatment of intermittent fever (Guibert), and in 1868, Gubler stated the dose of the muriate of cocaine to be from 7 to 30 grains (Gm. 0.50–2)! (*Commentaires thérap.*). In 1879, Kobert found that it acted on striated muscle in the same manner as lead and emetine; and even as late as 1885, Brunton wrote, "Emetine and cocaine have a similar action to lead"! Meanwhile, Buchheim in 1883 described it as a feeble narcotic with a tendency to produce vomiting, colic, and diarrhœa! Although the local anæsthetic action of the salt was unnoticed by all of these experimenters except the first named, it was observed by Fronmüller in 1863, by Gazeaux in 1870, and by Fauvel in 1879. By Gazeaux it was employed to relieve some painful affections of the mouth and stomach. But these important observations attracted little attention, as well as those of Moreno y Maiz, who in 1868 asserted that the new alkaloid destroyed sensibility, but not motility, and that it dilated the pupil—a statement confirmed by Ott in 1874. In 1877, Saglia showed that tincture of coca obtunded the sensibility of the pharynx; and in 1882, Gougenheim stated that a watery solution of the extract produced a like effect upon the larynx. In 1880, Von Anrep's experimental investigations confirmed and enlarged previous results, and drew attention to the local anæsthetic action of the preparation. These various demonstrations, however, failed to attract general attention, and it was not until the anæsthetic virtues of cocaine in operations on the eye were exhibited by Koller at Vienna in October, 1884, that this precious discovery was accepted and generally employed in America and Europe. The observations of Koller, and those of Koenigstein made at the same time, entirely coincided.

Physiological Action.—*On Animals:* Frogs are said to be much more sensitive to the action of cocaine than warm-blooded animals, and are rendered anæsthetic by cocaine applied to the skin. According to some experimenters, it also impairs reflex activity. In doses of gr. $\frac{1}{120}$ to gr. $\frac{1}{40}$ (Gm. 0.0005–.0015) it stimulates and then paralyzes the organs of volition and respiration and dilates the pupils; larger doses occasion reflex spasm and anæsthesia; and excessive or lethal doses immediately produce muscular resolution. In warm-blooded animals the effects are essentially the same, and death is said to be directly due to an arrest of respiration. The breathing becomes hurried at first in these animals, but in the cold-blooded it is at once suspended. In both species respiration ceases before the heart. In large doses it produces an unsteady gait and general inco-ordination which may end in convulsions. Like many other stimulants, it excites and then depresses the great functions. Applied in a watery 2-per-cent. solution to the eye, it causes complete anæsthesia of the cornea and conjunctiva, which lasts ten minutes on an average. The iris retains its sensibility. Koenigstein is said to have enucleated the eye of a dog after injecting the orbit with a solution of cocaine without the animal's being secured or appearing to suffer (*Kobert's Jahresbericht*, 1885, p. 204). He also showed by an ophthalmoscopic examination that the red vascular network of the interior of the eye of a white rabbit became pale under the action of the medicine. In this connection it is to be noted that Beyer found in terrapins that the heart was stimulated and the blood-vessels contracted by cocaine (*Amer. Jour. of Med. Sci.*, July, 1885, p. 60). Experiments by Würdinger prove that a 5-per-cent. solution applied to a rabbit's eye, with continued exposure to the light, will produce an erosion of the cornea followed by opacity of this tissue—an effect ascribed to the action of cocaine in contracting the blood- and lymph-vessels of the part (*Centralbl. f. d. g. Therap.*, iv. 321). These results bear upon the alleged tendency of panophthalmitis to occur after operations on the eye in which cocaine is used.

On Man: Like many other nervines, cocaine in sufficient dose first excites and then benumbs general sensibility—an effect exhibited by the mouth and throat when the medicine has been applied in a liquid form. If water is taken immediately afterward, it produces an impression of coldness upon these parts, such as is felt after they have been touched with oil of peppermint. General numbness is not observed unless the dose is large, and does not usually follow the primary stimulation as rapidly as in the case of opium or alcohol. The action of cocaine upon the nervous system was first described by Schroff as resembling that of Indian hemp. It occasioned indistinctness or confusion of thought and of the senses, a glow throughout the body, and at first a general sense of cheerfulness and well-being, but later on giddiness, disorder of the senses, buzzing in the ears, dilatation of the pupils with impaired accommodation of the eye, paleness of the conjunctivæ, headache, restlessness, a sense of walking upon air, quickened and then retarded movements of the chest and heart, eructations, occasional vomiting, and sometimes sleep. This comparatively cheerful intoxication produced by moderate doses was associated with a singular endurance of fatigue and insensibility to hunger. These effects of an internal dose of about 2 grains of the substance may last four or five hours, during which time, says Freud, the muscular power is notably increased (*Lancet*, April 4, 1885).

Dr. DaCosta in 1884 found that, whether the hypodermic injection of cocaine rendered the pulse faster or slower, it always increased its fulness and strength, and also that the urine appeared to be increased in quantity, while its specific gravity was decidedly lowered and the phosphates in it were increased (*Trans. Coll. Phys. Philada.*, 3d Ser. viii. 39). In 1886, Drs. DaCosta and C. B. Penrose reported that in eight cases in which cocaine was administered from one to three times daily, by the mouth or hypodermically, and in doses of ½ to 1 grain, there was a marked increase in the amount of urine voided in seven, and that without any marked change in its specific gravity. These observers were disposed to attribute the diuretic action of the medicine to its raising the arterial tension, and to believe that this action persists for some time after the cocaine has ceased to be administered (*Ibid.*, xlviii. 677). Confirmation of these results is furnished by the experiments on men and dogs made by Bignon of Lima, who, however, found that the diuresis produced by cocaine is not the result of the primary action of the drug. On the contrary, he claimed that cocaine tends primarily to diminish, and in large enough dose to suppress, the urine and induce uræmic phenomena with a fatal tendency, but that in duly-apportioned doses it excites diuresis without cerebral symptoms (*Bull. de thérapeut.*, cxi. 121). It is to be remarked, however, that in none of the cases cited below to illustrate the action of cocaine is any mention made of its causing either diuresis or suppression of urine.

The effects of an inordinate dose taken internally were exhibited in the case of a man who is stated by Ploss to have swallowed a glass of beer containing 20 grains of cocaine. The first effect was a peaceful sleep of several hours, followed by thirst and a burning sensation and dryness in the mouth. Vomiting ensued, with retention of urine. It is said that neither heart nor mind was disturbed (Husemann and Hilger, *Die Pflanzenstoffe*, p. 882). Before an operation for stricture of the lachrymal duct a 4-per-cent. solution was applied over the lower punctum, and at the end of twenty minutes the patient complained of dryness of the tongue and dizziness, and the pupil was widely dilated (*Med. Record*, xxvii. 265). It is stated that no local anæsthesia was produced in this case, which suggests that the solution employed may have been one of atropine. A lady who had several drops of a cocaine solution instilled into the nostrils suffered chilliness, excitement followed by depression of spirits, staring eyes, nausea, wakefulness, difficulty of thinking and speaking, and her gait was tottering. She had a loathing for food (Bresgen, *Times and Gazette*, Nov., 1885, p. 709). A boy with laryngeal papilloma had a solution of cocaine liberally applied to the part. For five hours he lay in a sleepy condition, but with open eyes, whose pupils reacted normally. These symptoms lasted for ten hours, when they were followed by sleep (*Times and Gaz.*, Nov., 1885, p. 741). Ziem collected fourteen cases which occurred under similar conditions and with like results (*British Med. Jour.*, Nov. 21, 1885).

According to Grove, a solution which after a fortnight presents a fungoid growth within it does not lose its mydriatic power, although its anæsthetic virtue is impaired; and also a 1-per-cent. solution acts as a mydriatic as energetically as a 4-per-cent. solution, although the influence of the latter is more prolonged. By the same observer it is stated that blue eyes are more promptly affected than black. Meyer and Bardet, on the other hand, declare that a 10-per-cent. solution acts both more promptly and more energetically than a feebler one (*Bull. de thérap.*, cviii. 122). Dr. Warfield and Mr. Donaldson determined that in the eye and the mouth rendered anæsthetic by cocaine the perception of heat and cold is not lost (*Med. News*, xlvi. 623). The skin around the point of hypodermic injection becomes pale as well as anæsthetic within an area of from half an inch to an inch in diameter. Dr. Hepburn estimates this diameter at sixteen lines when 6 minims of a 2-per-cent. solution are injected (*Med. Record*, xxvi. 534). He made several self-injections in adjacent spots, and within half an hour found his pulse and respiration quickened, experienced an agreeable sense of warmth, some disorder of vision, and, when his eyes were closed, pleasant hallucinations. On one occasion he used sixteen injections of 8 minims each, and suffered a general impairment of cutaneous sensibility, with a tendency to walk on the heels, and, on grasping an object, a sensation as if something spongy were interposed. Another physician describes the effects of two subcutaneous injections, each of half a grain of muriate of cocaine and repeated within five minutes, as consisting only of slight dizziness, pricking of the fingers, and a sense of epigastric pressure. Later on, he employed 2 grains at once. Within two minutes his heart beat violently, the blood seemed rushing into his head, and roaring noises filled his ears. The mind and will were impaired. The fingers and toes twitched and were numb, and there was nausea with gastric oppression. The face was pale and covered with cold perspiration; the pupils were enlarged, and vision was slightly clouded; the pulse was feeble, and the heart's force somewhat reduced (*Jour. Amer. Med. Assoc.*, vi. 278).

Knapp and others early noted that the injection of a 3- or 4-per-cent. solution, especially into the loose tissue of the orbit, may be followed by pallor and faintness (*Med. Record*, xxvi. 662). A man had injected under the conjunctiva 4 minims of a 3½-per-cent. solution of cocaine muriate, and within eight minutes was seized with convulsions followed by maniacal frenzy (*Ibid.*). Possibly the patient was an epileptic. The injection of ʒss of a 2-per-cent., and immediately afterward of a 4-per-cent., solution into the urethra occasioned a tendency to collapse (*Med. News*, xlvi. 138); and one-third of a grain hypodermically produced similar effects, with the addition that "the pulse remained slow and feeble for some time afterward" (*Bull. de thérap.*, cviii. 122). Dujardin-Beaumetz relates that a morphine habitué under cocaine influence fancied himself a balloon for the space of twenty minutes. It would seem that the habit either of opiate or of alcoholic intemperance renders the action of cocaine less energetic. A consumer of morphine substituted cocaine for that drug, using it hypodermically. He increased the dose until it reached to from 5 to 7 drachms of a 4-per-cent. solution. The symptoms produced resembled those of delirium tremens (Merriman, *Jour. Amer. Med. Assoc.*, v. 430). Bauer reports the case of a drunkard who could take 10 grains of cocaine in a single hypodermic injection. Its direct action, which did not extend beyond two hours, presented nothing remarkable; but ultimately the pulse-rate was increased, the appetite impaired, emaciation set in, and constipation was established (*Med. Record*, xxviii. 603). A man gradually formed the habit of taking daily 12 grains of cocaine. He grew very weak, his pulse-rate was 100, and his mind was disordered as in delirium tremens (*Med. Record*, xxviii. 604). Medical Inspector Spear, U. S. N., has reported the case of an intemperate marine who took hypodermically 10 grains of muriate of cocaine within eighteen hours. About two hours after the last injection his face was ashy pale, his lips and hands blue, and his skin bathed in perspiration. The pulse was feeble and fluttering, his breathing slow and almost imperceptible, and the *pupils contracted.* The man recovered (*Med. Record*, xxviii. 36). Except in the state of the pupils this case is paralleled by that of a woman who snuffed 3 grains of powdered cocaine. She grew dizzy, weak, and faint, her sight was darkened, and semicoma followed, with a rapid pulse and dry hot skin. Yet she complained of cold and her teeth chattered, and her *pupils were dilated.* Recovery was promoted by brandy and ammonia (*Ibid.*, p. 604). The pupils were *contracted* in the case of a man into the sole of whose foot had been injected 10 drops of a 4-per-cent. solution. In four minutes alarming syncope occurred, the pulse was only 48, and the respiration from seven to eight a minute (*Ibid.*, p. 632).

Disorder of the nervous system was conspicuous in two cases reported by Dr. Brown (*Jour. Amer. Med. Assoc.*, vi. 61). A physician aged 30 began the use of cocaine as a remedy for hay fever, and at last took 5 grains at a dose in the morning. It excited him so much that he worked at his desk nearly all night, but on the succeeding day he had neither appetite for food nor any energy of body or mind. Gradually came on irregularity of the heart, emaciation, debility, dyspepsia, and pale stools. In the other case a physician substituted cocaine for opium, to the use of which he was addicted, and at last employed daily 15 grains of it hypodermically. He grew irritable, quarrelsome, and insisted that cocaine was a medical panacea. He became arrogant and overbearing, and brandished a pistol in public places, meanwhile neglecting all his duties and deteriorating mentally as well as physically. Finally, he was placed in an asylum, from which he eloped and disappeared. Obersteiner enumerates among the evils attributable to cocaine a persistent wakefulness that sometimes sets in a few hours after the medicine is used; sexual excitement, which is, however, seldom observed; and, at a later period vivid hallucinations (*Centralblatt. f. d. ges. Therap.*, iii. 496). The only case we have found recorded in which death seemed to have been at all the consequence of poisoning with cocaine is that of an insane woman with a suicidal tendency, who, however, appears to have been affected with disease of the brain (*Jour. Amer. Med. Assoc.*, vi. 166). A case reported by Schilling (*Centralblatt f. d. ges. Therap.*, iv. 88) is of special interest. A woman seven months pregnant, requiring the extraction of a tooth, had 2 drops of a 20-per-cent. solution injected into the gum. The usual toxical symptoms ensued, but persisted so long as to become alarming, when they were entirely dissipated by the inhalation of *amyl nitrite*.

The first trials with cocaine upon the eye, by Shakespeare, showed him that 2 drops of a 2-per-cent. solution instilled between the lids caused no pain, and rendered the conjunctiva insensitive to pain within five minutes, although the sense of contact and of temperature remained unimpaired. Ten minutes later the pupil expanded to nearly twice its original diameter, and the vision became slightly indistinct. Twenty-five minutes afterward the pupil was only a little larger than that of the opposite eye. At the end of four hours the pupil and the power of accommodation had become normal (*Med. News*, xlv. 508). Koller, in his original paper on this subject, says, however, that the senses of pain, contact, and temperature are abolished, as well as the reflex excitability; and such is the accepted belief. Koenigstein, and also Koller, observed that the cocainized eye protrudes more than the other, that the palpebral opening seems larger, and that the conjunctival blood-vessels contract so much as to render the surface pale. The last-named effect occurs in all vascular tissues to a greater or less degree. The conclusions of Zieminski from a large number of observations are practically important. From 3–6 drops of an 8–10-per-cent. solution of cocaine muriate can, in about five minutes on an average, produce anæsthesia of the cornea and conjunctiva sufficient for any operation on the eye, and lasting from nine to twelve minutes. Renewed applications will prolong the anæsthesia indefinitely. It is claimed that such uses of the agent neither irritate the eye nor affect the general system (*Jahresbericht d. Pharmakotherapie*, 1884, p. 206). This statement is no longer quite accurate. Many instances have been published of toxical phenomena following the use of cocaine in operations on the eye. Five such cases are reported by Bellyarminoff. The symptoms comprised headache, vertigo, nausea, vomiting, delay in the healing of the corneal wound, and sometimes keratitis (*Lancet*, Nov. 7, 1885). Again, Meyerhausen mentions the case of a girl who had the cornea scraped while at intervals about 15 drops of a 2-per-cent. solution of cocaine were instilled into the eye. She complained of headache, irritation of the throat, nausea, and anorexia; she was languid and feeble, staggered in walking, and her speech was thick. These symptoms continued for nearly a day (*Centralblatt f. d. ges. Therap.*, iii. 457). Schwarzbach relates that a woman affected with trichiasis applied a solution of cocaine to the eye to relieve pain. She suddenly fell into a collapse, from which wine and strong coffee rescued her (*Phil. Med. Times*, xvi. 787).

The question has been asked, How can coca be a nervous stimulant when its alkaloid, cocaine, is a nervous sedative? It is merely a question of dose. All stimulants of the nervous system become sedatives of it when employed in excessive doses—*e. g.* heat, cold, alcohol, opium, ether, chloroform, etc. An internal dose proportioned to that which occasions anæsthesia in the space of a square inch would directly arrest the essential functions of life.

Surgical Uses.—The sole purpose of cocaine is to prevent or relieve pain by its local anodyne or anæsthetic action. It is evident that the number of cases in which these indications may exist is almost endless. We shall enumerate the most important of them. First in point of time, and perhaps in relation to the usefulness of the medicine, are *diseases of the eye* requiring operations. As already stated, it was in them that it was first practically made useful by Koller in 1884, and in October of that year employed in New York by Agnew, Moore, Roosa, Knapp, and Mittendorf in various minor ophthalmic operations, including *strabismus*, and shortly afterward in *cataract*, *iridectomy*, and *wounds* of the eye. Within a week or two it had been tested in the same way by ophthalmologists in Boston and Philadelphia and other cities, and all agreed that henceforth neither chloroform nor ether need be used in operations upon the eye, and that, consequently, the safety of patients and the convenience both of patients and surgeons were greatly promoted by the new discovery. The use of this agent in operations for cataract has, however, been charged with certain untoward effects by several oculists, including ulceration and exfoliation, or opacity, of the cornea, tardy healing of the wound made in operating, and even destructive inflammation of the globe. But it is denied, on the other hand, that such results are attributable to cocaine when a fresh solution of it is employed, and certainly they are not more frequent than such as attend the use of general anæsthetics. Indeed, it is claimed that it obviates most of the risks which they involve. Among the other operations in which this agent has been found valuable are the following: *incision of the lachrymal ducts*, *growths on the conjunctiva and cornea*, and all operations on the *interior of the eye*, including *paracentesis*, *iridectomy*, *prolapse of the iris*, *enucleation*, and *evacuation of the eyeball*. In the two operations last mentioned it is necessary to inject the solution behind the globe. The operations for *staphyloma*, *pterygium*, *tenotomy*, *annoying foreign bodies*, *cautery*, and *trachoma* have been greatly facilitated by its use. It has been suggested that its association with atropine, so as to obtain a maximum dilatation along with the greatest hyperæsthesia, is to be preferred in iritis, and is indicated in operating for cataract by extraction (atropine $\frac{1}{5000}$ and cocaine $\frac{1}{200}$ in solution or in gelatin disks). If the dilating action is excessive, it can be corrected by eserine. This agent has also been used to combat the injurious effects of cocaine in *glaucoma*, as it had already been for a similar purpose where atropine was employed to dilate the pupil. But the dominant opinion is that cocaine is not adapted to the operation for glaucoma. Indeed, there is also laid to its charge that it tends to cause opacity of the cornea after operations for cataract; and this effect is explained by its constringing action upon the blood-vessels: it has certainly seemed to occasion exfoliation of the corneal epithelium. Objection has also been made to introducing it into the anterior chamber of the eye to blunt the sensibility of the iris: it is charged with having in this way caused panophthalmitis. Cocaine is incomparably the best application for relieving *photophobia* in cases of ulcer of the cornea or conjunctiva, and for facilitating *ophthalmoscopic examinations*. An East Indian surgeon states that a 2-per-cent. solution reduced greatly the size of *hypopion*. In a word, the most important indication for the use of cocaine is the spontaneous existence or the mechanical production of pain. It is thought by some that the *oleate* is superior to the muriate of cocaine, especially in ophthalmic surgery, on the ground that it is a more powerful anæsthetic, that it causes more prolonged mydriasis, and that it is less liable to be washed away by the tears (*Med. Record*, xxvii. 264).

Cocaine is of singular utility in affections of the *nasal cavity*, owing not only to its anæsthetic virtues, but also to its power of contracting or constringing the Schneiderian membrane and thereby enlarging the nostrils. In ordinary *coryza*, whether acute or chronic, this action is of marked advantage. A roll of fine and soft cambric saturated with a 5–10-per-cent. solution of cocaine muriate has been introduced into the nostril, but the mechanical irritation thus produced is very objectionable. Absorbent cotton is preferable to any woven tissue for this purpose. Cocaine mixed with an inert powder and used as a snuff has also been employed, especially in *hay fever*, but it also is irritating to the inflamed membrane. Dr. DaCosta has recognized the truth that in this disease cocaine is rather a palliative than a cure, but, still, a very valuable remedy. He recommends that from 5 to 8 drops of a 4-per-cent. solution should be injected into each nostril with a syringe while the head is thrown backward and care is taken not to irritate the nasal membrane with the instrument (*Trans. Coll. of Phys. Philadelphia*, 3d Ser. viii. 197). Some persons have advised that the solution be applied to the eyes and allowed to reach the nostrils through the lachrymal ducts. But this is an indirect and unpractical method. The constringing and anæsthetic action of the preparation facilitates all *operations* within the nose, such as the removal of *polypi* and other *tumors*, the reduction of *hypertrophy* of the lining membrane, the overcoming of nasal *stenosis*, the use of *caustics*, etc. It is also valuable as a means of arresting *epistaxis*.

The application of cocaine to the *pharynx* has been of great value in facilitating the use of *instruments* employed in treating affections of this region and of the larynx, including the use of the *rhinoscope* and the *laryngoscope*, and also the introduction of the *stomach-tube*. In removing tumors of the larynx the previous great difficulties of the operation have in a great measure been overcome by its use. It has also rendered more tolerable the difficulties of *deglutition* which occur in certain cases of pulmonary *tuberculosis*, *syphilis*, *cancer*, etc. Strong solutions are here to be preferred, such as from 4 to 6 per cent., but some German operators have used even 20-per-cent solutions. It has been claimed that a 4-per-cent. solution will dissolve the false membranes of *diphtheria* (*Med. News*, xlvi. 455; *Therapeutic Gaz.*, ix. 657). *Tonsillotomy* is said to be painless after the enlarged gland is well painted with a 3-per-cent. solution. The operation for *cleft palate* is greatly facilitated by it. In *hydrophobia* it is alleged to have enabled the patients to swallow liquids (*Therap. Gazette*, ix. 395). Before the introduction of cocaine infusions of coca were used as gargles, and also as atomized liquids, in various affections of the air-passages and throat, and particularly in the treatment of *whooping cough*; the alkaloid and its preparations have been applied to the same purpose, and with good effect, in palliating the paroxysms and preventing vomiting, but not in shortening the disease.

Various painful affections of the *ear* are mitigated by cocaine, such as *inflammation*, *neuralgia*, *tumors* of various sorts, etc. It greatly facilitates specular examination of the *auditory canal*, the use of instruments in this part, the catheterism of the *Eustachian tube*, and all operations upon either. Dr. Burnett (*Med. News*, xlvii. 100) enumerates as follows the limits of its usefulness: "It is not efficient when the pain is due to inflammation in the dense tissues of the external auditory canal, as in furuncles of the part, nor when acute inflammation occurs in chronically-thickened periosteal and mucous tissues in the tympanic cavity. It is, however, efficient to induce local anæsthesia, as a 4-per-cent. solution, in cases of not excessive congestion of the skin of the fundus of the auditory canal, and in the membrana flaccida of the drum membrane as it is observed in acute coryza. . . . . But solutions of cocaine are not competent to produce local anæsthesia in the external auditory canal profound enough to permit painless incisions into it." Paracentesis of the membrana tympani is not painful enough to require local anæsthesia. It is, however, very difficult to anæsthetize this membrane: Kircher found that nothing short of a 20-per-cent. solution would have this effect; and Zauful, confirming this statement, also mentions that in large perforations the mucous membrane can be reached and anæsthetized (*Philada. Med. Times*, xvi. 4). *Tinnitus* is palliated by cocaine, but, as this symptom usually depends on permanent conditions, palliation is of little value.

A 10- to 20-per-cent. solution of hydrochlorate of cocaine is a palliative of the pain and swelling of the lining membrane of the mouth in *mercurial salivation*. It is certain that *toothache* due to exposure of the pulp in a carious tooth is greatly mitigated by filling the cavity with cotton wool saturated with a solution of cocaine; it is also certain that rheumatic toothache and the pains of dentition are palliated by painting the painful gum with the same solution. The severe aching in the socket of a molar tooth which had just been extracted was at once relieved by filling the cavity with cocaine solution on cotton wool. On the other hand, its claim to prevent the pain caused by excavating sensitive teeth is denied by some dental surgeons, and it has been suggested that in these cases and in the extraction of teeth the expectation of the patients must be given due weight (*Ephemeris*, p. 762). Dr. Marshall of Chicago, having failed to prevent pain by using muriate of cocaine in excavating carious teeth, employed instead the *citrate*, which had been applied to this purpose in Germany. He found it much more efficient than the muriate, although when first applied it occasioned a stinging pain. The application usually made by him was of $\frac{1}{16}$ grain (*Jour. Amer. Med. Assoc.*, v. 290). Martindale and Tuttle report that a 5-per-cent. solution of the *oleate* of cocaine rubbed into the gum, and the hypodermic injection of 2 or 3 minims of a 4-per-cent. solution of it, enabled him to extract a tooth with little or no pain, and that a carious maxillary bone may be painlessly removed after a similar procedure. In extracting teeth about eight minutes should elapse between the application and the operation (*Med. Record*, xxviii. 651). Dr. Marshall, above quoted, on the other hand, did not find the oleate as efficient as the muriate or the citrate. Undoubtedly, the only way of rendering this method efficient is by injecting the solution into the gum in two doses. External *neuralgia* may be palliated by muriate of cocaine applied upon the superficial and painful points of the affected nerve, and probably better still by hypodermic injections.

In the various painful affections and operations involving the *urethra* and the *bladder* cocaine is incomparably the best anæsthetic. It renders the passage of all appropriate instruments painless, and therefore lessens the shock of operations requiring this procedure. Hence it has greatly facilitated the treatment of urethral *strictures* by dilatation or by cutting, and operations for removing *stone* in the bladder by crushing it. In one reported case the bladder was injected with half an ounce of a 4-per-cent. solution of cocaine, and the operation was begun and completed painlessly in a quarter of an hour (*Lancet*, Jan. 17, 1885). It is the most efficient agent in promoting the reduction of *phimosis* and *paraphimosis*, and in preventing pain in surgical operations for their cure. The operation of *circumcision* may be rendered painless by its use. Suppositories or enemata containing it are very serviceable in cases of enlarged *prostate* causing vesical or rectal tenesmus, and also for *irritable bladder*. *Spasm* in the female as well as in the male urethra has been completely overcome by injections of this preparation; and there is no better remedy for *chordée* than it is when applied by the urethra or the rectum. In that most painfully distressing affection, *vaginism*, this preparation has repeatedly overcome a spasm that had recurred again and again for years, and has permitted the full and painless accomplishment of the generative act. In like manner it has been used in a 4-per-cent. ointment, or preferably in a watery solution, to mitigate the pains of *labor*, and especially of its first stage, and in appropriate forms to relieve *dysmenorrhœa* and other uterine pains, such as depend upon endometritis, lacerated cervix, etc. It has been employed with like advantage in many operations upon the vagina and uterus, as in those for *lacerated cervix*, *vesico-vaginal fistula*, extraction of a *vesical calculus* through the vagina (*Med. News*, xlvi. 602), etc. This preparation renders all exploratory examinations of the vagina and rectum painless, as well as such operations as those for *fissure*, *ulcer*, *hæmorrhoids*, *fistula*, etc. It is even claimed that it removes the chief objections to the operation of excision of piles. A 4-per-cent. solution may be painted over the swellings, and a minim of the same injected into each one at the muco-cutaneous junction. The rectal symptoms of *dysentery* may be greatly palliated by cocaine enemata or suppositories. Various small *tumors* have been removed without pain under the action of cocaine, which, as in the case of hæmorrhoids, have first been rendered insensitive by injecting a solution of it into the substance of each tumor and around its base; and in like manner foreign bodies lodged in the nostrils, in the ears, or in the tissues have been removed. In the latter cases it causes the swollen tissues to shrink as well as to become insensible. It has also been applied to removing *epithelioma* by means of the curette. In the operation for *hydrocele*, after the withdrawal of the liquid from the sac a drachm, more or less, of a 5-per-cent. solution of a cocaine salt is injected, which is allowed to bathe the interior during from five to ten minutes, after which the usual iodic solution may be employed. The pain of *burns* is greatly mitigated by a 2-per-cent. solution of this preparation; and *wounds* of the eye and other delicate parts may in like manner be so benumbed as to bear the necessary manipulation without difficulty; and *fractures* with displacement of the fragments belong to the same category. *Irritable tumor*, or *caruncle*, of the female *urethra* may be also rendered insensible before excision or destruction by cautery. *Abscesses* may be treated in like manner before puncture, and especially that very painful variety, *whitlow*. Even *amputations* have been performed with its aid. Dr. Mott has reported two cases of amputation of the finger treated hypodermically with cocaine, and also by means of Esmarch's bandage; and Dr. Varick, a case of amputation of the thigh, which in this manner was rendered nearly painless (*Med. Record*, xxix. 94; *Amer. Jour. of Med. Sci.*, Apr., 1886, p. 622). The excruciating pain caused by the operation for *ingrown toe-nail* has been entirely annulled by this anæsthetic applied in a 10-per-cent. solution so as to saturate the raw portions of the part (*Med. Record*, xxvii. 627, xxviii. 257; *Med. News*, xlvii. 34). *Vaccination* may be rendered altogether painless by painting a small area of skin with a strong solution of muriate of cocaine, and after a few minutes scraping away the epidermis from the spot and reapplying the anæsthetic. *Pruritus vulvæ* and other analogous affections are greatly palliated by this agent. In a case of spontaneous *hæmorrhage* from the gums, with ecchymoses elsewhere, bleeding was arrested by a 4-per-cent. solution of cocaine after various styptics had failed (*Philada. Med. Times*, xv. 380).

The application of cocaine to the treatment of internal diseases has not hitherto been very extensive, because its action has appeared to be almost entirely local except when it is taken in toxical doses. But for this reason it must have appropriate uses in *cancer*, *simple ulcer*, *neuralgia*, and *hæmorrhage* of the *stomach*, and in the *vomiting* occurring in sea-sickness and in pregnancy. In *sea-sickness* it has been employed with excellent results, according to Manassein (*Med. News*, xlvii. 320). He used the following formula: Muriate of cocaine 0.15 parts, rectified spirits of wine q. s., distilled water 150 parts; of which a teaspoonful was to be taken on starting for sea, and every two or three hours subsequently until the danger of sickness ceased. It seemed to act both as a prophylactic and a remedy. These results were confirmed by Wicherkiewicz (*Ibid.*, p. 626) and by Mason (*Med. Record*, xxix. 706). Otto, who employed $\frac{1}{4}$ to $\frac{1}{3}$ grain two or three times a day, was not so uniformly successful (*Ibid.*, xxviii. 656); and Bissell, who seems to have fairly tested the medicine, condemns it as worthless, and even injurious (*Ibid.*, p. 683). It has been employed to promote a cure in the *alcohol habit* and also in the *opium habit*, and success has been claimed for it when it was administered hypodermically as well as by the stomach. But Smidt and Rank (*Med. News*, xlvii. 454) state that when given hypodermically, even in doses of $\frac{5}{6}$ gr., it sometimes caused *maniacal excitement.* It would seem, from the cases above cited, that this effect is peculiarly liable to occur in the slaves of opium and alcohol. Accurate observers generally agree with Erlenmeyer and Obersteiner that the action of cocaine is too fugitive to be permanently useful to these persons. Mosler claims to have *cured* a number of cases of *asthma* by the hypodermic use of salicylate of cocaine. As coca was originally employed to prevent or relieve excessive *fatigue*, so cocaine has been found to counteract the exhaustion experienced by *loss of sleep* and anxiety (*Boston Med. and Surg. Jour.*, March, 1885, p. 287); but it may be doubted whether coffee or tea would not have answered equally well. It has also been known to dissipate the gloom of *hypochondria* due to mental or physical causes of a temporary sort. In chronic melancholy with delusions it is useless. If the diuretic action which Drs. DaCosta, Penrose, and Bignon observed should be confirmed to this medicine, it may be added to the several remedies for *dropsy* and other disorders depending upon debility of the *heart;* and in *uræmia*, with scanty secretion of urine, it may be worth a trial.

Administration.—The mode of using cocaine has been fully set forth in the preceding pages, but some additional remarks may here be made. It is essential that the part to which the solution is to be applied should, if accessible, be cleansed of any secretion or deposit it may hold. For this purpose, especially in operations upon the eye, a solution of boric acid, 1 : 26, has been recommended. The strength of the solutions of cocaine salts employed has varied greatly. In ophthalmic surgery a 4-per-cent. solution is the most usual one, and it should be instilled at intervals of three or four minutes during a quarter of an hour. The portion of the solution used should be held in a vessel apart, to prevent contamination of the body of the liquid, and it should be applied with a dropping-tube rather than with a brush. All acid solutions are to be discarded. Some European ophthalmic surgeons have recommended 8–10-per-cent. solutions, but they are generally unnecessary. To economize and concentrate the anæsthetic, small disks, either of filtering-paper or fine linen or cotton fabric, or of gelatin, have been made use of. The last have been made each to hold $\frac{1}{25}$ grain of cocaine muriate. In Vienna solutions applied within the larynx have usually had a strength of from 15–20 per cent. A 4-per-cent. solution in almond oil has been used to anoint urethral instruments. A vaseline 2-per-cent. ointment may be applied with advantage to the eye when lachrymation is profuse. It is alleged (Corning) that by compressing the veins above the point at which the solution of cocaine is employed its action may be intensified and prolonged. In January, 1885 (*Med. News*, xlvi. 49), Drs. Randolph and Dixon found that when a saturated solution of cocaine muriate in strong nitric acid was applied to the skin, it produced an eschar such as the acid alone would occasion, but more slowly than usual, and that the process was almost entirely painless. In October of the same year they applied this method to destroying cancerous growths by means of a paste formed by cocaine muriate, fused potassa, and vaseline, after having previously bathed the parts with a 10-per-cent. solution of the cocaine salt. Gilliam observed that a mixture of cocaine and salicylic acid rendered friable a supposed epithelioma of the face, and permitted the curette to be applied painlessly. Doubtless the action was in this, as in other cases, anæmiating as well as anæsthetic.

In cases of poisoning by cocaine it is probable that nitrite of amyl would be the proper antidote.

EXTRACTUM CASCARÆ SAGRADÆ, *Br.*—EXTRACT OF CASCARA SAGRADA.

Extractum Rhamni Purshiani.—*Extrait de cascara sagrada*, Fr.; *Cascara-sagrada-Extrakt*, G.

Preparation.—Take of Cascara Sagrada, in No. 40 powder, 1 pound; Proof Spirit, Distilled Water, of each a sufficiency. Mix the cascara with 2 pints (Imperial) of the spirit, and macerate in a closed vessel for 48 hours; then transfer to a percolator, and when the fluid ceases to pass continue the percolation with water until 3 pints of liquid have been collected or the cascara is exhausted. Evaporate the percolated liquid by a water-bath until the extract has acquired a suitable consistence.—*Br.*

Dose, from 2 to 8 grains (0.12–0.50 Gm.).

EXTRACTUM CASCARÆ SAGRADÆ LIQUIDUM, *Br.*—Liquid Extract of Cascara Sagrada.

Extractum Rhamni Purshiani liquidum.—Extrait liquide de cascara sagrada, Fr.; *Flüssiges Cascara-sagrada-Extrakt*, G.

Preparation.—Take of Cascara Sagrada, in coarse powder, 1 pound; Rectified Spirit 4 fluidounces; Distilled Water a sufficiency. Boil the bark in three or four successive quantities of the water until exhausted. Evaporate the strained liquors by a water-bath to 12 ounces; when cold add the spirit, allow the mixture to remain for some hours, then filter, and make up to the volume of 16 fluidounces with distilled water.—*Br.*

The menstruum contains about 22 volumetric per cent. of alcohol. A stronger alcoholic menstruum like that directed for the fluid extract of frangula (see p. 633) would seem to be better adapted for the United States.

The *dose* is from $\frac{1}{2}$ to 2 fluidrachms (2–4 Gm.). (See p. 712.)

FABIANA.—Fabiana.

The branches of Fabiana imbricata, *Ruiz et Pavon.*

Nat. Ord.—Solanaceæ, Nicotianeæ.

Origin and Description.—The plant is tree-like, or more frequently shrubby, and grows in sandy fields and on dry hills in Chili, where it is known as *pichi.* It is about 15 or 18 feet (4.5–5 M.) high, and bears single flowers terminating the numerous branches, and having a tubular white and purplish corolla $\frac{1}{2}$ to $\frac{3}{4}$ inch (12–19 Mm.) long, much exceeding the small calyx; the fruit is a small, two-celled, and two-valved capsule, containing few subglobular and angular seeds. The larger branches are covered with a thin, smoothish, somewhat warty, brown-gray bark, which adheres firmly to the yellowish tough wood. The younger branches are $\frac{1}{12}$ to $\frac{1}{5}$ inch (2–5 Mm.) thick, and are densely covered by the scale-like and closely-imbricated leaves, which are about $\frac{1}{24}$ inch (1 Mm.) long, sessile, ovate, entire, smooth, and of a bluish-green color. The drug has a peculiar aromatic odor and a disagreeable bitter taste.

Constituents.—Dr. Rusby's experiments (1885) indicated the presence of an alkaloid. Dr. Lyons (1886) obtained about 0.1 per cent. of this alkaloid, which is soluble in ether, forms crystallizable bitter salts, and yields precipitates with the usual reagents; also, a considerable quantity of bitter resin soluble in alcohol, ether, chloroform, and alkalies; a tasteless crystalline, neutral body, soluble in benzin and ether, and crystallizing from the alcoholic tincture; some volatile oil and a fluorescent compound resembling æsculin in behavior and possessing a very bitter taste. Benzin dissolves about 3 per cent., and ether about 33 per cent., of the drug; the alcoholic tincture yields a dense precipitate with water.

History and Uses.—Pichi, or fabiana, is a popular medicine in Chili for urinary disorders, and has even been credited with cures of stone and gravel. It was also used in dyspeptic, and especially hepatic, diseases. Relief obtained by a prominent citizen from its use in some vesical affection attracted attention, and induced Dr. Ramirez to inquire into its real value. It was found to resemble very closely that of various terebinthinate, balsamic, and other medicines that impregnate the urine and either heal or protect the mucous lining of the urinary passages. Like them, it is totally unfit for use in structural diseases of the kidneys. Several cases illustrating its utility in *vesical catarrh* have been published (Wyman, *Therapeutic Gaz.*, x. 221). The virtue attributed to it in hepatic disease is believed to depend upon its favorable influence upon gastric digestion. Pichi is regarded by the Chilian shepherds as very efficacious in a disease of sheep which is supposed to be hydatids of the liver.

A decoction prepared by boiling ℥j (Gm. 32) of the coarsely-powdered twigs in 2 pints (Gm. 1000) of water should be taken in four equal portions in 24 hours; or a fluid extract, of which a tablespoonful represents ʒij (Gm. 8) of the plant, may be given, diluted, at similar intervals.

FRANCISCEA.—Franciscea.

Franciscea uniflora, *Pohl.*

Nat. Ord.—Solanaceæ, Salpiglossideæ.

Origin and Description.—This shrub is indigenous to Brazil, and, according to Martius (1829), is known there as *manacán*, and in some parts as *geratacáca* or *cam-*

gambá; in Para it is called *mercurio vegetal.* The stem, which is about 6 feet (1.8 M.) high, together with the root, has been introduced under the name of *manaca*, and is seen in commerce in pieces 6 or 8 inches (15–20 Cm.) long and ¼ to 1 inch (6–25 Mm.) thick. The bark is quite thin, adheres firmly to the wood, is smooth and dark brown, and on older parts scaly and rust-brown; the wood is reddish-yellow, tough and hard, and encloses a thin pith; the drug is inodorous and has a bitter taste. The leaves, which are also employed, are short-petioled, about 2 inches (5 Cm.) long, 1 inch (12 Mm.) broad, elliptic, acute, entire, and on the lower side grayish-green. The bell-shaped corolla is white and purplish, the fruit capsular, two-celled, and the seeds somewhat triangular and finely pitted. *White* and *red* manaca have been met with in commerce, the two kinds being probably of different origin; and in some parts of South America the bark of Piscidia Erythrina, *Jacquin*, is said to be known as manaca.

Constituents.—R. Lenardson (1884) analyzed red manaca, which, from the microscopic structure, he believes may belong to the Apocynaceæ. Besides fat, resin, 1.07 per cent. of ash, 11.25 starch, and various other compounds, a poisonous alkaloid, manacine, and a fluorescent compound were isolated. The latter is readily soluble in alcohol, chloroform, and spirit of ether, less freely in water, benzol, and ether, reduces alkaline copper solution, is not a glucoside, and is probably identical with *gelsemic acid;* the aqueous solution has an acid reaction, is yellow in transmitted light and blue in reflected light, the fluorescence being increased by ammonia. *Manacine* is a weak base, has a slight bitter taste, dialyzes readily, but has not been obtained in crystals; it dissolves readily in water, alcohol, and methyl alcohol, is insoluble or nearly so in other liquids, is easily decomposed in solution, with separation of a brown resin, the hydrochloric acid solution being more stable than others, and is precipitated from its more or less concentrated solution by the reagents for alkaloids, but not by alkalies; the precipitate by phospho-molybdic acid dissolves in potassa with a blue color. Characteristic color reactions were not observed. The alkaloid *franciscceine*, which is stated to have been recently extracted from manaca, is probably the same as that just described.

History and Action.—In 1867, Edmon, who lived on the Amazon, reported that at Para the flowers of manaca, or franciscea, were applied to indolent ulcers, and that a decoction of the root was regarded as a sovereign remedy for "rheumatism." It was given in a decoction, which at first produced pains in the head and back, and afterward a profuse critical perspiration. Manaca, we are further told, is in small doses an emeto-cathartic diaphoretic and diuretic, and in large doses an acrid poison. It was employed not only in rheumatism, but in syphilis and other diseases "in which mercury is indicated" (*Therapeutic Gaz.*, v. 24). This description suggests the operation of sarsaparilla, guaiacum, and mezereon. From other sources we learn that the "rheumatism" here spoken of was the muscular and tendinous form of the disease, and also that the whole plant, but the root especially, acts as an irritant of the stomach and bowels, causing vomiting and purging, abortion in pregnancy, and even death (*Kobert's Jahresbericht*, 1885, p. 310).

In 1882, Brewer studied the action of franciscea. In man one or two fluidrachms (Gm. 4–8) of the fluid extract produced restlessness, which was allayed by walking, and was followed by a peculiar sense of fatigue, as if it cost an effort to move. From these observations, and from experiments on frogs and kittens, Dr. B. concluded—"1, that there is no effect upon the brain; 2, that the special senses are uninfluenced; 3, that the spinal cord is the chief field of action wherein (*a*) the motor centres are stimulated, and (*b*) the reflex function is abolished in the full physiological effect; 4, the cardiac reflex centre is depressed; 5, the respiratory reflex centre is depressed; 6, the glands are stimulated, especially the salivary, gastric, intestinal, and cutaneous, the liver and kidneys; 7, the duration of action is about three and a half hours; 8, the infusion prepared from the ground root contains the virtues of the drug" (*Therapeutic Gaz.*, iii. 326). Dragendorff and Lenardson found that manacin in the dose of ⅙ grain (Gm. 0.01) occasioned in frogs muscular contraction, profuse sweating, and paralysis of the nerves of sensation. Larger doses paralyzed also the motor nerves: 5 grains (Gm. 0.30) administered to a cat produced diarrhœa, muscular twitching, and dyspnœa (*Kobert, loc. cit.*).

Uses.—Manaca has been employed almost exclusively in the treatment of "rheumatism," but the reporters have not always distinguished between muscular and articular rheumatism, nor between the acute and chronic forms of both, between the simple and the syphilitic forms, etc., nor between the effects of the medicine and the natural tendency of the disease under favorable hygienic conditions to get well. The chief contributors to the history of this matter are Gottheil (*Med. Record*, xxiv. 258), Pepper

(*Therap. Gaz.*, Sept., 1882), Rogers (*Ibid.*, Dec., 1884, p. 532), Garland (*Boston Med. and Surg. Jour.*, July, 1885, p. 80), and Caldwell (*Med. Record*, xxvi. 31). After a careful comparison of the statements of these witnesses, we have reached the conclusion that manaca has little or no influence on the course or issue of articular rheumatism, and that it may be used, as numberless other diaphoretics, sedatives, etc. are employed, with more or less advantage in the so-called muscular form of the disease.

The fluid extract of manaca may be given in doses of fʒss–fʒj (Gm. 2–4).

GLYCERINUM ALUMINIS, *Br.*—Glycerin of Alum.

Glyceritum aluminis.—*Glycéré d'alum*, Fr.; *Alaunglycerit*, G.

Preparation.—Take of Alum, in powder, 1 ounce (1 part); Glycerin 5 fluidounces (5 fluid parts). Stir them together in a porcelain dish, gently applying heat until solution is effected. Set aside, and pour off the clear fluid from any deposited matter.—*Br.*

Uses.—Like all solutions of astringents in glycerin, this one is of inferior value to that of a watery solution of alum. It is, however, used, like other astringent glycerins, to check mucous secretions and slight passive hæmorrhages, to constringe soft granulations, relaxed membranes, etc.

GLYCERINUM PLUMBI SUBACETATIS, *Br.*—Glycerin of Subacetate of Lead.

Glycéré de sous-acétate de plomb, Fr.; *Bleiglycerit*, G.

Preparation.—Take of Acetate of Lead 5 ounces; Oxide of Lead, in powder, 3½ ounces; Glycerin 20 fluidounces; Distilled Water 12 fluidounces. Mix together and boil for a quarter of an hour; then filter, and evaporate until the water is dissipated.—*Br.*

This is used for preparing Unguentum glycerini plumbi subacetatis, *Br.* (See p. 1564.)

GLYCERINUM TRAGACANTHÆ, *Br.*—Glycerin of Tragacanth.

Glycéré de gomme adragante, Fr.; *Traganth-Glycerit*, G.

Preparation.—Take of Tragacanth, in powder, 110 grains (3 parts); Glycerin 1 fluidounce (12 fluid parts); Distilled Water 74 fluidgrains (2 fluid parts). Mix the tragacanth with the glycerin in a mortar, add the water, and rub until a translucent, homogeneous jelly is produced.—*Br.*

This preparation is useful as an excipient for many pill-masses. (See p. 1163.)

GYMNOCLADUS.—Gymnocladus.

The seeds of Gymnocladus canadensis, *Lamarck.*

Nat. Ord.—Leguminosæ, Cæsalpinieæ.

Origin.—This handsome tree attains a height of about 70 feet (21 Mm.), grows from Tennessee to the Indian Territory, Wisconsin, and Western New York, and is cultivated for ornament; it is usually known as *coffee tree* or *Kentucky coffee tree*, and also as *Kentucky mahogany* on account of its rose-colored, close-grained wood, which is very tough and susceptible of a high polish. The oddly bipinnate leaves are 2 or 3 feet (0.6–0.9 M.) long, widely-branched; the lowest division has a single pair, the others from 7 to 13 ovate, short-stalked leaflets. The flowers are diœcious, racemose, greenish-white, and produce an oblong flattened brown legume about 6 to 8 inches (15–20 Cm.) long, with two light-brown ridges along each suture, and with more or less prominent veins on the valve. The four to six seeds are separated by transverse partitions, surrounded by a sweetish brown pulp, are flattish orbicular or roundish quadrangular, about ¾ inch (19 Mm.) broad and ⅜ inch (10 Mm.) thick, and have a whitish oblong hiluad, to which a portion of the firm podosperm is attached; the testa is dark-brown, somewhat glossy, delicately veined, minutely pitted, and very hard and thick; the embryo is whitish, firm, granular, inodorous, has a bean-like taste, and consists of two closely-appressed, flattish cotyledons and a small curved radicle.

Constituents.—The plant has not been analyzed.

Action.—In a preliminary report upon this product by Dr. Bartholow it is stated that under the name of coffee-bean it has been known to be poisonous to flies. Its botanical affinities pointed to its analogy with physostigma, and an experimental investigation has demonstrated the fact. Applied to frogs, it affected sensibility first, and afterward motility, finally inducing a soporose and insensible condition. On the motor nervous system its first action was exhibited by spastic rigidity, followed by paresis in the hind limbs. The motor nerves and the muscles, however, did not lose their irritability to the faradic current. Hence its operation was central, and not peripheral. It reduced the pulse-rate one half, and lowered, after having raised, arterial tension (*Amer. Jour. of Med. Sci.*, April, 1886, p. 582).

HYDROQUINONUM.—Hydroquinone.

Hydrokinone, Hydrochinone.

Formula $C_6H_4(OH)_2$. Molecular weight 110.

Preparation.—Hydroquinone was discovered by Wöhler (1844) amongst the products of dry distillation of kinic acid, and was shown by Strecker to be identical with Kawalier's *arctuvin*. (See p. 1584.) It is also obtained on the dry distillation of the salts of succinic, gentisic, and oxysalicylic acid, and from aniline by oxidizing 2 parts of it with a solution of 5 parts of potassium dichromate in 60 parts of water and 16 parts of sulphuric acid; after the reaction has taken place sodium sulphite is added and the hydroquinone is dissolved by ether.

Properties.—Hydroquinone crystallizes in hexagonal colorless prisms, which are inodorous, have a sweetish taste, melt at 169° C. (336.2° F.), and sublime when carefully heated in shining scales resembling benzoic acid, but when rapidly heated are partly decomposed into yellow quinone and green quinhydrone. It dissolves at 15° C. (59° F.) in 17 parts of water, and is freely soluble in hot water, alcohol, and ether. The aqueous solution is colored red-brown with ammonia, and after having been mixed with solution of lead acetate yields with ammonia a yellowish precipitate changing to green. The rather concentrated solution gives with a small quantity of ferric chloride or of other oxidizing agents lustrous green needles of *quinhydrone*, $C_{12}H_{10}O_4$, and with an excess yellow *quinone*, $C_6H_4O_2$. From its two isomerides hydroquinone is distinguished as follows: *Resorcin* melts at 110° C., boils at 271° C. (519.8° F.), and in aqueous solution is colored violet by ferric chloride; *pyrocatechin* melts at 104° C. (219.2° F.), boils at 245.5° C. (473.9° F.), and in aqueous solution assumes with ferric chloride a dark-green color, changing to violet with a little ammonia, sodium bicarbonate, or tartaric acid.

Action and Uses.—The action of hydroquinone is analogous to that of resorcin, but it is much more powerful. Experiments on frogs by Dr. Kinnicutt showed that 5 c. ctm. of a 1 : 1000 solution produced convulsions in a few minutes and death in four and a half hours (*Med. Record*, xxvii. 593). In rabbits a half gram occasioned slight spasms, and three-quarters of a gram clonic convulsions, dyspnœa, dilatation of the arterioles, increased salivary and lachrymal secretions, diminution of reflex irritability, a rise of temperature of 2.7° F., and death in one and a half hours. In another experiment, 4 grains (gram .25) given hypodermically excited violent muscular twitching, salivation, fecal and urinary discharges, and priapism, opisthotonos, and clonic spasms, followed by complete resolution. During the convulsions the temperature in the rectum rose to 104° or 105° (*Ibid.*, xxviii. 182). Beyer, experimenting with the frog and terrapin, concluded that hydroquinone reduces temperature mainly by increasing heat-radiation through its dilating action upon the veins, capillaries, and arterioles, while it diminishes the heat-production of the red corpuscles of the blood. In other words, its action is similar to that of kairine and thalline (*Amer. Jour. of Med. Sci.*, Apr., 1886, p. 391). Like them, it tends to paralyze the auricles and greatly to lower the tone of the walls of the veins; hence the danger to the animal experimented upon, says Beyer, "of bleeding to death into its own veins."

Dr. Kinnicutt found that single doses of 10 and 20 grains produced no appreciable symptoms in healthy persons. The pulse, respiration, and temperature were unaffected. A single dose of 40 grains was followed in ten minutes by a feeling of slight fulness in the head and dizziness, which disappeared in fifteen minutes.

Seifert found that in daily quantities of from 15 to 90 grains (Gm. 1–6), hydroquinone exercised a favorable antipyretic influence, and without any drawbacks, in *typhoid fever*, *pneumonia*, *scarlatina*, *pleurisy*, and *phthisis*, and that it maintained clearness of the mind and senses. In typhoid fever he observed that a 15-grain dose would cause a fall of temperature of from 1.8° to 3.6° F., and sometimes much more than this. Dr. Kinnicutt (*loc. cit.*) confirmed these observations in cases of general tuberculosis, erysipelas, and septicæmia, and noted that the pulse and respiration subsided along with the temperature. He also observed that the medicine rendered the urine greenish-brown or dark-brown. As a general conclusion, he stated that hydroquinone is a safe and efficient antipyretic, but that it does not arrest or abridge the specific febrile process. It may therefore be added to the list of agents which have been employed for the same purpose, but whose real utility in the treatment of febrile diseases has never been demonstrated.

Hydroquinone has been given in doses of from 15 to 20 grains to control the febrile exacerbations in phthisis. Where there is a tendency to a continuously high temperature, as in pneumonia, three or four such doses may be administered in the course of twenty-four hours. By the rectum the dose should be twice as large as that by the mouth.

HYPNONUM.—HYPNONE.

Acetophenone, Phenylmethyl-ketone.

Formula C_8H_8O or $C_6H_5.CO.CH_3$. Molecular weight 120.

Preparation.—The name hypnone has been proposed for phenylmethyl-ketone, which is formed by the action of zinc-methyl upon benzoyl chloride, and was first prepared by Friedell (1857) by the dry distillation of a mixture of molecular weights of benzoate and acetate of calcium, and subjecting the product to fractional distillation for the separation of acetone, benzol, and other compounds.

Properties.—Hypnone crystallizes readily in large laminæ, which, if pure, melt at 20.5° C. (68.9° F.) (Staedel, 1880). Liquid hypnone is colorless, mobile, very refrangent, has a persistent odor of bitter almond and cherry-laurel water, and is not inflammable, but intensifies the combustion of substances impregnated with it. It boils at 200° C. (392° F.), has the specific gravity 1.032, remains for some time suspended in water in the form of globules, is insoluble in water, sparingly soluble in glycerin, and freely soluble in alcohol, ether, chloroform, benzol, and fixed oils. It is not affected by cold sulphuric acid, hydrochloric acid, or ferric chloride, is colored yellow by nitric acid, dissolves iodine and bromine freely and with the development of heat, and by chromic acid is converted into benzoic acid and carbon dioxide. From 38 to 40 drops of hypnone weigh one gram.

Pharmaceutical Preparations.—GELATIN CAPSULES OF HYPNONE, containing 2 drops of hypnone and 4 or 6 drops of expressed oil of almond, have been proposed by Limousin (1885).

SYRUP OF HYPNONE. Hypnone 1 drop, alcohol (60 per cent.) 1 Gm., syrup of orange-flowers 6 Gm. (Vigier).

ELIXIR OF HYPNONE. Hypnone 1 drop, alcohol 3 Gm., syrup of peppermint 3 Gm.

Action and Uses.—Dujardin-Beaumetz, who in 1885 described the virtues of this product, pronounced it to be a pure hypnotic, and gave it the name it bears. Administered hypodermically to a guinea-pig in the dose of from 7–15 grains, it occasioned a general torpor, followed by insensibility, and in five or six hours by death. It seemed to this physician to be a soporific rather than an anodyne. Its action on man was compared to that of chloral and also of paraldehyde. In the dose of 6–8 drops it usually caused tranquil sleep, but many persons did not feel its influence. Some immediately after swallowing it complained of heat in the throat and stomach, pricking in the nostrils, a slight cough, and even nausea or retching. Offensive eructations (of acetone) were apt to follow. Headache and slowing of the pulse were noted among its remoter effects. The sleep produced by it is said to be calm, and the awaking not attended with unpleasant feelings. These conclusions, more or less confirmed by Vigier, Limousin, Lailler, and others, are opposed by those of Hirt, who found the medicine absolutely null in its action when employed by him in hospital practice (*Centralbl. f. d. g. Ther.*, iv. 260). Mairet and Combenvale also found it of little value.

Hypnone cannot be relied upon to secure sleep for those who cough or suffer pain, but only when wakefulness is due to nervous excitement.

It is best administered in capsules, each containing 4 drops (Gm. 0.10) of hypnone dissolved in almond oil.

INJECTIO APOMORPHINÆ HYPODERMICA, *Br.*—HYPODERMIC INJECTION OF APOMORPHINE.

Injection hypodermique (sous-cutanée) d'apomorphine, Fr.; *Subcutane Apomorphin-Einspritzung*, G.

Preparation.—Take of Hydrochlorate of Apomorphine 2 grains; Camphor-Water 100 minims. Dissolve and filter. The solution should be made as required for use.—*Br.* *Dose*, by subcutaneous injection, 2 to 8 minims (Gm. 0.12–0.50). (See also p. 223.)

INJECTIO ERGOTINI HYPODERMICA, *Br.*—Hypodermic Injection of Ergotin.

Injection hypodermique (sous-cutanée) d'ergotine, Fr.; *Subcutane Ergotin-Einspritzung*, G.

Preparation.—Take of Ergotin 100 grains; Camphor-Water 200 fluidgrains. Dissolve by stirring them together. The solution should be made as required for use.—*Br.*

Dose, by subcutaneous injection, 3 to 10 minims (Gm. 0.2–0.6). (See also p. 585.)

IODOLUM.—Iodol.

Pyrrol tetriodide.

Formula $C_4H_5NI_4$. Molecular weight 573.4.

Preparation.—Iodol is stated to be prepared from pyrrol by precipitating it with iodine dissolved in potassium iodide. Pyrrol was discovered by Runge (1834), and was first prepared pure by Anderson (1857). It exists in empyreumatic animal oil and in coal-tar, and is formed on the dry distillation of ammonium mucate and saccharate. It is prepared from animal oil by distilling its solution in somewhat diluted sulphuric acid, heating the distillate with potassa until the impurities have been volatilized, dissolving the potassium-pyrrol in water, and rectifying the separated oil.

Properties.—Iodol is a brown or reddish-brown powder, nearly inodorous, and decomposed by heat with the evolution of iodine, leaving a bulky charcoal as residue. It is almost insoluble in water, but dissolves freely in alcohol, ether, and chloroform; the alcoholic solution is not affected by the addition of glycerin, but is precipitated by water, and on being heated with nitric acid acquires a bright red color. Iodol gives with sulphuric acid a green color. It contains 88.3 per cent. of its weight of iodine.

Pharmaceutical Preparation.—Iodol Gauze. Dissolve 1 part each of iodol and resin in 10 parts of alcohol, add 1 part of glycerin; saturate gauze with this mixture, and let dry.

Surgical Uses.—In 1885–86 iodol was tested in the *syphilitic* wards of Rome by Silber, Ciamiccian, and Mazzini as a dressing for *ulcers.* It acted upon them as a wholesome stimulant, like iodoform, but was free from the disagreeable smell of the latter agent. It was applied in the same manner—*i. e.* was sprinkled as a powder upon the raw surfaces or on prepared gauze or in a vaseline ointment, or suspended in glycerin or in an alcoholic solution diluted with glycerin (iodol 1 part, alcohol 16 parts, glycerin 34 parts). After from four to six applications the sores began to granulate, and the glandular swellings connected with them either subsided, or, if they went on to suppuration, were evacuated and injected with the iodol solution. This method availed in simple as well as in syphilitic ulcers and abscesses. It failed when the parts were gangrenous or sloughing. Iodol appears to act as a superficial caustic, and forms a whitish film on the ulcerated surface (Mazzini, *Centralblatt f. d. g. Therap.*, iv. 33). Experiments by Sternberg show that it is destitute of germicide powers (*Med. News*, xlviii. 150). As a dressing it does not display any poisonous qualities. In *lupus* it showed a healing power after injections of it were made into the morbid tissue; and in *fungous disease* of the joints its alcoholic solution shrivelled the vegetations, and a cure ensued. In *cancer* of the rectum and of the uterus it has promoted cicatrization when applied upon tampons. Applied as a fine powder or in a 20–30-per-cent. vaseline salve by Glässner, it was found useful in *pannus*, *corneal opacities*, *serous iritis*, and *blepharitis*; but it was not beneficial in *phlyctenous conjunctivitis.* In the same class of affections, but especially in the ulcerous forms of ophthalmia, it has been employed as an ointment, and with marked success, by Trousseau. He found the alcohol and glycerin solution too painful for ordinary use (*Bull. et Mém. de la Soc. de Thér.*, 1886, p. 99).

JACARANDA.—Jacaranda.

Jacaranda procera, *Sprengel*, s. Bignonia Copaia, *Aublet*, s. B. Caroba, *Velloso*,
Nat. Ord.—Bignoniaceæ.

Description.—This tree, which grows to the height of about 40 feet (12 M.), is found in the forests of Guiana and southward, and is known in Brazil as *caroba.* The root is of a deep red-brown and internally yellowish color; the bark is ash-gray; the leaves are bipinnate, the leaflets nearly sessile, varying in length between about ⅜ and 2½ inches (0.9 and 6 Cm.), elliptic, oblong or lance-oblong, rather obtuse, or more frequently acute, the base uneven and oblique, the margin entire or occasionally with one or two irregular teeth, the texture rather leathery, the lower surface somewhat velvety near the veins, both sides with short hairs and glands; the odor is slight and the taste bitter and astringent.

Constituents.—Hesse (1880) found the leaves to be free from alkaloid and to contain mainly aromatic resin, which Peckolt (1881) named *carobone;* it exists in the leaves to the extent of 2.67 per cent., is greenish, amorphous, and has slight acid properties. Peckolt found also 1.44 caroba-balsam of a tonka-like odor, a bitter principle, tannin, crystallizable inodorous *carobin*, tasteless resin, and several acids. The bark likewise contains carobin, bitter principle, tannin, resin, etc.

Allied Plants.—Several plants of the same order are known in Brazil as caroba, and are more or less employed like the preceding—namely, Jacaranda subrhombea, *De Cand.;* Jac. oxyphylla, *Chamisso;* Bignonia nodosa, *Manso;* Cibistax antisyphilitica; *Martius;* and Sparattosperma lithontripticum, *Martius.*

Uses.—Mennell (*British Med. Jour.*, Feb. 14, 1885) and Wright (*Lancet*, Feb. 28, 1885) have employed this drug, the latter in *gonorrhœa* alone, and the former in the acute and chronic form of that disease and in *vesical* affections attended with purulent and muco-purulent urine. In its native country, Colombia, S. A., it is said to be used as a remedy for venereal diseases, and that its administration causes neither nausea nor any other inconvenience. It may be given, as a fluid extract made from the leaf, in doses of from 20 to 30 minims three or four times a day.

Carobin, the active principle of jacaranda, has been regarded as nearly analogous to sarsaparillin. Peckolt recommended it in doses of about 1 grain (Gm. 0.05) in syphilis and scrofula.

LAMELLÆ, *Br.*—DISCS, GELATIN-DISCS.

Laminæ gelatinosæ.—Disques de gélatine, Fr.; *Gelatinplatten*, G.

The preparation of gelatin-discs or *medicated gelatin* has been briefly described on page 725. They are usually made about 1 Mm. ($\frac{1}{25}$ inch) thick, and a small quantity of glycerin is added to the mixture to prevent the discs from becoming hard and brittle on keeping. The British Pharmacopœia has admitted three kinds of medicated gelatin-discs, but does not give formulas for their preparation. In each case the discs are to be of gelatin, with some glycerin, and each is to weigh about 1.3 Mgm. ($\frac{1}{50}$ grain).

LAMELLÆ ATROPINÆ, *Br.* Discs of atropine, *E.;* Disques d'atropine, *Fr.;* Atropinplättchen, *G.*—Each disc is to contain 0.00013 Gm. = 0.13 Mgm. ($\frac{1}{500}$ grain) of sulphate of atropine.

LAMELLÆ COCAINÆ, *Br.* Discs of cocaine, *E.;* Disques de cocaïne, *Fr.;* Cocainplättchen, *G.*—Each disc is to contain 0.00032 Gm. = 0.32 Mgm. ($\frac{1}{200}$ grain) of hydrochlorate of cocaine.

LAMELLÆ PHYSOSTIGMINÆ, *Br.* Discs of physostigmine, *E.;* Disques d'ésérine, *Fr.;* Physostigmin-plättchen, *G.* Each disc is to contain 0.000064 Gm. = 0.064 Mgm. ($\frac{1}{1000}$ grain) of physostigmine.

LANOLINUM.—LANOLIN.

The fat prepared from sheep's wool.

Origin and Preparation.—The keratin-holding tissues, such as sheep's wool, hair, feathers, skin, hoofs, etc., contain peculiar fats which in wool are partly combined with potassium and are known as *suint* (Wollschweiss, *G.*). The total amount is between 30 and 45 per cent. of the weight of the wool, of which, on the average, about 15 per cent. is soluble in water. In the scouring and washing process to which crude wool is subjected it is heated with a weak solution of alkali; the emulsion thus obtained is treated with sulphuric acid, and the fat separated from the impurities by expression. In this condition it is of a dark-brown or blackish color, and has a disagreeable animal odor. For further purification the fat is boiled with diluted sulphuric acid, washed with water, and bleached by treatment with potassium chlorate or chromate and sulphuric acid. Treatment of the crude fat with charcoal has but little effect. A much purer fat is at once obtained from wool which has been thoroughly washed with water and cleaned from dirt by exhausting it with solvents which do not injure the softness and flexibility of the wool, such as benzin, benzol, or ether; the pure fat is left behind on distilling off the solvent.

Properties.—Lanolin is a yellowish, light-brown, or pale greenish-brown solid, greasy to the touch, of a rather tough consistence, and should have the characteristic odor of wool only in a slight degree. Rubbed on the skin, it renders the latter greasy, but is gradually absorbed, the odor disappearing at the same time. Its density is .973, it melts at about 40° C. (104° F.), burns with a smoky flame, is soluble in the usual solvents for fats, but, unlike the latter, may be mixed with its own weight of water by trituration in a mortar, and on boiling with alkalies is saponified with considerable difficulty. Jaffé and Darmstaedter recommend testing the purity of lanolin by heating a little of it with caustic soda solution, when ammonia should not be given off; by heating 1 part of lanolin with 5 parts of water, when the melted lanolin should form a clear layer upon the water, and the latter should not contain any glycerin; and by kneading lanolin under water, when it should take up its own weight of water without becoming soapy. The solution of lanolin in glacial acetic acid, on the addition of concentrated sulphuric acid, acquires a rose color, which rapidly changes to blue and green. Lanolin mixed with water is less tough, and when kept in the melted condition separates the water.

Composition.—Lanolin does not contain any glycerides, but is a mixture of the cholesterin-ether of stearic acid, $C_{26}H_{43}C_{18}H_{35}O_2$, with those of palmitic, oleic, valerianic, benzoic, and probably other acids, and with a resin-like body and coloring-matter.

Pharmaceutical Uses.—For the preparation of ointments, more particularly such as are to be combined with aqueous liquids.

Medical Action and Uses.—The medicinal employment of the fat obtained from sheep's wool is very ancient. Pliny says that its uses are numberless, and he describes the manner of procuring it from the wool beneath the fore legs and the thighs of the animal by boiling the wool in water and skimming off the floating fat (*Hist. Nat.*, xxix. 10). These directions were rehearsed from age to age. In the seventeenth century they were repeated by Culpepper. More recently, according to Strumpf (*Handbuch*, i. 128), this fat had a place in the Spanish Pharmacopœia, and uncleansed wool was employed as a dressing for scrofulous and other swellings, and also in gout and rheumatism. The value of lanolin in medicine is due to its power of absorbing its own weight of water and nearly twice its weight of glycerin. It is not at all irritating to the skin, but does not render it as supple as some other emollients do. The former property makes it a valuable excipient for many medicines which are applied to the skin, including metallic mercury and mercurial salts, iodoform, potassium iodide, chrysarobin, etc. After friction with a lanolin ointment containing $\frac{1}{100}$ of corrosive sublimate a metallic taste may be perceived in the mouth; and a 5-per-cent. carbolic-acid ointment prepared with it occasions a sense of numbness in the skin in the course of a few minutes, but does not irritate it. Rubbed with the finger upon the back of the hand, it is promptly absorbed, leaving the skin dry and with a feeling of tension.

Lassar (*Berlin klin. Wochenschrift*, 1886, No. 5) made use of lanolin ointments in 400 cases of diseases of the skin. A case of *eczema* of the scalp and face was cured in a week by a 2-per-cent. lanolin-salicylic ointment. One of contagious *impetigo* was cured in ten days by means of a paste composed of salicylic acid 2 parts, lanolin 50 parts, and oxide of zinc and starch, of each 24 parts. *Pityriasis versicolor* with extreme itching was successfully treated by means of an ointment containing salicylic acid 2, sulphur 10, and lanolin 88 parts. In many cases of inveterate *scabies*, in *tylosis*, and especially in *sycosis* and other acneiform eruptions, it was often of great service, and in all affections in which the epidermis is thickened or hard it lessened this obstacle to cure. The following paste is particularly recommended in scabies: Naphthol 5–10, green soap, chalk, sulphur, and lanolin, of each 25 parts; and in *psoriasis* an ointment made with lanolin and 25 per cent. of chrysarobin. Lanolin forms the most appropriate excipient for ointments of iodine, potassium iodide, etc., to be applied by friction to *glandular swellings*; for all such as are applied to the *hairy scalp*; and also for those employed in *seborrhœa*, *chilblain*, *chapped hands*, *pruritus ani aut vulvæ*, etc. If the object be to render the skin softer, it may be desirable sometimes to dilute the thicker ointment with 20 per cent. of vaseline; but in superficial affections, and where a lenitive and protective action is desired, lanolin may be applied alone after thoroughly cleansing the skin with warm water and soap, bran, or Indian corn meal.

The results obtained by Lassar have been fully confirmed by those of O. Liebreich, who tested its virtues clinically. He recommends it, on account of its unirritating qualities, as the best unguent for *massage*. It appears to form the best excipient for chrysarobin in the treatment of *favus*. A number of formulæ for the use of this preparation have been published by Liebreich (*Brit. Med. Jour.*, Feb., 1886, p. 282; and *Braithwaite's Retrospect*, xciii. 159).

LIQUOR FERRI ACETATIS, *Br.*—SOLUTION OF ACETATE OF IRON.

Preparation.—Take of Strong Solution of Acetate of Iron 5 fluidounces; Distilled Water sufficient to produce after admixture 20 fluidounces.—*Br.*

This solution has the specific gravity 1.031, and is of the same strength as the tincture of acetate of iron, *Br.*

Dose, from 5 to 30 minims (Gm. 0.30–2).

LIQUOR FERRI ACETATIS FORTIOR, *Br.*—STRONG SOLUTION OF ACETATE OF IRON.

Preparation.—Take of Solution of Persulphate of Iron 5 fluidounces; Glacial Acetic Acid 3 fluidounces; Solution of Ammonia, Distilled Water, of each sufficient. Mix 8 fluidounces of solution of ammonia with 1 pint of distilled water; to this gradually add the solution of persulphate of iron, previously diluted with about a pint of distilled water; stir the whole thoroughly, taking care that the ammonia is, even finally, in slight excess, as indicated by the odor of the mixture. Let the whole stand for 2 hours, stirring occasionally; then put it on a calico filter, and when the liquid has drained away, wash the precipitated ferric hydrate with distilled water until the liquid which passes through the filter ceases to give a precipitate with solution of chloride of barium. Let the ferric hydrate drain; squeeze it to remove superfluous moisture; dissolve it in the glacial acetic acid; and make the volume up to 10 fluidounces with distilled water. Allow any insoluble matter to subside, and pour off the clear solution.—*Br.*

(For explanations of the process and for the chemistry of ferric acetate see pp. 899 and 900.) The strong solution of the Br. P. is about one-third stronger than the liquor of the P. G., and consists of normal acetate with excess of acetic acid. Its specific gravity is 1.127, and it contains 6.4 per cent. of iron or 9.2 per cent. of Fe_2O_3. 1 fluidrachm of it, diluted with water, yields with ammonia 5.7 grains of ferric oxide.

MENTHOL, *Br.*—MENTHOL.

Menthol, Fr., G.

Formula $C_{10}H_{20}O$. Molecular weight 156.

Origin and Preparation.—The Chinese and Japanese solid oil of peppermint, which consists mainly of menthol, was shown by E. M. Holmes to be prepared from the varieties *glabrata* and *piperascens* of Mentha arvensis, *De Candolle.* Within the past few years A. M. Todd has prepared a very handsomely crystallized and perfectly dry menthol from oil of peppermint distilled from Mentha piperita grown in the United States. This volatile oil, carefully rectified by steam, is cooled by means of ice and salt to — 22.2° C. (— 8° F.), and after it has solidified the temperature is allowed to rise very slowly, the liquid portion being drained off from time to time. This article has become known in our commerce as *pipmenthol.* The yield is about 20 per cent. of the weight of the oil.

Properties.—Menthol forms colorless acicular glossy crystals, which, seen in quantity, have a white appearance; if rapidly congealed the crystals are thin, stellately arranged, and of a satiny lustre. They melt at 42° C. (107.6° F.) to a colorless liquid, boiling at 212° C. (413.6° F.), and have an agreeable odor and taste of peppermint, producing, if air is inhaled, a sensation of coolness. The Chinese menthol appears either in fused crystalline masses or in colorless acicular crystals, which are more or less moist from adhering oil, melt at about 41° C. (105.8° F.), and differ somewhat in odor from that of pipmenthol; the melting-point is increased to 42° C. by prolonged exposure to the air. Menthol dissolves sparingly in water, but is freely soluble in alcohol, ether, chloroform, and other solvents of volatile oils; the solutions have a neutral reaction to test-paper. Boiled with sulphuric acid diluted with half its volume of water, menthol acquires an indigo-blue or ultramarine color, the acid becoming brown. Menthol should be entirely volatilized by the heat of a water-bath (absence of magnesium sulphate and other saline or waxy impurities). In contact with thymol, which has a higher melting-point, it becomes liquid (Flückiger, 1885). Triturated with an equal weight of chloral at 35° C. (95° F.), an oily colorless liquid is produced, soluble in alcohol, benzin, chloroform, ether, and carbon bisulphide, and on being mixed with sulphuric acid acquiring a blue color, the mixture yielding with alcohol a nearly colorless solution (H. V. Becker, 1886).

Uses.—To the statements made under *Oleum menthæ piperitæ* (p. 1067) the following may be added: Menthol in a solid form has but a trifling advantage over the oil of peppermint. Like it, and like various other essential oils, counter-irritants, and anodynes, it is a palliative of superficial *neuralgia*. It has been employed to relieve itching and burning pain in *pruritus ani*, *eczema*, *zora*, *bites of insects*, superficial *burns* and *scalds*, *boils*, *carbuncles*, and all analogous affections. It has been tried to obtund the sensibility of the *pharynx* and *larynx* in manipulations and operations involving these parts, but is not as eligible as cocaine. For some of its applications it may be mixed with cocaine or with chloral.

PHORMIUM.—Phormium.

New Zealand flax (hemp), E.; *Lin (Chanvre) de la Nouvelle-Zélande*, Fr.; *Flachslilie, Neuseeländischer Flachs*, G.

The root and leaf-bases of Phormium tenax, *Forster.*

Nat. Ord.—Liliaceæ, Lilieæ.

Origin and Description.—The plant is indigenous to New Zealand and the Chatham Islands, has been introduced into Australia, the Azores, and other countries, and in temperate climates is cultivated as an ornamental hot-house plant. It has a fleshy rhizome, beset with nearly simple roots, and sending forth from its end a tuft of leathery linear-lanceolate leaves, which are from 5 to 8 feet (1.5–2.4 M.) long and 3 to 4 inches (7–10 Cm.) broad. The leaves, sufficiently matured, are cut off above their base, the remaining portion attached to the rhizome, and, with the rootlets, constituting the drug. The straight fibres of the leaves, separated from the other tissue, are brought into commerce as New Zealand flax; they are cream-colored, of a silky lustre, tough, but rougher than hemp, and are mainly used for cordage. The flowering stalk attains a height of about 15 feet (4.5 M.).

Constituents.—The drug has not been subjected to analysis.

Uses.—New Zealand flax was made use of in a strong decoction by Mr. Monckton (*Therapeutic Gaz.*, ix. 320) as a dressing for all manner of lesions of continuity, including *lacerations* and *amputations*. As it readily deteriorated by fermentation, he added to each quart of the decoction about an ounce of equal parts of carbolic acid and glycerin. With this he washed the part and maintained cotton wool or lint soaked in it constantly, and declared that the discharges were altogether insignificant. Without further knowledge of the constitution and qualities of Phormium tenax, it would be unjust to suggest that its value is perhaps overestimated; but unless the results of its use without the adjunction of carbolic acid were furnished, we can scarcely refuse to the latter agent a large part in the success of the compound.

SULPHOPHENOLUM.—Sulphophenol.

Sulphocarbol, Aseptol, Orthophenol-sulphonic acid.

Formula $C_6H_4.OH.SO_3H$. Molecular weight 174.

Preparation.—Two of the three sulphophenols are obtained by the action of sulphuric acid upon carbolic acid, the para-compound being produced at an elevated temperature, while the ortho-compound is formed in the cold by leaving together for a week 10 parts of carbolic acid and 12 parts of sulphuric acid, after which time the excess of the latter is removed by calcium carbonate or barium carbonate.

Properties.—Sulphophenol is a reddish or amber-colored viscous liquid having the specific gravity 1.45, an odor resembling that of carbolic acid, and a caustic taste. It is readily soluble in water, alcohol, and glycerin. The commercial article, known as aseptol, is mostly a straw-colored, slightly caustic liquid of the density 1.167, and containing between 30 and 35 per cent. of sulphophenol. Its aqueous solution should give no precipitate with barium chloride.

Action and Uses.—In 1884, Vigier described the action and uses of this compound (*Bullétin et Mém. de la Soc. de Thérap.*, Juin, 1884, p. 82); he stated that it was not caustic, nor, like carbolic acid, poisonous in its medicinal use. He satisfied himself of its power to arrest fermentation, showing that urine containing it in the proportion of ¼ of 1 per cent. might be kept for months without putrefying, and that blood and other animal matters remained equally unchanged under its influence. Fermentable liquids containing glucose were protected from change by the addition to them of 1 part of this compound to 1000 of the liquid. Solutions of it in the proportion of from 5 to 10 per cent., and properly diluted, did not act poisonously when given internally, although its coagulating power on the contents of the stomach was decided. In this, as in other respects, it was contrasted with carbolic acid. Injected into the veins of dogs, solutions varying in strength from 1 to 20 per cent., and in small portions at a time, did not occasion much disorder of the functions, but stronger solutions or in greater bulk rendered the heart and respiration irregular, and brought on copious frothy salivation, etc. When the individual injections amounted to f℥ss (14 c.c.), containing 42 grains (Gm. 2.80) of sulphophenol, the animal was bent backward spasmodically, respiration and circulation were suspended, a copious discharge of urine took place, the pupils were dilated, and the animal died. The cause of death was disclosed by the coagulated blood, especially on the right side of the heart, and the blood-vessels communicating with it. Animals thus poisoned resist putrefaction indefinitely. Numerous wounds in different animals, including fresh granulating and suppurating wounds, and also abscesses, were washed with a 10-per-cent. solution, with the result of quickening granulation, arresting suppuration and fetid secretions, and hastening the cure. The application did not appear to cause pain, and no symptoms of poisoning by the preparation arose.

Vigier states that in the course of a day he took about 150 grains of sulphophenol dissolved in 2 pints of water without experiencing any inconvenience. Lightly applied to the tongue, it caused a slight pricking and astringent sensation; the mucous membrane was whitened, and the epithelium exfoliated on the following day. In view of its antiseptic virtues, Vigier recommends solutions of sulphophenol (1–5 per cent.) as an ordinary dressing for *wounds*, in various diseases of the *uterus*, *bladder*, and *urethra*, in open *cancer*, and in fetid *ulcers* of every sort. He particularly insists upon its superiority over carbolic acid and corrosive sublimate in *obstetrical* medicine and surgery for its freedom from smell and irritating properties. He recommends solutions of 1–10 per cent. as lotions in *eruptive fevers* and in *parasitic diseases of the skin.*

THALLINÆ SULPHAS.—Sulphate of Thalline.

Thalline, E., Fr.; *Thallin*, *Thallinsulfat*, G.

Formula $(C_{10}H_{13}NO)_2H_2SO_4.2H_2O$. Molecular weight 460.

Preparation.—The base thalline, which is the methyl ether of tetrahydro-paraoxychinoline, and its salts were discovered by Skraup in 1884, and is prepared from *paraquinanisol* by treatment with tin and hydrochloric acid. This last-named compound is an oily base, and is obtained by heating to about 145° C. (293° F.) a mixture of paramidoanisol, paranitranisol (or another nitro-compound), glycerin, and sulphuric acid. The base thalline forms thick white prisms, which are freely soluble in alcohol, ether, and benzol, but dissolve sparingly in benzin and water. The sulphate, which has become known by the name of the base, thalline, is formed by dissolving the latter in dilute sulphuric acid and crystallizing or granulating.

Properties.—Thalline sulphate is usually seen in the form of a white or whitish granular crystalline powder, which is permanent in the air, and has a slight anise-like odor and a nauseous, bitter, saline, and pungent taste, becoming more agreeable and aromatic in dilute solutions. The salt is freely soluble in hot water, sparingly soluble in chloroform and in ether, and requires for solution 5 parts of cold water and 100 parts of alcohol, the solutions becoming darker on exposure to light. A solution of the salt in 10,000 parts of water acquires an emerald-green color on the addition of a little ferric chloride or other oxidizing agent, the color being not altered by sulphuric acid, but changed to purplish, reddish, or yellow by reducing agents. The solution of thalline is colored deep red on being heated with fuming nitric acid; it is not affected by tannin or mercuric chloride, but yields a yellow precipitate with picric acid, and alkalies separate from it the base in oily drops, becoming crystalline and having a coumarin-like odor.

Allied Salt.—Thalline tartrate closely resembles the sulphate in appearance and taste, but has a coumarin-like odor, and is much less soluble, requiring at 15° C. (59° F.) about 10 parts of water.

Action and Uses.—According to Brouardel and Loye, thalline deteriorates the hæmoglobin of the blood, converting it into methæmoglobin, and thereby diminishing its oxidizing power. Huchard, while he failed to detect the latter product, observed a great reduction in the oxyhæmoglobin, in consequence of which guinea-pigs employed in his experiments perished as if they were anæmiated. He also found that thalline was rapidly eliminated in the urine, and, indeed, in all the secretions (*Bull. et Mém. de la Soc. de Thérap.*, Avril, 1885, p. 46). The experiments of Beyer (*Amer. Jour. of Med. Sci.*, Apr., 1886, p. 386) on the frog and terrapin proved that "repeated thallinization of the heart is followed by a peculiar shrinkage of the organ, during which it presents the dark color of thallinized blood;" that, as had already been shown, "it reduces the temperature by diminishing heat-production and increasing heat-radiation;" and that "its influence upon the blood-corpuscles is sufficient to condemn it" as a medicine.

In man, thalline produces a fall of temperature which is nearly always attended with profuse sweating; it reaches the minimum in from one to three hours, and recovers its former height in from four to five hours, but sometimes more rapidly, and in that case chilliness is experienced. Yet not unusually both chill and sweat are wanting. The rise and subsequent fall of temperature are more rapid than are caused by antipyrine, but less so than kairine occasions; yet it maintains the maximum longer than is done by either of these preparations (Mengazzini; Anseroff). After its completed action the temperature is apt to rise higher than at first. According to Welt, a watery diarrhœa is frequently produced by thalline, and vomiting in about 7 per cent. of the cases (*Deutsch. Arch. f. klin. Med.*, Dec. 3, 1885). The repeated administration of medicinal doses now and then occasions a papular erythema, especially of the limbs. Some clinical observations of Dr. Griffith on the use of thalline point to its sometimes causing profuse sweating in phthisis. Twice in thirty-eight cases of this disease and in acute febrile affections a decided depression of strength occurred, which "indicated that it must be given with great care to debilitated subjects" (*Med. News*, xlviii. 370). Jaccoud maintained, but we believe without adequate evidence, that the reduction of temperature produced by thalline is limited to the surface of the body; and he adds that this peripheral cooling does not benefit, but rather weakens (*Archives gén.*, Dec., 1885, p. 796).

Thalline is unquestionably an antipyretic, probably the most certain and powerful of its class, and for that reason calls for the condemnation which was pronounced upon it by Jaksch in Vienna, who first brought the preparation into notice. "Drugs," he said, "which are only antipyretics are of very little use" (*Times and Gaz.*, Dec., 1884, p. 797). In this sentence Prof. Nothnagel concurred, protesting against the indiscriminate use of "antipyretics," as if fever were a substantial disease, and not the outcome of necessary chemical and physiological changes in the tissue-elements. We have long inculcated the opinion he thus expressed: "Fever is not a symptom to be removed in every case. According to my conviction, which is also that of many other investigators, it is a very beneficial phenomenon—one of those processes of reaction which one must look upon as compensatory. . . . . Although we may succeed in lowering the temperature, we do not shorten the duration of an acute fever by a single day. . . . . In general, a temperature that does not exceed 104° F. does not injure the patient." In relapsing fever the temperature often rises to 105° F., and even to 106° F., without in the least disturbing the mind, and the patient recovers—exhausted indeed, but not otherwise injured. Jaksch claimed for thalline that it provoked neither vomiting, cyanosis, nor collapse, and that only occasionally did it produce sweating and rigors. Now that this judgment is known to be too favorable, we may all the more readily accept his further conclusions, confirmed by later observers. He confessed that the medicine neither shortens nor radically modifies febrile affections, including intermittent fever, acute articular rheumatism, measles, puerperal septicæmia, pneumonia, erysipelas, and tuberculosis. "Fever, indeed, it suppressed, but all the rest remained unchanged" (*Wiener med. Wochensch.*, No. 48, 1884). Hallopeau pronounced a similar judgment in the matter (*Bull. et Mém. Soc. de Thérap.*, 1885, p. 57). Maragliano's observations confirm the conclusions already stated. He found that in non-febrile states the temperature was but slightly affected by thalline; that in these, as in febrile states, it occasioned a decided loss of heat; that during its action the excretion of urea and the elimination of carbonic acid are diminished; and that it also lessens the absorption of oxygen by the blood in the lungs (*Zeitschr. f. k. Med.*, 1886, x. 462).

Thalline salts, the sulphate or the tartrate, may be prescribed in doses of from 4 to 12 grains (Gm. 0.25–0.75). They may be administered in powder, contained in wafers, or in solution. They are said to act perfectly through the rectum. Hypodermically, they do not produce abscess or otherwise irritate the tissues.

URETHANUM.—URETHANE.

Ethyl carbamate, E.; *Uréthane*, Fr.; *Urethan*, G.

Formula $C_3H_7NO_2$ or $CO.NH_2.OC_2H_5$. Molecular weight 89.

Preparation.—Urethane was discovered by Dumas in 1833, and may be prepared, according to Cahours, by leaving ethyl carbonate in contact with ammonia, when urethane and alcohol are produced. A similar reaction takes place between ethyl chlorocarbonate and ammonia, resulting, however, in the production of ammonium chloride and urethane.

The same compound is also formed by heating urea (or preferably nitrate of urea) with alcohol, when ammonia will be liberated. Numerous other processes are known.

Properties.—Urethane crystallizes in white or colorless tables, which are not deliquescent, are inodorous, have a pleasant saline taste, and melt below 100° C., the liquid congealing again in a pearly crystalline mass resembling spermaceti. Urethane boils at 180° C. (356° F.), but sublimes at a much lower temperature; it is readily soluble in water, alcohol, and ether. Heated above its melting-point in the presence of moisture, it is partly decomposed with the evolution of ammonia; and when heated with ammonia urea is formed. It is decomposed by potassa, with the formation of potassium carbonate, ammonia, and alcohol.

Action and Uses.—Schmiedeberg, in his experiments with urethane upon frogs (*Practitioner*, xxxv. 279), found that by gradually increasing the dose he could produce various degrees of hypnotism in these animals, from mere dulness to profound and prolonged stupor. Huchard gave to a rabbit three successive doses of 18 grains (Gm. 1.25): the temperature and respiration declined, and in about half an hour the animal fell into a state of cataleptic insensibility of several hours' duration. Smaller doses only rendered it dull and torpid. A rabbit was kept insensible for a whole day by repeated hypodermic injections, amounting in all to 45 grains (Gm. 13), and another animal of the same species was not killed by 135 grains (Gm. 9) administered in a similar manner (*Bull. dé therap.*, cx. 104). The punctures became sore, but other observers—and notably Coze—declare that urethane is not a local irritant. A solution containing 120 grains and thrown into the peritoneal cavity caused no ill results. Under the primary action of this compound Coze found that the blood-pressure increases, but soon returns to its normal standard; that it causes the blood to absorb an increased proportion of oxygen, and probably to retain it with abnormal tenacity; and that it slows the respiration and lowers the temperature (*Ibid.*, cx. 337). The most important fact determined by Coze is the power of urethane as an antidote to *strychnine.* It was manifested in frogs, guinea-pigs, rabbits, and dogs (*Ibid.*, cx. 342).

In 1885, Jaksch found that in man a dose of from 8–15 grains of urethane produced peaceful slumber of several hours' duration (*Times and Gaz.*, Oct., 1885, p. 485). It did not appear to exert any direct anodyne influence. Friedländer's investigations seemed to prove that even in the minute dose of $\frac{1}{50}$ grain (Gm. 0.001) it occasioned lassitude and depression, with retching and vomiting. The visible mucous membranes turned pale, the pupils acted irregularly, and the pulse and heart failed. But no such effects from similar doses have been noted by other observers. While suffering from pain he took a drachm of urethane, and secured thereby a comfortable night's rest, while on the following night it excited him (*Therap. Gaz.*, ix. 852). The inharmonious statements concerning the effects of this preparation do not appear to diminish as its use becomes less restricted. Hübner and Sticker affirm that it occasions no unpleasant after-effects, and that a dose of 30 grains is not less hypnotic than a dose of 60 grains; but Otto and Koenig allege that it is more apt than paraldehyde to occasion vomiting, and that its narcotic action is less decided. They also accuse it of producing loss of appetite, etc. On the whole, the action of this preparation resembles that of paraldehyde, over which it has the advantage of being free from unpleasant smell and taste.

The therapeutical value of urethane has not yet (Oct., 1886) been sufficiently tested. Kroepelin found it a useful hypnotic for melancholic patients suffering from *insomnia* and in cases of "mild excitement or depression accompanied by exhaustion or depressed nutrition" (*Med. News*, xlviii. 626). Otto and Koenig, on the other hand, claim it to have had a very favorable action in violence of a hysterical or epileptic nature, and Rottenbiller seems to have used it with general advantage for the relief of insomnia in the insane in doses of from 30 to 60 grains. He also employed with similar results hypodermic injections, two of which, of 4 grains each, sufficed (*Therapeut. Gaz.*, x. 474). A case of traumatic *tetanus* in a boy of fifteen years is related as having been cured by urethane given in 4-grain doses every two hours—a result that it would be desirable to have confirmed by experience. A case of severe and obstinate *chorea* is reported in which urethane procured sleep and tranquillity after the bromides had failed to do so (*Boston Med. and Surg. Jour.*, May, 1886, p. 419). In many cases it has been found an efficient substitute for opiates.

Urethane may be given in capsules or in a flavored and sweetened watery solution. Its average dose is about 15 grains, but three times as much has frequently been taken without untoward effects.

APPENDIX.

TABLE OF MAXIMUM DOSES.

Based upon Table A of the Pharmacopœia Germanica, 1882.

IN Germany physicians are not permitted to prescribe heroic medicines in larger doses than those given in the table, without adding the sign ! indicating that the larger dose has been intentionally ordered. With very few exceptions, these doses are larger than the maximum doses given by the Belgian Pharmacopœia. The doses of those preparations not contained in or differing materially from those of the German Pharmacopœia, have either been reduced to the United States standard or are quoted from the Belgian or first German Pharmacopœia; they are indicated by x. All doses are intended for adults.

	For a single dose.		For a day.	
	Gram.	Grain.	Gram.	Grain.
Acidum arseniosum	.005	$\frac{1}{13}$	.02	$\frac{3}{10}$
" carbolicum (crystal)	.1	$1\frac{1}{2}$	.5	$7\frac{1}{2}$
x " hydrocyanicum dilutum	.05	$\frac{3}{4}$	.20	3
x Aconitina (see page 112)	.004	$\frac{1}{16}$	.03	$\frac{9}{20}$
Aconiti radix	.1	$1\frac{1}{2}$	.5	$7\frac{1}{2}$
Antimonii et potassii tartras	.2	3	.5	$7\frac{1}{2}$
Apomorphinæ hydrochloras	.01	$\frac{3}{20}$	.05	$\frac{3}{4}$
Aqua amygdalæ amaræ and Aqua laurocerasi	2.0	$30\frac{3}{4}$	8.0	$123\frac{1}{2}$
Argenti nitras	.03	$\frac{9}{20}$	.2	3
x Arsenici iodidum	.025	$\frac{3}{8}$	.05	$\frac{3}{4}$
Atropina and its salts	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Auri et sodii chloridum	.05	$\frac{3}{4}$	.2	3
x Barii chloridum	.12	$1\frac{7}{8}$	1.5	23
Belladonnæ folia	.2	3	.6	$9\frac{1}{4}$
x " radix	.1	$1\frac{1}{2}$	.4	6
Caffeina	.2	3	.6	$9\frac{1}{4}$
Cambogia	.3	$4\frac{1}{2}$	1.0	$15\frac{3}{8}$
Cantharides	.05	$\frac{3}{4}$	.15	$2\frac{1}{3}$
Chloral	3.0	$46\frac{1}{4}$	6.0	$92\frac{1}{2}$
Codeina	.05	$\frac{3}{4}$	.2	3
Colocynthis	.3	$4\frac{1}{2}$	1.0	$15\frac{3}{8}$
x Coniina	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Conii herba	.3	$4\frac{1}{2}$	2.0	$30\frac{3}{4}$
Creasotum	.1	$1\frac{1}{2}$	.5	$7\frac{1}{2}$
x Cupri acetas	.1	$1\frac{1}{2}$	.4	6
x " sulphas	.1	$1\frac{1}{2}$	.4	6
" " in divided doses as an emetic	1.0	$15\frac{3}{8}$	—	—
x Cupri et ammonii sulphas	.1	$1\frac{1}{2}$	.4	6
Digitalis folia	.2	3	1.0	$15\frac{3}{8}$
Ergota	1.0	$15\frac{3}{8}$	5.0	77
x Extractum aconiti foliorum	.1	$1\frac{1}{2}$	.4	6
" aconiti radicis	.02	$\frac{3}{10}$	.1	$1\frac{1}{2}$
" belladonnæ	.05	$\frac{3}{4}$	.2	3
" cannabis indicæ	.1	$1\frac{1}{2}$	.4	6
x " colchici aceticum	.2	3	.8	$12\frac{1}{3}$

Table of Maximum Doses.—*Continued.*

	For a single dose.		For a day.	
	Gram.	Grain.	Gram.	Grain.
x Extractum colocynthidis	.05	$\frac{3}{4}$	.2	3
x " conii	.18	$2\frac{3}{4}$	.6	$9\frac{1}{4}$
" digitalis	.2	3	1.0	$15\frac{3}{8}$
" hyoscyami	.2	3	1.0	$15\frac{3}{8}$
x " ignatiæ	.05	$\frac{3}{4}$	.15	$2\frac{1}{3}$
x " lactucæ	.6	$9\frac{1}{4}$	2.5	$38\frac{1}{4}$
" nucis vomicæ (alcoholicum)	.05	$\frac{3}{4}$	.15	$2\frac{1}{3}$
x " nucis vomicæ aquosum	.2	3	.6	$9\frac{1}{4}$
" opii	.15	$2\frac{1}{3}$	.5	$7\frac{1}{2}$
x " physostigmatis	.02	$\frac{3}{10}$	.06	$\frac{9}{10}$
x " pulsatillæ	.2	3	1.0	$15\frac{3}{8}$
x " sabinæ	.2	3	1.0	$15\frac{3}{8}$
" scillæ	.2	3	1.0	$15\frac{3}{8}$
x " stramonii foliorum	.1	$1\frac{1}{2}$	.4	6
x " " seminis	.05	$\frac{3}{4}$	.25	$3\frac{3}{4}$
x Hellebori viridis radix	.3	$4\frac{1}{2}$	1.2	$18\frac{1}{2}$
Hydrargyri cyanidum	.03	$\frac{9}{20}$	.1	$1\frac{1}{2}$
" chloridum corrosivum	.03	$\frac{9}{20}$	.1	$1\frac{1}{2}$
" iodidum rubrum	.03	$\frac{9}{20}$	.1	$1\frac{1}{2}$
" " viride (flavum)	.05	$\frac{3}{4}$	.2	3
" oxidum rubrum or flavum	.03	$\frac{9}{20}$	.1	$1\frac{1}{2}$
x " protonitras	.015	$\frac{2}{9}$	.06	$\frac{9}{10}$
Hyoscyami folia	.3	$4\frac{1}{2}$	1.5	$23\frac{1}{8}$
Iodoformum	.2	3	1.0	$15\frac{3}{8}$
Iodum	.05	$\frac{3}{4}$	.2	3
Lactucarium	.3	$4\frac{1}{2}$	1.0	$15\frac{3}{8}$
Liquor potassii arsenitis	.5	$7\frac{1}{2}$	2.0	$30\frac{3}{4}$
x Liquor arsenici et hydrargyri iodidi	.4	6	2.0	$30\frac{3}{4}$
Morphina or its salts	.03	$\frac{9}{20}$	.1	$1\frac{1}{2}$
Nux vomica	.1	$1\frac{1}{2}$	.2	3
Oleum tiglii	.05	$\frac{3}{4}$	.1	$1\frac{1}{2}$
Opium	.15	$2\frac{1}{3}$	.5	$7\frac{1}{2}$
Phosphorus	.001	$\frac{1}{64}$	.005	$\frac{1}{13}$
Physostigminæ salicylas	.001	$\frac{1}{64}$	.003	$\frac{1}{22}$
Pilocarpinæ hydrochloras	.03	$\frac{9}{20}$	.06	$\frac{9}{10}$
Plumbi acetas	.1	$1\frac{1}{2}$	.5	$7\frac{1}{2}$
x Potassii arsenias	.005	$\frac{1}{13}$	.025	$\frac{3}{8}$
x " cyanidum	.03	$\frac{9}{20}$	.12	$1\frac{7}{8}$
Sabadillæ fructus	.25	$3\frac{4}{5}$	1.0	$15\frac{3}{8}$
Sabina	1.0	$15\frac{3}{8}$	2.0	$30\frac{3}{4}$
Santoninum	.1	$1\frac{1}{2}$	.3	$4\frac{1}{2}$
x Sodii arsenias	.005	$\frac{1}{13}$	.025	$\frac{3}{8}$
Stramonii folia	.2	3	1.0	$15\frac{3}{8}$
x " semen	.2	3	.8	$12\frac{1}{3}$
Strychnina or its salts	.01	$\frac{1}{6}$	.02	$\frac{3}{10}$
x Tinctura aconiti radicis	.15	$2\frac{1}{4}$	.5	$7\frac{1}{2}$
x " belladonnæ	1.0	$15\frac{3}{8}$	4.0	$61\frac{3}{4}$
x " cantharidis	1.0	$15\frac{3}{8}$	3.0	$46\frac{1}{4}$
x " colchici	1.3	20	4.0	$61\frac{3}{4}$
" colocynthidis	1.0	$15\frac{3}{8}$	3.0	$46\frac{1}{4}$
x " digitalis	1.0	$15\frac{3}{8}$	3.3	$50\frac{4}{5}$
" iodi	.2	3	1.0	$15\frac{3}{8}$
x " lobeliæ	.5	$7\frac{1}{2}$	2.5	$38\frac{1}{4}$
x " nucis vomicæ	.5	$7\frac{1}{2}$	1.0	$15\frac{3}{8}$
" opii	1.5	$23\frac{1}{8}$	5.0	77
x " opii deodorata	1.5	$23\frac{1}{8}$	5.0	77
x " stramonii	1.0	$15\frac{3}{8}$	3.0	$46\frac{1}{4}$
x " veratri viridis	.5	$7\frac{1}{2}$	2.0	$30\frac{3}{4}$
x Toxicodendri folia	.4	6	1.2	$18\frac{1}{2}$
Veratrina	.005	$\frac{1}{13}$	.02	$\frac{3}{10}$
x Veratrum album or Veratr. viride	.3	$4\frac{1}{2}$	1.2	$18\frac{1}{2}$
x Vinum colchici	1.3	20	4.0	$61\frac{3}{4}$
" opii	1.5	$23\frac{1}{8}$	5.0	77
x Zinci chloridum	.015	$\frac{2}{9}$	.1	$1\frac{1}{2}$
x " lactas	.06	$\frac{9}{10}$	.3	$4\frac{1}{2}$
x " sulphas	.06	$\frac{9}{10}$	.3	$4\frac{1}{2}$
" " in divided doses as an emetic	1.0	$15\frac{3}{8}$	—	—
x " valerianas	.06	$\frac{9}{10}$	.3	$4\frac{1}{2}$

TABLES OF WEIGHTS AND MEASURES.

Apothecaries' or Troy Weight, U. S.

One pound,	℔	= 12 troyounces	= 5760 grains	= 13 ounces avoirdupois	72.5 grains.
One troyounce,	℥	= 8 drachms	= 480 "	= 1 ounce "	42.5 "
One drachm,	ʒ	= 3 scruples	= 60 "		
One scruple,	℈		= 20 "		
One grain,	gr.		= 1 grain.		

Apothecaries' or Wine Measure, U. S.

				Cubic inches.	Troy grains of water at 60° F.
1 minim, ♏				0.00376	0.95
60 minims	= 1 fluidrachm, ʒ			0.2256	56.96
480 "	= 8 fluidrachms	= 1 fluidounce, f℥		1.8047	455.69
7680 "	= 128 "	= 16 fluidounces	= 1 pint, O	28.875	7291.11
61440 "	= 1024 "	= 128 "	= 8 pts. = 1 gal., Cong.	231.	58328.88

Weights and Measures of the British Pharmacopœia.

One pound,	℔	= 16 ounces	= 7000 troy grains	= ℔i ℥ij ʒiv gr. xl.
One ounce,	oz.		= 437.5 "	= ʒvij gr. xvijss.
One grain,	gr.		= 1 grain.	

The pound and ounce of the British Pharmacopœia are identical with the same denominations of *avoirdupois weight.* The avoirdupois ounce is subdivided into 16 drachms (1 drachm = 27.34 troy grains); but the British Pharmacopœia recognizes no subdivisions between the ounce and grain. It is, however, optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such be found to conduce to accuracy or convenience.

				Troy grains.	Avoirdupois.
1 minim, *min.*				0.91	
60 minims	= 1 fluidrachm, *fldr.*			54.7	
480 "	= 8 fluidrachms	= 1 fluidounce, *floz.*		437.5	= 1 ounce.
9600 "	= 160 "	= 20 fluid ozs.	= 1 pint, O	8750.	= 1.25 pound.
76800 "	= 1280 "	= 160 "	= 8 pints	= 7000.	= 10 pounds.

Metric Weights and Measures.

The ingredients of all preparations, whether liquid or solid, are ordered by the pharmacopœias (except the British Pharmacopœia and for the fluid extracts U. S. P.) in *parts by weight*, definite weights being directed only when necessary on account of the dose.

			Troy weight.
1 milligram (Mgm.)	= 0.001 gram (Gm.)		.015 grain.
10 milligrams	= 1 centigram (Cgm.)	= 0.010 gram (Gm.)	.154 "
100 "	= 10 centigrams "	= 1 decigram (Dgm.) = 0.100 gram (Gm.)	1.543 "
1000 "	= 100 " "	= 10 decigrams " = 1.000 "	15.432 "

			Troy grains.	Av. weight.
1 gram (weight of 1 cubic centimeter of water at 40° C.).				
10 grams	= 1 dekagram		154.323	.3527 ounce.
100 "	= 10 dekagrams	= 1 hektogram	1543.235	3.5274 ounces.
1000 "	= 100 "	= 10 hektograms = 1 kilogram (Kgm.).	15432.350	35.274 "
10 kilograms	= 1 myriagram	= 22.046 lb. av.		
100 "	= 1 quintal	= 220.46 "		
1000 "	= 1 millier or tonneau	= 2204.6 "		

			Apothecaries' measure.
1 milliliter (or 1 cubic centimeter, Ccm.)		= 0.001 liter	16.23 minims.
10 milliliters	= 1 centiliter	= 0.010 "	2.71 fluidrachms.
100 "	= 10 centiliters	= 1 deciliter = 0.100 liter	3.38 fluidounces.
1000 "	= 100 "	= 10 deciliters = 1.000 "	33.81 "

			Wine measure.
1 liter (or 1 cubic decimeter)			1.0567 quarts.
10 liters	= 1 dekaliter		2.6417 gallons.
100 "	= 10 dekaliters	= 1 hektoliter	26.417 "
1000 "	= 100 "	= 10 hektoliters = 1 kiloliter or stere	264.17 "

The unit of all metric measures is the *meter* (French, *mètre*), and this is the ten-millionth part of the quadrant or fourth part of the terrestrial meridian, the quadrant being the distance from the equator to the pole. The cube of the tenth part of a meter, denominated *liter* (Fr. *litre*), was adopted as the unit of measures of capacity. The weight of the one-thousandth part of a liter of distilled water at its greatest density (4° C.) was denominated *gram* (Fr. *gramme*), and adopted as the unit of weight. The subdivisions of all measures are named by prefixing to the name of the unit the Latin numerals *deci* (.1), *centi* (.01), and *milli* (.001), and the larger denominations by prefixing the Greek numerals *deka* (10), *hekto* (100), *kilo* (1000), and *myria* (10000).

Measures of Length.

METRIC.

	Inches.
1 millimeter (Mm.)	.039370
10 millimeters " = 1 centimeter (Cm.)	.393704
100 " " = 10 centimeters " = 1 decimeter (Dm.)	3.937043
1000 " " = 100 " " = 10 decimeters " = 1 meter (M.) . . .	39.370432
10 meters = 1 dekameter	32 feet 9.7 inches.
100 " = 10 dekameters = 1 hektometer	328 " 1 inch.
1000 " = 100 " = 10 hektometers = 1 kilometer	3280 " 10.4 inches.

1 kilometer = 4 furlongs 213 yards 1 foot 10.43 inches.
10 kilometers = 1 myriameter = 6.2137 miles.

ENGLISH.

1 inch	0.0254 meter.
12 inches = 1 foot	0.3048 "
36 " = 3 feet = 1 yard	0.9144 "
198 " = 16½ " = 5½ yards = 1 rod	5.0292 meters.
220 yards = 40 rods = 1 furlong	201.1662 "
1760 " = 320 " = 8 furlongs = 1 mile	1609.3297 "

Measures of Surface.

METRIC.

Hektare	10,000 square meters =	2.471 acres.
Are	100 " =	119.6 square yards.
Centare	1 square meter =	1550 square inches.

Relative Value of Wine or Apothecaries' and Imperial Measures.

Wine measure.	Imperial measure.				Imperial measure.	Wine measure.				
	Pints.	Floz.	Fldr.	Minims.		Galls.	Pints.	f℥.	fʒ.	Minims.
1 minim	...	...	...	1.04	1 minim	...	...	...	...	0.96
1 fluidrachm	...	...	1	2.5	1 fluidrachm	...	...	...	...	58
1 fluidounce	...	1	0	20.	1 fluidounce	...	...	...	7	41
1 pint	...	16	5	19.	1 pint	...	1	3	1	38
1 gallon	6	13	2	32.	1 gallon	1	1	9	5	4

24 fluidounces wine measure = 25 fluidounces Imperial measure (difference 1 grain).

Value of Apothecaries' or Troy Weights in Metric Weights.

Grain.		Milligrams.	Grains.		Grams.	Apothecaries' weight.		Grams.
$\frac{1}{64}$	=	1.013	i	=	0.0648	ʒ i	=	3.888
$\frac{1}{60}$	=	1.080	ij	=	0.1296	ʒ ij	=	7.776
$\frac{1}{50}$	=	1.296	iij	=	0.1944	ʒ iij	=	11.664
$\frac{1}{48}$	=	1.350	iv	=	0.2592	ʒ iv	=	15.552
$\frac{1}{40}$	=	1.620	v	=	0.3240	ʒ v	=	19.440
$\frac{1}{36}$	=	1.800	vi	=	0.3888	ʒ vi	=	23.328
$\frac{1}{32}$	=	2.025	vij	=	0.4536	ʒ vij	=	27.216
$\frac{1}{30}$	=	2.160	viij	=	0.5184	℥ i	=	31.103
$\frac{1}{25}$	=	2.592	ix	=	0.5832	℥ ij	=	62.207
$\frac{1}{24}$	=	2.700	x	=	0.6480	℥ iij	=	93.310
$\frac{1}{20}$	=	3.240	xij	=	0.7776	℥ iv	=	124.414
$\frac{1}{16}$	=	4.050	xv	=	0.9720	℥ v	=	155.517
$\frac{1}{15}$	=	4.320	xvi	=	1.0368	℥ vi	=	186.621
$\frac{1}{12}$	=	5.400	xviij	=	1.1664	℥ vij	=	217.724
$\frac{1}{10}$	=	6.480	xx	=	1.2960	℥ viij	=	248.828
$\frac{1}{8}$	=	8.100	xxiv	=	1.5552	℥ ix	=	279.931
$\frac{1}{6}$	=	10.800	xxv	=	1.6200	℥ x	=	311.035
$\frac{1}{5}$	=	12.960	xxx	=	1.9440	℥ xi	=	342.138
$\frac{1}{4}$	=	16.200	xl	=	2.592	℔i	=	373.242
$\frac{1}{3}$	=	21.600	l	=	3.2400	℔ij	=	746.484
$\frac{1}{2}$	=	32.399	lx	=	3.8879	℔iij	=	1119.726

Value of Apothecaries' or Wine Measures in Metric Measures.

Minims.		Cubic centimeters.	Fluidrachms.		Cubic centimeters.	Fluidounces.		Cubic centimeters.
1	=	.061	1	=	3.697	1	=	29.574
2	=	.123	1½	=	5.545	2	=	59.148
3	=	.185	2	=	7.393	3	=	88.721
4	=	.246	2½	=	9.242	4	=	118.295
5	=	.308	3	=	11.090	6	=	177.443
10	=	.616	3½	=	12.988	8	=	236.590
15	=	.924	4	=	14.787	12	=	354.885
20	=	1.232	5	=	18.484	16	=	473.180
30	=	1.848	6	=	22.180	32	=	946.360
40	=	2.464	7	=	25.877	64	=	1897.720
50	=	3.082	7½	=	27.726	128	=	3785.441

Rules for Converting Apothecaries' Weights and Measures into their respective Equivalents in Metric Terms for Medical and Pharmacal Purposes.

The following rules are condensed from those prepared by Professor Oscar Oldberg, Phar. D., adopted by John M. Woodworth, M. D., Surgeon-General United States Marine Hospital Service, and approved in 1878 by Hon. John Sherman, Secretary of the Treasury.

1. To express quantities by weight of the Apothecaries' system in Metric terms, or to write medical prescriptions in Metric weights.

Rule A. *Reduce each quantity to grains; then divide the number by* 10 (or move the decimal point one place to the left), *and from the quotient subtract one-third.* The remainder is in each case the number of grams representing (nearly) the same quantity. Or,

Rule B. *Reduce each quantity to drachms, and multiply the number by* 4. The product is in each case the number of grams representing (nearly) the same quantity. Or,

Rule C. *Reduce each quantity to ounces, and multiply the number by* 32. The product is in each case the number of grams representing (nearly) the same quantity.

To illustrate: By Rule B, 4000 Gm. would be (nearly) equivalent to 1000 drachms; but 4000 Gm. is equal to exactly 61,729.40 + troy grains, while 1000 drachms is only 60,000 troy grains. The deviation from exactness, therefore, in the answer arrived at by Rule B (as also in the answers arrived at by Rules A and C), is equivalent to an excess of 1729.40 + troy grains for every 1000 drachms, or about 14 grains for every ounce, or 28.82 + grains for every 1000 grains, or less than 2.9 per cent. To ensure greater accuracy, if in any case deemed necessary, 3 per cent. may be deducted from the answer arrived at by either of the Rules, A, B, or C. The deviation from exactness will then be reduced to ⅕ of 1 per cent., the remainder being less than the exact equivalent sought by only 2.04 grains for every 1000 grains, or about 1 grain for every ounce.

2. To express quantities by measure of the Apothecaries' system in Metric terms, or to write medical prescriptions in Metric cubic measures.

Rule D. *Reduce each quantity to minims; then divide the number by* 10 (or move the decimal point one place to the left), *and from the quotient subtract one-third.* The remainder is in each case the number of cubic centimeters representing (nearly) the same quantity. Or,

Rule E. *Reduce each quantity to fluidrachms, and multiply the number by* 4. The product is in each case the number of cubic centimeters representing (nearly) the same quantity. Or,

Rule F. *Reduce each quantity to fluidounces, and multiply the number by* 32. The product is in each case the number of cubic centimeters representing (nearly) the same quantity.

To illustrate: By Rule E, 4000 Ccm. would be (nearly) equivalent to 1000 fluidrachms; but 4000 Ccm. is equivalent to exactly 64,924.67 + minims, while 1000 fluidrachms is only 60,000 minims. The deviation from exactness, therefore, in the answer arrived at by Rule E (as also in the answers arrived at by Rules D and F) is equivalent to an excess of 4924.67 + minims for every 1000 fluidrachms, or about 41 minims for every fluidounce, or 82.08 − minims for every 1000 minims, or 8.2 per cent. To ensure greater accuracy, if in any case deemed necessary, 8 per cent. may be deducted from the answer arrived at by either of the Rules D, E, or F. The deviation from exactness will then be reduced to less than ½ of 1 per cent., the remainder being less than the exact equivalent sought by only 4.49 − minims for every 1000 minims, or less than 2¼ minims for every fluidounce.

Table for Converting Apothecaries' Weights and Measures into Gram Weights.

The gram-values given below are practical approximations to the correct values. The column for *liquids lighter than water* refers to the officinal spirits and tinctures prepared with stronger alcohol, also to volatile and fixed oils, not exceeding 0.95 in specific gravity. The column for *liquids of specific gravity of water* refers to medicated waters, to tinctures prepared with diluted alcohol, and to fluid extracts prepared with diluted alcohol and alcohol, all having approximately the specific gravity of water. The column for *liquids heavier than water* refers to glycerin, syrups, honeys, and to fluid extracts prepared with glycerin:

Troy weight.	Grams.	Apothecaries' measure.	Grams for liquids.		
			Lighter than water.	Spec. grav. of water.	Heavier than water.
Grain $\frac{1}{16}$	.004	Minim 1	.055	.06	.08
$\frac{1}{12}$	.005	2	.10	.12	.15
$\frac{1}{10}$	.006	3	.16	.18	24
$\frac{1}{8}$	.008	4	.22	.24	.32
$\frac{1}{6}$	.010	5	.28	.3	.40
$\frac{1}{4}$	.016	6	.32	.36	.48
$\frac{1}{3}$	.02	7	.38	.42	.55
$\frac{1}{2}$	.03	8	.45	.5	.65
$\frac{3}{4}$	.05	9	.50	.55	.73
1	.07	10	.55	.6	.80
2	.13	12	.65	.72	.96
3	.20	14	.76	.85	1.12
4	.26	15	.80	.9	1.20
5	.32	16	.90	1.0	1.32
6	.39	20	1.12	1.25	1.60
7	.45	25	1.40	1.55	2.00
8	.52	30	1.70	1.90	2.50
9	.59	35	2.00	2.20	2.90
10 (℈ss)	.65	40	2.25	2.50	3.30
12	.78	48	2.70	3.0	4.00
14	.90	50	2.80	3.12	4.15
15	1.00	60 (fʒi)	3.40	3.75	5.00
16	1.05	65	3.60	4.0	5.30
18	1.18	72	4.05	4.5	6.00
20 (℈i)	1.3	80	4.50	5.0	6.65
24	1.5	90 (fʒiss)	5.10	5.6	7.50
30 (ʒss)	1.95	96	5.40	6.0	8.00
32	2.1	100	5.60	6.25	8.30
36	2.3	120 (fʒii)	6.75	7.5	10.00
40 (℈ii)	2.6	150 (fʒiiss)	8.50	9.5	12.50
45	3.0	160	9.00	10.0	13.30
50 (℈iiss)	3.2	180 (fʒiii)	10.10	11.25	15.00
60 (ʒi)	3.9	210 (fʒiiiss)	11.80	13.0	17.50
70	4.55	240 (fʒiv)	13.50	15.0	20.00
80 (℈iv)	5.2	fʒv	16.90	18.75	25.00
90 (ʒiss)	5.9	fʒvss	18.60	20.75	27.50
100 (℈v)	6.5	fʒvi	20.25	22.5	30.00
110 (℈vss)	7.1	fʒvii	23.60	26.25	35.00
120 (ʒii)	7.80	fʒviii (f℥i)	27.00	30.0	40.00
150 (ʒiiss)	9.75	fʒix	30.40	33.75	45.00
180 (ʒiii)	11.65	fʒx	33.75	37.5	50.00
240 (℥ss)	15.5	fʒxii (f℥iss)	40.50	45.0	60.00
300 (ʒv)	19.4	fʒxiv)	47.25	52.5	70.00
360 (ʒvi)	23.3	f℥ii	54.00	60.0	80.00
420 (ʒvii	27.2	f℥iiss	67.50	75.0	100.00
480 (℥i)	31.1	f℥iii	81.00	90.0	120.00
℥ii	62.2	f℥iiiss	94.50	105.0	140.00
℥iv	124.4	f℥iv	108.00	120.0	160.00

Approximate Measures.

In Great Britain prescriptions are compounded by weighing the solids and measuring the liquids, and the same course is very generally followed in the United States; but on the continent of Europe weights alone are employed in the making of preparations as well as in the compounding of prescriptions. Medicines are, however, taken by familiar domestic measures, which are subject to considerable variations, but are usually estimated as having the following capacity:

In the United States.		In France.
A teaspoonful	1 fluidrachm	5 grams of water.
A desertspoonful	2 fluidrachms	10 “ “ “
A tablespoonful	½ fluidounce	15 “ “ “
A wineglassful	2 fluidounces	———
A glassful	———	150 grams of water.
A teacupful	4 fluidounces	———
A tumblerful	8 fluidounces	———

The approximate measures by the *handful* (Fr. *poignée*) and pinch (Fr. *pincée*) are almost completely discarded, or employed only for the least active drugs.

The measuring of small quantities of liquids by drops gives very uncertain and variable results, which are influenced by the viscidity of the liquid, the size, shape, and fulness of the vessel, the curvature of the lip, the temperature, the rapidity of dropping, and probably by other circumstances. As a rule, it may be said that aqueous liquids yield larger drops than those containing little or no water; but very different results are obtained with the same liquid dropped from different bottles, or even from the same bottle under different conditions; the differences amount frequently to 50, and occasionally to 200, per cent. For these reasons medicated liquids should not be ordered in drops, but preferably by weight or measure; and whenever it is desirable for the patient to take a medicine by drops, the dose may be approximated by estimating each minim to contain of—

Ether and ethereal solutions	2½ to 3 drops.
Tinctures, alcoholic solutions, and volatile oils	1½ to 2 or 2½ drops.
Medicated wines	1 to 1½ drops.
Water and aqueous solutions	¾ to 1 drop.

In order to avoid to some extent the discrepancies resulting from the dropping of liquids under various conditions, dropping-measures (*compte-gouttes*) have been constructed in France, yielding at 15° C. drops of distilled water, 20 of which weigh 1 Gm., at least within a limit of 2 per cent. The French Codex gives a table containing the weight of 1 drop, and the number of drops for 1 Gm. of various liquids, dropped under the conditions stated, which may be summarized as follows:

Number of drops	for 1 Gm. of the following liquids:
20	Hydrocyanic acid, Diluted sulphuric acid, Aqueous solutions of the salts of metals and the alkaloids.
21–26	Mineral acids, Ammonia-water, Glycerin, Fowler's solution, Vinegars.
31	Solution of chloral (⅓).
33	Wine (Grenache) and medicated wines.
43	Creasote.
48	Fixed oils.
50–57	Glacial acetic acid, Carbolic acid (alcoholic solution), Alcohol (sp. gr. .864 and over), Chloroform, Volatile oils, Tinctures, Spirit of nitrous ether.
61	Alcohol (sp. gr. .834), Tincture of iodine.
72	Spirit of ether.
90	Ether.

TABLE SHOWING THE RELATION OF THE DEGREES OF BAUMÉ'S HYDROMETERS TO SPECIFIC GRAVITIES.

The hydrometers most frequently used in the United States are those constructed upon the plan of Baumé. For liquids *heavier* than water the point to which the instrument sinks in pure water is 0, and the point to which it sinks in a solution of 15 parts of dry table-salt in 85 parts of water is marked 15, the distance between the two points being divided into 15 equal parts, and the scale continued with divisions of the same size. For liquids *lighter* than water the instrument is floated in a solution of 10 parts of dry table-salt in 90 parts of water, and afterward in pure water, the distance being divided into 10 equal parts, and the scale continued in like manner; the point indicating the density of water is marked 10. The hydrometers were originally constructed at a *medium* temperature. In the United States they are made for the temperature of 60° F. (15.55° C.), and the scales as originally published by Henry Pemberton (1852) are recognized. They agree closely with the determinations made by Schober and Pescher for liquids heavier than water, and differ but little for liquids lighter than water.

Cartier's hydrometer, which is occasionally employed in France, agrees with Baumé's scale for liquids lighter than water, except that 16° of the latter are equal to 15° Cartier.

For Liquids Heavier than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
0	1.0000	16	1.1240	32	1.2831	48	1.4949	64	1.7901
1	1.0069	17	1.1328	33	1.2946	49	1.5104	65	1.8125
2	1.0139	18	1.1417	34	1.3063	50	1.5263	66	1.8354
3	1.0211	19	1.1507	35	1.3181	51	1.5425	67	1.8589
4	1.0283	20	1.1600	36	1.3302	52	1.5591	68	1.8831
5	1.0357	21	1.1693	37	1.3425	53	1.5760	69	1.9079
6	1.0431	22	1.1788	38	1.3551	54	1.5934	70	1.9333
7	1.0507	23	1.1885	39	1.3679	55	1.6111	71	1.9595
8	1.0583	24	1.1983	40	1.3809	56	1.6292	72	1.9863
9	1.0661	25	1.2083	41	1.3942	57	1.6477	73	2.0139
10	1.0740	26	1.2184	42	1.4077	58	1.6666	74	2.0422
11	1.0820	27	1.2288	43	1.4215	59	1.6860	75	2.0714
12	1.0902	28	1.2393	44	1.4356	60	1.7058		
13	1.0984	29	1.2500	45	1.4500	61	1.7261		
14	1.1068	30	1.2608	46	1.4646	62	1.7469		
15	1.1153	31	1.2719	47	1.4795	63	1.7682		

For Liquids Lighter than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
10	1.0000	23	0.9150	36	0.8433	49	0.7821	62	0.7290
11	0.9929	24	0.9090	37	0.8383	50	0.7777	63	0.7253
12	0.9859	25	0.9032	38	0.8333	51	0.7734	64	0.7216
13	0.9790	26	0.8974	39	0.8284	52	0.7692	65	0.7179
14	0.9722	27	0.8917	40	0.8235	53	0.7650	66	0.7142
15	0.9655	28	0.8860	41	0.8187	54	0.7608	67	0.7106
16	0.9589	29	0.8805	42	0.8139	55	0.7567	68	0.7070
17	0.9523	30	0.8750	43	0.8092	56	0.7526	69	0.7035
18	0.9459	31	0.8695	44	0.8045	57	0.7486	70	0.7000
19	0.9395	32	0.8641	45	0.8000	58	0.7446	71	0.6965
20	0.9333	33	0.8588	46	0.7954	59	0.7407	72	0.6930
21	0.9271	34	0.8536	47	0.7909	60	0.7368	73	0.6896
22	0.9210	35	0.8484	48	0.7865	61	0.7329	74	0.6863

Table for comparing Degrees of the Centigrade and Fahrenheit Thermometers.

Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.
— 40°	—40.0°	+ 21°	+ 69.8°	+ 81°	+ 177.8°	+ 141°	+ 285.8°	+ 201°	+ 393.8°
39	38.2	22	71.6	82	179.6	142	287.6	202	395.6
38	36.4	23	73.4	83	181.4	143	289.4	203	397.4
37	34.6	24	75.2	84	183.2	144	291.2	204	399.2
36	32.8	25	77.0	85	185.0	145	293.0	205	401.0
35	31.0	26	78.8	86	186.8	146	294.8	206	402.8
34	29.2	27	80.6	87	188.6	147	296.6	207	404.6
33	27.4	28	82.4	88	190.4	148	298.4	208	406.4
32	25.6	29	84.2	89	192.2	149	300.2	209	408.2
31	23.8	30	86.0	90	194.0	150	302.0	210	410.0
30	22.0								
		31	87.8	91	195.8	151	303.8	211	411.8
29	20.2	32	89.6	92	197.6	152	305.6	212	413.6
28	18.4	33	91.4	93	199.4	153	307.4	213	415.4
27	16.6	34	93.2	94	201.2	154	309.2	214	417.2
26	14.8	35	95.0	95	203.0	155	311.0	215	419.0
25	13.0	36	96.8	96	204.8	156	312.8	216	420.8
24	11.2	37	98.6	97	206.6	157	314.6	217	422.6
23	9.4	38	100.4	98	208.4	158	316.4	218	424.4
22	7.6	39	102.2	99	210.2	159	318.2	219	426.2
21	5.8	40	104.0	100	212.0	160	320.0	220	428.0
20	4.0								
		41	105.8	101	213.8	161	321.8	221	429.8
19	2.2	42	107.6	102	215.6	162	323.6	222	431.6
18	0.4	43	109.4	103	217.4	163	325.4	223	433.4
17	+ 1.4	44	111.2	104	219.2	164	327.2	224	435.2
16	3.2	45	113.0	105	221.0	165	329.0	225	437.0
15	5.0	46	114.8	106	222.8	166	330.8	226	438.8
14	6.8	47	116.6	107	224.6	167	332.6	227	440.6
13	8.6	48	118.4	108	226.4	168	334.4	228	442.4
12	10.4	49	120.2	109	228.2	169	336.2	229	444.2
11	12.2	50	122.0	110	230.0	170	338.9	230	446.0
10	14.0								
		51	123.8	111	231.8	171	339.8	231	447.8
9	15.8	52	125.6	112	233.6	172	341.6	232	449.6
8	17.6	53	127.4	113	235.4	173	343.4	233	451.4
7	19.4	54	129.2	114	237.2	174	345.2	234	453.2
6	21.2	55	131.0	115	239.0	175	347.0	235	455.0
5	23.0	56	132.8	116	240.8	176	348.8	236	456.8
4	24.8	57	134.6	117	242.6	177	350.6	237	458.6
3	26.6	58	136.4	118	244.4	178	352.4	238	460.4
2	28.4	59	138.2	119	246.2	179	354.2	239	462.2
1	30.2	60	140.0	120	248.0	180	356.0	240	464.0
0	32.0								
		61	141.8	121	249.8	181	357 8	241	465.8
+ 1	33.8	62	143.6	122	251.6	182	359.6	242	467.6
2	35.6	63	145.4	123	253.4	183	361.4	243	469.4
3	37.4	64	147.2	124	255.2	184	363.2	244	471.2
4	39.2	65	149.0	125	257.0	185	365.0	245	473.0
5	41.0	66	150.8	126	258.8	186	366.8	246	474.8
6	42.8	67	152.6	127	260.6	187	368.6	247	476.6
7	44.6	68	154.4	128	262.4	188	370.4	248	478.4
8	46.4	69	156.2	129	264.2	189	372.2	249	480.2
9	48.2	70	158.0	130	266.0	190	374.0	250	482.0
10	50.0								
		71	159.8	131	267.8	191	375.8	260	500.0
11	51.8	72	161.6	132	269.6	192	377.6	280	536.0
12	53.6	73	163.4	133	271.4	193	379.4	300	572.0
13	55.4	74	165.2	134	273.2	194	381.2	350	662.0
14	57.2	75	167.0	135	275.0	195	383.0	400	752.0
15	59.0	76	168.8	136	276.8	196	384.8	450	842.0
16	60.8	77	170.6	137	278.6	197	386.6	500	932.0
17	62.6	78	172.4	138	280.4	198	388.4	600	1112.0
18	64.4	79	174.2	139	282.2	199	390.2	700	1292.0
19	66.2	80	176.0	140	284.0	200	392.0	800	1472.0
20	68.0								

Réaumur's scale is rarely used at the present time; the freezing-point of water is indicated by 0, and the boiling-point by 80°. Therefore 4 degrees of Réaumur are equal to 5 degrees of Centigrade and to 9 degrees of Fahrenheit. The freezing-point of water in Fahrenheit's scales is at 32°.

TABLE OF ELEMENTS.

	Symbols.	Atomic value.	Atomic weight.
Aluminium	Al	III	27
Antimony (Stibium)	Sb	III, V	120
Arsenic	As	III, V	74.9
Barium	Ba	II, IV	136.8
Beryllium (Glucinum)	Be	II	9
Bismuth	Bi	III, V	210
Boron	B	III	11
Bromine	Br	I, III, V, VII	79.8
Cadmium	Cd	II	111.8
Cæsium	Cs	I	132.6
Calcium	Ca	II	40
Carbon	C	II, IV	12
Cerium	Ce	III, IV	141
Chlorine	Cl	I, III, V, VII	35.4
Chromium	Cr	III, VI	52.4
Cobalt	Co	II, III, VI	58.9
Copper (Cuprum)	Cu	I, II	63.2
Didymium	D	III	144.6
Erbium	Eb	III	165.9
Fluorine	F	I	19
Gallium	Ga	III	68.8
Gold (Aurum)	Au	I, III	196.2
Hydrogen	H	I	1
Indium	In	III	113.4
Iodine	I	I, III, V, VII	126.6
Iridium	Ir	II, IV, VI	192.7
Iron (Ferrum)	Fe	II, III, VI	55.9
Lanthanum	La	III	138.5
Lead (Plumbum)	Pb	II, IV	206.5
Lithium	Li	I	7
Magnesium	Mg	II	24
Maganesium	Mn	II, IV, VI	54
Mercury (Hydrargyrum)	Hg	II	199.7

	Symbols.	Atomic value.	Atomic weight.
Molybdenum	Mo	II, IV, VI	95.5
Nickel	Ni	II, VI	58.1
Niobium	Nb	III, V	94
Nitrogen	N	I, III, V	14
Osmium	Os	II, IV, VI, VIII	198.5
Oxygen	O	II	16
Palladium	Pd	II, IV	105.7
Phosphorus	P	III, V	31
Platinum	Pt	II, IV	194.4
Potassium (Kalium)	K	I	39
Rhodium	Rh	II, III, IV	104.1
Rubidium	Rb	I	85.3
Ruthenium	Ru	II, IV, VI, VIII	104.2
Scandium	Sc	III	44
Selenium	Se	II, IV, VI	78.8
Silicium	Si	IV	28
Silver (Argentum)	Ag	I	107.7
Sodium (Natrium)	Na	I	23
Strontium	Sr	II, IV	87.4
Sulphur	S	II, IV, VI	32
Tantalum	Ta	V	182
Tellurium	Te	II, IV, VI	128
Thallium	Tl	I, III	203.7
Thorium	Th	IV	233
Tin (Stannum)	Sn	II, IV	117.7
Titanium	Ti	IV	48
Tungsten or Wolfram	W	II, IV, VI	183.6
Uranium	U	IV, VI	238.5
Vanadium	V	III, V	51.3
Ytterbium	Yb	III	172.7
Yttrium	Y	III	89.8
Zinc	Zn	II	64.9
Zirconium	Zr	IV	90

In addition to the above, the discovery of the following elements has been announced, but little is known of their properties: Actinium (Ac), Decipium (Dp), Holmium (Ho), Ilmenium (Il), Lavœsium (Lv), Mosandrium (Mo), Neptunium (Np), Philippium (Pp), Samarium (Sa), Terbium (Tb), and Thulium (Tu).

List of Reagents

employed in Chemical Testing, according to the United States, British, and German Pharmacopœias.

1. *General Reagents and Test Solutions.*

For preparing the test solutions and in the application of tests *pure* (*distilled*) *water*, free from mineral or other impurities, is used. The proportions adopted by the pharmacopœias are for 1 part of the reagent usually 10 or 20 parts (9 or 19 parts, *P. G.*) of distilled water; when the difference in strength is considerable it is indicated in the following list. All test solutions should be perfectly transparent, and if necessary should be obtained clear by decantation, or, if admissible, by filtration.

Acetic acid: Acetic acid, spec. grav. 1.040 to 1.048.
Boric acid: Boric acid dissolved in 8 parts of alcohol.
Hydrochloric acid: Pure hydrochloric acid, spec. grav. 1.12 to 1.16.
Hydrosulphuric acid: Sulphuretted hydrogen gas generated from sulphide of iron and diluted sulphuric acid; or a fresh saturated solution of the gas in water, 1 part of ferrous sulphide, 1.5 parts of sulphuric acid, and 15 parts of water will generate gas sufficient for about 50 parts of water.
Nitric acid: Pure nitric acid, spec. grav. 1.185 (*P. G.*), 1.420 (*U. S.*).
Nitroso-nitric or *Fuming nitric acid:* Spec. grav. 1.45 to 1.50.
Oxalic acid: Oxalic acid purified by recrystallization, and leaving no residue when heated to 176.7° C. (350° F.). For solution dissolve it in 10 parts of water.
Picric acid: Crystallized picric acid dissolved in 100 parts of water.
Sulphuric acid: Sulphuric acid, spec. grav. 1.840.
Diluted sulphuric acid: Sulphuric acid, spec. grav. 1.067 (*U. S.*), 1.114 (*P. G.*).
Tannic acid: Tannic acid dissolved in 9 parts of water, with 1 part of alcohol (*U. S.*), (a fresh solution in 19 parts of water, *P. G.*).
Tartaric acid: Tartaric acid dissolved in 5 parts (*U. S.*), 4 parts (*P. G.*) of water; in 8 parts of water with 2 parts of alcohol (*Br.*).
Albumen: The white of one egg dissolved in 100 Ccm. = 3.4 fluidounces (*U. S.*), 4 oz. av. (*Br.*) of water.
Alcohol and *Absolute alcohol* (see page 140).
Aluminium in the form of wire or ribbon.
Ammonia-water: Pure ammonia-water, spec. grav. 0.960.
Ammonium carbonate: Carbonate of ammonium in small pieces dissolved in 10 (*U. S.*), 20 (*Br.*) parts of water. 1 part ammonium carbonate, 1 part ammonia-water, and 3 parts water (*P. G.*).
Ammonium chloride: Pure chloride of ammonium dissolved in 10 parts of water.
Ammonium oxalate: Crystallized oxalate of ammonium dissolved in 20 parts of water.
Ammonium phosphate: Phosphate of ammonium dissolved in 10 parts of water.
Ammonium sulphide: Saturate 3 ounces of ammonia-water with sulphuretted hydrogen; to this liquid add 2 ounces of ammonia-water.
Barium chloride: Chloride of barium dissolved in 10 parts of water.
Barium nitrate: Nitrate of barium dissolved in 20 parts of water.
Benzol (see page 313).
Bismuth subnitrate (see page 321).
Bromine-water: Bromine dissolved in 40 parts of water.
Calcium hydrate or *Lime-water:* A saturated solution of calcium hydrate in water.
Calcium chloride: Chloride of calcium dissolved in 10 parts of water.
Calcium chloride, saturated solution: Chloride of calcium 4 parts dissolved in 5 parts of water.
Calcium sulphate: A saturated solution of sulphate of calcium in water.
Carbon bisulphide (see page 386).
Chlorine-water: A saturated solution of chlorine gas in water.
Chloroform (see page 437).
Cochineal solution: Powdered cochineal 3 Gm., alcohol 50 Ccm., water 200 Ccm. It is used as an indicator, the yellowish-red color being changed to violet by alkalies and restored by mineral acids; the color is only slightly modified by carbonic acid.
Copper: Pure thin and bright copper-foil or wire.
Copper acetate: Subacetate of copper 1 part, acetic acid 2 parts, water sufficient for obtaining 10 parts of filtrate.
Copper ammonio-sulphate: Carefully add ammonia-water to test solution of copper sulphate until the precipitate formed is nearly redissolved, and filter.
Copper anhydrous sulphate: Sulphate of copper deprived of its water of crystallization by heat of 205° C. (400° F.).
Copper sulphate: Crystallized sulphate of copper dissolved in 10 parts of water.
Ether (see page 122).
Ferric chloride: Ferric chloride dissolved in 10 parts of water.

Ferrous sulphate: A fresh solution of ferrous sulphate in 10 parts (2 parts, *P. G.*) of water.

Gelatin: Russian isinglass dissolved in 50 parts of warm water.

Gold: Pure metallic gold in the form of leaf.

Gold chloride: Pure chloride of gold (see page 291) dissolved in 20 parts of water.

Guaiacum-paper: Unsized white paper steeped in diluted tincture of guaiacum (1 resin to 100 alcohol) and dried. Used as *Schœnbein's test:* the paper, moistened with diluted solution of copper sulphate, turns blue in presence of free hydrocyanic acid.

Indigo solution or *Sulphate of indigo:* Heat in a water-bath for one hour indigo 1 part in sulphuric acid 12 parts (20 parts, *Br.*); then add to sulphuric acid 500 parts (1600 parts, *Br.*), and decant from the undissolved powder.

Iodine solution: Iodine 1 part and potassium iodide 3 parts, dissolved in water 50 parts.

Lead acetate: Crystallized acetate of lead dissolved in 10 parts of water; if necessary, add a few drops of acetic acid, so that the solution has a faint acid reaction.

Litmus solution or *Tincture:* Litmus 1 part, diluted alcohol 10 parts.

Litmus-paper, blue: Unsized white paper steeped in tincture of litmus.

Litmus-paper, red: Unsized white paper steeped in tincture of litmus previously reddened by a very minute quantity of dilute sulphuric acid.

Magnesium hydrate: Precipitate a solution of 3 parts of magnesium sulphate with excess of soda solution; wash the precipitate thoroughly, and then add water to make the weight 10 parts.

Magnesium test solution (ammonio-sulphate): Magnesium sulphate 1 part, ammonium chloride 2 parts, water 8 parts, ammonia-water 4 parts; dissolve and filter, *U. S.* Magnesium sulphate 2 parts, ammonium chloride 1 part, water 18 parts, and ammonia-water 1 part. *Br.*

Magnesium sulphate: Sulphate of magnesium dissolved in 10 parts (2 parts, *P. G.*) of distilled water.

Mercuric chloride: Corrosive sublimate dissolved in 20 parts of distilled water.

Mercury and *Potassium iodide:* Mix test solutions of mercuric chloride 100 parts, and of potassium iodide 367 parts.

Phenolphthalein: Dissolve phenolphthalein 1 Gm. in 60 per cent. alcohol 100 Gm. The colorless solution is turned red by alkalies, and again colorless by acids, including carbonic acid; used as an indicator.

Platinum black: Platinum in a state of minute division, obtained by adding excess of carbonate of sodium and some sugar to solution of perchloride of platinum, and boiling until a black precipitate is formed, which is washed and dried.

Platinic chloride: Dissolve platinic chloride (see p. 1184) in 20 parts of water.

Potassium acetate: Potassium acetate dissolved in 10 parts (2 parts, *P. G.*) of water.

Potassium bichromate: Potassium bichromate dissolved in 10 parts of water.

Potassium chromate: Potassium chromate dissolved in 10 parts of water.

Potassium ferricyanide: A fresh solution of potassium ferricyanide in 10 parts (20 parts, *Br.*) of water.

Potassium ferrocyanide: Potassium ferrocyanide dissolved in 10 parts (20 parts, *Br.*) of water.

Potassium iodate: Digest 5 parts each of iodine and chlorate of potassium, 1 part of nitric acid, and 20 parts of water, until the color of iodine disappears; boil for a minute, evaporate to perfect dryness at 100° C. (212° F.), and dissolve the residue in 430 parts of water.

Potassium iodide: Iodide of potassium dissolved in 20 parts (9 parts, *P. G.;* 10 parts, *Br.*) of water.

Potassium permanganate: Permanganate of potassium dissolved in 1000 parts of water. 62.8 Ccm. of this solution, acidulated with 5 Ccm. of diluted sulphuric acid, should require 2 Ccm. of volumetric solution of oxalic acid for complete decoloration, *U. S.* 0.1 Gm. of pure iron wire dissolved in diluted sulphuric acid should require the addition of 562 Ccm. of the test solution before a permanent red color appears, *P. G.*

Potassium sulphate: Sulphate of potassium dissolved in 15 parts of water.

Potassium sulphocyanate: Sulphocyanate of potassium dissolved in 19 parts of water.

Silver ammonio-nitrate: Drop ammonia-water into test solution of silver nitrate until the precipitate formed is nearly redissolved; filter, *U. S.* Crystallized nitrate of silver 1 part, ammonia-water 2 parts, water sufficient to make 40 parts, *Br.*

Silver nitrate: Nitrate of silver dissolved in 20 parts of water.

Silver sulphate: Sulphate of silver dissolved in 250 parts of water.

Soda solution (see page 922).

Sodium: Metallic sodium preserved under petroleum.

Sodium acetate: Acetate of sodium dissolved in 10 parts (*Br.*), 4 parts (*P. G.*) of water.

Sodium bitartrate: A saturated solution of sodium bitartrate in water.

Sodium carbonate: Pure carbonate of sodium dissolved in 10 parts (4 parts, *P. G.*) of water.

Sodium hyposulphite: Hyposulphite of sodium dissolved in 10 parts of water.

Sodium molybdate: Used as *Fröhde's reagent*, which is a solution of 1 part of sodium molybdate in 100 parts of sulphuric acid.

Sodium phosphate: Pure phosphate of sodium dissolved in 10 parts (19 parts, *P. G.*) of distilled water.

Sodium sulphite: Sodium sulphite dissolved in 9 parts of water.

Starch gelatinized: A gelatinous mixture prepared from 1 part of starch and 200 parts of boiling water, *U. S. A.:* a filtered weak solution of indefinite strength, *P. G.*

Stannous chloride: Heat moderately granulated tin 2 parts, hydrochloric acid 7 parts, and water 2 parts, until gas ceases to be evolved; then dilute with sufficient water to obtain 12 parts, and preserve the liquid together with the undissolved tin.

Tin: Metallic tin in the form of a granular powder.

Turmeric solution or *Tincture:* Bruised turmeric 1 part, alcohol (diluted alcohol, *U. S.*) 6 parts, *Br.*

Turmeric-paper: Unsized white paper steeped in tincture of turmeric.

Zinc: Chemically pure metallic zinc; the absence of arsenic is determined by Marsh's test (see page 27).

Zinc iodide and *Starch:* Dissolve 4 Gm. of starch by boiling in 20 Gm. of zinc chloride and 100 Gm. of water; add 2 Gm. of zinc iodide, and dilute to 1 liter. It is a test for chlorine, bromine, etc., and is used as an indicator.

2. *Volumetric Solutions for Quantitative Tests.*

The test liquids for volumetric analysis are made so that one liter contains the hydrogen equivalent ($H = 1$) of the reagent weighed in grams (normal solutions), or one-tenth of this weight (decinormal solutions $= \frac{N}{10}$); occasionally centinormal solutions ($\frac{N}{100}$) are used, which are one-hundredth of the normal strength. All the pharmacopœial volumetric solutions are decinormal except those of oxalic acid and soda, which are normal. The solutions of the United States and British Pharmacopœias are identical, and agree also with three solutions of the German Pharmacopœia, while the latter authority has admitted normal solutions of hydrochloric acid and of potassa in place of oxalic acid and soda, potassium bromide ($\frac{N}{20}$) and potassium bromate ($\frac{N}{100}$) for the estimation of phenol, and sodium chloride ($\frac{N}{10}$) for the estimation of silver; in addition to these solutions of cochineal, phenolphthalein, and zinc iodide with starch, described above, are admitted as indicators, and solution of potassium permanganate for the determination of iron.

In the preparation and use of these solutions metric weights and measures are employed; but, for the convenience of those who have not the necessary apparatus and weights, the British Pharmacopœia expresses the quantities of test solutions employed in testing in *grain-measures*, the grain-measure being the volume of a grain of distilled water at 15.55° C. (60° F.). Weight and measure of each system bear to each other precisely the same relation; but since the *gram* is more than fifteen times greater than the *grain*, it will be found convenient, in employing the metric system, to reduce the values of all the numbers to one-tenth of the values of the grains and grain-measures given by the Br. P.

Volumetric solution of oxalic acid ($H_2C_2O_4.2H_2O = 126$): Pure oxalic acid in crystals, quite dry, but not effloresced, 63 Gm.; distilled water sufficient for obtaining 1000 Ccm. (1 liter) of solution. 100 Ccm. of this solution contain, in grams, $\frac{1}{20}$ molecule of oxalic acid, and will neutralize $\frac{1}{10}$ of an equivalent in grams of an alkali or alkaline carbonate; as an indicator, phenolphthalein is preferable to litmus (see above). The following articles are tested with this solution: Ammonii carbonas, Aqua ammoniæ, Aqua ammoniæ fort., *U. S.*, *Br.;* Borax, Liquor calcis, Liq. calcis sacchar., *Br.;* Liq. plumbi subacet., Liq. potassæ, Liq. sodæ, *U. S.*, *Br.;* Liq. potass. efferv., Liq. sodæ efferv., Plumbi acetas, Potass. bitartras, *Br.;* Potassa, Potassii acetas, Potass. permang., *U. S.;* Potass. bicarb., Potass. carb., Potass. citras, Potass. et sod. tartr., Potass. tartras, Soda, Sodii bicarb., Sodii carb., *U. S.*, *Br.;* Sodii carb. exsicc. and Spiritus ammoniæ, *U. S.*

Volumetric solution of hydrochloric acid ($HCl = 36.4$): Hydrochloric acid (sp. gr. 1.124) 146 Gm.; distilled water sufficient for 1 liter. The actual strength of this solution should be determined by titration with volumetric solutions of soda and silver nitrate, or by pure sodium carbonate, and should correspond with the strength of the preceding solution, in the place of which it may be employed except for the lead compounds.

Volumetric solution of iodine ($I = 126.6$): Iodine 12.66 Gm.; iodide of potassium 18.0 Gm.; distilled water sufficient for obtaining 1000 Ccm. (1 liter) of solution. 100 Ccm. of this solution correspond to 0.17 Gm. of sulphuretted hydrogen, 0.32 Gm. of sulphurous and 0.495 Gm. of arsenious acid. This solution is used as an oxidizer, and is added to the solution to be tested (the latter containing a little gelatinized starch as an indicator) until the blue color ceases to be discharged. The strength is determined by sodium hyposulphite or by pure arsenious acid. The following articles are tested by this solution: Acidum arseniosum, Acid. sulphurosum, Liquor acidi arseniosi, Liq. potass. arsenit., *U. S.*, *Br.;* Potassii sulphis, Sodii bisulphis, Sodii sulphis, *U. S.*

Volumetric solution of potassium bichromate ($K_2Cr_2O_7 = 294.8$): Bichromate of potassium 14.74 Gm.; distilled water sufficient for obtaining 1000 Ccm. (1 liter) of solution. 100 Ccm. of this solution are capable of converting 1.677 Gm. of iron from the state of ferrous to that of ferric salt. The solution is added to the ferrous solution acidulated with sulphuric acid, and the ferrous salt is known to have been converted into ferric salt when a minute drop of the liquid, placed in contact with a drop of the solution of ferricyanide of potassium on a white plate, ceases to strike with it a blue color. The following articles are tested with this solution: Ferri arsenias, Ferri oxid. magn., Ferri phosphas, *Br.;* Ferri carb. sacch., *U. S.*, *Br.;* Ferri sulphas, Ferri sulphas exsicc., *U. S.* Ferric salts may likewise be tested by this solution after having been previously reduced to ferrous salts by an excess of zinc and diluted sulphuric acid.

Volumetric solution of potassium bromate ($KBrO_3 = 166.8$): Pure dry potassium bromate 1.668 Gm.; distilled water sufficient for 1 liter.

Volumetric solution of potassium bromide ($KBr = 118.8$): Pure dry potassium bromide 5.94 Gm.; distilled water sufficient for 1 liter.

On mixing 50 Ccm. each of these two solutions, and adding 5 Ccm. of sulphuric acid, sufficient bromine is liberated to convert 0.0469 Gm. of carbolic acid into tribromophenol. Paper previously steeped in solution of zinc iodide with starch is used as an indicator.

Volumetric solution of potassa ($KHO = 56$): Solution of potassa free from carbonate, and of such a strength that 15.873 Ccm. of it are exactly neutralized by 1 Gm. of oxalic acid, or 100 Ccm. by 6.3 Gm. of the acid or by 100 Ccm. of the volumetric solution of oxalic acid. The solution may be employed in precisely the same manner and for the same purposes as the volumetric solution of soda.

Volumetric solution of silver nitrate ($AgNO_3 = 169.7$): Dry crystallized or pure fused nitrate of silver 16.97 Gm.; distilled water sufficient for obtaining 1000 Ccm. (1 liter) of solution. 100 Ccm. of this solution contain $\frac{1}{100}$ of an equivalent in grams of nitrate of silver (or 1.697 Gm.). This is used by adding it to the solution to be tested, the latter being neutral and containing a little potassium bichromate as an indicator, until the liquid acquires a red tint which does not disappear on stirring. Potassium cyanide may be tested without using the indicator by adding the volumetric solution until the white precipitate just begins to be permanent. The strength of the solution is conveniently determined by $\frac{N}{10}$ solution of sodium chloride. The following articles are tested by this solution: Acidum hydrocyan. dil., Potassii bromidum, *U. S., Br.;* Ammonii bromidum, Potassii cyanidum, Sodii bromidum, *U. S.;* Sodii arsenias, *Br.*

Volumetric solution of soda ($NaHO = 40$): Solution of soda free from carbonate, and of such a strength that 15.873 Ccm. of it are exactly neutralized by 1 Gm. of oxalic acid, or 100 Ccm. by 6.3 Gm. of the acid or by 100 Ccm. of the volumetric solution of oxalic acid. The solution is used by adding it to the liquid to be tested, the latter containing either solution of litmus or of cochineal or of phenolphthalein as an indicator, until the mixture has a neutral reaction. The following articles are tested with this solution: Acetum, *Br.;* Acid. acet., Acid. acet. dil., Acid. acet. glac., Acid. citric., Acid. hydrochlor., Acid. hydrochlor. dil., *U. S., Br.:* Acid. hydrobrom., Acid. lactic., *U. S.;* Acid. nitro-hydrochlor. dil., *Br.;* Acid. nitric., Acid. nitric. dil., Acid. sulphuric., Acid. sulph. arom., Acid. sulphur. dil., Acid. tartar., *U. S., Br.;* Syrupus acidi hydriodici, *U. S.*

Volumetric solution of sodium chloride ($NaCl = 58.4$): Dry pure sodium chloride 5.84 Gm.; distilled water sufficient for obtaining 1000 Ccm. (1 liter) of solution. This is a decinormal solution, and if mixed with a little potassium bichromate is completely precipitated by an equal volume of the volumetric solution of silver nitrate before the mixture acquires a permanent red tint.

Volumetric solution of sodium hyposulphite ($Na_2S_2O_3.5H_2O = 248$): Dissolve hyposulphite of sodium 32 Gm. in enough distilled water to make the solution measure 1000 Ccm. Measure exactly 100 Ccm. of the volumetric solution of iodine, and add to it a sufficient quantity of the solution of hyposulphite of sodium, from a burette, nearly to decolorize the iodine solution; then add freshly gelatinized starch, and continue the addition of the hyposulphite until the blue color of the mixture is just destroyed, noting the number (n) of Ccm. added. Then take of the solution of hyposulphite of sodium ten times ($10n$) this number of Ccm., and add thereto enough distilled water to make the solution measure 1000 Ccm. (1 liter). 100 Ccm. of this solution correspond to 1.266 Gm. of iodine ($\frac{1}{100}$ of an equivalent). The strength is determined by volumetric solution of iodine, of which it should decolorize an equal volume. It is used for the determination of free or liberated iodine by adding it to the liquid until the color of iodine is discharged, a little gelatinized starch being added to the mixture toward the close of the process, and the addition of the volumetric solution being continued until the blue color has just disappeared. The following articles are tested with this solution: Aqua chlori, Calx chlorata, Iodum, Liquor sodæ chloratæ, *U. S., Br.:* Liq. calc. chloratæ, *Br.;* Liq. iodi compositus, Tinctura iodi, *U. S.*

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